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## **O 1. BIOCHAR PRODUCED FROM PYROLYSIS OF OLIVE POMACE AS AN ADSORBENT FOR CR (VI) REMOVAL FROM AQUEOUS SOLUTIONS**

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**ABSTRACT:** In this study, utilization of biochar obtained from pyrolysis of olive pomace as an adsorbent for removal of Cr (VI) from aqueous solution under different conditions. The adsorption experiments were implemented in batch process. The effects of various process parameters were investigated on the adsorption efficiency. The optimum removal conditions were determined as pH 3, time 30 min, concentration 10 mg L<sup>-1</sup>, dose 0.4 g and temperature 30 °C. The properties of biochar before and after adsorption were examined with Fourier transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM) and energy dispersive X-ray (EDX) analyses. The adsorption performance of biochar was evaluated by Langmuir and Freundlich isotherm models by using different concentrations of Cr (VI) in the range of 10-80 mg L<sup>-1</sup>. Langmuir isotherm fitted to experimental data with higher accuracy and a maximum adsorption capacity of 4.9 mg g<sup>-1</sup>. The pseudo second order kinetic model gave a better fit with best correlation to the kinetic data. In the light of the results, it can be said that the biochar was successfully used as a low-cost and environmental friendly adsorbent for Cr (VI) removal from contaminated water.

*Keywords: Olive pomace, pyrolysis, biochar, adsorption, Cr (VI)*

### **1. INTRODUCTION**

With rapid industrialization and economic development, the discharge of heavy metals to water has become one of the worldwide problems that threaten human health and ecosystem (Basha et al., 2008; Ibrahim et al., 2010). Heavy metals are very toxic even at very low concentrations, because they are non-biodegradable materials and have tendency to accumulate in living organisms (Fu & Wang, 2011). Chromium (Cr) which exists in two forms of III and VI is one of these toxic metals. Cr (VI) is more hazardous than Cr (III) due to its toxicity and carcinogenic properties (Hu et al., 2011).

Cr (VI) was classified as one of the top 16<sup>th</sup> hazardous substances by the agency for Toxic Substances and Disease Registry (ATSDR) (Jain et al., 2010). In many countries, the permissible limit of Cr (VI) to be discharge to surface water from industrial effluents varies from 0.05 to 0.1 mg L<sup>-1</sup> (Bansal et al., 2009). So, the removal of Cr (VI) from wastewater originated in leather tanning, cooling tower, plating, electroplating etc, is very important (Owlad et al., 2009). Various techniques such as flotation (Rubio et al., 2002), ultrafiltration, membrane (Landaburu-Aguirre et al., 2010), reverse osmosis (Benito & Ruiz, 2002), chemical precipitation, ion exchange, coagulation, flocculation (Fu & Wang, 2011), photocatalysis (Yoon et al., 2009) and adsorption are used to remove heavy metals from aqueous solution. Among the treatment techniques, adsorption was considered as one of the most effective methods because of high cost and residual sludge of other techniques (Zhong et al., 2013).

The Cr (VI) removal process have been carried out using different bioadsorbents such as biochar derived from rice straw (Gao et al., 2008), maize tassel (Zvinowanda et al., 2009), sunflower waste (Jain et al., 2010), sugar beet tailing (Dong et al., 2011), oak wood, oak bark (Mohan et al., 2011), wheat straw (BCS), wicker (Tyłak et al., 2015), peanut hull (Han et al., 2016) and corn stalk (An et al., 2018).

Olive pomace as a by-product of olive production industry have been used in different adsorption processes (Pagnanelli et al., 2002; Vegliò et al., 2003; Martín-Lara et al., 2008). In this study, char obtained from pyrolysis of olive pomace was investigated as an adsorbent for Cr (VI) removal. The effects of adsorption parameters (pH, time, mass of adsorbent, initial metal concentration and temperature) on the adsorption efficiency were examined. And also, the isotherms, kinetics and thermodynamic of Cr (VI) adsorption onto the char were studied at optimum conditions.

## 2. MATERIALS AND METHOD

### 2.1. Preparation of Olive Pomace Char

Olive pomace char was obtained as solid residue after pyrolysis of olive pomace in fixed bed pyrolysis reactor. Pyrolysis process was carried out at 500 °C with a heating rate of 10 °C/min under N<sub>2</sub> gas (150 cm<sup>3</sup>/min).

### 2.2. Cr (VI) Adsorption Studies

The stock solution of Cr (VI) (1000 mg L<sup>-1</sup>) was prepared by dissolving potassium dichromate (K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>) in deionized water. The effects of pH, time, mass of adsorbent, initial Cr (VI) concentration and temperature on adsorption were studied using the experimental conditions as shown in Table 1. Cr (VI) concentration was determined with measuring absorbance of 540 nm by UV-vis spectrophotometer. The percentage removal (R, %) of Cr (VI) and adsorption capacity (q<sub>e</sub>, mg g<sup>-1</sup>) were calculated using the following equations:

$$R = \frac{C_0 - C_e}{C_0} \times 100 \quad (1)$$

$$q_e = \frac{(C_0 - C_e) \times V}{m} \quad (2)$$

where C<sub>0</sub> and C<sub>e</sub> are the initial and equilibrium concentration of Cr (VI) (mg L<sup>-1</sup>), respectively. V is the volume of Cr (VI) solution (L) and m is the mass of the adsorbent (g).

### 2.3. Characterization

The FTIR analyses were used to determine vibration frequency changes in functional groups of char before and after Cr (VI) adsorption. The morphology and elemental composition of the char were investigated by SEM analysis equipped with EDX analysis.

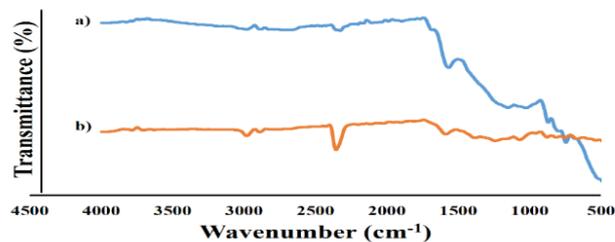
**Table 1.** Experimental Conditions for Cr (VI) Adsorption Process

	pH (A)	Time (B) (min)	Initial concentration (C) (mg L <sup>-1</sup> )	Adsorbent dose (D) (g)	Temperature (E) (°C)
Effect of A	<b>1.5-6</b>	30	20	0.1	20
Effect of B	3	<b>15-120</b>	20	0.1	20
Effect of C	3	30	<b>10-80</b>	0.1	20
Effect of D	3	30	10	<b>0.05-0.4</b>	20
Effect of E	3	30	10	0.4	<b>20-50</b>

## 3. RESULTS AND DISCUSSION

### 3.1. FTIR Analysis

The FTIR spectrum of char is shown before and after Cr (VI) adsorption in Fig. 1. The peaks at 1100 cm<sup>-1</sup> and 3641 cm<sup>-1</sup> were indication of existence of carboxyl and hydroxyl groups. These peaks a bit shifted to lower wavenumbers. It can be said that the carboxyl and hydroxyl groups could be main functional groups for Cr (VI) adsorption (Bansal et al., 2009; Gan et al., 2015; Garg et al., 2007).



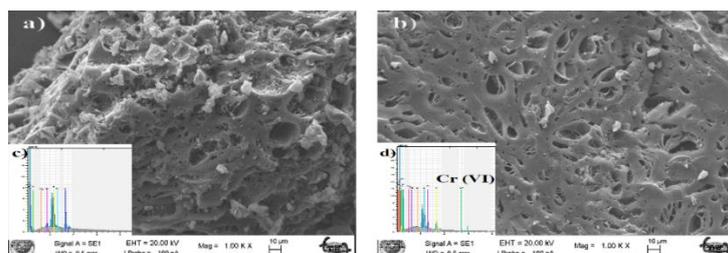
**Figure 1.** FTIR Spectrum of Char (a) Before and (b) After Adsorption of Cr (VI)

### 3.2. SEM Analysis

The SEM image of char is shown before and after Cr (VI) adsorption in Fig. 2. As seen in Fig. 2a, the surface of char was rough before Cr (VI) removal. However, it was observed that the surface of char was smooth after Cr (VI) removal (Fig. 2b).

### 3.3. EDX Analysis

The EDX spectrum of char is shown before and after Cr (VI) adsorption in Fig. 2c-d. A reduction in intensity of C peak was clearly seen after Cr (VI) removal when compared to the fresh one. Also, the strong peak of Cr (VI) component was determined in the EDX spectrum of char in case of Cr (VI) adsorption.



**Figure 2.** SEM Image of Char (a) Before And (b) After Adsorption of Cr (VI). Inserts show EDX Spectra of Char

### 3.4. Effect of Experimental Parameters on Cr (VI) Removal

#### 3.4.1. The effect of pH

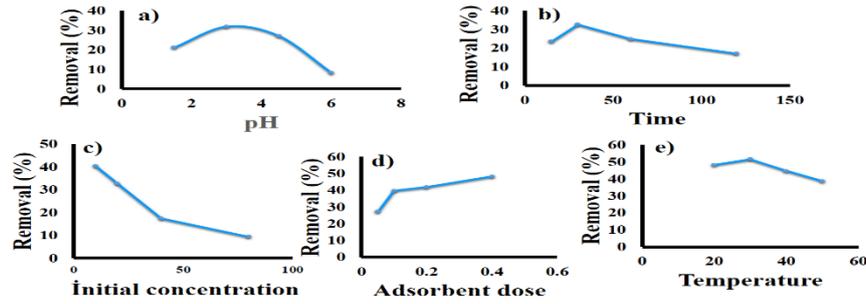
Different experiments were carried out by varying pH from 1.5 to 6, while the other parameters were kept constant in order to explain the effect of pH of the solution on the adsorption of Cr (VI). Removal of Cr (VI) at different pH values is shown in Fig. 3a. It was observed that removal of Cr (VI) increased with increase pH until pH 3. And then, Cr (VI) removal considerably decreased. It can be said that the increase of Cr (VI) removal at low pH values is due to presence a lots of H<sup>+</sup> ions. H<sup>+</sup> ions scattered in solution made a neutralization with negatively charged hydroxyl ions which cause a hindrance to diffusion of the positively charged dichromate ions (Dubey & Gopal, 2007). In the highly pH, the H<sup>+</sup> ions decrease which lead decreasing Cr (VI) adsorption (Selvi et al., 2001).

#### 3.4.2. The effect of time

Removal of Cr (VI) as a function of time is shown in Fig. 3b. Maximum removal of Cr (VI) was determined in 30 min due to more available sites of adsorbent at beginning of adsorption. As the available adsorption sites become to decrease, percentage removal of many substances usually decreases in adsorption processes (Bulut, 2007).

#### 3.4.3. The effect of initial concentration

The effect of initial concentration on removal of Cr (VI) is shown in Fig. 3c. It was observed that removal of Cr (VI) decreased with increasing initial concentration. During the adsorption, a decrease in the number of active vacant sites on the surface of adsorbent causes to reduce percentage removal (Gupta & Balomajumder, 2015). In spite of a decrease in Cr (VI) removal, adsorption capacity increased. As the initial concentration increase from 10 to 80 ppm, the adsorption capacity increased from 2.019 to 3.678 mg g<sup>-1</sup>, respectively. It could be attributed to the greater mass driving force which works to overcome the transfer limitation (Agarwal et al. 2013).



**Figure 3.** The Effect of Parameters on the Adsorption of Cr (VI) (a) pH, (b) Time, (c) Initial Concentration, (d) Adsorbent Dose and (e) Temperature

### 3.4.4. The effect of adsorbent dose

The effect of adsorbent dose on removal of Cr (VI) is shown in Fig. 3d. It was clearly seen that removal of Cr (VI) significantly increased with amount of adsorbent dose. High surface area exposed to adsorption and availability of more adsorption sites generally have synergistic effects on the adsorption process (Garg et al., 2007).

### 3.4.5. The effect of temperature

The effect of temperature on removal of Cr (VI) is shown in Fig. 3e. The removal of Cr (VI) demonstrated an increase with increasing temperature from 20 to 30 °C. It can be attributed to a decrease in solution viscosity, in other words, helps to increase rate of adsorbed Cr (VI) molecules within the pores (Agarwal et al. 2013). However, the removal of Cr (VI) decreased above 30 °C which is probably due to tendency of desorption. And also, it was stated that the adsorption process of Cr (VI) was exothermic process (Saltalı et al., 2007).

## 3.5. Adsorption Isotherms

The isotherm adsorption data was represented by Langmuir and Freundlich isotherm models, respectively (SenthilKumar et al., 2011).

### 3.5.1. Freundlich isotherm model

Freundlich isotherm model describes adsorption on the heterogeneous surface with uniform energy (Foo & Hameed, 2010). Freundlich isotherm equation is given as:

$$\log_{10} q_e = \log_{10} K_f + \frac{1}{n} \log_{10} C_e \quad (3)$$

where  $q_e$  is adsorption capacity ( $\text{mg g}^{-1}$ ),  $C_e$  is equilibrium concentration of Cr (VI) ( $\text{mg L}^{-1}$ ).  $K_f$  ( $\text{l g}^{-1}$ ) and  $n$  are Freundlich constants which related to adsorption capacity and adsorption intensity.

### 3.5.2. Langmuir isotherm model

Langmuir model assumes monolayer adsorption without interaction and steric hindrance between adsorbed molecules (Bansal et al., 2009). Langmuir isotherm equation is given as:

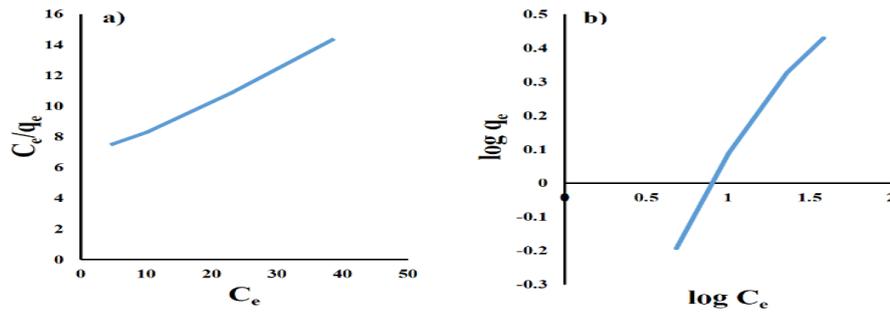
$$\frac{C_e}{q_e} = \frac{1}{Q_m \cdot b} + \frac{C_e}{Q_m} \quad (4) \quad \text{where}$$

$Q_m$  ( $\text{mg g}^{-1}$ ) and  $b$  ( $\text{L mg}^{-1}$ ) are Langmuir constants related with adsorption capacity and adsorption rate, respectively. A dimensionless constant, commonly known as separation factor ( $R_L$ ) is represented as:

$$R_L = \frac{1}{(1+b \cdot C_0)} \quad (5)$$

The value of  $R_L$  indicates unfavorable ( $R_L > 1$ ), linear ( $R_L = 1$ ), irreversible ( $R_L = 0$ ) or favorable ( $0 < R_L < 1$ ) processes (Foo & Hameed, 2010).

Langmuir and Freundlich isotherms are shown in Fig. 4. And also, isotherm parameters are given in Table 2. When compared to correlation coefficients ( $R^2$ ), it was deduced that Langmuir isotherm model was well fitted the experimental data. The maximum adsorption capacity of Cr (VI) was determined as  $4.9 \text{ mg g}^{-1}$ . The adsorption process was favorable according to  $R_L$ .



**Figure 4.** (a) Langmuir and (b) Freundlich Isotherms at Optimum Conditions (pH 3, time 30 min, initial concentration 10 ppm, adsorbent dose 0.4 g and temperature 30 °C)

**Table 2.** Langmuir and Freundlich Isotherm Parameters

Langmuir model			Freundlich model			
$Q_m$ (mg g <sup>-1</sup> )	$b$ (l mg <sup>-1</sup> )	$R^2$	$R_L$	$K_f$ (l g <sup>-1</sup> )	$n$	$R^2$
4.9	0.032	0.996	0.757	0.229	1.443	0.987

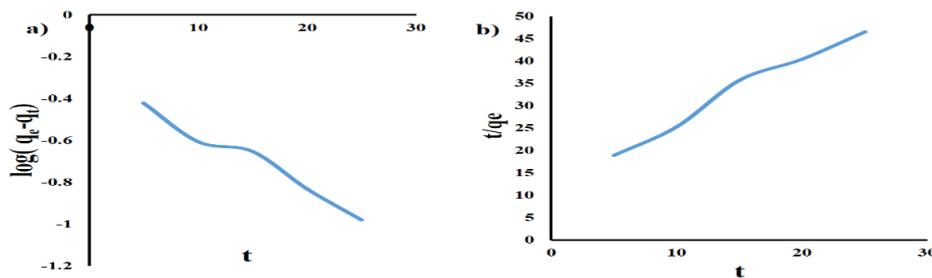
### 3.6. Adsorption Kinetics

The kinetics are used to explain the mechanism of adsorption process. The kinetic models are pseudo first order and pseudo second order were utilized to simulate the experimental kinetic data. The pseudo first and second order of the equations is given as, respectively:

$$\log_{10} (q_e - q_t) = \log_{10} q_{ecal} - k_1 \cdot t \quad (6)$$

$$\frac{t}{q_e} = \frac{1}{k_2 \cdot q_{ecal}^2} + \frac{t}{q_{ecal}} \quad (7)$$

where  $k_1$  (min<sup>-1</sup>) and  $k_2$  (g mg<sup>-1</sup> min<sup>-1</sup>) are the pseudo first order and pseudo second order reacted rate constants, respectively (Chakravarty et al., 2010). Fig. 5 shows the kinetic models and kinetic parameters are presented in Table 3. As per  $R^2$  values, it was observed that the pseudo second order is more fitted the experimental data than the pseudo first order. The chemisorption of Cr (VI) on char was rate limiting mechanism in this process and it can be said that Cr (VI) ions were onto the surface of char by chemical interaction (Gan et al., 2015).



**Figure 5.** (a) Pseudo-First Order and (b) Pseudo-Second Order Kinetic Model

**Table 3.** Kinetic Parameters

Pseudo-First order			Pseudo-Second order		
$q_{ecal}$ (mg g <sup>-1</sup> )	$k_1$ (min <sup>-1</sup> )	$R^2$	$q_{ecal}$ (mg g <sup>-1</sup> )	$k_2$ (g mg <sup>-1</sup> min <sup>-1</sup> )	$R^2$
0.5049	0.0268	0.9778	0.7117	0.1606	0.9850

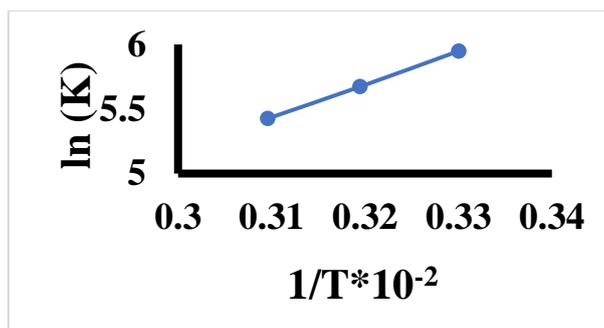
### 3.7. Adsorption Thermodynamics

The parameters of thermodynamics (Gibbs free energy ( $\Delta G^\circ$ ), enthalpy ( $\Delta H^\circ$ ) and entropy ( $\Delta S^\circ$ )) were calculated by given equations:

$$\Delta G^{\circ} = -RT \ln(K) \quad (8)$$

$$\ln(K) = \frac{\Delta S^{\circ}}{R} - \frac{\Delta H^{\circ}}{RT} \quad (9)$$

K was calculated by  $K = 55.5 \times q_e / C_e \times M_{\text{adsorbate}}$ . 55.5 was the concentration of water and  $M_{\text{adsorbate}}$  was the molecular weight of adsorbate (Anastopoulos & Kyzas, 2016). The entropy and the enthalpy were calculated from the intercept and slope, respectively from the Fig. 6. And also, thermodynamic parameters are given in Table 4. The negative values of  $\Delta G^{\circ}$  indicate the spontaneous adsorption process and the negative value of  $\Delta H^{\circ}$  confirms the exothermic nature of process. Moreover, a negative value of  $\Delta S^{\circ}$  indicates the decrease of randomness.



**Figure 6.** lnK as a function of 1/T

**Table 4.** Thermodynamic Parameters

T (°C)	ln (K)	$\Delta G^{\circ}$ (cal mol <sup>-1</sup> )	$\Delta H^{\circ}$ (cal mol <sup>-1</sup> )	$\Delta S^{\circ}$ (cal mol <sup>-1</sup> K <sup>-1</sup> )
30	5.948994202	-3576.697	-5075.3101	-4.949707
40	5.673216563	-3523.463		
50	5.426428173	-3477.864		

#### 4. CONCLUSION

In this study, Cr (VI) adsorption from aqueous solution using olive pomace char as an alternative adsorbent was successfully carried out. The maximum removal efficiency was determined as 51.52% with a maximum adsorption capacity 4.9 mg g<sup>-1</sup> at optimum condition (pH 3, time 30 min, initial Cr (VI) concentration 10 mg L<sup>-1</sup>, amount of adsorbent 0.4 g and temperature 30 °C). The results showed that the low-cost olive pomace char can be potentially applied in environmental fields. And also, usage of this char provided to decrease waste accumulation which limits environmental pollution.

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## **O 2. NATURA 2000 POTENTIAL SITES IN ALBANIA – A CONTRIBUTION OF FISH SPECIES OF COMMUNITY INTEREST**

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**ABSTRACT:** The aim of this presentation is to address the Fish Species of Community Interest (FSCI) revealed through a three years identification process in selected sites all over Albania. At the European scale fishing was pointed out as one of the major threats to the both marine and freshwater environment. Based on FSCI populations presence in different sites of Albania (including freshwater, coastal marine and lagoon), their variation under qualitative and quantitative aspects, relations with their ecological needs and the presence of different human impact through the NATURA 2000 AI project were highlighted the main management directions which should create the framework for the actual and future management plan for the selected areas with protected status.

The fish species present in the Annex II of the Habitats Directive (92/43/EEC) of the potential Natura 2000 sites in Albania management elements include: *Acipenser naccarii*, *Acipenser sturio*, *Alosa falax*, *Alosa sp. nov. 'Scadar'*, *Cottus gobio*, *Misgurnus fossilis*, *Alburnoides prespensis*, *Alburnus belvica*, *Pelagus prespensis*, *Rutilus prespensis*, *Rhodeus amarus*, *Telestes montenegrinus*, *Telestes pleurobipunctatus*, *Aphanius fasciatus*, *Knipowitschia montenegrina*, *Eudontomyzon stankokaramani*, *Petromyzon marinus*, *Lampetra planeri*, *Lampetra fluviatilis*, *Salmo marmoratus*, *Salmo peristericus*, *Valencia letourneuxi*.

The identified and delivered conservation goal for fish species of community interest is focused on: Maintain and restore viable populations of existing fish species as an integral part of the NATURA 2000 site ecosystems. In order to reach this goal, it is necessary to identify and mitigate or remove threats to the fish populations and their habitat.

*Keywords: Fish species, freshwater, lagoon system, marine environment, conservation goal*

### **1. INTRODUCTION**

For aquatic livings it is unclear if terrestrial hypotheses (species-area, species-energy, environment-energy, terrestrial primary productivity, environmental spatial heterogeneity, and climatic heterogeneity) that are known to explain species richness patterns of terrestrial organisms, especially when they are combined can be useful to explain the species richness pattern (Hawkins and Porter, 2003; Maceda-Veiga *et al.*, 2017; Veiera *et al.*, 2018). The locally tested hypotheses separately in Vjosa River confirm that the temporal heterogeneity best explains the distribution of fish species richness. However, a multiple-hypotheses approach, as water-energy, productivity and temporal heterogeneity hypotheses together might best describe the richness distribution with Albanian territory.

The fish data are part of the Biodiversity National Network of Albania (BioNNA) database that has been created. In the site surveys are given the fish distribution and diversity as direct authors observation and references existing so far from different authors without discussions of current taxonomic accuracy, but data network readers will be able to view through records and authors in different time periods. The more than 1020 records are also referring to current conservation status and conservation needs in line with side designations (See Table 1).

The considerations for the protection of this fish species of conservative interest populations in Albania from the initial start is based on its environment protection through integrated management which should solve the following identified problems: large areas of riparian zones have been reduced or eliminated by the agriculture expansion, alterations and detrimental agriculture practices, resulting the diminishing river shading and rising aquatic habitat temperatures; extreme sedimentations problems due to erosion with specific intensity in central Albania (Devolli/Osumi/Semani basin, and not only), channel incisions and storm water runoff increased by the absence of riparian vegetation; constant inputs of pollutants at significant levels (with different origin including lack of the waste water, solid waste, etc); erosion (due to historical reasons and not only) and sedimentation problems result from a lack of riparian vegetation

along long sectors of river corridors and can lead to siltation of gravel beds critical to this (aquatic) insectivorous species; human disturbed hydrologic regime become the most serious impacting activity through intensive hydropower plant construction; the artificial stream barrier (present from '60/'70 in large rivers and rapidly progressing within small rivers) which influence the fish migrations; habitat loss induced native fish species decline and the appearance of no native fish species that are more tolerant of different types of human affected habitats (specific species as *Pseudorasbora parva*, *Lepomis gibosus*, *Carasius* spp., *Gambusia holbroki*, etc); the riverine flood plains important at least for the cyprinids species have been radical reduced; the habitat loss facilitate overcrowded situations which lead to appearance and eruptions of diseases; over canalizations, many stream sectors were channelized and isolated from their natural floodplains, etc.

Beside that knowledge and understanding of the diversity and distribution patterns of freshwater fishes in most of the European Mediterranean has increased considerably, in general the freshwater fish of Albania is still poorly known. Whereas for the surrounding areas updated information exists (Mrakovčić *et al.*, 2006; Economou *et al.*, 2007) such data on Albanian species are missing, apart from recent publications on loaches (Cobitidae and Nemacheilidae) (Šanda *et al.*, 2008), salmonids (Snoj *et al.*, 2009) and barbels (genus *Barbus*; Cyprinidae) (Marková *et al.*, 2010). The only available sources of information are the general works of Poljakov *et al.*, (1958) who included 36 freshwater species and Rakaj (1995) listing 77 species. The difference between the coverage in these two publications is probably in part due to inclusion of newly introduced species, but more so by changes in the taxonomic status of many species. The deficiency in the knowledge of the diversity of freshwater fishes of Albania has been confirmed by recent descriptions of many new species from the area (Economidis *et al.*, 2001, Kovačić & Šanda 2007, Miller & Šanda 2008, Zupančič *et al.*, 2010, Bogutskaya *et al.*, 2010, Shumka *et al.*, 2008, Shumka *et al.*, 2010, Shumka *et al.*, 2013, Shumka, 2015).

## **2. MATERIAL AND METHODS**

Referring to the fish species of community interest the site assessment criteria are based on aggregation and interpretation of available literature and/or field data. Proposed site for habitat types of community interest, the following are the criteria listed in Annex III of the Habitats Directive (stage I) that should be applied: the habitat identified in the site should be representative of the habitat type described in the Habitats Interpretation Manual; the area covered by the habitat type in the site should be large enough for the long-term maintenance of the habitat; the degree of conservation of structure and functions and possibilities of restoration should be considered; the value of the site for the long-term maintenance of the habitat should be assessed

Other important criteria are: proportionality: rarer and more localized species need a larger coverage by the network; priority species need in general larger coverage by the network; sites for a given species should reflect its genetic variation within the bio-geographical region; no need to propose sites for introduced populations outside the historical range of the species; sites must be proposed for reintroduced populations within the historical range; sites must cover all essential parts of the annual cycle or life cycle of a species;

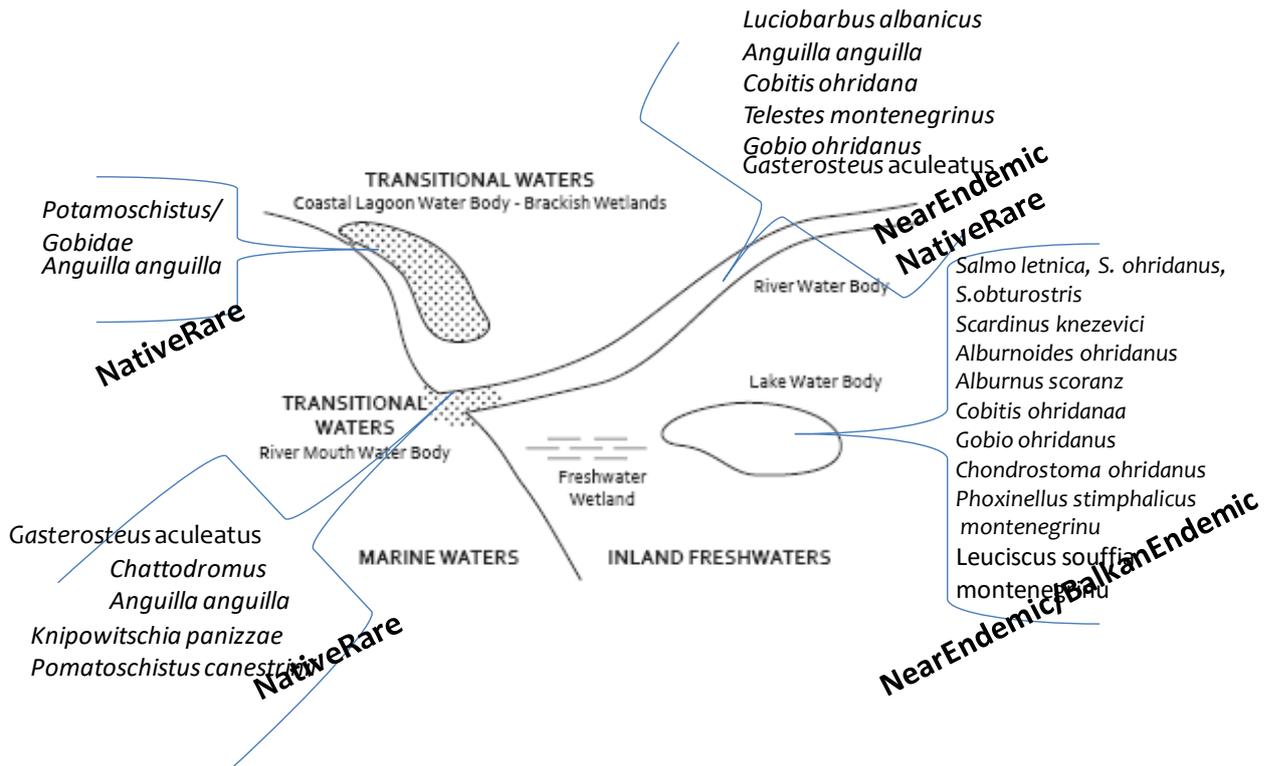
## **3. RESULTS AND DISCUSSIONS**

Based on the above detailed analyses the current situations the native fish populations and particularly identifies fish species of community interest in Albania (both freshwater and lagoon systems) are threatened by several anthropogenic activities and factors like: (i) rapid development of hydropower plants, damming and other related interventions; (ii) Water pollution and lack of integrated management approaches; (iii) Unregulated fishery practices and illegal fishing; (iv) Overfishing; (v) rapid spread of the non native fish species; (vi) Impacts on specific spawning grounds for specific species and (vii) poor integration of fishery management practices into entire management of protected areas in both continental and coastal areas.

**Table 1.** Fish Species of Community Interest in Albania

<b>SPECIES</b>	<b>IUCN RED LIST CATEGO RY</b>	<b>EUR HAB DIR ANNEXE S</b>	<b>SITES PRESENCE ALBANIA</b>	<b>MULTY- IMPACT SENSITIVITY</b>
<b>ACIPENSERIDAE</b> <i>ACIPENSER NACCARII</i>	CR	II	BUNA	VERY HIGH
<b>CLUPEIDAE</b> <i>ALOSA FALLAX</i> <i>ALOSA SP. NOV. 'SKADAR'</i>	LC VU	II II	BUNA, SHKODRA, NARTA BUNA, SHKODRA	MODERATED MODERATED
<b>COBITIDAE</b> <i>MISGURNUS FOSSILIS</i>		II	VJOSA	MODERATED
<b>COTTIDAE</b> <i>COTTUS GOBIO</i>	LC	II	ALBANIAN ALPS	VERY HIGH
<b>CYPRINIDAE</b> <i>ALBURNOIDES</i> <i>PRESPENSIS</i> <i>ALBURNUS BELVICA</i> <i>PELAGUS PRESPENSIS</i> <i>RUTILUS PRESESPENSIS</i> <i>RHODEUS AMARUS</i> <i>TELESTES</i> <i>MONTENEGRINUS</i> <i>TELESTES</i> <i>PLEUROBIPUNCTATUS</i>	VU VU EN VU LC LC LC	II II II II II II II	PRESPA PRESPA, GJANC PRESPA PRESPA SHKODRA, DRINI, OHRI, PRESPA SHKODRA, BUNA BUTRINT	LOW-MODERATE LOW-MODERATE LOW LOW LOW MODERATE MODERATE
<b>CYPRINODONTIDAE</b> <i>APHANIUS FASCIATUS</i>	LC	II	ORIKUM, NARTA, BUTRINT, VELIPOJA	LOW
<b>GOBIDAE</b> <i>KNIPOWITSCHIA</i> <i>MONTENEGRINA</i>	VU	II	SHKODRA, BUNA, TIRANA ARTIFICIAL LAKE	MODERATED
<b>PETROMYZONTIDAE</b> <i>EUDONTOMYZON</i> <i>STANKOKARAMANI</i> <i>LAMPETRA SP.</i>	LC LC	II II	DRINI (KORAB-KORITNIK)  BUNA, PEROI IZVORIT, BISTRICA	HIGH  HIGH
<b>SALMONIDAE</b> <i>SALMO MARMARATUS</i> <i>SALMO PERISTERICUS</i>	LC EN	II II	ALBANIAN ALPS PRESPA, BISTRICA	VERY HIGH HIGH
<b>VALENCIIDAE</b> <i>VALENCIA LETOURNEUX</i>		II	BUTRINT	VERY HIGH

During the year 2019, based on the biological and ecological characteristics of the fish species of conservative interest of the Llogara-Karaburrun potential Natura 2000 sites were identified problems in relation with species present and highlighted different conservation and management directions and needs, with the goals to preserve a good conservation status of the local fish populations and the associated biota, and to induce good conditions for the fish natural populations growth. Following the analyses it has been revealed the actual not general compliance with the requirements for the waste water and solid waste management and the lack of sufficient capacities appeared to be the main reason of some of the studied area areas and sectors (Coastal water, Lagoon of Orikumi, adjacent streams, etc).



**Figure 1.** Habitats and relevant species of interest in Albania

Following specific approach developed in Llogara-Karaburun area the observed distribution of *A. fasciatus*, *A. anguilla*, etc in the Orikumi Lagoon shallow waters is in accordance with the findings of studies in other Mediterranean brackish areas. The results of the one year's approach indicate the marginal salt marsh areas in the Orikumi Lagoon as important habitats for these species, thus suggesting their suitability as areas of conservation of the species, as required by the Habitat Directive (92/43/EEC). The identified and delivered conservation goal for fish species of community interest is focused on: Maintain and restore viable populations of existing fish species as an integral part of the Natura 2000 site ecosystems. In order to reach this goal, it is necessary to identify and mitigate or remove threats to the fish populations and their habitat.

Following the Habitats Directive, based fish species conservation objectives of a specific site were presented in the light of the importance of the site for the maintenance or restoration, at a favorable conservation status, of natural habitat types in Annex I or species in Annex II. Defined conservation objectives were regarded in line to the morphological, chemical and biological processes within different aquatic bodies. The ecological functions of rivers, lakes, estuaries and coastal waters were recognized, such as hydrological functions, function as spawning area, nursery or seasonal habitats for migratory species (mentioned widely in above sections of this abstract). Further on the conservation objectives and measures for Natura 2000 sites should be based on the assessment of the local conservation status of protected habitats and species, and with these regard specific objectives has to be drawn. The actual conservation status at the date of designation must be used as a reference value for evaluating the integrity of the site or its deterioration. With this regard the already completed Standard Data Form (SDF) with NATURA 2000 project also remains an important reference document with this regard.

#### 4. CONCLUSIONS

This study shows that fish fauna in Albanian rivers, lakes and coastal lagoons is at risk by multiple impacting factors. Different indicators of fish conservation value are related to different sets of impacting factors, but restoring water quality and natural flow regimes were considered as management priorities for the national and local authorities. It will directly help the conservation of aquatic diversity and further on ensure survival of the quality of freshwater resources.

Along with recovery and conservation measures, we propose proper monitoring and further abatement of introduced and alien species in various water bodies as current native fish diversity refugees are concerned.

More specifically it has been concluded: (i) Conservation of the aquatic natural habitats and habitats of fish species, their populations and distribution within the Natura2000 site, in order to achieve and maintain their favorable conservation status; (ii) Improving where necessary, the status of the described types of natural aquatic habitats and fish species; (iii) Restoration, where necessary, of the aquatic types of natural habitats and species habitats.

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**O 3. SURVEY ON STONE DEGRADATION AND USE OF DIAGNOSIS FOR ITS  
CONSERVATION**

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**ABSTRACT:** In this contribution are presented the approaches for the conservation of stone as it is fundamental for the preservation of our architectural components and cultural monuments. Stone degradation in the Post-Byzantine monuments of culture has been counted as one of the most serious threats to the integrity and values. From the immoral time due to its unique features, the stone is considered as one of the most resistant materials, while there are many factors that contribute towards its deterioration. The aim of this paper is to present the current state of the stone materials used in construction of Post-Byzantine monuments, reflecting in particular the rate of deterioration in the St. Mary's Monastery in Narta at the southern part of Albania, the main deterioration factors, such as air pollution, the presence of soluble salts due to proximity with marine area, and biodegradation. Following the field measurements, the external construction elements as colonnades, walls, supporting basins, etc, are affected loosing respectively > 50%, 30% and 20 % of the original dimensions. It is trusted that the description of the state and degradation factors serves as the basis to present the importance of a right diagnosis regarding the origin of the current deterioration and further on propose the appropriate solution for address the problem and conservation approaches.

*Keywords: Degradation, stone, monastery, conservation, heritage*

#### **O 4. CLIMATE CHANGE EFFECT ON MICROBIOME OF TERRESTRIAL ECOSYSTEMS**

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**ABSTRACT:** Climate change has a deep impact on terrestrial ecosystems. Important parameters of the soil microbiome are the number and functional diversity of microorganisms, soil respiration (CO<sub>2</sub> emission) and enzymatic activity. Well known that more than 1 billion tones of carbon are added to the atmosphere each year trough change of land use. The purpose of our studies was to investigate the dynamics of CO<sub>2</sub> emission from soils of agrogenic, postagrogenic and natural ecosystems and they soil microbiome for 10 years. Monitoring studies of the emission of carbon dioxide from soddy-podzolic soils and analysis of soil microbiome were conducted from 2008 to 2018 in dynamics. It has been established that over the past 10 years, the number of antibiotic-resistant bacteria has increased by 32,7% in natural ecosystems and by 78,2% in the transformed terrestrial ecosystems. Were isolated 624 dominant bacteria, among them 268 antibiotic-resistant bacteria. All isolates were multi-drug resistant, of which greater than 81,4% were resistant to 9 antibiotics. The maximum level of intensity of carbon dioxide emissions from soils of the studied ecosystems was fixed from the beginning of May to the end of June, due to a favorable combination of abiotic factors for the activity of the soil microbiota. The amount of carbon dioxide produced by virgin soddy-podzolic soils averaged - 83.51 (mg CO<sub>2</sub> / kg soil / day); postagrogenic - 68.35 (mg CO<sub>2</sub> / kg soil / day); agrogenic - 50.33 (mg CO<sub>2</sub> / kg soil / day). In general, carbon dioxide emissions from soil for 10 years have increased by 27.8%. Global warming causes significant changes in the structure and functions of soil microbiome.

*Keywords: Soil, ecosystem, climate change, microbiome*

## **O 5. THE LIVESTOCK HYGIENE AND THE ENVIRONMENTAL IMPLICATIONS**

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**ABSTRACT:** The heightening of livestock Animals creation results in expanded utilization of veterinary items, for example, pesticides, and the generation of various sorts of waste, similar to compost from feedlots. The contamination or sullyng of the earth, particularly water supplies, because of creature squanders (excrement and fluid fertilizer) is an expanding issue and should be anticipated when arranging new creature lodging, particularly in the mechanical generation frameworks. The legitimate move must be made for the cautious use or safe transfer of the slaughterhouse squander. These can be profitable results if properly handled. This ought to include cleansing or rendering of all denounced or tainted material before further handling and discharge for use. Ill-advised transfer of this sort of waste can prompt an expansion of ruthless creature species (for example hyenas, country hounds, and so on., ashore and sharks with transfer to the ocean). Also, squander nourishment from the universal ocean and air traffic must be sanitized to keep away from the dispersal of creature malady through debased creature items. Ecologically amicable strategies for applying bug sprays (targets and devices for tsetse control) and acaricides (pour on) are getting to be accessible. These have the potential for decreasing conceivable outcomes of pollution of nature and ought to be used where down to earth. The utilization of pesticides might be limited by utilizing breeds or their crosses that are impervious to parasitic species, for example, trypanotolerant steers or tick-safe breeds.

*Key words: Animals waste, livestock, drinking water, animal hygiene*

## **O 6. ENVIRONMENTAL IMPACTS OF GLASS BEVERAGE PACKAGING**

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**ABSTRACT:** Rapidly developing packaging sector is an important factor to enhance of the sustainability of the industry. Glass is one of the most extensively used materials for packaging, thanks to its skills and proprieties. This study aims to assess the potential environmental impacts of glass packaging. Life cycle environmental impacts of glass beverage packaging in the volume of 200 ml was evaluated. Life cycle assessment (LCA) study has been carried out in compliance with the ISO 14040 and 14044 standards. The scope of the study is from cradle to grave starting with the extraction of natural resources to final disposal of the product. LCA software tool CCaLC2 has been used for calculating six environmental impacts. In this study, the life cycle carbon footprint quantities of 200 ml glass bottles required to store 1000 L beverages were 370 kg CO<sub>2</sub>-eq/1000 L drinks. Approximately 63% of the life cycle carbon footprints of glass bottles are from energy usage, 20% are from raw material, 14% from transport, and 3% from use stages. Glass beverage packaging has the acidification potential, eutrophication potential and human toxicity potential 1,4 kg SO<sub>2</sub>-eq/1000 L, 506 g phosphate-q./1000 L and 86,2 kg DCB-eq./1000 L, respectively.

*Keywords: Life cycle analysis, sustainability, glass packaging, carbon footprint and environmental impact*

## **O 7. ROBOTIC SYSTEMS USED IN DAIRY CATTLE FARMS**

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**ABSTRACT:** Robotic systems are one of the applications that facilitate our life in animal husbandry. In recent years, especially in cattle breeding, to avoid integration led to the increasing number of large-scale livestock farms in both the world and Türkiye. This situation caused to increase the mechanization and use of robotic systems in animal breeding. Innovation studies in livestock breeding developed as in many industries. The aim of this study was to examine the robotic systems used in dairy cattle breeding and to determine their effects on animal breeding. The robotic systems used in animal husbandry allow the animals to carry out the practice they need in their own right at any time, without human control, with the freedom of movement within the shelter. In this study, robotic systems used in dairy cattle breeding investigated under three different headings as robotic systems used in milking, robotic systems used in feeding and robotic systems used in fertilizer cleaning. The use of robotic systems in dairy cattle farms provides benefits such as ease of farm management, more efficient control of animals, gain of human labor, improvement of cow welfare, increase in milk yield and quality.

*Keywords: Dairy cow, dairy farm, milking, robotic milking, robotic systems*

### **1. INTRODUCTION**

In order to ensure a healthy and balanced diet, it is of great importance and benefit to have animal foods in their daily foods. In animal foods, meat and milk are the most important products. Today, the consumption level of animal products in a country is an indicator of the development of that country (Uzal and Uğurlu, 2004).

Animal husbandry today in Türkiye is largely done with traditional methods. The most important feature of traditional animal husbandry is that it is based on manpower and the mechanization is not used. Animal husbandry is carried out by machines rather than manpower in developed countries and in most Cattle Farms in our country (Anonymous 2019 c).

Today, the number of large-scale integrated cattle enterprises using modern technologies in Türkiye as well as in the world is increasing rapidly. It should be noted also that, in animal husbandry in the world and Türkiye is not spread as far as the mechanization of labor-intensive industrial and service sector still continues to feature. Modernization and mechanization in cattle farms mainly focus on feeding, milking and animal welfare (Anonymous 2019 c).

Robot, mechanical systems and associated control and detection systems with they are intelligent machines depending on computer algorithms. Robot reprogrammable; agents, pieces, appliances, they are multifunctional machines that carry or process according to the work to be done with programmed movements (Anonymous 2019 d).

The robotic system, industrial robot, parts, agents, tools or special processing tools, with various programs, is a design that can move according to the desired task. The first articulated arm was developed in the 1950s. Especially for industrial automation and with the use of computer applications in management systems, there have been many developments in this field. From the first development of the additive arm in the 1950s and various types of robots depending on advances in microprocessor technology, figure and started to be used in sizes. Robots have a wide range of tasks. In fact, the need for robots is strong and competitive environment provided by economic performance and to adapt to each business environment. This workplace welder, paint jobs, take any substance and put it in a place etc (Anonymous 2019 d).

Because people are not physically able to do all their work physically, has developed different machines to use in places where power is insufficient. First of all, these machines, working with human assistance, developed over time and has been made to operate automatically without the need of human by using various peripherals with it. For these reasons, robots have an important place in our lives. Generally, reduce production cost and is used to make better quality production (Anonymous, 2019 e).

In this study, robotic systems which are rapidly being used in dairy cattle breeding as in every field, robotic systems used in milking, robotic systems used in feeding and fertilizer used for cleaning robotic systems it has been evaluated under three headings.

### **1.1. Robotic System Used in Milking**

Today, milking units are widely used for milking in modern dairy cattle farms. Milking units, it is a very complex unit of a modern dairy business. The most important elements of a milking place, dairy cattle and milkers. Therefore, milking parlors are designed, constructed and managed to create the most favorable environmental conditions for animals and milkers. Thus, insufficiency of equipment used in animal milking system in milking center, locations of entry and exit doors and problems such as inaccurate dimensions or slippery of the slabs will negatively affect the comfort of dairy cattle and thus lead to a decrease in milk production. Similarly, milking performance and indirectly milk quality decrease in conditions that disturb the milking system's working order (Olgun, 2011).

Use of robotic systems in animal husbandry, people physical, bodily and to be able to perform all jobs as qualified and since it is not possible to be equipped, robots developed to be used where people cannot afford milking, at feeding and fertilizer has also started to be used in animal husbandry.

Experts working in this field in recent years, in order to eliminate the problems experienced in milking units, they turned to the search for alternative systems. As systems that can eliminate these problems, propose robotic milking systems. Robotic milking, cows enter the milking system at any time without human control and moves freely in the shelter. Preparing the breast for milking, installation of milking units and removal control of automatic devices recognizing cows, system is made with the help of computer (De Koning et al. 2001, Graves 2002, Reinemann 2002).

Computer among robotic milking equipment, sensors, milking stop, automatic doors, feeding place, cleaning system, milking system, milk meters, cooling tank and robotic arm countable (Aliç and Yener 2006).

Robotic milking system, cows visit the system voluntarily. The cow goes directly to the milking station for milking or forage. Cows, when it comes to milking stop system starts to work. The milking system starts the milking process with the help of magnetic chips in the cows' neck (Aliç and Yener 2006).

Milking takes place in the following order,

1. After the entrance door of the system is closed electronically, feed is provided with electronic feeders.
2. The metal robotic arm, which is part of the system, comes under the cow and the nozzles are cleaned with the washing system mounted on the metal robot arm.
3. After washing, the cylindrical brush for cleaning is withdrawn and the laser unit is used to determine the position of the cow's nipples.
4. After determining the nipple position with laser system the milking heads on the metal robot arm are attached to the cow's udder.

Each milking head has its own measuring device. Vacuum in milking heads decreases when milk flow decreases and milking heads are removed. After all the milking caps have been removed, each milking head is washed on the metal robot arm, metal robotic arm moves again under the cow and disinfectant solution is sprayed on each nozzle. After this process is completed, the exit doors are opened and cows leave the milking station (Halladay 1999, Cooper 2001, Gearin 2001, Dick 2002, Hopster et al 2002, Rodenburg 2002, Radford 2003, Wilson 2003, Halachmi 2004, Anonymous 2005 b).

Business owners achieve high milk quality using the robotic milking system. However, some management strategies differ from a conventional milking system. For example, mastitis control, a drying service for dry teats in conventional milking systems and it requires immersion for an uninfected breast after milking. On the other hand, in a robotic milking system, the nipples are automatically dried, after milking, the same processes are carried out using a spray instead of dipping (Radfor, 2003).

Careful monitoring of both cow and system performance in robotic milking system and how to control the milking system in terms of learning the business owner has some responsibilities. Robotic milking unit cows that do not visit voluntarily should be directed to milking regularly.

The advantages of milking robot used in dairy cattle shelters are given below,

- ✓ It reduces the time allocated for milking.

Milking in dairy cattle, it constitutes a large part of the work done within the enterprise. Without mechanization and the time spent on milking is higher in enterprises that are heavily utilized in the labor force. Therefore, milking, dairy cattle farms emphasis on required it is one of the daily jobs.

- ✓ An increase in milk yield and quality occurs.

Robotic milking, milk yield of cows owned by a farm and improve the quality and improve the quality of life of the owner (Helgren and Reinemann 2003).

In another study conducted in the Netherlands in a dairy farm 2 times a day from traditional milking to robotic milking an average increase of 11.4% was observed in milk yield (Helgren and Reinemann 2003).

- ✓ You do not need to be near the animals for milking.

The main difference between robotic milking and the traditional milking system, the fact that each cow can be milked without the owner (Van't Land et al. 2000, Helgren and Reinemann 2003).

- ✓ Breast and animal health are controlled more effectively.

Human observations and the decisions taken as a result, milk quality and breast health is not enough to determine (Helgren and Reinemann 2003, Anonymous, 2004 a).

- ✓ Your cows will be quieter and more docile.

Robotic milking, can also cause some psychological effects on cows. Robot milked cows are quieter and docile than traditional milked ones (Demir & Öztürk, 2010).

- ✓ Cow welfare holds an important place in robotic milking for cows have the opportunity to move freely.

A robot system installed in the barn, more control over the daily habits of cows with cow welfare development. Besides, robotic milking when established time cows adapt to the system quite quickly. Working staff also cows up it is well adapted to the system. Production increases significantly, cow and breast health are also positively affected. This technology, retention of cows in rural areas and successive odor, pollution and will help to eliminate problems related to animal welfare (Alıç and Yener 2006).

The most important feature of milking robots, cows to their milking times to decide for themselves opportunities.

Milking robots, designed for a business, save labor, yield, cow behavior, feeding habit of cows with impact on management practices should be taken into consideration (Van Landt Land et al. 2000).



**Figure 1.** Robotic Milking System (Anonymous 2019 g)

## **1.2. Robotic Systems Used in Feeding**

The genetic structure of today's dairy cattle has superior features. Milk yield of genetic structure and improvement of properties in terms of other efficiency parameters for work continues. Genotype of animals developed phenotype needs should be met at parallel level. In other words the effect of genetic structure on animal productivity is 30% environmental conditions are effective at the level of 70% (Ekmekyapar, 1991). Therefore, milk quantity and quality animal welfare and environmental conditions affecting it is very important. Design of animal shelters, consideration of animal welfare and preferences of animals, environmental conditions should be determined in accordance with animal welfare.

Feeding is of great importance in a cattle farm. Because fertility in the first place impending milk yield and all other yields strictly associated with feeding. Feeding with robotic systems saving labor and time in addition to providing more regular feeding and 24/7 access to fresh food possibility it provides. Mechanization in feeding has two dimensions. The first of these is clover, also called roughage, meadow grass, corn, barley, wheat, oats such as yields of plants, vetch, sainfoin, clover, beet such as production of feedstuffs. Production of these feedstuffs with normal agricultural tools and machines, is done in accordance with normal agricultural rules. Mechanization is mostly in forage silage production and It is used to obtain concentrate feed from different feed materials in the enterprise. Storage of silage green feed by fermentation and is a storage process to ensure the use of winter. Silage in the world and Türkiye is most commonly made of corn silage forage crops. The corn must be harvested before making the corn silage. Here it is a mechanization come into play and silage machine is used (Anonymous 2019 c).

1. Forage harvesting equipment yet to fruit trunk of unreached corn and cut together with leaves of certain lengths in addition situated into the truck or tractor's trailer acts as an installer. Used for this purpose and Türkiye has also produced numerous silage machine model (Anonymous 2019 c).

2. Another machine used in feeding feed crushing-mixing machine. Medium and large scale cattle enterprises for many years even dense feeds sack from feed mills or silos pour have provided. But in recent years these businesses need animals concentrate feeds themselves. For this purpose, purchased and corn stored in suitable conditions, barley, wheat, sunflower meal, cottonseed meal, corn silage, hay, dry clover and similar to other feed ingredients specific ration complying with the daily needs list put into feed crushing-mixing machine, the machine breaks down these feedstuffs into small pieces that can be eaten by the animal while mixing and homogenizing them. Forage crushing-mixing machine same time smashed baits it also undertakes the function of distributing an equal amount to the animal feeders in the shelters (Anonymous 2019 c).

3. Another machine used in feeding is automatic feeding system. Daily quantity of concentrate and roughage in this system feed way proceeding the cows' feed is missing laser system by sensing in front of the automatic feeding unit missing feed is poured into the manger and the cow is eating as much food as it needs. This system also serves to sweep the feed.

4. It is known as belt feed distribution system. Feed distribution in this system, animals on a moving band system provides access to food. This platform can be planned unilaterally or mutually according to the number of animals. Animal feed, they can be consumed in any amount of time and amount of freshness and provides easy cleaning of feed residues.

Frequent feed distribution in a relaxing environment, it improves both animal feed intake and consequently feed use. Constant collection of feed ensures that the feed is always kept fresh and that fermentation processes do not occur. Cows always enjoy optimal feed rate and cleaning in the feed section is indicative of this. Your healthy cows will produce the best quality milk.

The advantages of the feed robot used in dairy cattle shelters can be listed as follows.

- Fully automated system minimizes workload (Anonymous 2019 f).
- Precise weighing and distribution ensures savings in feed costs (Anonymous 2019 f).
- Provides simple and effective feed management.
- Providing swept feed to the manger without contamination, prevents feed waste.
- Optimal feed use ensures the highest quality milk.



**Figure 2.** Feed Distribution In Robotic Systems (Anonymous 2019 h)

### **1.3. Robotic Systems Used in Fertilizer Cleaning**

In animal production, large amounts of fertilizer are produced. Therefore, manure management, is one of the major problems in livestock enterprises. Fertilizer management, without harmful to human and animal health, environmental pollution and fertilizer efficiency it should be done at minimum cost without causing a reduction. Fertilizer management, grown animal-dependent for all livestock enterprises without affiliation has great importance. However, the amount of daily fertilizer obtained per animal is high the importance of fertilizer management in cattle holdings is increasing (Olgun, 2011). Fertilizer, from animals obtained stool and urine it is formed. In addition to fertilizer feeding in shelter, irrigation, milking and solids obtained as a result of daily activities such as maintenance and liquid wastes, bearing material, precipitation and miscible with water from other sources mixture of materials such as soil is understood.

Cleaning of manure in shelter mechanical systems are used. These are generally;

- Manure removal robots (mobile systems),
- There are two groups as mechanical scraper systems.

Manure removal robots, is widely used in mechanization of solid fertilizer.

Mobile systems have various advantages. These include; low investment, ease of adapting to different types of shelters, manure cleaning can be specified easily (Olgun, 2011).

Mechanical scraper systems, said scrapers, located on concrete slabs or grilled floors below canal pouring out or by collecting the accumulated fertilizer in the urine canals to a storage tank or a fertilizer spreader. In this system during operation of automatic scrapers animals do not need to be taken out of the shelter. One of the most important advantages of the system labor requirement is very low (Olgun, 2011).

The system to be selected is completely the length of the barn, the number of animals and accordingly is associated with the amount of fertilizer. Equipment safety, easy movement of animals, the health of animals and people and manure cleaning process is carried out without causing environmental pollution.

#### **Advantages of Robotic System Used in Fertilizer Cleaning**

It is advantageous that the scraper blades have rubber on them so as not to damage the floor. This rubber, as the structure of the soil prevents degradation at the time of stripping more uniform and residue-free stripping. Fertilizer on concrete-based service roads should be cleaned at least once a day. Automatic fertilizer stripping systems are large and frequentuse in manure stripping farms and and saves labor costs. This system, less expensive than stripping with a tractor (labor, machine expense, maintenance, injured cows, etc.). Operationally, fertilizer stripping system blades to manure collection channel or from the edge of storage space will leave the storage space should be designed. Equipment working at the place where the manure will be poured; not harm the cows, other machine equipment parts do not interfere with the work routines and should not cause damage. Therefore, necessary measures should be considered during planning (Olgun, 2011).



**Figure 3.** Manure Removal Robot in Robotic System (Anonymous 2019 1)

## 2. RESULT

Use of robotic systems in dairy cattle shelters; decrease in milking time, increase in milk yield and quality, gain from the labor force, make animals more quiet and docile provides more effective control of animals.

The most important advantage of robotic systems, reducing dependence on labor force in animal husbandry and allow employees to have a holiday. Use of robotic systems in a dairy cattle farm without the owner of the business several (2-3) days of robotic systems it makes it possible to manage with.

Robotic systems used in dairy cattle breeding it also increases the quality of life of the enterprise. The use of robotic systems also facilitates management. A robotic system installed in the shelter, on the daily habits of cows performing further checks and to improve cow welfare.

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## **O 8. APPLICATION OF MAGNETIC BIOCHAR PRODUCED FROM ORANGE TREE SAWDUST AS AN ADSORBENT FOR THE REMOVAL OF CR (VI) IN WATERY ENVIRONMENT**

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**ABSTRACT:** In the present work, biochar was obtained from orange tree sawdust (OTS) and then it converted to magnetic form by a series treatment. This substance was applied as an ideal adsorbent for removal Cr (VI) from aqueous solution. The novel magnetic biochar (MB $\otimes$ OTS) originated from OTS is likely to enhance the adsorption potential of Cr (VI). The adsorption of Cr (VI) by MB $\otimes$ OTS and OTS was compared with each other for series of adsorption parameters. Magnetic form of OTS was constituted with FeCl<sub>3</sub>.6H<sub>2</sub>O and FeSO<sub>4</sub>.7H<sub>2</sub>O in a basic medium. The Magnetic OTS was heated in an oven at 500 °C for 60 min. The produced magnetic char was applied for the removal of Cr (VI). The optimum conditions for the maximum Cr (VI) adsorption by MB $\otimes$ OTS were determined as; 0.05 g adsorbent dosage, 40 mg/L Cr (VI) initial concentration, pH 2.01 and contact time, 180 min. The adsorption data were described well by the Langmuir isotherm model (R<sup>2</sup>=0.985) compared to the Freundlich isotherm model (R<sup>2</sup>=0.969). The maximum Cr (VI) adsorption capacity were calculated from the Langmuir equation was 30.36 mg/g for MB $\otimes$ OTS and 11.75 mg/g for OTS. The adsorption capacity of MB $\otimes$ OTS was higher than the capacity of raw OTS. The results showed that MB $\otimes$ OTS can be an alternative adsorbent for the removal of Cr (VI) in the aquatic environment.

*Keywords: Magnetic Biochar, Cr (VI), Adsorption, Kinetics*

### **1. INTRODUCTION**

Development industrial activities are highly threatening the clean water resources. Wastewaters are dumping from the industry without any treatment, so this situation causes a significant increase in chromium in soil, surface and groundwater resources (Vilardi et al. 2018). These kinds of wastewater contain heavy metal ions, which is a serious threat to both human health and all ecosystem. Heavy metals are non-biodegradable and have a tendency to accumulate in tissues through feeding and skin adsorption in all living tissues, from water microorganisms to animals and humans (Son et al. 2018). For example, if a certain concentration is exceeded in the body, it causes various diseases. Especially, chromium is widely used in many industrial applications. The wastewater released after various industrial activities sometimes contains trace amounts, sometimes-high concentrations of Cr (VI).

The most common wastewater containing chromium is released by paper, petrochemical, chlor-alkali production, fertilizer, iron and steel, leather and energy production (thermal) industries (Jia et al. 2018). Therefore, keeping the level of chromium in the wastewater at the limit level has been important in terms of environmental pollution. Regardless of its source, chromium pollution in drinking water is a serious problem in many parts of the world (Qian et al. 2019). The chromium exists either Cr (VI) or Cr (III) form in the environment. Cr (VI) is more toxic than Cr (III), which its analysis in environmental samples is more important. The removal of Cr (VI) ions from waters has been one of the most important issues investigated in the world (Lu et al. 2017). According to drinking water quality guidelines prescribed by the World Health Organization (WHO, 2011), the concentration of Cr (VI) in drinking water should not exceed 0.05 mg/L. It is important to control Cr (VI) pollution due to its toxicity. For this reason, the drinking water standards require an acceptable level of the metal ion in the medium and this requires new and highly effective treatment technologies (Zhang et al. 2019).

Numerous scientific researches and investigations have been carried out to determine and remove the levels of Cr (VI) ions causing pollution, and researchers have used a number of different analytical techniques and methods (Han et al. 2016; Shang et al. 2017). Generally, the methods used to treat wastewater containing heavy metal ions are chemical extraction (Yao et al. 2019), chemical oxidation-reduction (Huang et al. 2019), reverse osmosis (Gaikward et al. 2017), membrane separation (Laqbaqbia et al. 2019), ion exchange (Cao et al. 2018), adsorption (Cherdchoo et al. 2019) and biosorption (Xining

et al. 2015). One of the processes commonly used in the treatment of industrial wastewater is adsorption. The most significant advantage of adsorption based methods is the ability to separate trace amounts of pollutants from the large volume of wastewater. The adsorption method for heavy metals exist in the wastewater is a more economical and effective method compared to other separation methods depending on the type of adsorbent applied (Wang et al. 2014). For this reason, natural adsorbents are preferred in industrial applications and the related technologies are carried out on the development of adsorbents that can realize their adsorption activities more economically in wider application areas. Especially industrial and agricultural by-products are evaluated as adsorbents and solutions for current problems in the waste management area and lower cost adsorbents can be obtained. Appropriate assessment of these wastes and wastes is very important in preventing the national economy and environmental pollution (Chen et al. 2018).

OTS is abundant in nature and it is a low-price material. It can be used as a suitable adsorbent for the removal of toxic metals in wastewater in the present and modified form (Shukla et al. 2002). This material obtained as a by-product in wood production plants in the solid form and can be used as a low-cost adsorbent for the removal of heavy metals from water. OTS consist of (45-50%) cellulose and (23-30%) lignin, which contain hydroxyl, carboxylic and phenolic groups (Zakaria et al. 2009). The OTS can be treated with magnetic materials to increase the capacity of heavy metal bonding.

Biochar is a carbon-rich solid created by high-temperature pyrolysis of biomass heating in the absence of oxygen. Biochar has interested appreciable relevance in recent times owing to its remarkable properties, for example, its low cost, eco-friendliness, and the wide range of available feedstock materials, as well as mechanical and thermal stability, which facilitate the application of biochar in many environmental areas (Yap et al. 2017; Shang et al. 2017; Lyu et al. 2017). Furthermore, the feedstocks of biochar production can be acquired from a variety of waste biomass and produced at low cost, which mainly obtained from agricultural biomass and solid waste (Rajapaksha et al. 2018; Tan et al. 2015). Nowadays, the removal of heavy metals has become a key area of research interest in relation to the potential of biochar for wastewater remediation (Qian et al. 2019). As an adsorbent, MB@OTS has a porous structure similar to activated carbon, which is the most commonly employed and efficient adsorbent for the removal of chromium from water throughout the World (Wei et al. 2018; Zhang et al. 2019). Moreover, MB@OTS contains a large amount of oxygen-containing groups on the surface, which are quite effective for the adsorption of chromium. MB@OTS has been found to provide effective adsorptivity, ready separation, and easy recycling. MB@OTS described among these approaches and successfully produced by chemical co-precipitation of iron oxides. Recent studies have tended to use compounds or mixtures of biochar and iron-based materials to remediate pollutants (Qian et al. 2017). The recoverable magnetic biochar derived from orange tree sawdust is a good potential for water remediation (Shan et al. 2014).

In the present study, the main target is to produce MB@OTS from OTS with much higher capacity and to try the different parameters related to adsorption of Cr (VI) from the solution phase onto the MB@OTS. The parameters such as contact time, adsorbent dosage, initial metal ion concentration, and pH were investigated for the equilibrium stage. Applying the parameters obtained from the isotherm plot, the adsorbent capacities were determined.

## **2. MATERIALS AND METHODS**

### **2.1. Materials**

FeCl<sub>3</sub>.6H<sub>2</sub>O, FeSO<sub>4</sub>.7H<sub>2</sub>O, NH<sub>4</sub>OH, NaOH and HCl solutions were obtained from Merck Company. The pH of solutions was adjusted by adding 0.1 M NaOH and HCl solution. Ultrapure water was used throughout this study for all cleaning procedures and the dilution of concentrated solutions. Cr (VI) solutions were prepared using K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>. Stock solution (1000 mg/L) of Cr (VI) was prepared by dissolving the required quantity of K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> in ultrapure water.

For the adsorption experiments, Orion 900S2 Model pH meter, a thermo explicit shaker of GFL 3033 model was used for the simple adjustment of pH and mixing the solutions. UV-Visible Spectrophotometer (Shimadzu UV-1700) was used to determine the Cr (VI) concentration in all samples. The microstructure of the MB@OTS was examined by using a scanning electron microscope (SEM, Nova Nano SEM 200, FEI Company). The samples were coated with a fine gold before the measurement and then sprayed at 20kV in SEM.

## 2.2. Preparation of the Adsorbents

OTS was prepared from the orange trees garden in the southern parts of Muğla-Turkey. They were trimmed and washed several times with pure water. The woodchip obtained in natural condition were meshed with a saw machine and then dried in the oven. After that, they sieved in certain mesh sizes (65-125  $\mu\text{m}$ ).

Magnetic orange tree sawdust  $\text{M}\text{B}\text{O}\text{T}\text{S}$  (Figure 1.) was synthesized by a simple chemical precipitation method. OTS (5 g),  $\text{FeCl}_3 \cdot 6\text{H}_2\text{O}$  (6 g) and  $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$  (4 g) were transferred into a flask containing 100 mL of pure water. Furthermore, the pH of the reaction medium was adjusted to 10 by adding 1 M ammonia solution by dropwise and the reaction was held at 50  $^\circ\text{C}$ . During the experiment, the suspension was mechanically stirred for 1 hour.  $\text{M}\text{B}\text{O}\text{T}\text{S}$  was collected by filtering and then washed with pure water for several times to remove unnecessary ions until the effluent had a pH value of about 7. Then,  $\text{M}\text{B}\text{O}\text{T}\text{S}$  was separated from the mother liquid phase by centrifugation. Then, the  $\text{M}\text{B}\text{O}\text{T}\text{S}$  was dried approximately 36 h at the room temperature. The dried adsorbent was heated with at 500  $^\circ\text{C}$  for 1 h to obtained biochar. The  $\text{M}\text{B}\text{O}\text{T}\text{S}$  was stored for further experimental usage.

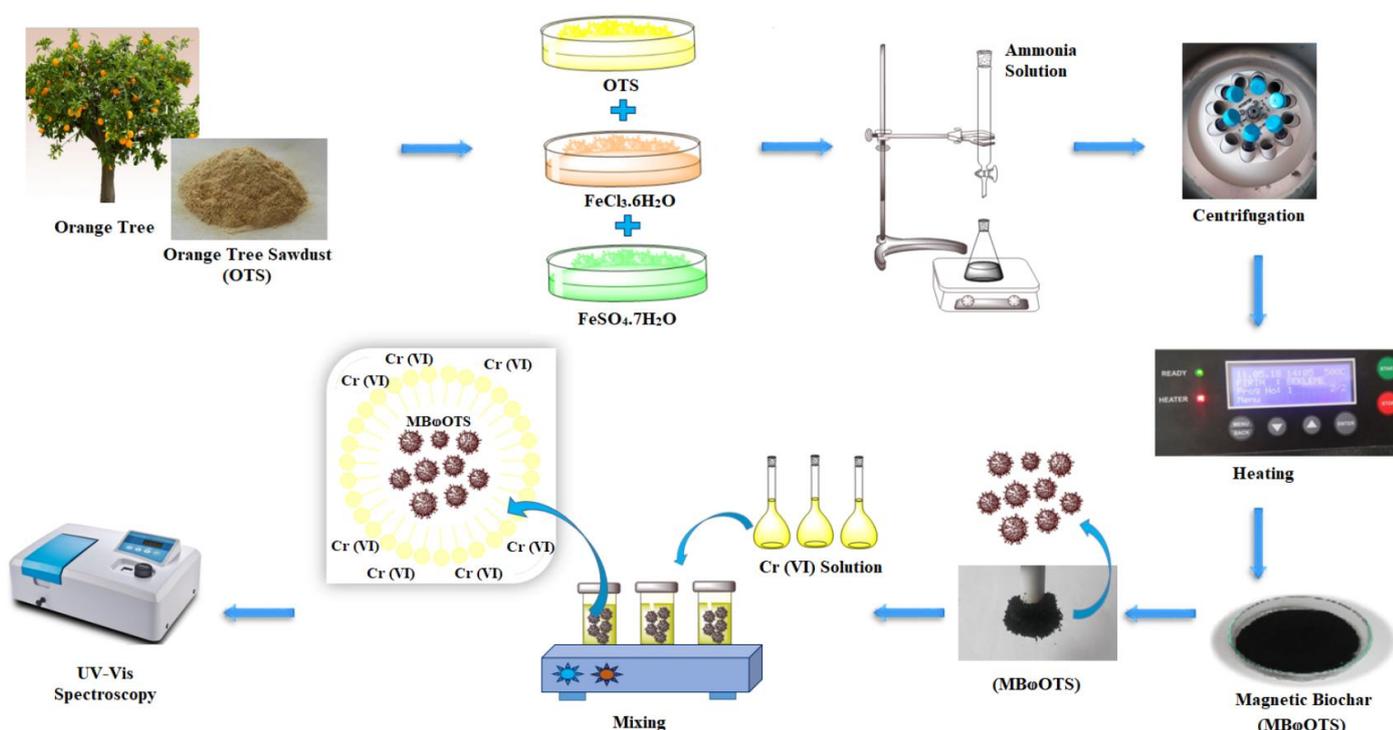


Figure 1. Preparation of  $\text{M}\text{B}\text{O}\text{T}\text{S}$  from OTS.

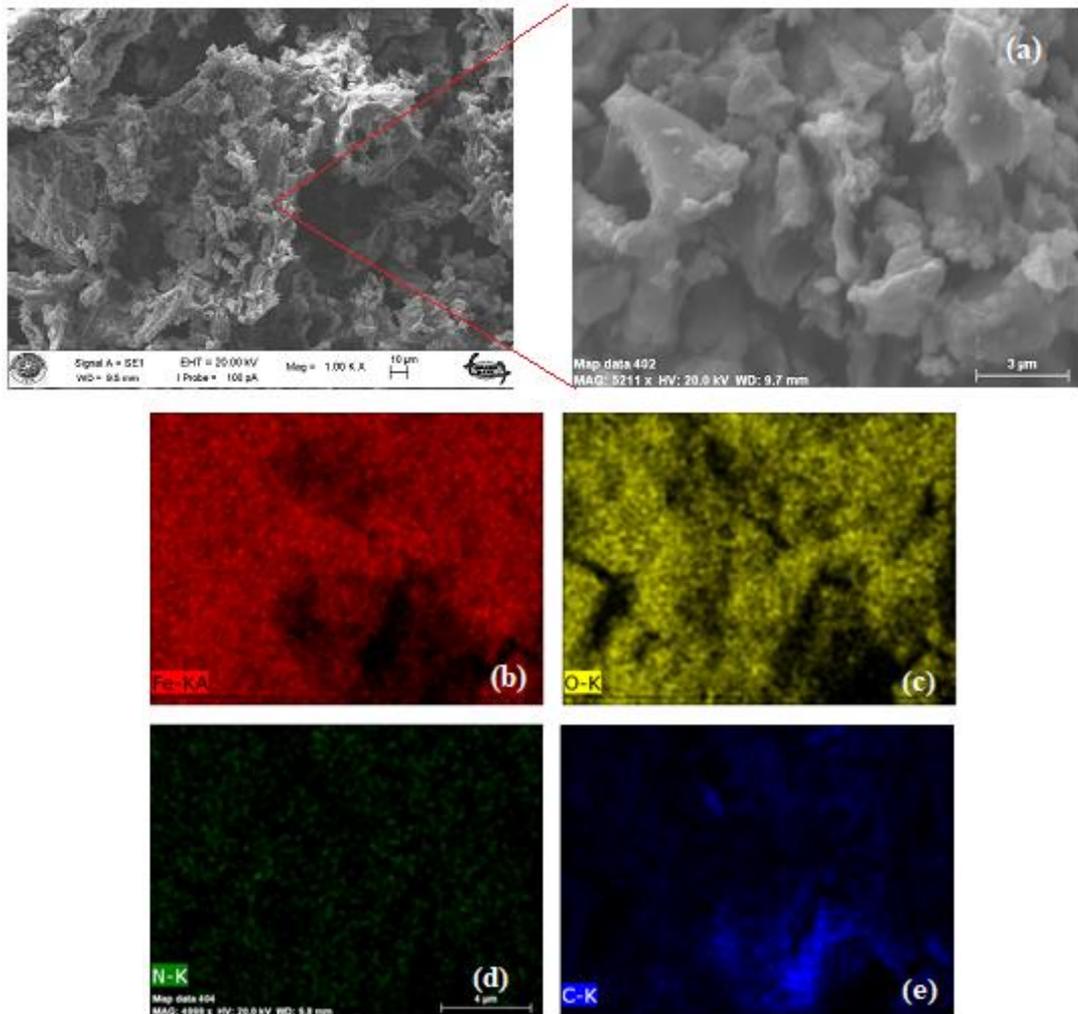
## 2.3. Experimental Method

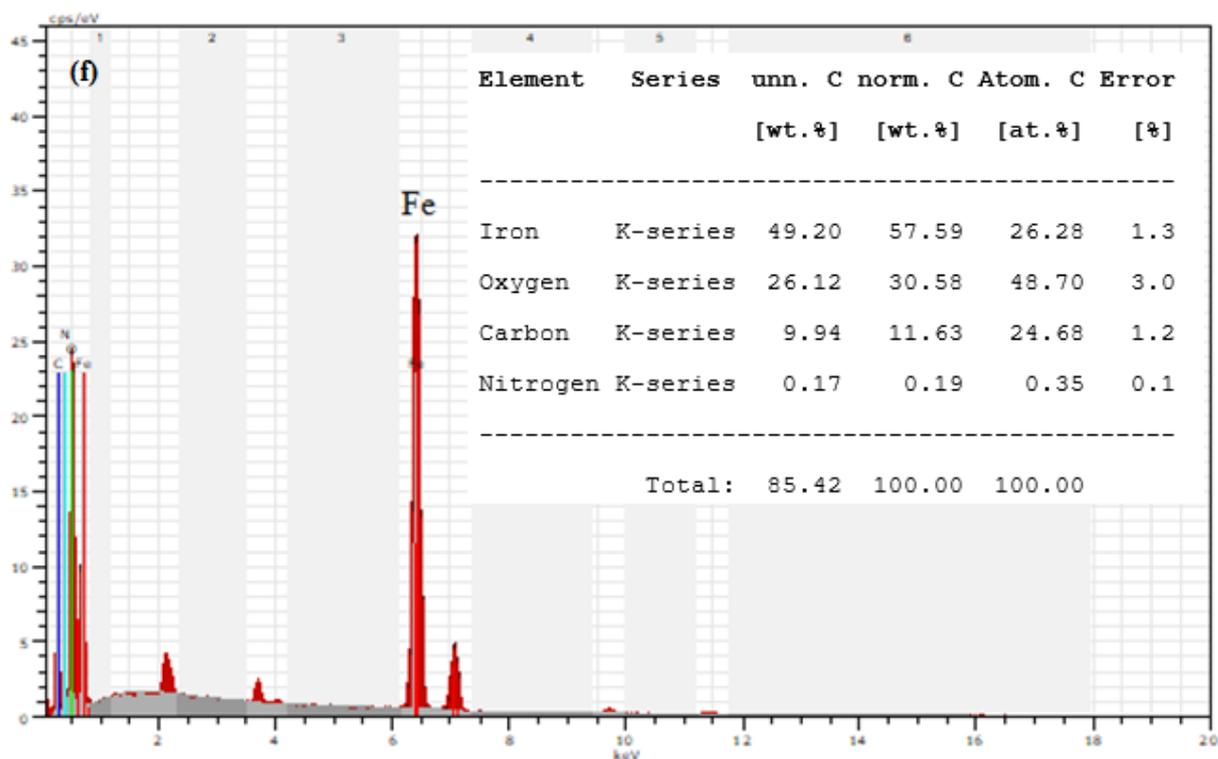
OTS and  $\text{M}\text{B}\text{O}\text{T}\text{S}$  were tested as an adsorbent for the Cr (VI) removal. The batch equilibrium studies were conducted by adding a uniform quantity 0.1 g of the dried OTS and 0.05 g of the  $\text{M}\text{B}\text{O}\text{T}\text{S}$  to 25 mL of the synthetic aqueous Cr (VI) solution having different initial concentrations (25–400  $\text{mg L}^{-1}$ ) in 100 mL flasks. The solutions were mixed well with a magnetic stirrer and maintained for a fixed time at 25  $^\circ\text{C}$ . To determine the adsorption capacity at various pHs, the pH of the Cr (VI) solution was adjusted with 0.1 M HCl or 0.1 M NaOH aqueous solutions to confirm the attainment of equilibrium. After the establishment of equilibrium, the residual concentration of the Cr (VI) in the filtrate was measured with a UV-Vis. Spectrophotometer.

## 2.4. Characterization of $\text{M}\text{B}\text{O}\text{T}\text{S}$

The surface structure of  $\text{M}\text{B}\text{O}\text{T}\text{S}$  was analysed by scanning electronic microscopy (SEM) (Figure 2.). As shown in Figure 2a., the typical SEM image indicates that a lot of iron nanoparticles uniformly dispersed on the surface of  $\text{M}\text{B}\text{O}\text{T}\text{S}$ . The textural structure examination of  $\text{M}\text{B}\text{O}\text{T}\text{S}$  particles can be observed from the SEM photographs. This figure reveals that the  $\text{M}\text{B}\text{O}\text{T}\text{S}$  particles were mostly

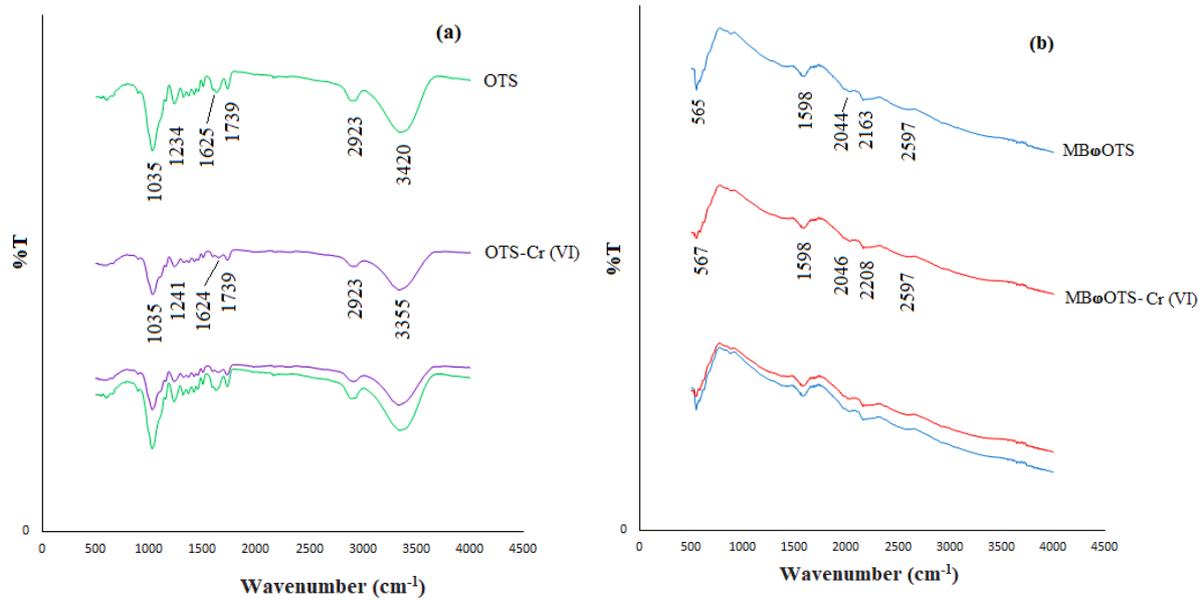
irregular in shape and porous. Element distribution maps and general EDS analysis results of MB $\phi$ OTS were given in Figure 2. (b, c, d, e, f). The distribution of the iron, oxygen, nitrogen and carbon in the MB $\phi$ OTS was characterized by mapping as shown in Figure 2. (b, c, d, e), respectively. When the element distribution mapping is examined, it is seen that the synthesized iron is distributed homogeneously in the structure of adsorbent. EDX spectrum of the prepared MB $\phi$ OTS is depicted in Figure 2f., which indicates the presence of iron, oxygen, nitrogen, and carbon. Table inset in Figure 2f. depicts the elemental analysis of the MB $\phi$ OTS, indicating the wt% of iron, oxygen, carbon, and nitrogen as 49.20, 26.12, 9.94 and 0.17, respectively.





**Figure 2.** Typical SEM micrograph of MB@OTS (a), the elemental mapping associated with iron, oxygen, nitrogen and carbon are depicted in (b) (c) (d) and (e), respectively and EDX spectra of MB@OTS (f)

The functional groups of OTS and MB@OTS can be better understood from a FTIR study of the adsorbent. The spectra can, therefore, help in the interpretation of the functional groups accountable for adsorption. The FTIR spectrum of the raw OTS before adsorption (Figure 3.a) depicts a relatively broad peak at  $3420\text{ cm}^{-1}$ , which is due to the H-bonded OH stretch, confirming the presence of a hydroxyl group. The band in the region of  $2923\text{ cm}^{-1}$  was attributed to C–H stretching of alkane (Danish et al., 2018). The peak found within  $1720\text{--}1620\text{ cm}^{-1}$  indicates the presence of carboxylic acid (C=O stretching vibration together with C–H stretching vibrations), which contains carboxyl and hydroxyl functional groups (Bardalai and Mahanta 2018). Aromatic C–O stretching vibrations of the lignin component and –C–O–C– stretching appearing at  $1035\text{ cm}^{-1}$ . The MB@OTS displays bands at  $2597$ ,  $2163$ ,  $2044$  and  $1598\text{ cm}^{-1}$  (Figure 3.b). The band around  $1598\text{ cm}^{-1}$  in MB@OTS was assigned to ring vibration in a large aromatic skeleton or carbon-carbon double bonds generally found in activated carbon (Guo and Rockstraw, 2007; Liu et al. 2010). This band was attributed to the stretching vibration and the torsional vibration of Fe–O bonds in the tetrahedral sites and in the octahedral sites of  $\text{Fe}_3\text{O}_4$  (Namduri and Nasrazadani. 2008; Liu et al. 2010; Reza and Ahmaruzzaman, 2015). Looking at the spectrum, it shows carboxylic acid, and hydroxyl groups showed a dominant role in the removal of Cr (VI) ions. Some clear shifts from the matrix of the adsorbents were seen after the adsorption of Cr (VI). This caused the decrease in the intensity of the band and changed the existing band to a narrow band spectrum. FTIR analysis of the adsorbents displayed that some bands shifted after Cr (VI) adsorption.

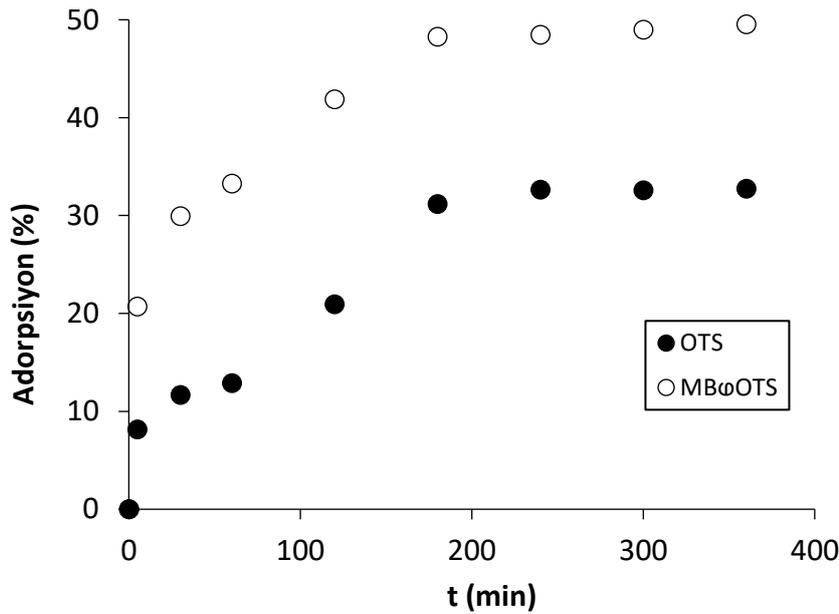


**Figure 3.** FTIR spectrum of OTS (a), MB@OTS (b) before and after adsorption Cr (VI).

### 3. RESULTS AND DISCUSSION

#### 3.1. Effect of Contact Time

The effect of contact time on the removal of Cr (VI) was showed in Figure 4. Contact time plays a significant role in the removal of Cr (VI). At first, the rise in adsorption is incredibly speedy as there are plenty of free sites for the adsorption to take place. The adsorption decreases at later stages until the equilibrium is reached because of the saturation of active sites. The quickest Cr (VI) uptake took place within the initial 30 min followed by slow uptake of the Cr (VI) for the next 180 min and eventually reached equilibrium after 180 min by using OTS and MB@OTS. The reason for this trend is that originally there's the accessibility of an oversized variety of vacant binding sites on the adsorbent surface promoting fast adsorption of Cr (VI). But, later on, the binding sites are being occupied gradually with time leading to the saturation of the adsorbent surface with the Cr (VI) molecules. Finally, once all the sites are occupied slowly, no subsequent adsorption takes place. The process then progressively decreases with time till it reaches the equilibrium due to the difficulty to access the remaining vacant adsorption sites.

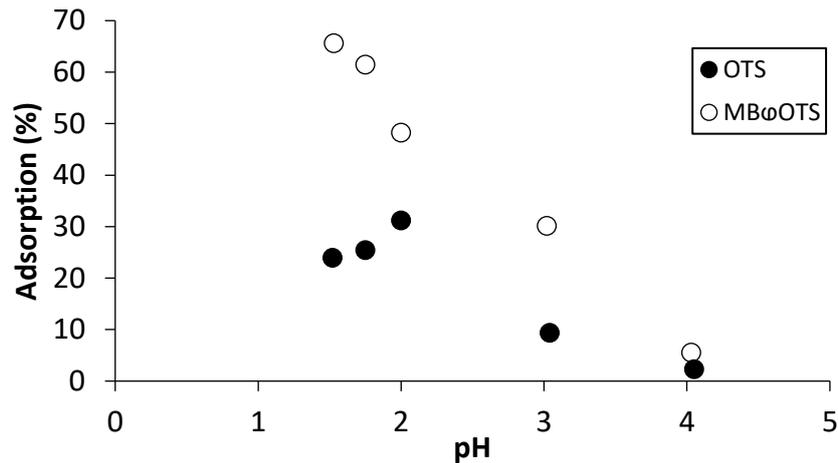


**Figure 4.** The effect of contact time on removal of Cr (VI) ions with a) OTS and b) MBOTs (Adsorption conditions: Cr (VI) concentration: 40 ppm, adsorbent amount: 0.1g, pH: 2, temperature:  $25 \pm 1$  °C for OTS and Cr (VI) concentration: 40 ppm, adsorbent amount: 0.05g, pH: 2, temperature:  $25 \pm 1$  °C for MBOTs.)

### 3.2. Effect of Solution pH

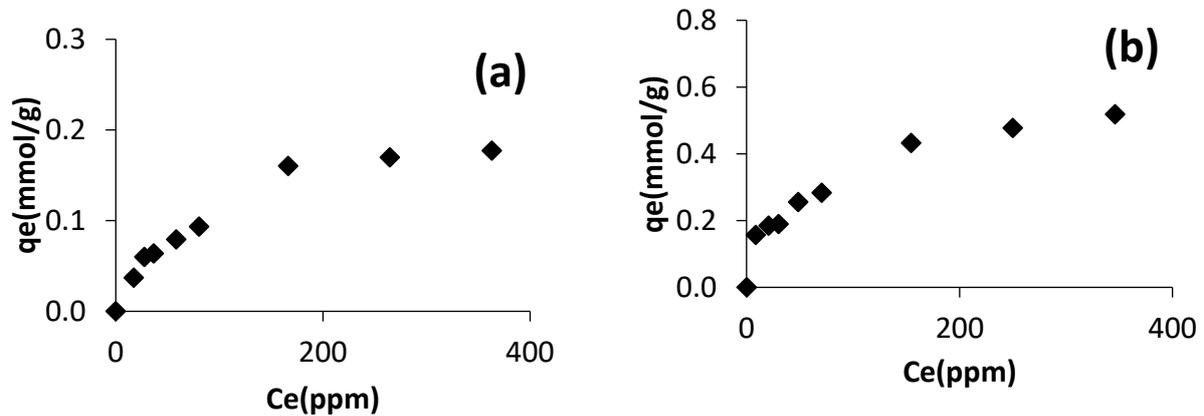
The relationship between the initial pH of the solution and Cr (VI) adsorption was investigated in pH studies. The influence of the initial aqueous pH solutions on Cr (VI) removal from the synthetic solutions by the OTS and MBOTs were investigated in a series of experiments for initial pH values of 1.5, 1.75, 2.0, 3.0, and 4.0 (Figure 5.). For the batch trials, pH was adjusted using small volume samples of 0.1 M HCl, and NaOH solutions. When the pH is lower than 1.8, the adsorption was decreased and it reached a maximum pH value at pH 1.9. When the pH of the solution is 2.0, the adsorption was also higher and this value was accepted as the maximum pH value for all experiments. It was observed that Cr (VI) residue on the adsorbent was lower at high pH values. Over pH 2.5, a slower Cr (VI) adsorption was observed.

Different mechanisms such as electrostatic interaction, ion exchange and chemical complexation are the mechanisms that may occur during adsorption. One of the mechanisms commonly proposed for the effect of pH on Cr (VI) adsorption is electrostatic interaction. It is important to have a proton abundance on the surface of the adsorbent for the rapid removal of Cr (VI). When the adsorbent surface is loaded with protons (positive surface), the electrostatic interaction takes place on the surface between Cr (VI) and the MBOTs. The increase of Cr (VI) adsorption at acidic pH should be due to the electrostatic attraction between positively charged groups of MBOTs and the  $\text{HCrO}_4^-$  anion, which is the dominant species at low pH. The decrease of the adsorption with increasing pH could be due to the decrease of electrostatic attraction and to the competitiveness between the chromium species ( $\text{HCrO}_4^-$  and  $\text{CrO}_4^{2-}$ ) and  $\text{OH}^-$  ions in the solution phase for the adsorption on the active sites of the adsorbent. Cr (VI) may exist in the fluid stage in numerous anionic forms, such as chromate ( $\text{CrO}_4^{2-}$ ), dichromate ( $\text{Cr}_2\text{O}_7^{2-}$ ), or hydrogen chromate ( $\text{HCrO}_4^-$ ), with full chromate concentrations and pH dictating which specific chromate species dominate. By lowering the pH of the solution, Cr (VI) adsorption increases to a certain pH, by creating more  $\text{HCrO}_4^-$  at the expense of  $\text{Cr}_2\text{O}_7^{2-}$ . At slightly acidic pH,  $\text{HCrO}_4^-$  is the most common sort of Cr (VI) species, but during Cr (VI) adsorption at acidic pH,  $\text{Cr}_2\text{O}_7^{2-}$  is also present inside the adsorbent.



**Figure 5.** Effect of pH on adsorption of Cr (VI) ions with a) OTS and b) MB@OTS (Adsorption conditions: Cr (VI) concentration: 40 ppm, adsorbent amount: 0.1g, contact time: 180 min, temperature:  $25 \pm 1$  °C for OTS and Cr (VI) concentration: 40 ppm, adsorbent amount: 0.05g, contact time: 180 min, temperature:  $25 \pm 1$  °C for MB@OTS.)

### 3.3. Adsorption Isotherms



**Figure 6.** Adsorption isotherm a) OTS b) MB@OTS. (Adsorption conditions: adsorbent amount: 0.1g, pH: 2; contact time: 180 min, temperature:  $25 \pm 1$  °C for OTS and adsorbent amount: 0.05g, pH: 2; contact time: 180 min, temperature:  $25 \pm 1$  °C for MB@OTS.)

The adsorption isotherm models including Langmuir Eq. (1), Freundlich Eq. (2), Dubinin–Radushkevich (D-R) Eq. (3) and Scatchard Eq. (4) were used to fit and evaluate the equilibrium data corresponding to the adsorption of Cr (VI) on OTS and MB@OTS (Figure 6.). The higher determination coefficients  $R^2 > 0.99$  of the Langmuir equation suggest that the Langmuir equation can be used to fit the experimental adsorption data and to evaluate the maximum Cr (VI) adsorption capacity of the OTS and MB@OTS.  $A_s$  and  $K_b$  were calculated from Eq. 1. and were given in Table 1. The maximum adsorption capacities of the Cr (VI) according to Langmuir isotherm model were 11.75 mg/g for OTS, 30.40 mg/g for MB@OTS. The Langmuir isotherm model is generally applicable to monolayer adsorption on surfaces containing a certain number of similar sites. Information about the suitability of adsorption is also supported by  $R_L$ . If its value is between 0 and 1, it shows the suitability of the adsorption.  $R_L$  values are 0.697 for OTS; and 0.569 for MB@OTS. The Freundlich equation of  $K_f$  and  $n$  values were calculated from Eq. 2.  $n$  values were found to be 1.95 for OTS and 2.79 for MB@OTS, indicating that the adsorption of these values was favourable from 1 to 10. Scatchard (Eq. 4.), related parameters are given in Table (1.),  $Q_s$  values were 11.89 mg/g for OTS and 32.20 mg/g for MB@OTS. D-R isotherm parameters were given in Table 1.  $E_{ad}$  values were found to be  $>8$  kJ mol<sup>-1</sup> (Eq. 3.). When the  $E_{ad}$  value is lower than 8 kJ mol<sup>-1</sup>, the adsorption process is said to be predominant by physical adsorption. If  $E_{ad}$  is between 8

and 16 kJ mol<sup>-1</sup>, the process is dominated by chemical ion exchange mechanisms and by chemical particle diffusion.

**Table 1.** Adsorption isotherm parameters for removal of Cr (VI)

MODEL	EQUATION	EQ	ADSORBENT	PARAMETERS FOR CR (VI)			REFERENC ES
LANGMUIR	$\frac{C_e}{q_e} = \frac{C_e}{A_s} + \frac{1}{K_b A_s}$	(1)	OTS	A <sub>s</sub>	K <sub>B</sub>	R <sup>2</sup>	(LANGMUIR , 1918)
			MB@OTS	11.75	0.011	0.986	
FREUNDLIC H	$\ln q_e = \ln K_f + \frac{1}{n} \ln C_e$	(2)	OTS	K <sub>F</sub>	N	R <sup>2</sup>	(FREUNDLI CH, 1906)
			MB@OTS	0.51	1.95	0.966	
D-R	$\ln Q_E = \ln Q_M - B E^2$	(3)	OTS	X <sub>M</sub>	K	E	R <sup>2</sup> (DUBININ AND RADUSHKE VICH, 1947)
			MB@OTS	(x10 <sup>-3</sup> ) 0.52	0.007	8.77	
SCATCHAR D	$Q_E / C_E = Q_S K_S - Q_E K_S$	(4)	OTS	Q <sub>S</sub>	K <sub>S</sub>	R <sup>2</sup>	(SCATCHAR D, 1949)
			MB@OTS	11.89	0.011	0.881	
			MB@OTS	32.20	0.014	0.966	

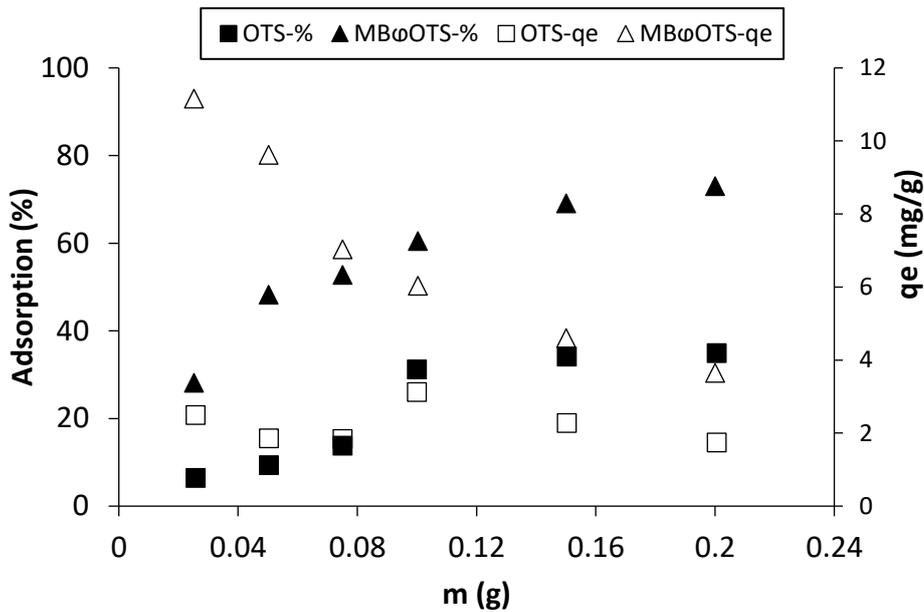
The results showed that the adsorption of Cr (VI) with OTS and MB@OTS takes place in a single-layer adsorption form. As shown in Table 2, the adsorption capacity of MB@OTS was compared with the other magnetic and biochar adsorbents. The capacity of MB@OTS is higher than others.

**Table 2.** Adsorption Capacity of OTS and MB@OTS Compared to The Other Published Low-Cost magnetic adsorbents for Cr (VI) Removal

Adsorbent material	Q <sub>max</sub> (mg/g)	References
Magnetic porous carbonaceous (MPC) materials derived from tea waste	21.23	(Wen et al. 2017)
Magnetic biochar prepared with Astragalus membranaceus	23.85	(Shang et al. 2016)
Magnetic biochar prepared phoenix tree leaves Fe <sub>3</sub> O <sub>4</sub> @SiO <sub>2</sub> -NH <sub>2</sub> magnetic particles	27.2	(Shi et al. (2018)
Magnetic biochar prepared Melia azedarach wood (MMABC)	25.27	(Zhang et al. 2018)
Chitosan combined with magnetic Loofah biochar (CMLB)	23.34	(Xiao et al. 2019)
<b>MB@OTS</b>	<b>30.36</b>	<b>This study</b>
<b>OTS</b>	<b>11.75</b>	<b>This study</b>

### 3.4. Effect of Adsorbent Dose

The impact of the adsorbent dosages on Cr (VI) removal was assessed for the adsorbent amount of 0.025, 0.05, 0.075, 0.10, 0.15 and 0.2g. It was noted that the adsorption percentage of Cr (VI) used for removal processes increases according to the amount of OTS and MB@OTS mass (Figure 7). This finding is justified by the high number of reactive available vacant sites forces the mass transfer of the Cr (VI) and the concentration gradient is high. This favours the transfer of the Cr (VI) to the external surface of adsorbent and increases on their removal percentage. As the adsorbents amount increases, there is an increase in the adsorption of Cr (VI) and as more the adsorbate concentration more is the adsorption exists on the surface of the adsorbents. The optimum dose was taken to be 0.1 g for OTS and 0.05 g for MB@OTS.



**Figure 7.** Effect of adsorbent amount on percentage removal and  $q_e$  of Cr (VI) ions with a) OTS and b) MB@OTS. (Adsorption conditions: Cr (VI) concentration: 40 ppm, pH: 2; contact time: 180 min, temperature:  $25 \pm 1$  °C for OTS and Cr (VI) concentration: 40 ppm, pH: 2; contact time: 180 min, temperature:  $25 \pm 1$  °C for MB@OTS.)

### 3.5. Adsorption Kinetics

The pseudo first-order and pseudo second-order reaction equations were applied for the equilibrium system. Pseudo-first-order kinetic model and pseudo-second-order kinetic model for Cr (VI) on OTS and MB@OTS have been demonstrated in Table 3. The pseudo-second-order kinetic model was used based on the following differential equation: where  $k_2$  is the rate constant of pseudo-second-order adsorption ( $\text{g mg}^{-1} \text{min}^{-1}$ ). The boundary condition  $q_t=0$  at  $t=0$  and the equation can be linearized as Eq. (5):

$$\frac{1}{q_t} = \frac{1}{k_2 q_e^2} + \frac{1}{q_e t} \quad (5)$$

The pseudo-second-order kinetic model was found to agree between the experimental and calculated data, as indicated by the correlation coefficients higher than 0.99 obtained using this model.

**Table 3.** Kinetic parameters of Cr (VI) adsorption

Adsorbent	$q_{e \text{ exp}}$	Pseudo First-order			Pseudo Second-order		
		$k_1$	$q_e$	$R^2$	$k_2$	$q_e$	$R^2$
OTS	3.29	0.016	3.40	0.954	0.0051	3.37	0.980
MB@OTS	9.86	0.018	7.86	0.969	0.0048	10.38	0.995

## 4. CONCLUSION

In this research, a new magnetic adsorbent was prepared from OTS and effective conditions for Cr (VI) removal were determined by changing the initial Cr (VI) concentration, contact time, adsorbent amount and pH values. MB@OTS was prepared from OTS and its property was intensively studied using SEM, EDX analyses. The novel produced MB@OTS was tested for the removal of Cr (VI). MB@OTS showed good selectivity for Cr (VI) removal. Langmuir, Freundlich, Scatchard and Dubinin-Radushkevich isotherms were tried and they were evaluated to determine the effectiveness of MB@OTS. Langmuir isotherm model was preferred for the adsorption process ( $R^2$  is 0.985). By applying the Langmuir model equation, the maximum Cr (VI) capacities of MB@OTS and OTS were found to be 30.36 and 11.75 mg/g, respectively. MB@OTS has a good adsorption capacity for removal Cr (VI) ions in the aqueous

solutions, which is compared with the raw OTS. The adsorption studies revealed that the optimum contact time for the equilibrium was found to be 180 min for MB@OTS, OTS, respectively. An optimum pH value for the adsorption of Cr (VI) was found as 2.0. The produced adsorbent was generated from the natural sources that claim it is an environmental friendly adsorbent for the application of Cr (VI) removal from the polluted solution.

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**O 9. COMPARISON OF ENERGY EFFICIENCY OF DAIRY FARMS WITH LOOSE HOUSING SYSTEM HAVING DIFFERENT DAIRY COW CAPACITIES AND DETERMINATION OF OPTIMUM DAIRY FARM CAPACITY#**

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**ABSTRACT:** Energy is an important resource with an indispensable place in human life. Energy efficiency is very important for the sustainability of human life and agricultural production. The main aim of this study was to determine optimum animal capacity for dairy farms with loose housing in terms of energy efficiency. The second aim was to evaluate the energy efficiency of dairy cow farms having different animal capacity with loose housing system, widely used in dairy cattle breeding. The data of this research was collected by survey method which was carried out face to face with owners of 16 dairy farms with loose housing in Konya region, Türkiye. All data obtained from this study were applied one-way ANOVA. Examined dairy cow farms were evaluated under four different animal capacity (farm animal capacity; 1-49, 50-99, 100-149, 150 and above animals). In this research, energy use efficiency, energy productivity, and specific energy were calculated as 0.130±0.005, 4.33±0.17 L/100MJ and 23.23±0.95 MJ/L for I.group; 0.157±0.013, 5.24±0.45 L/100MJ and 19.58±1.91 MJ/L for II.group; 0.096±0.003, 3.21±0.107 L/100MJ and 31.30±1.05 MJ/L for III.group; 0.125±0.008, 4.18±0.26 L/100MJ and 24.27±1.65 MJ/L for IV.group, respectively. According to the results of this study, dairy farms with loose housing system having 50-99 dairy cows have more advantageous in terms of energy efficiency in dairy cattle breeding.

*Keywords: Dairy cow farm, energy use efficiency, energy productivity, loose housing system, specific energy*

*#This study is presented a part of MSc Thesis of Mevlüt Şimşek.*

**O 10. STRUCTURAL FEATURES OF THE SHELTER SYSTEM WITH ROBOTIC MILKING  
SHELTER SYSTEM AND PARALLEL MILKING UNIT SHELTER SYSTEM AND THEIR  
COMPARISON IN TERMS OF ANIMAL WELFARE**

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**ABSTRACT:** Robotic systems have been successfully used instead of human labor in many areas with the development of modern technology. One of the major problems encountered in the livestock sector in recent years is the demand for qualified human labor. In dairy cattle breeding, this need is further increased, especially in regular and hygienic practices of milking. For this reason, Robotic milking systems have been used in the livestock sector in recent years. However, the advantages and disadvantages of the system have not been evaluated. In this study, dairy cattle enterprises with robotic milking system and parallel milking system were compared in terms of animal welfare and breeding characteristics. For this purpose, the farm, which has 20 robotic milking systems with a 1000 head milk cow capacity in Konya Region and farm farms with 12 \* 2 parallel system milking units having 1000 cow milk capacity were examined as material. In the study, the general characteristics, technical characteristics, farming system, efficiency parameters of animals were examined and compared in terms of animal welfare. As a result of the study, it was determined that the use of robotic systems largely eliminated the dependence on the labor force. Animal welfare has increased since it provides animals with the time and number of milking they want during the day. In addition, increased milk quality and yield was observed in robotic milking system compared to other systems. In spite of this, not planning the open navigation courtyard in the shelters where robotic milking system is used in the world and in Türkiye is undesirable and needs to be solved in terms of animal welfare.

*Keywords: Free-standing dairy cattle shelters, structural properties of shelters*

## **1. INTRODUCTION**

In order to ensure a healthy and balanced diet, it is of great importance and benefit to have animal foods in their daily foods. In animal foods, meat and milk are the most important products (Uğurlu and Uzal, 2004). Dairy cattle farming is an important sector in Türkiye has contributed to the development of the country (Boz, 2013).

Konya in Türkiye has great importance in animal breeding. Availability of suitable pasture and forage crop production areas in Konya animal breeding, existence of land of appropriate size for animal husbandry the lack of processing and marketing difficulties provides an advantage for the sector.

Today, technology has become an indispensable part of our lives. One of them is robotic systems used in dairy cattle breeding. Use of robotic systems in dairy cattle; decrease in milking time, increase in milk yield and quality, gain from the labor force, it makes the animals quieter and more docile and provides more effective control of the animals (Van't Land et al. 2000; Helgren and Reinemann 2003; Alıç and Yener 2006; Demir and Öztürk, 2010).

In our researches on this subject for years, one of the major problems encountered in the livestock sector is the need for qualified human labor. Robotic systems are used to meet the demand for this workforce. Use of robots in animal breeding, especially the use of milking robots is increasing rapidly.

Konya, 921,572 head of cattle and cattle Türkiye (17,220,903) having 04.05% (Tüik, 2018). Sheep, with goats and dairy cattle being Konya Türkiye constitutes the health share of 13.90% (Tüik, 2018). Türkiye 6.8% of the total milk production is achieved from Konya. Konya to meet milk consumption Türkiye takes first place in the last five years (Anonymous, 2019 a ).

The aim of animal breeding; high level of productivity and to make a profitable livestock. This situation, it is possible by increasing the yield per animal (Uzal, 2008). Increasing the animal yield, it will be possible to prepare a more suitable ration program for high-yielding animals and to improve the hosting factors of the animals in addition to proper nutrition. Improving the hosting factors of these is extremely important (Mundan et al., 2018).

Livestock enterprises; structures and facilities, tools and equipment, live animals that make up herd projection, including caregiver and manager the personnel consists of four main elements (Mundan et al., 2018). Animal shelters, it is designed to eliminate stress factors in animal welfare as well as animal welfare. Stress factors are examined under four groups; climatic, structural, social and other factors (dust, noise etc.) (Uğurlu and Uzal, 2004).

Open shelters with free stops, it is a shelter system where cows are allowed to move freely. It is known that animals are not affected much by cold climatic conditions (Mundan et al., 2018). Determination of suitable shelter type for animal comfort in the shelter, the natural behavioral characteristics of the animal (movement, lying, ruminating, eating and drinking, etc.), determination of the dimensions of all criteria within the shelter to ensure animal health, optimum conditions are necessary for the execution of daily tasks such as irrigation, feeding, milking and fertilizer cleaning. Keeling and Jensen (2002), animal welfare 'adaptability to the environment in which they live' definition of, they are one of the most accepted approaches today (Uzal, 2008).

The purpose of the free stops; comfortable to cattle, to provide a clean and dry individual rest area (Bewley, 2010). Cows should be able to get in and out of the stalls easily and be able to lie down without any hindrance (Bickert, 2000). Well-designed and regularly maintained free station reduce standing time, improves ruminating efficiency, makes cattle and stations cleaner, minimizes injuries (Graves et al., 2009).

Dairy cattle barns were built in Türkiye, in different climatic zones, different climatic conditions of each region, new models should be developed according to their structural and technical characteristics and larger scale studies should be carried out (Uzal, 2008).

During the planning of animal shelters, the level of mechanization should be determined and dimensioned very well considering the current situation. In dairy cattle farms, the percentages of the workforce used in various jobs vary depending on the type of shelter and the level of automation applied. The approximate labor force required in dairy cattle 50% to obtain milk, 25% clean fertilizer, 15% feeding and 10% is used for other animals (Claesson, 1977; Mutaf ve Sönmez, 1984; Ayık, 1985). As the mechanization level increases, the share of labor used to obtain milk increases in the total labor force, whereas feeding, fertilizer cleaning etc. the percentage shares of jobs are decreasing (Alkan, 2015).

Operating capacity in large shelters, the use of conventional milking systems is not very effective. In these systems, in addition to the availability of fast and inefficient equipment, milking takes a lot of time despite the low cost (Steevens, 1992). Robotic milking system technology, it allows more cattle to be milked per unit time without much labour (Alıç and Yener, 2006).

Robotic systems, which have started to be used in recent years, have been developed in terms of both animal welfare and milking processes in dairy cattle breeding, it is seen that the demand for hygienic and qualified labour force is met.

This work, general characteristics of robotic milking shelter system and shelter system with parallel milking unit managed in Konya region as two different enterprises within the same enterprise management, technical specifications, aquaculture system and yield parameters evaluation in terms of for the purpose. In addition, the proposed systems were evaluated in terms of animal welfare and productivity and solutions were proposed to the problems.

## **2. MATERIAL METHOD**

This work, 2018-2019 yılları arasında Konya'da faaliyet gösteren Laranda Tarım ve Hayvancılık İşletmesinde yapıldı. Laranda Agriculture Plant which first applied robotic milking system in Konya Region, it was established in 2012 and has been using the robotic milking system since 2018.

The study area was established on an area of 11.000 da and the total area covered by roads and buildings is 25.050 m<sup>2</sup>. Operating, one free-standing shelter where one robotic milking system is applied, two parallel milking free-standing milk cattle shelter and one calf shelter, one young animal shelter, infirmary and administrative buildings it is formed.

In research Planning principles of Robotic milking shelter system and parallel milking unit shelter system in Laranda Agriculture and Livestock Enterprise and animal welfare in terms of assessment was carried out. The shelter planning system examined, building type and milking system has different features.

The study was conducted, shelter systems operate in the form of two different enterprises where the same management practices are carried out within a single enterprise. The milk produced in both milking systems is collected in different tanks and sold without mixing. The quality characteristics of the milk differ.

In order to identify the structures within the enterprise to determine the current situation in the selected enterprises measurement sketch, observation and photo shootings were performed. Use of labour force in the enterprise, animal welfare, adaptation of animals to the system, information on increase in milk quality and yield it was obtained. General characteristics of shelter systems in the enterprise, technical specifications, aquaculture system, planning parameters by examining yield parameters and animal welfare in terms of Noton (1982), Ekmekyapar (1991), Olgun (2011), Uzal Seyfi (2013 a), Uzal Seyfi (2013 b) from evaluated using. In addition, in dairy cattle breeding of enterprises, especially milking operations are carried out in comparison with regular and hygienic execution.

### **3. RESEARCH RESULTS AND DISCUSSION**

The characteristics of robotic milking and parallel milking unit shelter systems examined in the study are determined and given in Table 1.

**Table 1.** Characteristics of Shelters Using Different Milking Systems

<b>Features</b>	<b>Systems used</b>	
	<b>Robotic Milking Shelter</b>	<b>Parallel Milking Shelter</b>
Total Area of Business	5.500 da	5.500 da
Area Covered by Roads and Buildings	21.000 m <sup>2</sup>	4050 m <sup>2</sup>
Production time	1.5 yıl	4 yıl
Shelter Type	Free Standing (Folding screen)	Free Standing (with backyard)
Business Capacity	1500 animal	400 animal
Number of Milking Cows	433	427
Shelter Dimensions (width x length x ridge height)	55 x 370 x 1500 cm	27 x 150 x 1000 cm
Side Wall Height	120 cm	170cm
Stop Dimensions (width x length x height)	120 x 190 x 125 cm	120 x 190 x 125 cm
Rest area placement frequency	2,3 m <sup>2</sup> /animal	2,3 m <sup>2</sup> /animal
Service Path Width	350 cm	280 cm
Shelter floor	Concrete grid	Concrete grid
Stall floor	Rubber bed on concrete	Rubber bed on concrete
Shelter Wall material	Press bricks	Concrete
Roof frame material	Steel	Steel
Roof Tilt Angle	36 <sup>0</sup>	32 <sup>0</sup>
Navigation courtyard dimensions and settlement frequency	No navigation yard	18 m x150 m
Frequency of navigation yard placement	No navigation yard	13,5 m <sup>2</sup> /baş
Backyard courtyard floor	No navigation yard	Cobblestone
Dimensions of the central feed path number	2 piece5 x 350 m	1 piece 5 x 150 m
Feed Path Width	5 m	5 m
Feeding length	50 cm	75 cm
Feed distribution	Fodder distribution trailer	Fodder distribution trailer
Number of feeds (repeat / day)	3 times / day	2 times / day

Drinker length	15 cm/animal	15 cm/animal
Number of milkings (repeat)	2-7 times / day	2 times / day
Milk Quality Values		
Milk yield	28 lt/animal	30 lt/animal
Somatic Cell Number	96.000	120.000
Electrical Conductivity	4	4,5
Other Quality Parameters	Oil:3,94, protein:3,46, YKM:9,09, SH:6,61,	
How many skilled manpower are needed	3	2
Midden	80 cm diameter corrugated pipe is transported to the fertilizer pool	
Dimensions of fertilizer	7,5 m depth x 18 m diameter and 3 m depth x20mx 50m	
Evaluation of Fertilizer	Used in our land as solid-liquid	
Maturation Time of Fertilizer	24-72 hours in composting machine	
Separator	There is	There is

When both milking systems were evaluated in terms of milk quality; somatic cell count of milk obtained by robotic milking 96.000 while in the other system is 120.000. The electrical conductivity of the milk is four in the robot milking system and 4.5 in the other system. Fat and protein ratios are higher than the other system with 3.94 and 3.46. The milk yield was 30 l / animal in the robotic system and 28 l / animal in the other system. (Table 1) When the parameters which are the criteria of milk quality are taken into consideration, it is determined that the robotic milking system produces much better quality milk than the other system.

Main benefits of robotic milking in the enterprise, milk yield increases due to the high frequency of milking, decrease in labour force, no need to have staff working to regulate milking times in the study (Van't Land et al., 2000; Anonymous 2004 b). Milk quality is very important in terms of milk production. Milk pricing systems and consumer requirements, it is quite large and constitutes the basis of milk production (Klungel et al., 2000; Hogeveen et al., 2000a; Justesen and Rasmussen 2000; Pomies and Bony 2000; Van der Vorst and Hogeveen 2000; Rasmussen and Madsen 2000; Billon 2001).

Both shelters because it is a free-stop system animal welfare and farming system, in terms of. In the shelter where the robotic system is applied, no navigation yard was used. As the shelter where the robotic system is used is more suitable for animal welfare, animals can survive without stress. However, integration of the navigation yard into the system animals on natural soil floor and benefit from solar radiation considering will be more advantageous. In the shelter where robotic milking is applied, animals are milked 2-7 times a day. Milking process takes 7-8 minutes. Milking robots allow animals to be milked at any time of the day and in any number of times. Milking process is carried out by 2 people with robots without the need for qualified personnel. It is only checked 2-3 times during the day the system operates regularly. This control requires only half an hour of labour due to the new installation of the system. In the shelter where parallel milking system is used, milking is performed twice a day as 4.00 in the morning and 16.00 in the evening. Parallel milking is also needed, and milking of animals twice a day occurs. Automatic milking nozzle cleaning to prepare for milking, attaching milking heads, it is responsible for controlling milk flow and cow during milking. Reduction of labour force in robotic milking shelter system compared to parallel milking shelter system and working staff per more free time provided. There is no need for robotic milking and the installation and control of milking heads. There is no need for robotic milking and the installation and control of milking heads. As robotic milking is carried out regularly and hygienically both animal health and milk quality in terms of it was found to be more suitable in terms of animal breeding. Robotic milking, increase the milk yield and quality of cows owned by a company improves the quality of life of the owner (Helgren and Reinemann 2003).

Shelter widths are 55m in robotic milking system, length 370m, ridge height 15m and side wall height is 5m. The wall height of the side wall is 120cm press bricks are open. A portable folding screen system is planned to be closed only in cold weather. Building width is 55m, 10 in-line finding free stops, two 5.0m wide central feed paths, service roads are explained by the fact that it is quite wide as 3.50m. Although the building is quite spacious side wall height and ridge height to be as high as 5.0 - 10.0m,

lighthouse roof system and 3.80m of the side wall is open prevents the formation of bad odours in the shelter. Because of these advantages, it is well ventilated compared to other system air of a clean shelter it was determined.

Ventilation in animal shelters, establishing adequate health conditions for animals, increasing production, ensuring proper working conditions, necessary to extend the service life of equipment and buildings (Sallvik and Bartussek 1989). The side wall height of the shelter with robotic milking system is 120 cm and the wall material is press brick. The rest is open. The side wall height is 170 cm in the shelter where the parallel milking system is applied. It provides the animals with healthier and cleaner air and provides quality living opportunities but it is planned not to affect their performance.

In addition, the fact that the building length is 370m in the robotic milking system is due to the longitudinal planning of the system to be managed by robots. Due to ventilation problems, animal shelters are allowed to be planned to be 30-60m long and up to 100m long (Ekmekyapar, 1991; Olgun, 2011).

However, since the planning of the shelter with the robotic system is quite smooth, and since most of the side wall is open, no ventilation problems were encountered. The shelter is made of pressed bricks and has a good aesthetic appearance as well as the advantage of thermal insulation.

Stall dimensions examined in the research were measured the same (120x190x125) in both systems. Olgun (1989 a), The purpose of making a free stop, to create a clean resting place where each cattle can use and sleep without harming themselves and each other. In free stop system; the free stall should be planned to ensure that the cattle are in an appropriate position while lying and standing at the stall (Olgun, 1989 b). The free stall design for dairy cattle; cows entry and exit to the stops, stall and to lift adequate space and appropriate stop surface should be provided (Nordlund and Cook 2003). Noton (1982), free stall width 1.00-1.10 m for cattle greater than 15 months, the length of the stall is 1.90-2.10 m for cattle older than 15 months. Research, stall sizes reserved for animals are in accordance with literature reports.

In both of the studied shelter systems, shelter floor concrete grid, the stall floor was found to be rubber bed material on concrete.

Bickert et al., (1995), as stall base material in free shelters; compacted soil, concrete coating, limestone, brick and insulated rubber surfaces can be used. Dumelow (1995), In his study on dairy cattle, the thin bed material is better, it reports the best performance of a 45 mm thick rubber backing material. The use of rubber is more suitable for animal welfare. Rest time for animals at the stops and considering the comfort of animals it can be said that both shelter systems are advantageous in terms of animal welfare. Area for animals for shelters in the shelters, the promenade is not planned in the robotic milking shelter and is planned to be planned in the future. In other system navigation courtyard (18x150m) for each animal 13.5m<sup>2</sup> / animal area is falling. It was found out that the parquet flooring of the parquet flooring system in the parallel milking unit system was cobblestone floor.

Uğurlu and Uzal (2004), in the case of navigation yard soil, 24 m<sup>2</sup> area per animal of separation will be appropriate. Ekmekyapar (1999), navigation area requirement for coated floors at least 5.5-6.5m<sup>2</sup> / animal or equal to the rest area, if the possibilities allow 9-10 m<sup>2</sup>/animal should be taken as. Our work walked Robotic milking in the shelter there is no navigation courtyard. Parallel milking unit system is applied in shelters per yard and per animal 13,5m<sup>2</sup>/animal as the navigation courtyard is separated animals under the optimum conditions of navigation yard is not enough.

Feeding length in robotic milking system 50 cm / animal feeding area whether feeding is done three times a day. Feeding length in parallel milking, another system 75cm / animal feeding area is and twice daily feeding it was determined that the process occurred.

Feeding length is reported to be between 60-80 cm / animal values (Ekmekyapar, 1999). Feeding area, easy transportation, easy to clean, business economics and labour force utilization will be planned to provide (Uzal and Uğurlu, 2007).

Dimensions of fertilizer (20mx50m) the same fertilizer pool is used in both systems and both systems manure as solid-liquid used on their land used in their own land. Since both shelter floors are concrete for the convenience of animals in cleaning the fertilizer providing a clean and healthy environment it is also important for the health of the workers working in the shelter.

As a result, milk quality and increasing animal welfare, with the aim of eliminating labor dependency use of robotic milking systems it has been found to be quite useful. However, robotic milking shelter system design of the navigation yard is an important issue that needs to be meticulously studied.

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**O 11. TREATMENT OF TEXTILE WASTEWATERS WITH ELECTROCOAGULATION  
ADVANCED TREATMENT DROGEN PEROXIDE SENSOR APPLICATION OF TI AND  
TINI CATALYSTS**

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**ABSTRACT:** Textile industry wastewater is one of the most important hazardous wastewater species threatening the environment and public health. Textile wastewater with a high proportion of dyestuffs accumulates in the receiving environment, disrupts the aesthetic appearance of the waters and reduces the light penetration. Reduction of light penetration and dissolved oxygen leads to a decrease in the living organism population and restricts the use of water resources. It is also known that certain types of dyestuffs have toxic properties. Textile wastewaters containing even very small amounts of dyestuffs have high dispersion rates and can spread to largely water bodies and threaten the environment and human health, when discharged without treatment. While adsorption, filtration and chemical processes are preferred for color removal, biological activated sludge systems are used for COD removal from colored wastewaters, generally. Today, nanotextile membrane processes are used for more efficient treatment. However, compared to other treatment methods, it can be concluded that electrocoagulation (EC) processes are more suitable for color and COD removal from textile industry wastewater. Electrocoagulation, which has a wide application area in wastewater treatment, makes a major contribution to the economy of concentrated waste discharging industries. Moreover, these processes can greatly reduce the pollutant load. In the studies carried out by the electrocoagulation process of textile industry wastewater, up to 100% color removal was determined. In addition, high levels of chromium, COD and turbidity removal efficiencies were observed from tannery industry wastewater with high Cr content by EC process.

*Keywords: Electrocoagulation, Dyestuff, Wastewater Treatment, Textile Industry.*

## **1. INTRODUCTION**

In recent years, studies on electrooxidation and electrocoagulation (EC), which have environmental impact, high pollutant removal rates, operational convenience and economic efficiency, have begun to attract much attention (Cameselle et al., 2005; Chen, 2004; Mollah et al., 2001). With the electrocoagulation process, the pollutant removal from wastewater can be provided by coagulation, adsorption, precipitation and flotation methods and combinations. In this process, metal anodes such as aluminum and iron are used and hydrolysis of metal hydroxides is formed by anodic dissolution and thus, the basic mechanism of the treatment process is realized. Due to its advantages, the electrocoagulation process is now used as an effective method in treatment of various industrial wastewaters.

In general, the wastewaters from the textile industry are among the high polluted wastewaters due to their high pH, high color content and also low biodegradability (Lin and Chen, 1997). The increase in product diversity and the use of dyestuffs with highly variable chemical properties make the treatment of textile industry wastewater much more difficult (O'Neill et al., 1999).

These wastewaters contain high concentrations of dyestuff, BOD, COD and suspended solids. Substances with high COD and color content cause wastewater to be aesthetically distorted, reducing the amount of dissolved oxygen required for normal aquatic life and making the treatment of wastewater more difficult (Dörtkol, 2014). In terms of dye process, the properties of the wastewater vary depending on the chemistry of the process, the batch or continuous dyeing process (Şahin, 2014). Wastewater discharged into the receiving aquatic environments with color content prevents the spread of light into the water and thus, photosynthetic activities are adversely affected. In addition, dyestuffs accumulate in some aquatic organisms and this poses a risk of toxic and carcinogenic products (Kocaer and Alkan, 2002). These toxic effects cause the change of flora and fauna of the current receiving aquatic environment. As a result of direct discharge of wastewater containing dyestuff without treatment, may

cause significant environmental impacts such as the formation of aromatic amines having toxic and carcinogenic properties under anaerobic conditions (Mıdık, 2011). The wide range of pollutant parameters present in textile industry wastewaters necessitates the use of different treatment methods in treatment of wastewater belonging to this sector (Dörtkol, 2014). Therefore, before the discharge of the textile wastewater into the receiving environment, the sources of the pollutant parameters should be determined and the necessary treatment processes should be applied in accordance with the characteristics of the wastewater.

For this purpose, conventional methods such as adsorption, biological treatment, oxidation, coagulation and flocculation are used (Jia et al., 1999). However, due to the difficulty of adsorbent regeneration in the adsorption process (Daneshvar et al., 2004), extra contamination and excess sludge formation due to unwanted reactions as a result of chemical addition in chemical coagulation (Lin and Chen, 1997), toxic effects of certain dyestuffs on microorganisms, there is need to develop other methods from biological treatment. However, these methods are often expensive and ineffective due to the wide variety of components of textile wastewater (Vlyssides et al., 1999). Many studies show that COD, turbidity and dissolved solids are effectively eliminated by EC process in treatment of textile wastewater (Bayramoglu et al., 2004; Daneshvar et al., 2004; Kobya et al., 2003; Can et al., 2003; Lin and Chen, 1997). For the development and optimization of the EC unit; process configurations such as the characteristics of wastewater such as pH, current density and application time, and the type of connection with the type of electrode material should be considered in detail. In this study, the effects of the treatment of textile wastewater with EC on the COD and turbidity parameters were determined by taking into consideration the effect of electrode material and connection form. For this purpose, process analysis were carried out both technically and economically by founding the conditions when the highest pollutant removal occurs for the EC process widely used in treatment of textile wastewater and at the same time economic data are minimum. In addition, the advantages and disadvantages of this process and the issues to be considered in process selection were investigated.

## 2. ELECTROCOAGULATION PROCESS

Electrocoagulation (EC) is a process that consists of dissolving the anode as a result of electrolysis and forming metal hydroxide flocks in the wastewater to be treated. The principle of the EC process in removing contaminants is based on one or more of the coagulation, adsorption precipitation and flotation removal mechanisms, the anodic dissolution, hydrolysis of the metal anodes such as aluminum and iron and the formation of metal hydroxides such as  $Al(OH)_3$ ,  $Fe(OH)_2$  ve  $Fe(OH)_3$  (Holt et al., 2002; Mollah et al., 2001). Metal ions dissolved from these electrodes form metal-polymer complexes according to ambient conditions and are coagulated adsorbing the contaminants. It is generally accepted that there are three consecutive stages in EC process; 1. formation of coagulant species and electrode dissolving in electrolytic oxidation, 2. destabilization of pollutants, particle suspension and breakage of emulsions, 3. collecting of flocks in destabilized phases (Mollah et al., 2001; Canizares et al., 2005). The rate of formation of different types of metal-polymer complexes plays an important role in color removal. Several interaction mechanisms are possible between dye molecules and hydroxyl products. They depend on the ambient pH and the type of ions present. In general, there are two main mechanisms. Adsorption at  $pH > 6.5$  and precipitation at lower pH values (Kobya et al., 2003; Alinsafi et al., 2005; Gurse et al., 2002; Rebhun and Lurie, 1993).

### Precipitation



### Adsorption



The formed amorphous  $Al(OH)_3$  “sweeper flocks” have a large surface area. Thus, they rapidly remove the organic compounds in wastewater and remove the colloidal particles by catching them from the wastewater. These flocks are polymerized as  $n Al(OH)_3$ ;  $Al_n(OH)_{3n}$ . They can be easily removed either by precipitation or  $H_2$  flotation.

### **3. ELECTROCOAGULATION OF TEXTILE WASTEWATERS**

Due to its advantages, the electrocoagulation process is now used as an effective method in treatment of industrial wastewater, especially in treatment of textile industry wastewater. The increase in product diversity and the use of dyestuffs with highly variable chemical properties make the treatment of textile wastewater difficult (O deđişkenneill et al., 1999). In addition, a wide range of pollutant species in textile industry wastewater requires the use of different methods for treatment of such wastewater (Dörtkol, 2014).

Many studies have shown that COD, turbidity and dissolved solids are effectively eliminated by electrocoagulation process in treatment of textile wastewater (Bayramoglu et al., 2004; Daneshvar et al., 2004; Kobya et al., 2003; Can et al., 2003; Lin and Chen, 1997). In this study, the effects of the treatment of textile and tannery wastewater with EC on the removal efficiencies were demonstrated considering the effect of the electrode material and the shape of the connection (Table 1.). Process analyzes were carried out both technically and economically by founding the conditions when the highest pollutant removal occurs for the EC and at the same time economic data are minimum. Also, the advantages and disadvantages of the process and the issues to be considered in process selection were investigated.

**Table 1.** The effects of the treatment of textile wastewater with EC on the removal efficiencies

Wastewater type	Reaction conditions	Removal efficiencies (%)	References
Textile wastewater	continuous operation mode, iron anode and aluminum cathode	35% BOD, 42% TDS, 42% COD and 46% Cr	Babu et al. (2007)
Textile wastewater	Fe hexagonal wire anode-cathode, 200 A/m <sup>2</sup> current density, pH 7 and 90 min reaction time	%93 and 93 for COD and dyestuff	Tezcan and Aytac (2011)
Textile wastewater	batch mode and monopolar parallel iron anode&cathode	70% SS, 97% Cr, 46% COD and 90% sulfide	Apaydin et al. (2009)
Textile wastewater	batch mode, iron anode&cathode	84% COD and 100% color	Zaroual et al. (2006)
Textile wastewater	pH 7,5-10, 30 min reaction time and 30 V voltage with Fe-Fe anode&cathode	60-92% orange II dye	Nazrul et al. (2011)
Textile wastewater	batch mode with monopolar parallel aluminum anode&cathode and iron anode&cathode	82.2% COD (Al-Al), 85.5% TSS (Al-Al), 67.4% COD (Fe-Fe) and 86.2% TSS (Fe-Fe)	Varank et al. (2014)
Tannery wastewater	batch mode with monopolar parallel iron anode&cathode	96% turbidity, 98% Cr, 80% TVS, more than 80% Ca, 80% Zn, 50% COD and 65% TSS&TFS	Espinoza-Quinones et al. (2009)
Textile wastewater	batch reactor operation and aluminum anode&cathode	98% dyestuff (direct red 81)	Aoudj et al. (2010)
Textile wastewater	monopolar parallel, aluminum anode&cathode with batch mode	49%, 57% TOC and 59% 63% dye for DY and 81%, 89% TOC and 96% 99.9% dye	Eyvaz et al. (2009)
Textile wastewater	pH 9, 140-170 A/m <sup>2</sup> current density with Fe-Fe anode&cathode, 60 min reaction time	%76 and %95 for BR dye 5001B and COD	Tyagi et al. (2014)
Textile wastewater	pH 3-11, 10-50 V, with Al-Al anode&cathode for 10-60 min reaction	%99,88 for RG-19 dye	Alizad et al. (2014)
Textile wastewater	batch operation mode with monopolar aluminum and iron anode&cathode	76% COD (Fe-Fe) and 65% COD (Al-Al)	Can et al. (2006)
Textile wastewater	at pH 12 and 80 A/m <sup>2</sup> with Fe-Fe anode&cathode for 10-20 min	%80 for MB dye	Mahmoud et al. (2013)

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Textile wastewater	2 stage electrocoagulation process at batch mode with iron and aluminum anode&cathode	68% COD, 43.1% ammonia, 55.1% TOC 96.7% sulfide and 84.3% color	Feng et al. (2007)
Textile wastewater	batch reactor mode with bipolar iron and aluminum anode&cathode	82% COD, 90% sulfide and 96% oil-grease	Şengil et al. (2009)
Textile wastewater	Al-Al anode&cathode, pH 6,5-9,7 251,6 A/m <sup>2</sup> current density and 60 min reaction time	87-97% for 4 synthetic dyes	Zerrouki et al. (2014)
Textile wastewater	at the conditions of 10-40 V, pH 2, 10-25 min reaction time	99.27% for azo dye	Yari et al. (2013)
Textile wastewater	100-300 A/m <sup>2</sup> current density with Fe-Fe anode&cathode	96.5% for RS dye	Kumar and Sahu (2013)
Textile wastewater	pH 5-7, 50-125 A/m <sup>2</sup> current density with Fe-Fe anode&cathode, 0-60 min reaction	%79.86 for COD and %96.88 for turbidity	Hossain et al. (2013)
Textile wastewater	at pH 3-11, 10-60 V, 0-5 A for 10-60 min with Al-Al anode&cathode	97.7% for BR-18 dye	Abbas and Ali (2018)
Textile wastewater	at pH 3-9 and 10-50 A/m <sup>2</sup> current density with Fe-Fe and Al-Al anode&cathode for 2-24 min of reaction	100 (Fe-Fe) and 95.78 (Al-Al) for MB dye	Mostafa et al. (2015)

Babu et al. (2007) studied treatment of textile wastewater with electrocoagulation (EC) process, at the conditions of continuous operation mode, iron anode and aluminum cathode and they obtained 35% BOD, 42% TDS, 42% COD and 46% Cr removal efficiencies. Tezcan and Aytac (2011) obtained max removal efficiency (%) as %93 and 93 for COD and dyestuff parameters, respectively for the EC of textile wastewater, with Fe hexagonal wire anode-cathode, 200 A/m<sup>2</sup> current density, pH 7 and 90 min reaction time. Apaydin et al. (2009) investigated EC of textile wastewater with batch mode and monopolar parallel iron anode&cathode, and 70% SS, 97% Cr, 46% COD and 90% sulfide removals were observed. Zaroual et al. (2006) studied EC with batch mode, iron anode&cathode and they found 84% COD and 100% color removal efficiencies. Nazrul et al. (2011) obtained 60-92% removal rates as the best for the orange II dye parameter, with pH 7.5-10, 30 min reaction time and 30 V voltage with Fe-Fe anode&cathode. Varank et al. (2014) obtained 82.2% COD (Al-Al), 85.5% TSS (Al-Al), 67.4% COD (Fe-Fe) and 86.2% TSS (Fe-Fe) removal, at the conditions of batch mode with monopolar parallel aluminum anode&cathode and iron anode&cathode. Espinoza-Quinones et al. (2009) investigated EC of tannery industry wastewater and they observed 96% turbidity, 98% Cr, 80% TVS, more than 80% Ca, 80% Zn, 50% COD and 65% TSS&TFS at batch mode with monopolar parallel iron anode&cathode. Aoudj et al. (2010) studied with batch reactor operation and aluminum anode&cathode and they observed more than 98% dyestuff (direct red 81) degradation. Eyvaz et al. (2009) investigated electrocoagulation of textile wastewater containing disperse dye (DY) and reactive dye (RY) and they obtained 57% TOC and 63% dye removals for DY and 89% TOC and 99.9% dye removals for RY, at the conditions of monopolar parallel, aluminum anode&cathode with batch mode. Tyagi et al. (2014) studied at the conditions of pH 9, 140-170 A/m<sup>2</sup> current density with Fe-Fe anode&cathode, and they obtained %76 and 95 removal efficiencies for the BR dye 5001B and COD parameters respectively, in 0-60 min reaction time. Alizad et al. (2014) found 99.88 removal efficiency for RG-19 dye at pH 3-11, 10-50 V, with Al-Al anode&cathode for 10-60 min reaction. Can et al. (2006), found 76% COD (Fe-Fe) and 65% COD (Al-Al) mineralizations at batch operation mode with monopolar aluminum and iron anode&cathode. Mahmoud et al. (2013) studied electrocoagulation of textile wastewater and they found %80 removal efficiency for MB dye for 10-20 min, at pH 12 and 80 A/m<sup>2</sup> with Fe-Fe anode&cathode. 68% COD, 43.1% ammonia, 55.1% TOC, 96.7% sulfide and 84.3% color removal efficiencies were obtained in a study with textile wastewater for 2 stage electrocoagulation process at batch mode with iron and aluminum anode&cathode (Feng et al., 2007). Şengil et al. (2009) found 82% COD, 90% sulfide and 96% oil-grease removals in their studies made at batch reactor mode with bipolar iron and aluminum anode&cathode. Zerrouki et al. (2014) studied removal of 4 synthetic dyes with EC, at the conditions of Al-Al anode&cathode, pH 6.5-9,7, 251.6 A/m<sup>2</sup> current density and 60 min reaction time and 87-97% max removal efficiencies were observed. Yari et al. (2013) investigated azo dye removal from the wastewater with EC, at the conditions of 10-40 V, pH 2, 10-25 min reaction time and they found 99.27% degradation. Kumar and Sahu (2013) obtained 96.5% removal efficiency for RS dye at 100-300 A/m<sup>2</sup> current density with Fe-Fe anode&cathode. Hossain et al. (2013) investigated the electrocoagulation of textile wastewater and they observed the removal efficiencies %79.86 for COD and %96.88 for turbidity parameter as the best, at the conditions of pH 5-7, 0-60 min reaction time, 50-125 A/m<sup>2</sup> current density with Fe-Fe anode&cathode. In a study made with textile wastewater for EC process, 97.7% removal rate was observed for BR-18 dye, at pH 3-11, 10-60 V, 0-5 A for 10-60 min with Al-Al anode&cathode (Bazrafshan et al., 2014). MB dye treatment was investigated with electrocoagulation in textile wastewater by Mostafa et al. (2015), and 100, 95.78 removal efficiencies were observed as the best at pH 3-9 and 10-50 A/m<sup>2</sup> current density with Fe-Fe and Al-Al anode&cathode for 2-24 min of reaction.

#### **4. CONCLUSIONS**

Studies on electrocoagulation (EC), have begun to attract attention in recent years, for the textile wastewater treatment. The process is now used as an effective method in treatment of textile industry wastewaters, due to its advantages. These wastewaters, threaten the environment and human health, when discharged without treatment due to, have high dispersion rates, containing even very small amounts of dyestuffs. Nowadays, adsorption, filtration, chemical processes and biological activated sludge processes are preferred for color and COD removal from colored textile wastewaters. However, the electrocoagulation processes are more suitable for COD and color removal compared to other

methods. EC processes, having a wide range of application area in wastewater treatment, could make a major contribution to the economy of concentrated waste discharging industries. Moreover, these processes can greatly reduce the pollutant load. Up to 100% color removal and high levels of chromium, COD and turbidity removal efficiencies were observed from textile and tannery industry wastewaters by EC process, in the studies made by different researchers.

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## **O 12. EVALUATING GROUNDWATER QUALITY FOR IRRIGATION SUITABILITY IN KONYA CITY**

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**ABSTRACT:** The estimation of groundwater quality for irrigation suitability in Konya city had been investigated based on different indices such as Sodium Adsorption Ratio (SAR), Soluble Sodium Percent (SSP), Residual Sodium Carbonate (RSC), Magnesium Hazard (MH), Kelly's Ratio (KR) and EC concentration. The Wilcox's, US salinity (USSL) and Piper diagrams had been created in order to the water classification in the study area. The US salinity diagram shows that most of the samples of Konya groundwater fall in the field of C2-S1 and C3-S1 in both seasons, signifying medium and high salinity with low sodium water. Such regions necessitate special be interested to provide sufficient drainage and introduce alternative salt tolerance cropping. Moreover, in accordance with Wilcox's Diagram, the values of the most our samples are classified as excellent to good and good to permissible classes about 94.85% in the winter and 94.35% in summer. Other best-fitted models, such as SAR, Kelly's Index (KI), MH and RSC values indicate that groundwater is between moderate to good for irrigation purposes. The dominant groundwater classified into two water types were (Mg-Ca-HCO<sub>3</sub>) and (Ca-Mg-SO<sub>4</sub>-HCO<sub>3</sub>-Cl) types based on Piper diagram. Generally, estimation of water samples indicated that the most of the water samples are suitable for irrigation purpose, except some samples.

*Keywords: Irrigation Water Quality, Water Classification, Groundwater pollution*

### **1. INTRODUCTION**

Agriculture is the most user of water, covers functions related to the production of cultivated plants. In Turkey, the social and economic aspects, plays an important role in the lives of the people. Agriculture accounts for 19% of total national income and 9% of exports. About 51% of the society provides employment opportunities through agricultural functions (Kartal, Değirmenci, & Arslan, 2019; Kılınçer et al., 2002). However, the increase in water use causes very important problems. For example, underground water resources are depleted, other water ecosystems are polluted and degraded; there are also many environmental problems in irrigated agriculture. In fact, water, which is considered as a renewable natural resource, gains a very dangerous feature such as losing this feature in limited areas. As a result of the described situation, the provision and development of new water resources becomes very expensive and even impossible. Worse, the majority of the society is not interested in the fact that water will become a hindrance factor in adequate food production in the future (Pulido, Barrena-González, Alfonso-Torreño, Robina-Ramírez, & Keesstra, 2019; Rosegrant, Cai, & Cline, 2002; Singh, 2019; Wyman & Yao, 2019). One of the most important environmental problems in in-field irrigation is the accumulation of salt in the soil in case of excessive irrigation under inappropriate irrigation management and poor drainage (Ghassemi, Jakeman, & Nix, 1995; Haroon, Ping, Pervez, & Irshad, 2019; Masoumi, Gharaie, & Ahmadzadeh, 2019; Singh, 2019). The different structure of Turkey's agriculture, other physical, economic and socio-cultural characteristics, as well as the agriculture-environment interaction and especially the environmental negative effects of agricultural production are different from many EU countries. These effects, which have not been felt to date, have started to manifest themselves in recent years, especially due to the scarcity of water and pollution in water resources. Intensive agricultural activities in recent years both carry the risk of environmental pollution and increase the pressures on the environment and social life through the use of inappropriate natural resources. For many years, the EU is Turkey's full membership to EU harmonization is particularly vital for the agricultural sector. In this process, where alignment with the acquits has yet to be achieved, agricultural-environmental practices in the EU have not been adopted, but some steps have been taken in this context (Dişbudak & Saklıdır, 2008).

The objective of this study is determining the groundwater quality of Konya city using Inverse Distance Weighting (IDW) method within ArcGIS environment for Irrigation purposes based on different indices such as Sodium Adsorption Ratio, Soluble Sodium Percent (SSP), Residual Sodium Carbonate (RSC), Magnesium Hazard (MH), Kelly's Ratio (KR), piper, Wilcox and US salinity diagrams.

**2. METHODOLOGY**

The major source for drinking water, industrial and agriculture purposes is groundwater in Konya city that covers about 1050 km<sup>2</sup>. The sufficient amount of water is necessary for the suitable growth of crops, in addition, the water quality used for irrigation purpose must be well into the allowable limit otherwise it could negatively impact the growth of the plants. This study includes the investigation of chemical properties and some pollution parameters of groundwater wells data had been obtained from Konya city municipality around 123 well in summer 2012 and 96 well in winter 2012 that including electrical conductivity (EC), calcium (Ca<sup>2+</sup>), magnesium (Mg<sup>2+</sup>), sodium (Na<sup>+</sup>), chloride (Cl<sup>-</sup>), potassium (K), bicarbonate (HCO<sub>3</sub><sup>-</sup>), and carbonate (CO<sub>3</sub><sup>-</sup>). Groundwater quality in Konya city for irrigation suitability estimation was investigated based on different indicators such as Sodium Adsorption Ratio (SAR), Soluble Sodium Percent (SSP), Residual Sodium Carbonate (RSC), Magnesium Hazard (MH), and Kelly's Ratio (KR). The spatial distribution of the groundwater quality indicators had been produced applying ArcGIS 10.5 software, depending on the IDW interpolation technique. Then the water Classification have been evaluated by drawing Piper, Wilcox and US Salinity Laboratory diagrams. The irrigation indicators were calculated from the equations given in Table 1.

**Table 1:** The summarize of the irrigation indicators and their equations

The irrigation indicators	equations
Sodium Adsorption Ratio (SAR)	$SAR = \frac{Na^+}{\sqrt{\frac{Ca^{2+} + Mg^{2+}}{2}}}$
Soluble Sodium Percentage (SSP)	$SSP = \frac{(Na + K) \times 100}{Ca + Mg + Na + K}$
Residual Sodium Carbonate (RSC)	$RSC = [HCO_3^- + CO_3^-] - [Ca^{2+} + Mg^{2+}]$
Magnesium Hazard (MH)	$MAR = \frac{Mg^{2+}}{Ca^{2+} + Mg^{2+}}$
Kelly's Ratio (KR)	$KR = \frac{Na^{2+}}{Ca^{2+} + Mg^{2+}}$

**3. RESULTS AND DISCUSSION**

The SAR values in the samples of groundwater for the study area in summer 2012 range from 0.0176 to 9.649 and in winter 2012 range from 0.079 to 4.88 as shown in the figure 1, that mean all values were lower than 10, It can be categorized as excellent water for irrigation indicating that all the samples of groundwater based on SAR values are suitable for irrigation purposes. The SSP of the groundwater samples changed from 2.042% to 57.83% with a mean 16.53% in the summer season, while 3.47% to 63.91% with an average of 16.63% in the winter season as shown in the figure 2. The high soluble sodium percentage (SSP or Na%) relating to total cations in irrigation water reasons desolation of soils and weaken permeability of the soil, sodium relates with carbonate can lead to the formation of alkaline soils, whereas saline soils formation when sodium associated with chloride (Nagarajan, Rajmohan, Mahendran, & Senthamilkumar, 2010; Richards, 1954)

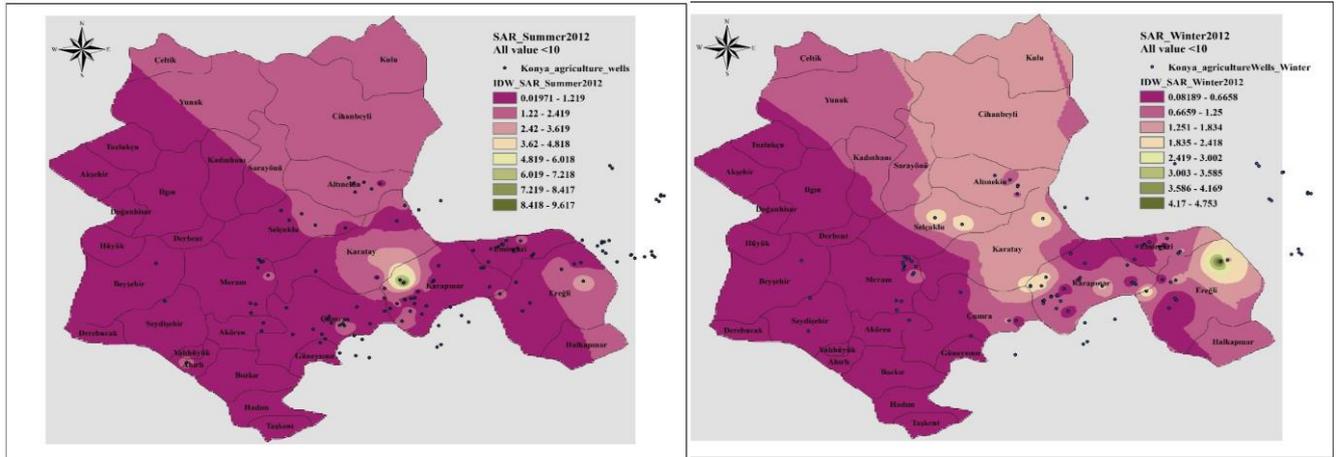


Figure 1. The spatial distribution of SAR values for Konya city in summer and winter 2012

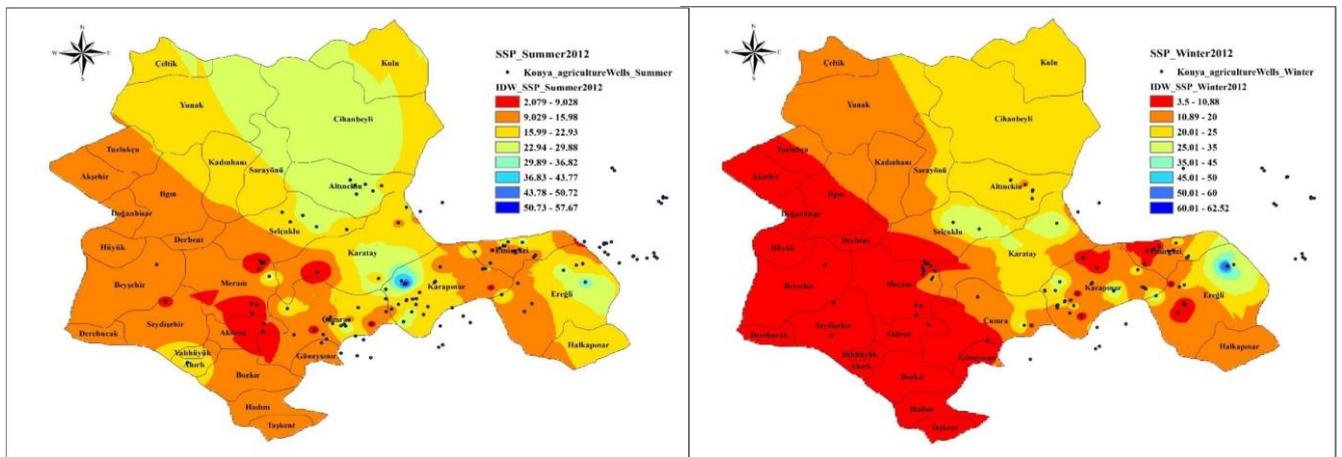


Figure 2. The spatial distribution of SSP values for Konya city in summer and winter 2012

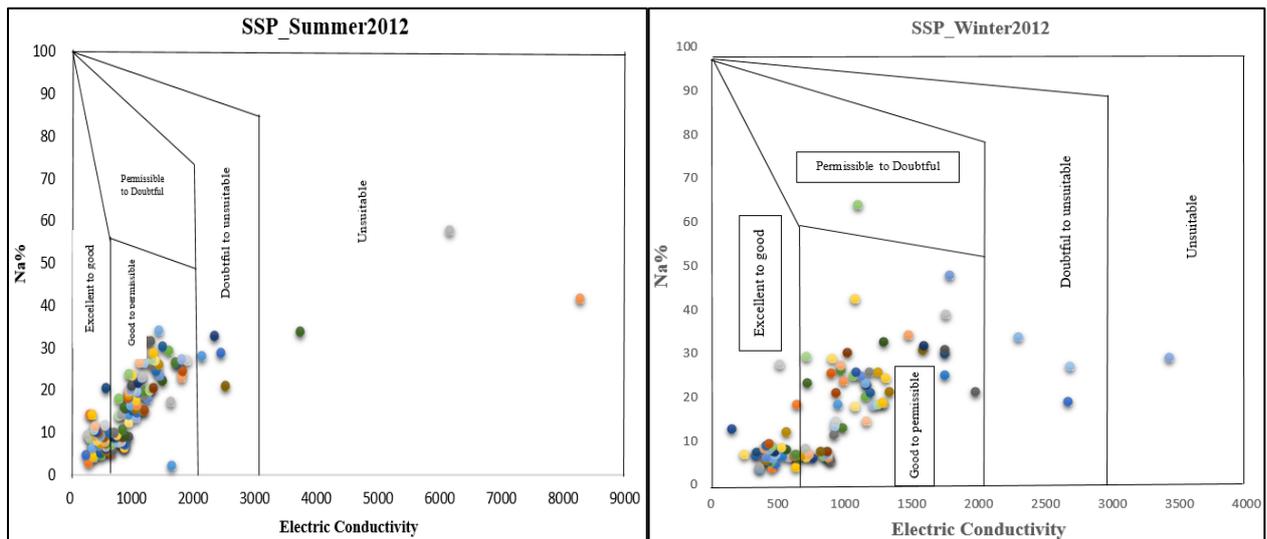


Figure 3. Sodium percent against electrical conductivity (Wilcox diagram) in summer and winter 2012

Wilcox (1995) has classified the water in accordance with some parameters (e.g., Na% and EC), and in accordance with his classification diagrams (Wilcox's Diagram). According to Wilcox's diagram about 94.35% and 94.85% of groundwater samples in summer and winter 2012, respectively, can be securely used for purposes of irrigation and some samples are unsuitable for purposes of irrigation within the

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doubtful to unsuitable classes as shown in figure 3. About 96.75% and 96.88% of the groundwater samples in summer and winter 2012 appeared a magnesium ratio below 50%, signifying their suitability, whereas only 3.25% and 3.12 % in summer and winter, respectively, fall in the unsuitable class with an MH of more than 50%, indicating their possible adverse influence on the crop yield that shown in figure 4.

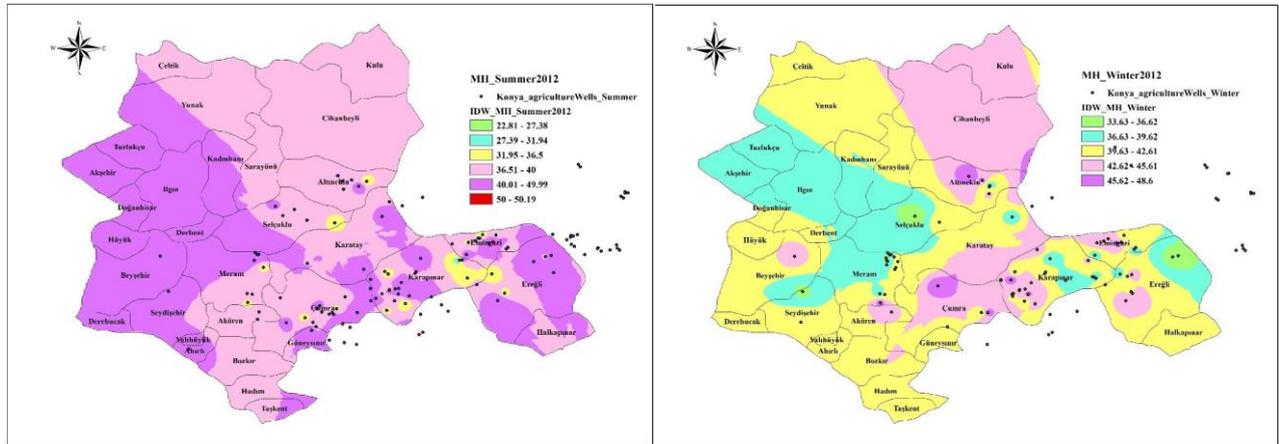


Figure 4. The Spatial distribution of MH for Konya city in summer and winter 2012

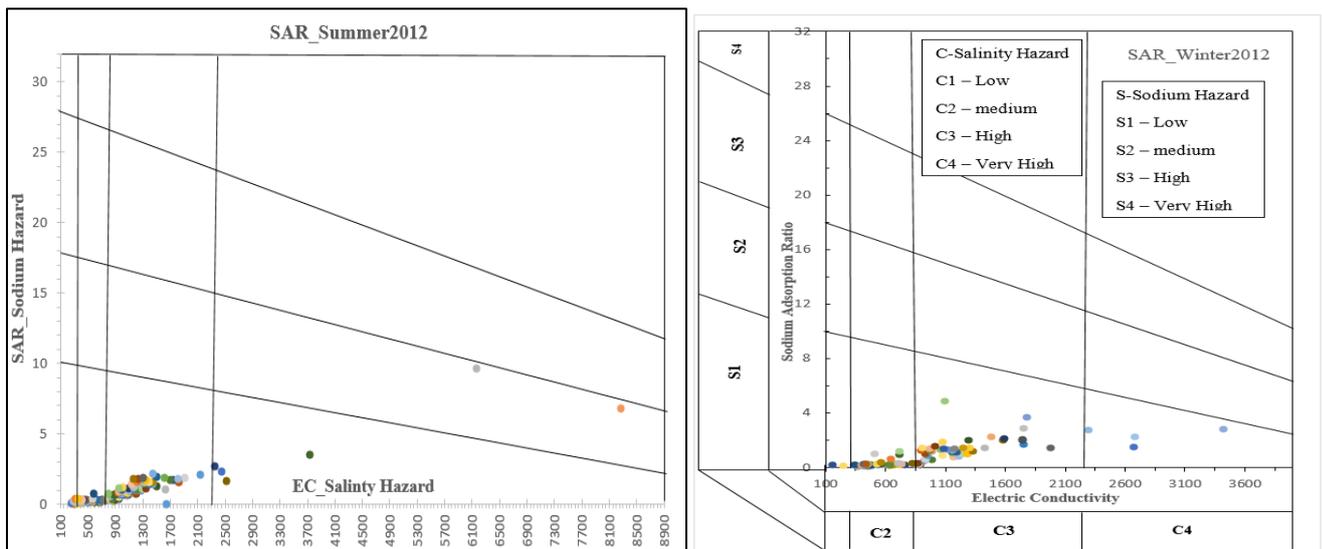


Figure 5. USSL diagram of Konya groundwater samples in summer and winter 2012

Based on classification of salinity and alkalinity hazard in summer and winter 2012 that shown in figure 5, most Konya groundwater samples occur with high salinity and low sodium hazard (C3-S1) that cannot be consumed on soils with limited drainage though they have little hazard for the development of harmful levels of exchangeable sodium, even with sufficient drainage, special management for control of salinity may be utilized although plants with good salt tolerance must be chosen for C3-S1, This shows that no alkali hazard is predicted to the yields, while Extra salinity decreases the osmotic activity of crops and consequently overlap with the water absorption and the soil nutrients. Figure 6 shows the spatial distribution of EC values where the highest values of EC found in the Karatay and Karapınar regions. The high amount of residual sodium carbonate (RSC) in water indicates to an excess in sodium absorption on the soil, RSC values of groundwater varied from -18.435 to 2.25 in the winter and from -42.63 to 44.85 in the summer. All the groundwater samples were less than 1.25 (good class) and acceptable for agriculture except one in the winter and another in the summer were greater than 1.25.

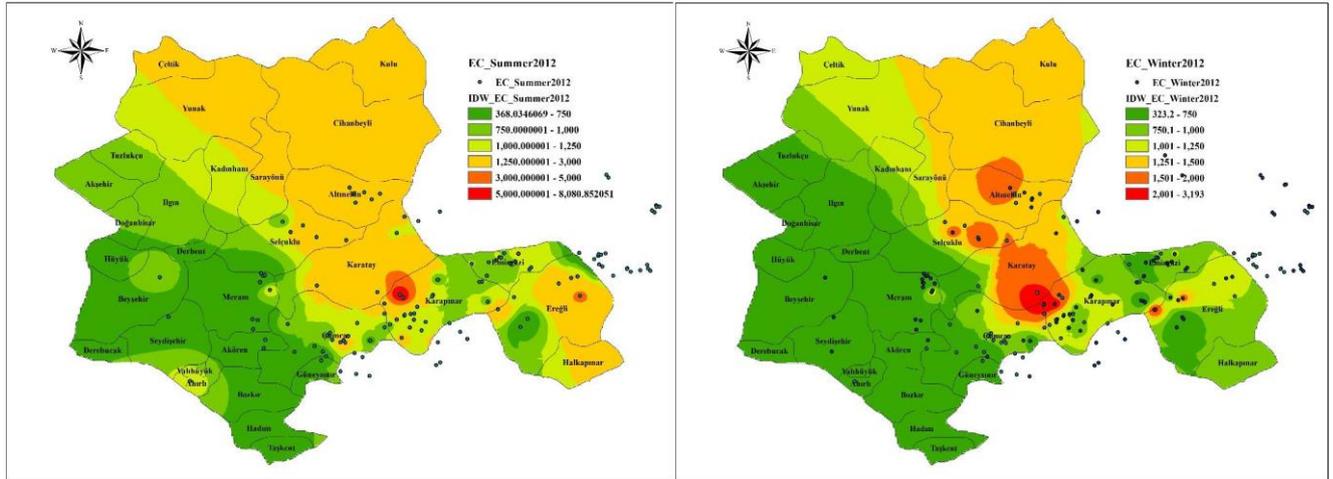


Figure 6. Spatial distribution of Electric Conductivity for Konya city in summer and winter 2012

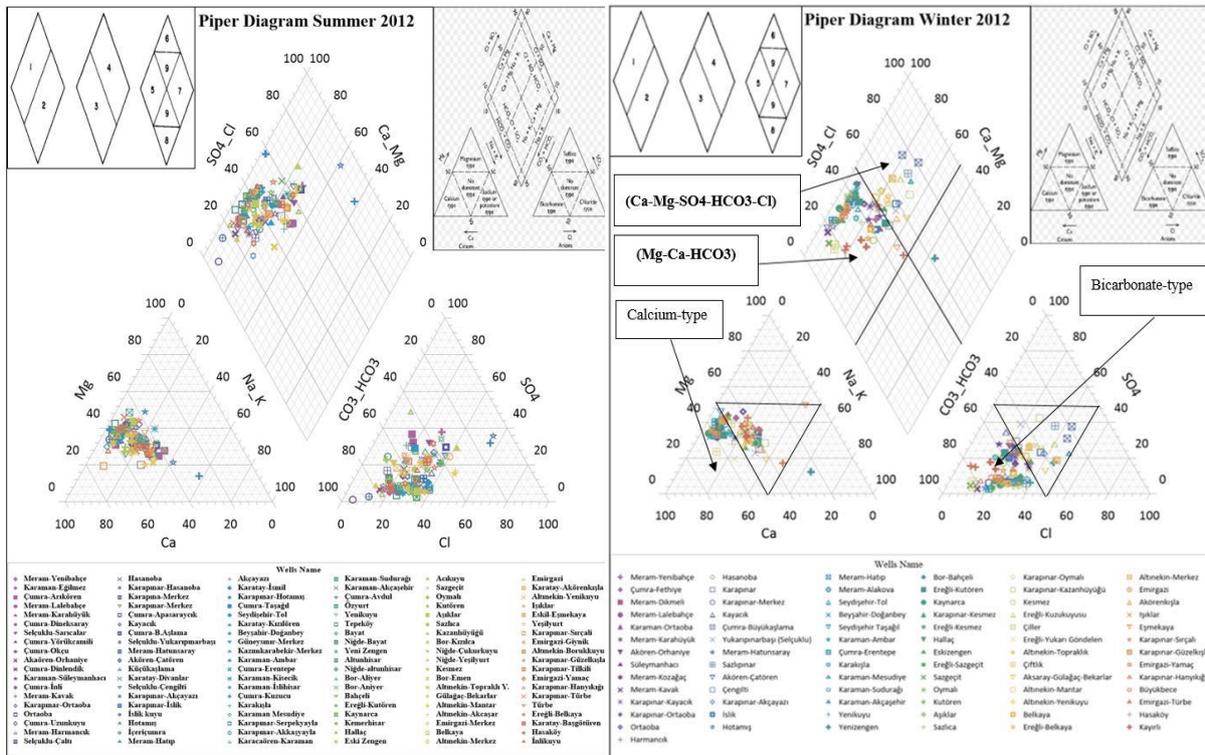


Figure 7. Piper diagram of the Konya groundwater samples in summer and winter 2012

The groundwater in the Konya city is mainly  $\text{CaCO}_3$  to  $\text{MgCO}_3$ , and the carbonate hardness is more than 50%. The waters according to the degree of hardness, classified as hard water class. Thus, groundwater in the study area classified as  $(\text{Mg}-\text{Ca}-\text{HCO}_3)$  and  $(\text{Ca}-\text{Mg}-\text{SO}_4-\text{HCO}_3-\text{Cl})$  types. The analysis in Piper diagram (Piper, 1944) indicates the dominance of alkaline earth ( $\text{Ca}^{2+} + \text{Mg}^{2+}$ ) over alkalis ( $\text{Na}^+ + \text{K}^+$ ) and overwhelming dominance of  $\text{HCO}_3^- + \text{SO}_4^{2-}$  over  $\text{Cl}^-$  as shown in figure 7.

#### 4. CONCLUSION

The using of water for agriculture purposes has become one of the most essential environmental events that are depleting very quickly. Therefore, irrigation with mostly groundwater is the only alternative for the continuation of agricultural activities in arid and semi-arid areas. In this study, the estimation of water samples indicated that the most of the groundwater samples are suitable for irrigation purpose, except some samples, especially in Karatay and Karapınar regions.

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### **O 13. ESTIMATION OF NITROGEN OXIDES POLLUTION USING GEOGRAPHICAL INFORMATION SYSTEM IN TURKEY**

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**ABSTRACT:** Air pollution is become one of the most important problems we are facing and has a negative impact on the health of living things, it is the presence of solid, liquid and gaseous pollutants that change the composition of the air in the atmosphere, which may harm human life and ecological balance. In this study, nitrogen oxides pollution was investigated by using GIS technique, the air pollution data had been collected from 137 air monitoring stations during 2016, 2017 and 2018 in turkey. The spatial distribution maps of the annual average concentrations of nitrogen oxides were created with the help of spatial analyst tools, interpolation (inverse Distance Weighted method) within ArcGIS environment. The critical level of NO<sub>x</sub> for the protection of vegetation is 30 µg/m<sup>3</sup> measured as an annual mean. The results indicated that most NO<sub>x</sub> concentrations, about 77.4%, 79% and 65.5% during 2016, 2017 and 2018 respectively, exceeding (30 ug/m<sup>3</sup>) the allowable limit value, where high levels of nitrogen oxides can make happen harm to the human respiratory tract and rise a person's susceptibility to, and the seriousness of, respiratory diseases and asthma.

*Keywords: Air pollution, nitrogen oxides, geographical information system*

#### **1. INTRODUCTION**

Air pollution in cities is closely related to human conditions as well as natural conditions. Increased energy consumption especially due to population growth and industrialization plays an increasing role in air pollution. Many factors have effects on air pollution. Among these factors, human activities take the first place. As a result of these activities, large amounts of SO<sub>x</sub>, NO<sub>x</sub>, CO and PM are mixed into the air (Çiçek, Türkoğlu, & Gürgen, 2004). It is observable that people living in big cities do not breathe fresh air. Smoke from factories, exhausts of vehicles that can see everywhere, fossil fuels and the list of factors that pollute the air we breathe is extended. Nitrogen oxides are the most important pollutants in the air. Nitrogen oxides composed of NO and NO<sub>2</sub> gases cause acid precipitation and directly affect human health and have poison effect, especially NO<sub>2</sub> causes edema and bleeding in the lungs. Nitrogen dioxide is known as the invisible killer because it is very toxic, this gas is very difficult to detect at low concentrations (Le Page, 2016). The presence of NO<sub>x</sub> in the atmosphere is approximately half due to vehicle exhaust and stationary combustion plants. These gases enter the natural gas cycle in the atmosphere and complete the chain reactions resulting in the formation of nitric acid (HNO<sub>3</sub>). The formation of HNO<sub>3</sub> in the atmosphere affects the formation of acid precipitation. In recent years, a study conducted in Denmark, ammonia evaporation of the sun. It is determined that its contribution to the formation of nitric acid in the atmosphere when exposed to radiation is negligible. Ammonium content of rain also increases the acidity of rain by 4 times when ammonium nitrite is converted to acid by the bacteria and oxygen that make nitrification in soil, water basins and lakes (Denhez, 2007; Đncecik, 1994; Edwards, 2019; Elkoca, 2003; İlhan, Dündar, Öz, & Kılınç, 2011; Lange, Richter, & Burrows, 2019; Robertson, Nowakowski, Hannum, & Storslett, 2019; Wei et al., 2019). NO<sub>x</sub> mainly impacts on respiratory conditions causing inflammation of the airways at high levels. Long term exposure can decrease lung function, increase the risk of respiratory conditions and increases the response to allergens. NO<sub>x</sub> also contributes to the formation of fine particles (PM) and ground level ozone, both of which are associated with adverse health effects (Bhandari & Bijlwan, 2019; Kampa & Castanas, 2008; Machin, Nascimento, Mantovani, & Machin, 2019; Muthusamy et al., 2019). Geographical Information Systems are distinguished from other information systems in terms of the data they contain and the characteristics of this data. The ability to address the location of objects or events (phenomena) on the earth is characteristic of such data. Therefore, the locations of objects or events and their relations with each

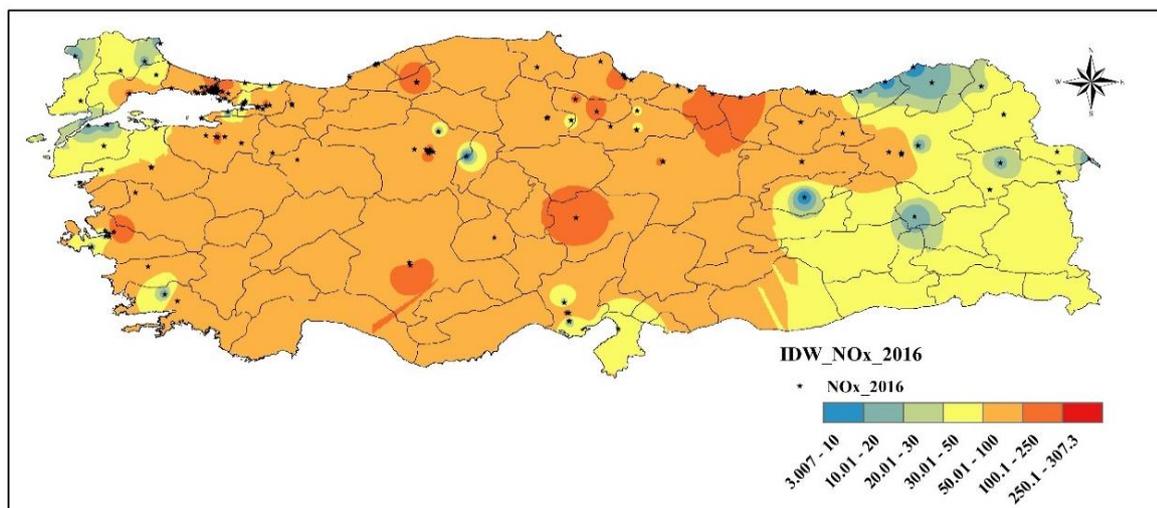
other can be visualized and this visualization is called map. The aim of this study is producing the spatial distribution maps of the annual NO<sub>x</sub> values that covered all Turkey regions for the period 2016–2019 by using Inverse Distance Weighted (IDW) method within the ArcGIS software environment.

## **2. METHODOLOGY**

Numerous researches using Geographical Information Systems (GIS) technology are used in the spatial and temporal analysis of air quality. Within the scope of this study, spatial pollution distribution maps were created by determining positional patterns related to air pollution parameters with GIS technique. Spatial variability and positional dependence relations of air pollutants were examined, and the findings were interpreted. Time-dependent changes of nitrogen oxides concentrations were investigated and analyzes were made with trend graphs. The air pollution data were collected from Turkish Ministry of Environment and Urbanization <http://www.havaizleme.gov.tr/Default.ltr.aspx> for 137 air monitoring stations during 2016, 2017 and 2018 in turkey. In ArcGIS 10.5 GIS software, a point layer was created using the coordinates of measurement stations and the annual average concentration values were added to this point layer as the attribute data. The spatial distribution maps of the annual average concentrations of nitrogen oxides were created with the help of spatial analyst tools, interpolation (Inverse Distance Weighted method) within ArcGIS version 10.5.1 environment.

## **3. RESULTS AND DISCUSSIONS**

The critical level of NO<sub>x</sub> for the protection of vegetation is 30 µg/m<sup>3</sup> measured as an annual mean. In the ArcGIS software, the NO<sub>x</sub> distribution maps of the Turkey were produced using the inverse Distance Weighted Interpolation Method (IDW). The results indicated that most NO<sub>x</sub> concentrations, about 77.4%, 79% and 65.5% during 2016, 2017 and 2018 respectively, exceeding (30 µg/m<sup>3</sup>) the allowable limit value especially in the central parts of Turkey as shown in the figures 1, 2 and 3, where the maximum values of NO<sub>x</sub> found in the Konya city in Konya Selçuklu Belediye (811.1675 µg/m<sup>3</sup>) and Konya Karatay Belediye (562.4825 µg/m<sup>3</sup>) stations during 2018, the high levels of nitrogen oxides can make happen harm to the human respiratory tract and rise a person's susceptibility to, and the seriousness of, respiratory diseases and asthma.



**Figure 1.** Spatial analysis of NO<sub>x</sub> during 2016 by using IDW method.

Figure 4 shows the prediction map of spatial analysis of NO<sub>x</sub> during 2018 by using ordinary kriging prediction method that chosen as best method after testing all semivariogram methods, there are small differences when comparison between figure 3 that shows IDW method and figure 4 that shows ordinary kriging prediction method. Figure 5 presents the relation between measured values of NO<sub>x</sub> as x-axis and predicted values of NO<sub>x</sub> as y-axis, the regression equation of the relationship is ( $y=0.51*x+32.71$ ,  $R^2=0.97$ )  $R^2$  values indicated to the strong correlation between measured and predicted values of NO<sub>x</sub> this mean fitting model.

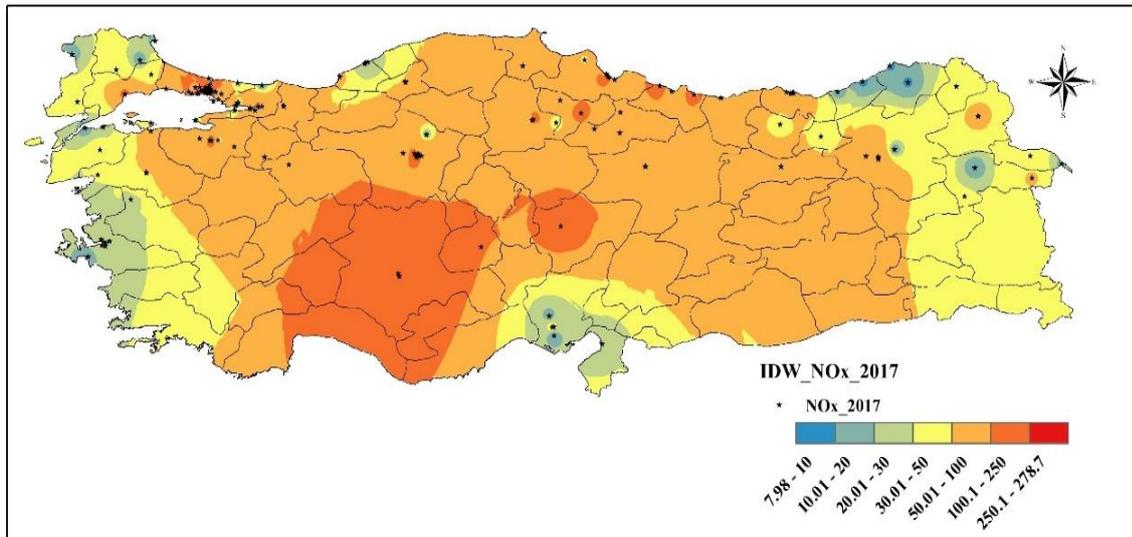


Figure 2. Spatial analysis of NO<sub>x</sub> during 2017 by using IDW method.

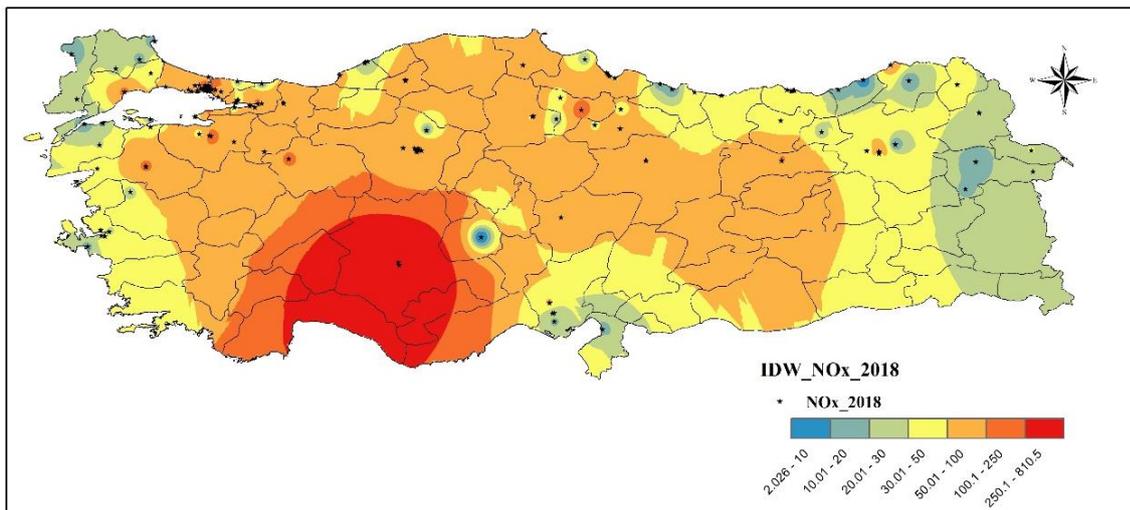


Figure 3. Spatial analysis of NO<sub>x</sub> during 2018 by using IDW method.

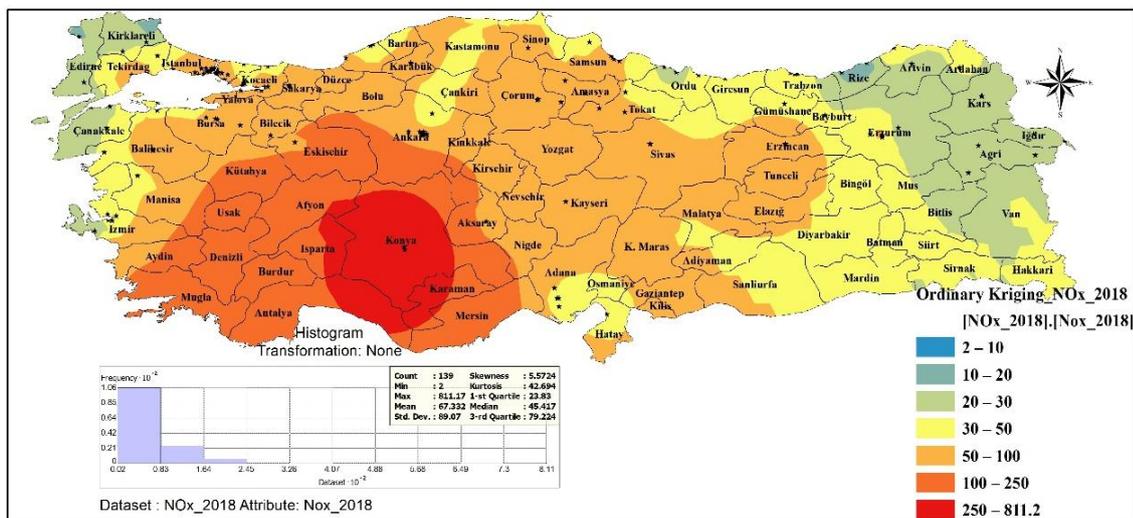


Figure 4. Spatial analysis of NO<sub>x</sub> during 2018 by using Ordinary Kriging prediction method.





#### **4. CONCLUSION**

In this study, the annual and spatial distribution of NO<sub>x</sub> measured by passive sampling at 137 points in Turkey, was investigated. According to the results, most values of NO<sub>x</sub> were exceeded limit value where the high levels of nitrogen oxides can make happen harm to the human respiratory tract and rise a person's sensitivity to, and the seriousness of, respiratory diseases and asthma, it is thought that the data obtained from this large scale study will be an important guide in the air quality improvement plans to be created by local decision makers in the region. As a result, local managements could organize an action plan and emission models for air pollution reduction in residential areas.

**Acknowledgement:** We would like to thank Konya Water and Sewerage Administration General Directorate to supporting data and Selçuk University BAP for supporting PhD. Thesis project.

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**O 14. ENVIRONMENTAL EFFECTS OF COAL COMBUSTION WASTES AND USAGE  
AREAS**

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**ABSTRACT:** Energy demand has been increasing all over the world with the various social and economic developments. Energy sources such as coal, oil and natural gas are widely used around the world in order to fulfil this demand. In our country, the amount of coal use is relatively higher than those of other sources. Therefore, the wastes of coal use cause significant economic and environmental problems. The wastes of coal are usually conveyed to storage sites by water way. After ashes was contacted with water, toxic metals contained in coal ash in the storage sites can be spread in the environment. Many studies have shown that living next to the coal ash storage areas increases the risk of cancer and other diseases. However, such wastes are suitable for recovery and can be used in different sectors. In this study, the general characteristics of these wastes, which are defined as coal combustion products, are evaluated in the studies on disposal methods and recovery. In addition, the possibilities of using these wastes in different industrial activities were investigated. The official regulations in our country and the world was evaluated. As a result, it has been pointed out that waste ash disposed by the existing water transport and storage method carries a risk for the environment and human health, and this method should be abandoned as soon as possible and the implementation of alternative waste ash treatment alternatives and the application of dry storage methods should be encouraged.

*Keywords: Coal combustion products, ash, environmental problem*

**O 15. THE TESTING OF COW MANURE FERTILIZER DOSES TO PLANT GROWTH COMPONENTS AND BIOACTIVE COMPOUND OF DEWA LEAF (*GYNURA PSEUDOCHINA* (L.) DC)**

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**ABSTRACT:** Dewa leaf (*Gyanura psudeochina* L) as a potentially medicinal plant have been widely studied for the contents of their metabolites. The content of secondary metabolites in dewa leaf has benefits such as anti-inflammatory, anti-allergic, bronchitis, kidney stones, uterine bleeding, diabetes and anti-HSV (Herpes Simplex Viral) which are effective against the infection of the herpes virus. The cultivation process of dewa leaf requires specific treatments to grow and produce the optimum bioactive materials. One factor that must be considered in the cultivation of medicinal plants is fertilization. The aims of this research was to study the growth and bioactive compounds of plant leaves of Dewa leaf as potential medicinal plants that cultivated with various doses of cow manure. The research was conducted at the Biofarmaka experimental station, Bogor Agricultural University. Chlorophyll analysis at Plant Molecular Biology Laboratory and post-harvest handling performed at the Post Harvest Laboratory, Department of Agronomy and Horticulture, Faculty of Agriculture, Bogor Agricultural University. The experiments were analyzed using a randomized block design, the first factor was the dose of cow manure with three levels i.e. 0 g polybag-1 (control), 500 g polybag-1 and 1000 g of polybag-1. The experiments used 4 replications. The data were analyzed by analysis of variance with SAS 9.1.3, if significantly different continued with Duncan's Multiple Range Test at 5% level. Results showed that fertilizer treatment of cow manure doses did not provide a significant difference in the growth and production of dewa leaf except for plant height at 3 weeks after planting and width of the widest leaf at 4 weeks after planting. Fertilizing with cow manure in this experiment is still not able to increase the growth of canopies, tubers and the content of the bioactive compounds of dewa leaf. The high rate of caterpillar attacks since the second week has disrupted growth and the production of bioactive compounds from the dewa leaf.

*Keywords: Cow manure fertilizer, bioactive compound, dose, Gynura pseudochina (L.) DC, physiology components*

**O 16. LANDSCAPE CONNECTIVITY IN PLANNING AND IMPLEMENTING  
CONSERVATION AND RESTORATION APPROACHES IN CENTRAL ALBANIA  
CARSTIC LAKES SYSTEM**

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**ABSTRACT:** The main aim of this contribution is to present the case of experiences with Lake Dumrea (Central Albania) when human intervention through land use change, deforestation, intensive agriculture development and habitat fragmentation led to a dramatic loss of water bodies and landscape degradation. As human interventions of before '90 converted land for resource extraction and for settlement and agricultural uses, and as our impacts on local scale continue to grow, there is a rapid changes of the physical, chemical, and biological character of these landscapes. Land use changes were significantly reduced the number of water bodies i.e. Dumrea lakes from historical 80 to current 50, while the amount of a aquatic habitat or fragment it, breaking it up into smaller or differently arranged units, including riparian habitats. From analyses process changed not only the size of habitat patches (Lakes surface and water volume) but also other landscape features, such as patch geometry or the amount of edge habitat, that are be of fundamental importance to species, communities, and ecological functions.

*Keywords: Landscape, planning, connectivity of habitats, aquatic ecosystems, environment*

## **1. INTRODUCTION**

In different situations the land use and development planning it is common to bring vegetation into play as a synthesis-indicator of many environmental circumstances (Ellenberg, 1979), and further on many authors treat naturalness as one more descriptor of vegetation (Blume & Sukopp, 1976). Another much larger group of authors refers to the naturalness/ artificialness of the landscape either only in its perceptual aspect or as a more general system. Evaluation alternatives and the impact of fragmentation is highly considered (Canter, 1997), further on assessing the interest of conservation of particular subsystems, i.e. vegetation for the complex ecosystems (Loidi, 1994; Edarra, 1997; Meaza & Cardinanos, 2000) and elaborating suitability matrixes (Gomez Orea, 2002). Several connectivity approaches and indices have been suggested so far for conservation approaches (Keitt et al., 1997; Tischendorf and Fahrig, 2000; Goodwin, 2003; Pascual-Hortal and Saura, 2006).

The purpose of this approach is to encourage the inclusion of proactive wetland management into watershed and regional plans because wetlands play an integral role in the healthy functioning of entire watershed. This approach promotes using a watershed approach that not only protects existing freshwater wetlands but also maximizes opportunities to use restored, enhanced, and created freshwater wetlands of Dumrea Lakes to address watershed problems such as habitat loss, hydrological alteration and water quality impairments. As usual the primary users for the approach are members and staff of watershed managers, local government, organizations and local/state agencies.

Dumrea Lakes – Current designation: Nature monument: Seferani, Dega Lake Location: Latitude 40°58'58" N; Longitude 19°54'22" E. The Dumrea Lakes are a complex of about 85 lakes of various sizes (ECBY, 2009), which have in general a circular or oval shape. The biggest lake of the group is Çestija with 94.5 ha surface, followed by Seferani, Merhoja, Dega and Belshi with 87.5, 65.5, 37.4 and 18.1 ha surface respectively. The lake with biggest water volume is Merhoja (11.3x10<sup>6</sup>m<sup>3</sup>), followed by Çestija, Seferani, Dega and Belshi. The Lakes of Dumrea in general have an average depth of 7 m.

Merhoja is exception as its average depth is 17.9 m, while its maximum is 61 m. Some of the lakes have been named after the villages, like the lakes of

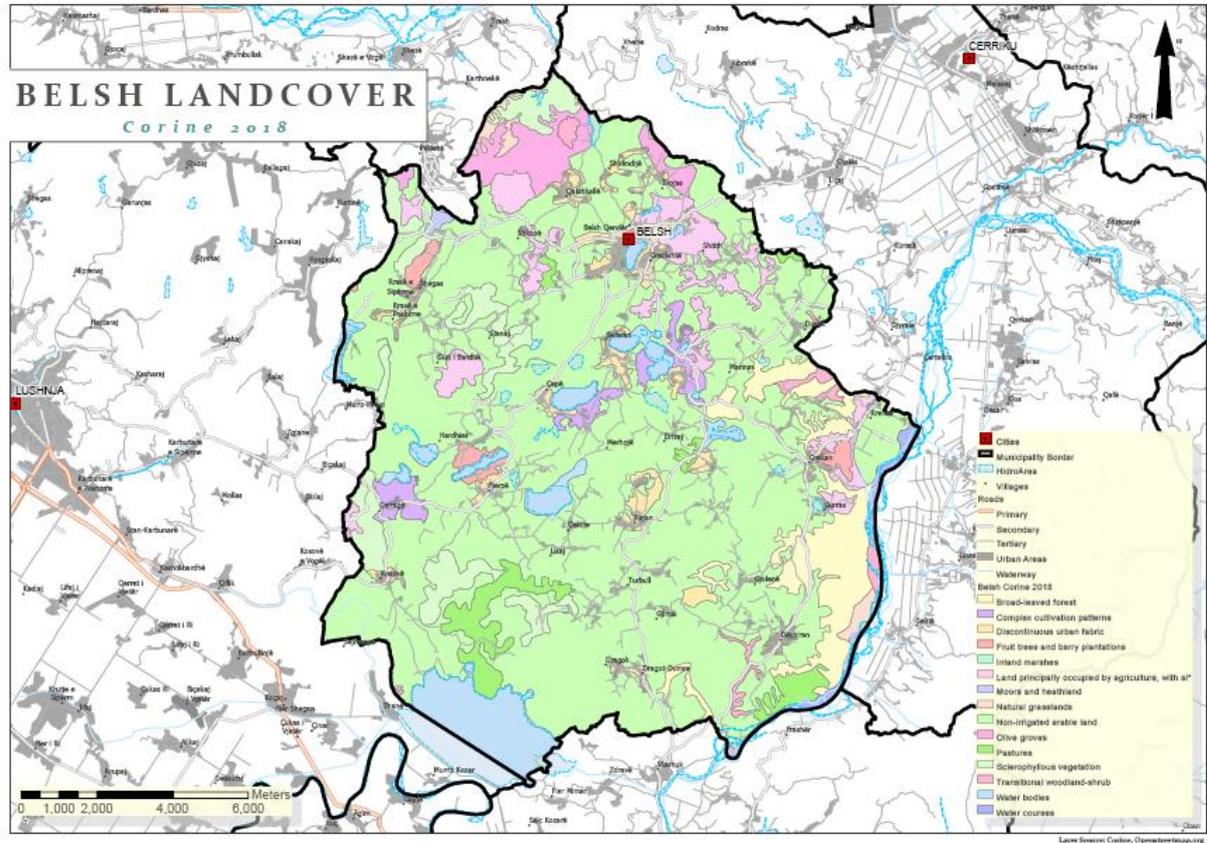


Figure 1. Land cover map of the Dumrea Lakes region

Seferani, Katundi, Cerraga etj, and some others after persons, like Millosh, Abaz, Todri, Bici. Finally, the names of some lakes are defined by their transparency or the colors of the waters, like Black Lake, the Red Lake, etc. The average monthly temperature of the surface waters of the lakes of Dumrea in winter is below 7.5°C and goes up to 26°C in summer. The amount of oxygen in the surface is 6.5-7.5 mg/l and decreases to 1.5 mg/l at 15 m depth. At bigger depths start to appear the presence of hydrosulfides (H<sub>2</sub>S).

The ecosystem stability and integrity, biodiversity conservation and sustainable planning of a certain area is very much linked with landscape connectivity (Taylor et al., 1993), while it has been highlighted as a crucial issue for biodiversity conservation and for the maintenance of natural ecosystems stability and territorial integrity (Taylor et al., 1993; With et al., 1997; Collinge, 1998; Crist et al., 2005; Sheldon et al., 2005).

Following the human interventions of several decades through converted land, there is a rapid changes of the physical, chemical, and biological character of these landscapes. Land use changes were significantly reduced the number of water bodies i.e. Dumrea lakes from historical 80 to current 50, while the amount of a aquatic habitat or fragment it, breaking it up into smaller or differently arranged units, including riparian habitats. From analyses process changed not only the size of habitat patches (Lakes surface and water volume) but also other landscape features, such as patch geometry or the amount of edge habitat, that are be of fundamental importance to species, communities, and ecological functions.

## 2. MATERIAL AND METHODS

Development of index of naturalness (following advanced improvements of Machando, 2004) for the Dumrea Lakes district is the main approach. The proposed index does not consider solitude, beauty and other intangible values of nature that are not strictly linked to ecology. All diagnostic criteria are based on aspects of the ecosystem that can be measured.

Analysis of data

**Table 1.** Naturalness categories (Source: Maschado, 2004)

[10]	Natural virgin system; only natural elements and processes. Possible anecdotal presence of negligible or hardly noticeable anthropic elements, or totally insignificant physical-chemical pollution coming from exterior anthropic sources	
[9]	Natural system; presence of few exotic biological elements (no qualitative effects); minimal artificial infrastructure, temporary or removable. Physical-chemical pollution absent or of no significance	
[8]	Sub-natural system; possible extended presence of wild exotic species, but not dominant (low impact); artificial elements located, not extensive. Occasional pollution processed by the system (does not go beyond resilience). Possible minor extraction of renewing resources. Fragmentation irrelevant. Natural dynamic little altered	
[7]	Quasi-natural system; extensive anthropic activities of low physical impact; facilities if present, dispersed, not connected; wild exotic species well established but not dominant; natural structures modified but not distorted (re-location of physical or biotic elements). Moderate extractions, if present. Little alteration of water dynamics	
[6]	Semi-natural system; anthropic infrastructure scarce or concentrated; possible dominance of wild exotic species; native elements considerably reduced. Occasional addition of energy and/or extraction of renewable resources or of non-relevant materials. General dynamic still controlled by natural processes. It may include abandoned cultural systems undergoing natural recovery	
[5]	Cultural self-maintained system; processes conditioned by extensive activities of man; biological production not too forced. Native species altered, occasionally managed. Little or no presence of constructions or artefacts. Little or no management of water cycle (passive)	
[4]	Cultural assisted system; important infrastructures and/or conditioning of the physical environment; forced biological production; moderate addition of matter (usually with pollution associated). Natural elements intermixed, in patches or corridors. Active management of water	
[3]	Highly intervened system: still areas with biological production (natural/cultivated/breeding) mixed (mosaic) with buildings and infrastructures. Natural biodiversity severely reduced; its elements rather isolated (intense fragmentation). Water dynamic manipulated. Geomorphology usually altered; soils eventually removed	
[2]	Semi-transformed system; biological production not dominant, disarticulated. Predominance of constructed elements. Occasional moderate vertical development of facilities. Intensive input of energy and matter (food, water) from the outside. Intensive control of water	
[1]	Transformed system; anthropic processes governing; clear dominance of artificial elements; frequent intensive vertical development; vestiges of natural elements; those exotic confined, decorative or not visible. Full dependence of external inputs of matter and energy. Absolute control of waters	
[0]	Artificial system; high closure; without self-maintained macroscopic life; microscopic life absent or in containers	

All useful information compiled has been transferred to a cartographic base (transparencies or GIS). It is practical to work on a topographic base map reflecting the major watersheds (bold lines). Aerial photography (1:18 000–1:25 000) were the best ally for land interpretation and almost an indispensable tool to work with large territories. Further on other maps of land use activities, infrastructure, cultivation, vegetation, cattle range or any other which reflects human influence on the territory.

Field inspection

The field checks of the territory were done in order to contrast the impressions derived from the analysis of available compiled data and, particularly, when needed to solve doubts or discriminate among close situations. Moreover, some aspects, like the presence/dominance of exotic species, are not normally registered in land or urban-planning processes.

## 3. RESULTS AND DISCUSSIONS

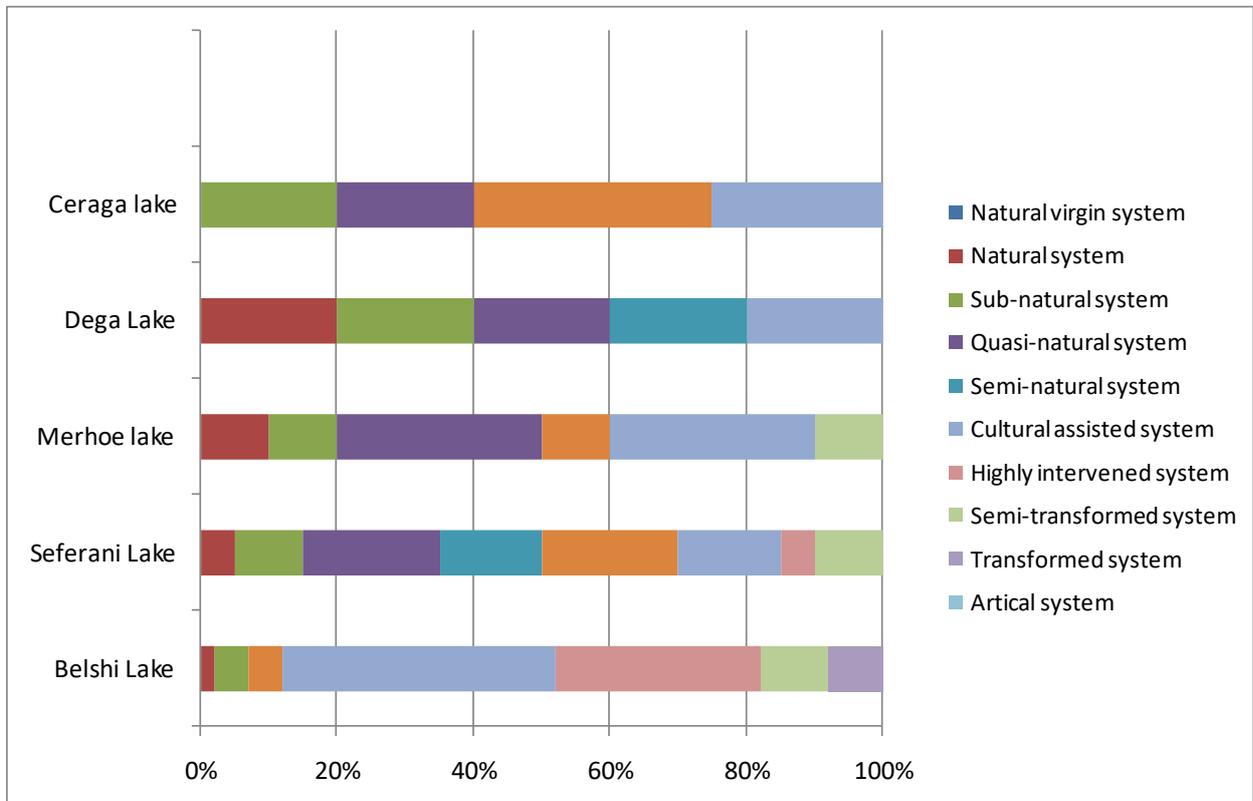
Based on Edarra (1997) and Mochado (2004), who proposes to estimate the naturalness of plant communities from 0 to 10, according to the grade of human influence, where value 0 corresponds to areas intensively urbanized, fully occupied by buildings, roads, etc, almost without plants; and 10 is the value for mature forests that are not exploited, vegetation on rocks, cracks and gravel beds, peat land,

marsh lands, coastal salt marshes, etc., the Figures 2, 3 and 4 represents the current naturalness rate of considered Dumrea lakes.

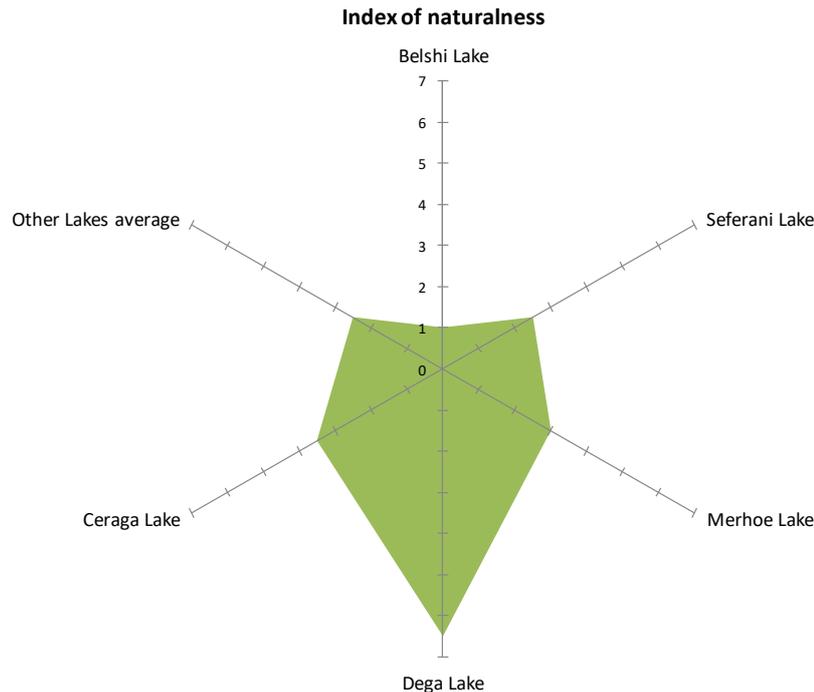
	Natural virgin system	Natural system	Sub-natural system	Quasi-natural system	Semi-natural system	Cultural semi maintained system	Cultural assisted system	Highly intervened system	Semi-transformed system	Transformed system	Artical system
<b>Belshi Lake</b>	0%	2%	5%	0%	0%	5%	40%	30%	10%	8%	0%
<b>Seferani Lake</b>	0%	5%	10%	20%	15%	20%	15%	5%	10%	0%	0%
<b>Merhoe lake</b>	0%	10%	10%	30%	0%	10%	30%	0%	10%	0%	0%
<b>Dega Lake</b>	0%	20%	20%	20%	20%	0%	20%	0%	0%	0%	0%
<b>Ceraga lake</b>	0%	0%	20%	20%	0%	35%	25%	0%	0%	0%	0%

**Figure 2.** Rate of naturalness of selected Dumrea Lakes

Following field analyses and elaborated data that are based different land use and land cover maps, it seems that the most impacted water body is Lake of Belshi (40% of shore line considered as Cultural assisted system and 30 as Heavily intervened system), remaining at only 2% as Natural system. Further on the Lake Dega, proclaimed also as a Nature monument along with Lake Seferani, seems to be less affected one with 20% as Sub-natural system, 20% as Quasi-natural system and 20% as Semi-natural system of entire shoreline (See Figure 2 and 3).



**Figure 3.** Different categories expressing current naturalness rate of Dumrea lakes



**Figure 4.** Assessed index of naturalness for selected lakes in Dumrea District

In the Figure 4 are shown the values of calculated Index of naturalness. The highest score 6.3 is calculated for the Lake Dega, while the lowest one of 1.1 is calculated for the Lake Beshi, reflecting directly the serious status of impacts, where 30% of entire shore line is considered as Highly intervened system. It is worth to mention that in our case the system is defined by its limits, its elements and the relations among these and with the exterior; it has a structure and behavior (Machado, 2004). This approach was implemented to our lakes ecosystem, and following Machado (2004), the naturalness index is based on a simple principle: ecosystems are artificially altered basically by three often interrelated causes: the incorporation of new elements (i.e. exotic species, pollutants, arte facts); the specific relocation or loss of its own elements as previously dominated from oak forest and currently by farming systems etc.

#### 4. CONCLUSIONS

Following analyses of the current wetlands connectivity and ecosystem functionality:

- (i) In the local or regional plan there is a need for recognizing the role and significance of the wetlands (ecosystems, economy-tourism, etc) in spatial long term planning;
- (ii) (The vision of Municipality should be centered on water ecosystems;
- (iii) Ensuring full awareness of the values and functions of wetlands in the area and this is fundamental in designing mid-term and long term objectives for balancing development and conservation;
- (iv) Addressing the integration of current land cover, land use, conservation and sustainable use of wetlands in broad-scale integrated ecosystem management.

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**O 17. TEXTILE DYE REMOVAL FROM AQUEOUS SOLUTION BY USING PEANUT AND PISTACHIO SHELLS**

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**ABSTRACT:** The use of peanut and pistachio shells as an adsorbent for the removal of Brilliant Blue and K-RED 198, Metil Oranj, and Metilen Blue was investigated. The commonly used isotherm models were applied for data obtained from further batch studies. Dye removal capacity is as follows 65% for Brilliant Blue, 73 % for KRED 198. Freundlich isotherm model were found to be the best fitted one and based on Friuendlich isotherm model adsorption capacities were 4,58 mg/g for Brilliant Blue, and 4,33 mg/g for K-RED 198 at peanut shells, and 4,04 mg/g for Brilliant Blue, and 4,64 mg/g for K-RED 198 at pistachio shells. Kinetic examinations were also carried out for two dyes tested and it was found that adsorption kinetic was best described by pseudo first-order kinetic model.

*Keywords: Textile dye, removal, peanut and pistachio shells, kinetic, isotherm*

## **O 18. HOW DOES ECONOMIC GROWTH AFFECTS DEFORESTATION: EVIDENCE FROM ALBANIA**

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**ABSTRACT:** This paper examines the relationship between environment and economic development in Albania. We use macroeconomic data for the period 2000-2018 in order to give answer to the research question on the relationship between deforestation trends and economic growth. According to the literature, there is a “U” shaped relationship between GDP and environment. This is called the environmental Kuznets curve (EKC), and shows a hypothesized relationship between environmental quality and economic development. So, various indicators of environmental degradation tend to get worse as modern economic growth occurs until average income reaches a certain point over the course of development. The dependent variable is used deforestation as a proxy for environment degradation. Moreover, deforestation is analysed in relation with the following set of control variables; GDP growth rate, energy consumption, trade openness, and population during the period of study. Time series data obtained from the Albanian Institute of Statistics, Albanian Ministry of Environment and Tourism, and World Bank Development Indicators were fitted using econometric techniques such as Autoregressive Distributed Lag (ARDL), Granger causality test, Johansen co-integration test and Vector Error Correction Method (VECM).

The empirical results of our analysis are in part consistent with similar studies focused on developing countries. The results confirmed the existence of co-integration among the variables both in long- and short-run paths.

*Keywords: Deforestation, Economic Growth, Granger Causality, Developing Countries*

### **1. INTRODUCTION**

Deforestation is the removal of a forest or stand of trees from land which is then converted to a non-forest use. This process is affected as a result of broad climate changes or catastrophes such as fire and landslides; growing populations that need expanding food supplies, so forests are cleared by shifting cultivators for annual or permanent crops; commercial logging operations that deplete forest stocks; using wood fuels for local populations. Also, deforestation leads to changed habitat, the release of carbon to the atmosphere, soil degradation, and flooding.

Deforestation facilitated development was also the experience in middle-ages Europe and Japan, pre-European Easter Island, and in post-European North America (Diamond, 2005). Presently, high rates of deforestation are found in lower income countries in the tropical belt (Chomitz et al., 2007).

In addition to agricultural benefits, deforestation has external costs. These costs are global: tropical deforestation accounts for approximately 12 per cent of total global emissions (Van der Werf et al., 2009).

The environmental Kuznets curve describes the environmental impact of economic growth in differently sized economies. In theory, the curve suggests pollution and other environmental problems will rise as less developed economies grow. But at a certain point, a growing economy matures enough that the environmental consequences of economic growth slow and begin to reverse.

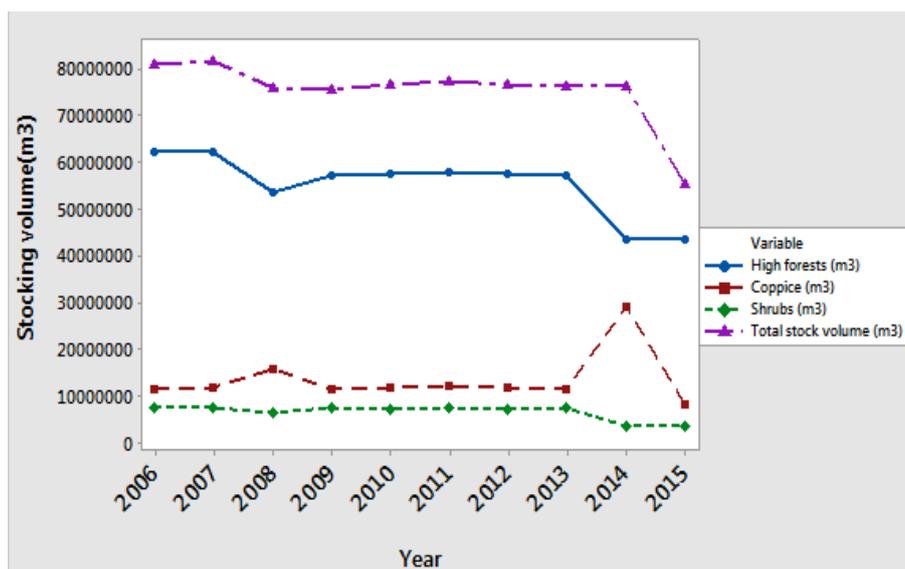
One important question which is still at stake, even more in an economic crisis context is whether environmental and economic objectives are compatible subjects. This question gets high resonance in the literature devoted to the Environmental Kuznets Curve (EKC) for deforestation which is a subject of confrontation between optimistic and pessimistic views of development (Carson 2010). This literature has gained considerable expansion in economics as well as in natural sciences (Mather et al. 1999).

From the 1990s onwards, numerous studies following the idea of (Grossman & Krueger 1995) tested an EKC for deforestation. Thus there seems to be a discrepancy between, on the one side, researchers who dismiss EKC's and, on the other side, scientists who consider that EKC's are relevant. Among the latter, the EKC is still presented as one of the hypotheses explaining the forest transition process (Barbier et al. 2010; Rudel et al. 2005; Mather 1992).

From the 1990s onwards, numerous studies following the idea of (Grossman & Krueger 1995) tested an EKC for deforestation. The EKC is still presented as one of the hypotheses explaining the forest transition process (Barbier et al. 2010; Rudel et al. 2005; Mather 1992). The EKC story will not fade until theoretical alternatives will be provided (Choumert, 2012).

Scientists say more needs to be done to mitigate the impact of economic development on forests. Economic activities if pursued without environmental considerations will in the long run limit the scope for growth and overall economic development, more so when the resources derivable from it are economic necessities.

According to the Statistical Office, forest area in Albania is 1.052 Millions of hectare (covering about 36% of the whole territory). Forest coverage in Albania has incurred many changes during the last 25 years. Albanian Forest Cadastre is the main information system which contains quantitative data about forest area and stocking volume. The current stocking volume according to forest cadastre is 55.2 Million cubic meter (INSTAT, 2017). Over the 1990 - 2000 periods, stocking volume has been increased with 123 thousand cubic meters. Thereafter a significant decrease accounted to 32% in stocking volume was noted during the 2006-2015 period. Figure 1 shows a similar trend in the stocking volume of high forests, shrubs and an opposite trend for coppice forests.



**Fig. 1.** Trend of stocking volume change from 2006 to 2015 (INSTAT, 2017)

What is seen in the figure is the result of the wrong way performed in the forest resources management during the transition period in Albania, which is related with a negative annual volume balance from 2007 to 2009 as well as from 2012 to 2015.

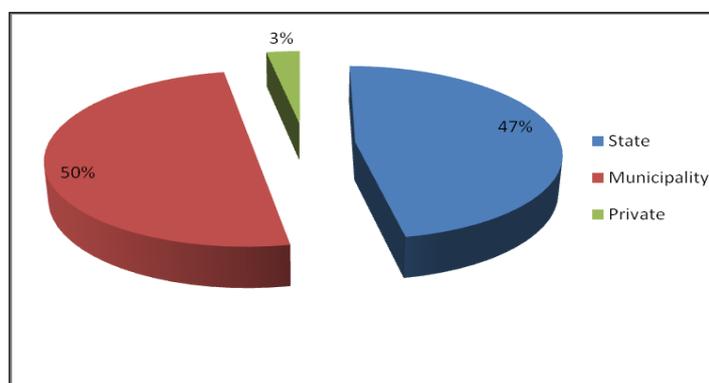
The forest sector in Albania has been constantly subject to frequent changes, which evidences the lack of a sustainable strategy and a proper analysis of this sector, but also the need for deep and long-term reform. Forests and their role in society, environment and the economy have not been given in these 25 years the proper attention. Despite the fact that it has been part of all government programs, the forestry sector has never been part of strategic priorities, as other natural resources water, or land.

The stocking volume felled during the 1990-2015 period, shows variability among years having a decreasing trend. The decrease of the harvested volume after 90' is a complex problem which is related to many reasons. Lack of the state financial funds to invest in opening of new forest roads and limited interventions in many forest parcels in remote areas have affected the forest area and volume obtained by final cutting operations. Meanwhile many private timber processing companies invested a lot of

money in manufacturing and this increased the demand for round wood. Firewood, round wood and wood for construction has been the most demanded commodities by the market. Firewood is an important wood fuel and the main source for heating especially in rural areas and in some public institutions such as schools, kindergarten etc. Firewood is an important source of heat that is used throughout Albania, especially in rural areas due to poverty and high costs of alternative energy sources, which makes the pressure towards the forest even higher. So, 85% of households in rural areas use firewood for heating, while the rest use gas, electricity, and very little coal and oil.

Forest ownership has changed drastically in Albania during the last 27 years. Until 90' all forest area were state owned but later the ownership changed as result of privatization and decentralization. According to the Forest Cadastre, 50% of the total forest area (522,607 ha) are owned by Municipalities, 47% (500,866 ha) by state and 3 % (28,780 ha) are private owned.

This fact has effected the situation of forest in Albania, and the deforestation of course. The dynamic change of the ownership in forestry sector is closely related to the process of decentralization. Table 8 shows that ownership structure changed since 2006 when the decentralization process started. The biggest change exists between two main forms of ownership which are linked closely with public forest areas. Thus, from 2006 to 2017 the state forest ownership is decreased around 27%, whereas the municipality forest area is increased with 55.6%.



**Fig. 2.** The percentage of forest ownership in Albania

Another issue to highlight is the relationship between export and import of wood. Referring to the customs data on the export and import of wood for the period 2016-2017, noted that there is a positive difference in favor of the import of wood, mainly due to the forest moratorium, but again the export is 10 times higher than imports. This is a consequence of allowing exports to concession companies as well as high import costs due to VAT and other barriers to the import of firewood from the countries of the region.

The aim of this paper is that using macroeconomic data for the period 2000-2018, we will give answer to the research question on the relationship between deforestation trends and economic growth in Albania.

The dependent variable is used deforestation as a proxy for environment degradation. Moreover, deforestation is analysed in relation with the following set of control variables; GDP growth rate, energy consumption, trade openness, and population during the period of study.

## **2. MATERIAL AND METHOD**

The data on the variables used in this study are taken from the World Development Indicators, database of World Bank; Institute of Statistics of Albania, reports and statistics; Albanian Ministry of Environment and Tourism.

The time span of the data is from 2000 to 2018. We use econometric techniques such as Autoregressive Distributed Lag (ARDL), Granger causality test, Johansen co-integration test and Vector Error Correction Method (VECM).

The dependent variable is used deforestation as a proxy for environment degradation. Moreover, deforestation is analysed in relation with the following set of control variables; GDP growth rate, energy consumption, trade openness, and population during the period of study.

Irrelevant econometric methods are also put forward. Early estimates relied on cross-section data which imply restrictive hypotheses (Dinda 2004; Koop & Tole 1999). More recent studies thus implemented panel data or more generally pooled cross sectional time series data. It may be worth to examine whether improvements made in econometric devices had an impact on the existence of an EKC for deforestation.

### 3. RESEARCH FINDINGS

The model of the study uses Granger Causality Test to analyze the direction of the causality between GDP growth and deforestation. Since carrying out regressions on non stationary time series data would lead to spurious regressions outcomes, we employ different tests. Moreover a linear regression model as represented below was evaluated.

$$DEF = f (EUSE, GDP, GDP^2, OPEN )$$

$$DEF_t = \beta_0 + \beta_1 EUSE_t + \beta_2 GDP_t + \beta_3 GDP^2_t + \beta_4 OPEN_t + \varepsilon_t$$

where: DEF is a proxy for deforestation, EUSE is the energy use per capita, GDP real and the square of GDP, OPEN is the degree of openness of the economy, expressed as follows:

$$OPEN = \frac{(X + M)}{Y}$$

Bellow are presented two regression results. The first one is used to prove if the series were or not stationary, and the second one, has used Johansen Test for Co-Integration. After these is used Granger causality test to analyze the direction of the causality between GDP growth and deforestation. Let see the results:

#### *Regression results (1):*

**Table 1.** Unit root test result: (1) Level; (2) First difference  
(1)

Variables	Constant	
	ADF test	
	Statistics	P-Value
EUSE	-1.018858	0.7384
GDP	-1.911148	0.3243
GDP squared	-3.254350	0.0234
OPEN	0.414861	0.9814

(2)

Variables	Constant	
	ADF TEST	
	Statistics	P-Value
EUSE	-3.926992	0.0041
GDP	-5.839043	0.0000
GDP squared	-3.940616	0.0039
OPEN	-3.801779	0.0057

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As we can notice from the first panel of table 2, p-values show that the series were non-stationary but in the second panel they become stationary after taking the first difference. This means that all the variables are integrated of the order of two.

**Regression results (2)**

**Table 2.** Johansen Test for Co-Integration

Hypothesized		Trace		Maximum Eigen		
No. of CE(s)	Statistic	Critical Value	Prob.**	Statistic	Critical Value	Prob.**
None *	61.57900	47.85613	0.0016	36.88080	27.58434	0.0024
At most 1	24.69820	29.79707	0.1725	15.14773	21.13162	0.2787
At most 2	9.550471	15.49471	0.3169	8.943504	14.26460	0.2909
At most 3	0.606967	3.841466	0.4359	0.606967	3.841466	0.4359

After proving that all variables are integrated the same order, a Johansen test for co-integration is conducted as shown in table 2. Results obtained in table 2 show that both the trace and eigenvalues are greater than 5 percent meaning that a long-run relationship exist and the series are co-integrated.

**Table 3.** Granger causality

Null hypothesis	Obs	F-Statistic	Prob.
EUSE does not Granger Cause DEF	18	9.16634	0.0001**
DEF does not Granger Cause EUSE		5.76134	0.0025**
GDP does not Granger Cause DEF	18	1.52817	0.2238
DEF does not Granger Cause GDP		0.28670	0.8347
OPEN does not Granger Cause DEF	18	0.31555	0.8140
DEF does not Granger Cause OPEN		0.90874	0.4464

Table 3 represents results from the Granger causality test. Empirical results show that causation between deforestation and economic growth could not be established in the Albanian context. The null hypothesis cannot be rejected in both directions. As causality cannot be established, changes in forestation cannot be predicted with changes in real GDP.

There is a positive and bidirectional causal effect of energy used per capita and deforestation. Energy use growth has caused the deforestation to increase.

**4. CONCLUSIONS AND DISCUSSION**

Deforestation is one of the major environmental problems that the world is facing. During the last 30 years in Albania is noticed a wrong way performance in the forest resources management. Sector development policies, strategies, and programs highlight the negative trend of forest development, with the urgent need to curb degradation to bring development in the right direction.

Based on the tragic figures in the last twenty years, where the national forest fund has been reduced by about 30 million m<sup>3</sup>, or by 40%, wood cutting for firewood is about 2-2.5 times more than their annual growth and also about two-thirds of the forests being cut (for firewood) are burned inefficiently, contributing essentially to their degradation, are needed strong government policies for a higher forestry control and also to offer other energy alternatives.

Empirical results show that causation between deforestation and economic growth could not be established in the Albanian context. There is a positive and bidirectional causal effect of energy used per capita and deforestation. Energy use growth has caused the deforestation increase.

Sector finance analysis highlights low funding, despite the measurable or immeasurable contribution that the forest sector provides to the economy and society as a whole. An important source of funding that has not been used up to date, not only for Albania but also for the countries of the region is funding from various international funds and institutions focusing on the environment and climate change. It is

necessary to attract donor funds and contribute to climate change, including the creation of a Balkan mechanism for maximizing funding, increasing the potential for attracting these funds (The document for forestry policies in Albania, 2019-2030).

The government should also make the people aware that the forests need to be maintained in order to contribute realistically to Albania's GDP by increasing the benefits from them, where, apart from other above-mentioned uses, need to pay attention to the importance of their exploitation for tourism and fun and also to the conservation of flora and wild fauna.

So, is good to recommend use of forest resources steadily and in function of the development of the country by optimizing its use and value, balancing the different uses to the maximum value that can take against the opportunities that the forests have to give without compromising the continuity of life and forest cycle, and also the future of generations.

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## **O 19. RAINWATER HARVESTING AS A SUSTAINABLE SOLUTION FOR DOMESTIC USE**

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**ABSTRACT:** Albania can be considered blessed for its water resources, well known for their clean and healthy water. On the other hand, water resources cannot be infinite. The main challenge of developing countries, such as Albania, is finding and managing water supplies.

Our study is focused on the city of Durrës, which is located on the Adriatic coast, and is the most visited by local and foreign tourists. Today, Durrës city suffers a difficult time of an urban chaos in center, as in suburb. Water supply has become very problematic. Considering the lack of water during summer days (in the city rains 116 days a year), it becomes important to well manage it.

This study is based on the management of rainwater through the construction of rainwater harvesting system and its implementation for domestic use.

*Keywords: Rainwater management, sustainable development, rainwater harvesting systems*

### **1. INTRODUCTION**

The biggest environmental challenge facing mankind today is the lack of water (informazioneambiente.it, 2017). As drinking water decreases on the ground, other ways must be found to save it. In the last two decades the interest for collecting rainwater has increased. Rainwater is the main source of all the drinking water on the Planet.

Rainwater is not considered anymore as waste that is transported through underground sewers without using it. Rainwater can be collected to be filtered and then used for house cleaning, laundry, toiletries, irrigation.

### **2. OVERVIEW OF THE STUDY**

During 28 years of democracy in Albania, even the city of Durrës has been subject of massive social economic changes. Because of its characteristics, offering economic and social opportunities, after 1990, it has become one of the most attractive cities for massive population migration from rural areas. This has led to an urbanization process with the doubling of the population and as a result the design of low performance buildings in terms of hydropower consumption and environmental impact. The time when rainwater was treated as “waste” transported through underground sewers, without using it, is gone (Tataveshi et al., 2018). In Durrës City, as a touristic city in the summer season, with continuously growing number of tourists, the water supply of the area has become quite problematic, reducing it to a timetable set by the municipality. For this reason, it is important to take potential measures for saving water to prevent this problem. During the autumn the number of rainy days increases (shije.al, 2016). Albania has a Mediterranean climate, where in the lowlands it is almost never cold. However, during the winter season, the rains are common and, in some cases, quite dense. Nowadays it is important to preserve drinking water as it is one of the main problems of the future.

#### **2.1. Rainfall data**

According to the data of the Meteorological Institute of Albania (IGjEUM, 2018), the amount of annual rainfall in the city of Durrës is an average of 931.1 mm rain per year, for 116.1 days of the year (Monthly Climate Bulletin, 2018).

The highest rainfall months are November (132.9 mm), December (113.0 mm) and January (110.6 mm), while the lowest precipitation months are June (38.7 mm), July (23.9 mm) and August (34.8 mm). The

average amount of rainfall in one month is 77.6 mm. The seasonal rainfall distribution is presented in Table 1 (Braholli, 2016).

**Table 1.** Average monthly rainfall in the city of Durres (Braholli, 2016)

Months (rainfall in mm)												Total
I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	
110.6	91.4	95.2	76.2	50.8	38.7	23.9	34.8	62.5	101.1	132.9	113.0	931.1

Referring to the average amount of rainfall in Albania, between 800 - 1100 mm/year, it is clear that the city of Durres is included in the districts with relatively low average amount of rainfall (Muka, 2015).

## 2.2. Domestic water consumption

The idea presented in this study consists in the rainwater management. One of the main problems encountered is the use of drinking water without criteria, often when it is not indispensable. A loss of significant amount of drinking water and an economic cost follow. At a present, in Albania, as well in Durres, the public water distribution system is the main system that supplies with drinking water.



**Figure 1.** Examples where drinking water can be safely replaced by rainwater (Kessel Catalogue, 2019)

According to the rate applied in Albania from 2010 - 2017, the average annual water capacity was estimated to be 240 million m<sup>3</sup> per year, corresponding to a rate of 150 liters per day per person (MPWT, 2011 - 2017).

A brief list of consumption due to daily operations is shown in Table 2. It shows clearly that a considerable part of drinking water consumption can be saved by using rainwater, especially for secondary water needs (cleaning, irrigation, laundry, etc.). Following, the water consumption bills can be reduced.

**Table 2.** Table of daily household water consumption (Montalbano et al., 2009)

Average daily water consumption	liters
Dishwashing	10
Cooking, drinking water	20
Self-care (shower or bath)	45
Cleaning	3

Irrigation	12
Laundry	45
Rinsing of sanitary hygiene equipment	15
<b>Total liters of water per day</b>	<b>150</b>

### 2.3. Financial analysis

Water bills are continuously growing. In Table 3 are given the values in m<sup>3</sup> for the drinking water and the polluted water including the 20% of VAT (Decision No. 31, 2017). The data show a continuous increase of water bills over the years.

**Table 3.** Annual price values (Regulatory Entity Annual Report, 2018)

Average price in years			
Years	Value in ALL/m <sup>3</sup> for drinking water	Value in ALL/m <sup>3</sup> for contaminated water	Total value in ALL/m <sup>3</sup>
<b>2008</b>	31	8	39
<b>2009</b>	38	8	46
<b>2010</b>	45	12	57
<b>2011</b>	36	11	47
<b>2012</b>	42	14	56
<b>2013</b>	58	35	93
<b>2016</b>	61	37	98
<b>2017</b>	70	50	120

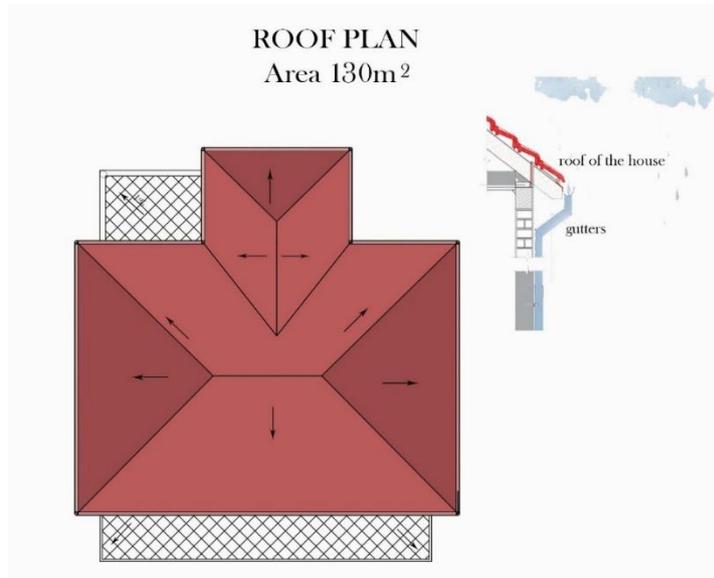
This problem can be solved by harvesting the rainwater and using it instead of wasting it. It can be easily used to cover daily consumption and it can also be used on non-rainy days. But the question is: *Can the harvested rainwater cover all the needs?* The easiest and quickest way to harvest rainwater is to place buckets and containers of different sizes around the garden or on the balcony and the terraces. It's clear that this will lead to a small amount of water, but if we want a more organized home system, a plant that transports water from the gutters can be designed. For this a Rainwater Harvesting System (RWH) is needed (Centre for Science and Environment, 2019). This system stores rainwater that can be used when and where necessary. RWH can be installed in any space that has a “catching area” like the roof or another space to collect the rain.

### 3. CASE STUDY

In this study, we have considered a construction facility near the city of Durres. In the existing situation, it is a one-story building (Figure 2), built years ago with residential function. After reconstruction, it would be a two-story building as shown in figure 4.a, b. During the period under construction, residents were supplied with drinking water from the public network. With the new intervention, in addition to the increase in the volume of the building, a single plant for the management of rainwater has been proposed. The surface area of the rainfall is 130 m<sup>2</sup> (the roof plan is given in Figure 3), with an average annual rainfall in the city of Durres of 931.1 mm per year, for 116 days of the year (Braholli, 2016).



**Figure 2.** Existing view of the building



**Figure 3.** The roof plan

The family consists of 4 people and the house has a greenery surface of 70 m<sup>2</sup>, with 20 m<sup>2</sup> of garden and 50 m<sup>2</sup> of vegetation. An important role in determining the amount of harvested rainwater plays the shape and the footprint of the roof, the orientation and the pendency. The maximum annual amount of the harvested rainwater is calculated by the following expression (Fanizzi and Misceo, 2008) and:

$$\begin{aligned} V &= \varphi \times S \times P \times \eta \\ &= 0.9 \times 130 \times 931.1 \times 0.95 \\ &= 103\,492 \text{ liters/year} \end{aligned} \quad (1)$$

where:

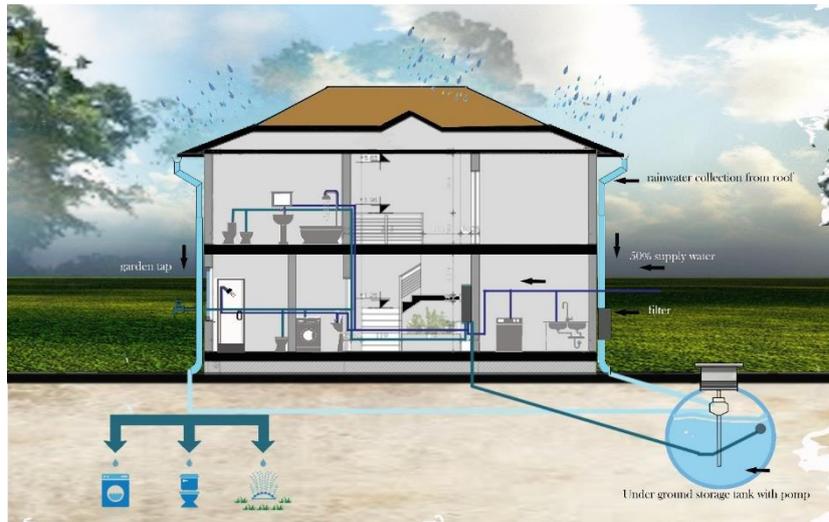
- V: the maximum volume of the accumulated rainwater (liters/year),
- $\varphi$ : the runoff coefficient is a dimensionless coefficient relating the amount of runoff to the amount of precipitation received. DIN 1989-1: 2002-04 sets the coefficients for each type of coverage. In Table 4 are shown the runoff coefficients for two types of exposed areas (Fanizzi and Misceo, 2008),
- S: the total rainwater capture surface (m<sup>2</sup>),
- P: the average annual rainfall data. For the year 2018, in the city of Durres, the data are given in Table 1,
- $\eta$ : the filter efficiency (Torlai, 2012) is a dimensionless number giving the ratio between the amount of water entering the filter and the amount of water exiting it. The performance values depend on filter characteristics and for two types of filters are listed in Table 5 (Fanizzi and Misceo, 2008).

**Table 4.** Runoff coefficient based on the type of the capture areas (Fanizzi and Misceo, 2008)

Type of the exposed areas	Runoff coefficient ( $\phi$ )
Corrugated plastic roof	0.90
Tiled roof	0.90

**Table 5.** Type of rainwater filters and their indicative average efficiency values (Fanizzi and Misceo, 2008)

Type of rain water filter	Average efficiency $\eta$ [-]
Centrifugal filter	0.7 ÷ 0.9
Auto clear filter	0.8 ÷ 0.9



**Figure 4.a, b** The proposed Rainwater Harvesting System

Following the data given above for the number of people that live in the building, the equipment types, and their annual consumption, the annual rainwater needs can be calculated as given in Table 6 and 7.

**Table 6.** Calculation of rainwater annual consumption for secondary needs

Use	Water needs (liters/person per day)	No. of persons	Annual period	Water needs (liters/family per year)
Toilet	15	4	365	21 900
Washing	45		365	16 425
Cleaning	3	4	365	4 380
<b>Amount of annual needs (liters/year)</b>				42 705

**Table 7.** Amount of annual rainwater needs for irrigation

For irrigation	Annual needs (liters/m <sup>2</sup> )	Surface (m <sup>2</sup> )	Water needs (liters / per year)
Park	60	20	1 200
Green surface	200	50	10 000
<b>Amount of annual needs (liters/year)</b>			11 200

Annual rainwater harvested is 103 941 liters/year (following expression 1). Based in Table 6 and 7, the total annual rainwater needs are 53 905 liters/year. So, this family can get more rainwater than it's needed (103 491 l/year > 53 905 l/year) (Graf water, 2019).

If the harvested rainwater is well managed it will cover all the needs of the family, without need to use in addition the public water distribution system. In this case of study, the building has a considerable surface of the yard that gives us the possibility to collect this amount of water in tanks. Underground types of tanks can be considered. The tanks selection must meet certain technical characteristics: ability to face weather, thermal changes, corrosion and oxidation. The system is independent of the public water distribution system. The basic elements are:

- gutters that serve to transport it to the water tanks,
- 2 filters, one in the inlet and one in the outlet (main function of the filters is the collection of the impurities and the prevention of their entry into the tanks),
- water tanks,
- collection pump.

Since the building is being completely reconstructed, the cost of installing an RWH is insignificant, because it does not need additional pipes, once they are integrated into the construction project.

#### 4. CONCLUSIONS

Rainwater Harvesting System (RWH) is a sustainable system to obtain water in addition to the public distribution system.

In our case of study, the harvested rainwater fully covers the needs of the family.

The cost of installing an RWH is insignificant, being it integrated into the reconstruction project.

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## **O 20. THE SYNTHESIS OF Ag/TiO<sub>2</sub> BY PHOTOCHEMICAL DEPOSITION METHOD AND ITS PHOTOCATALYTIC ACTIVITY**

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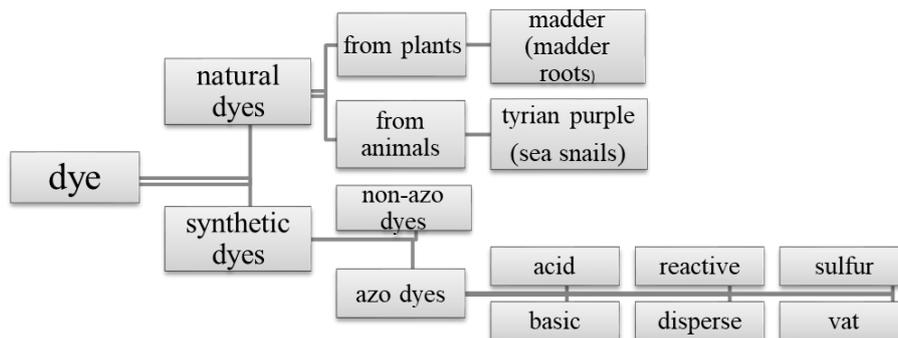
**ABSTRACT:** Photocatalysis defined as is one of the different types of AOPs, ecologically friendly processes have a major advantage over certain current techniques; it terminates contaminations instead of exchanging them to another phase without the utilization of potentially harmful oxidants. So as to increase their activity, photocatalysts have been doped with many metals, non-metals, and noble metals. Through a different metal was used for this aim, silver (Ag) suggested to be the most attractive in relations of photocatalytic production. Textile wastewater is classified as a complex treatment waste due to high organic pollution and metals, high toxicity and low biodegradation. In addition, dyes are discussed in the literature because of the large quantities of dyes and water used in the dyeing stages during the textile sector.

In this study, we used the photochemical deposition method to synthesize Ag/TiO<sub>2</sub> catalyst. The physical and chemical properties of the Ag/TiO<sub>2</sub> catalyst characterized by X-ray diffraction (XRD), scanning electron microscopy (SEM) and EDX. The Ag/TiO<sub>2</sub> catalyst was used to remove the most commonly used reactive red 195 dye in the textile industry. The removal was investigated using photocatalytic oxidation method with different light types such as UV-A and visible light.

*Keywords: Photocatalysis, Ag/TiO<sub>2</sub> catalyst, dye removal*

### **1. INTRODUCTION**

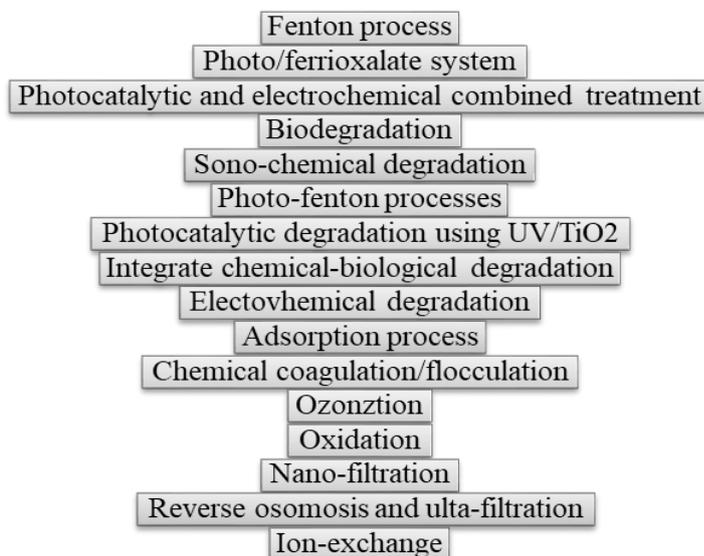
Textile is one of the most substantial industry for many countries, for example, China, Singapore, UK, Italy, Turkey, etc. (Yonar, 2011). At the same time, the disposal which produced from these industries considered as a significant source of environmental pollution particularly pollution of water (Abul et al., 2015). In Turkey, the textile is a standout amongst the most energetic, greatest industry and consume a quantity of water, because of many strategies and technologies applied in this sector (Cebeci and Torun, 2017). During the various stages of the textile industry, dye plant is the most toxic phase. The textile industry alone records for two-thirds of the whole dye stuff generation (Sartape et al., 2017). Moreover, the fundamental reason for color in the textile industry effluent is the consumption lot of dyestuffs during the coloring steps of the textile- manufacturing (Yonar, 2011). The author has discussed dyes more, due to their high dissolvability in water and as effluents containing environmentally dangerous materials. Also, the existence of a slight quantity of colors (under 1 ppm) is obviously visible as well as impact the aqueous environment significantly (Zangeneh et al., 2015). Moreover, source of dye can be comprised by the drainages of chemicals operation industry, for example, textiles, plastic, ceramic, ink and beauty product (Zangeneh et al., 2015). Dyes may have a severe and inveterate impacts on the exposed living thing depending on exposure time in addition to the concentration of dye as well as cause allergic dermatitis, skin agitation, mutation and several another illness (Bharathi and Ramesh, 2013). Fig.1 shows the general dye classification.



**Fig.1** Flow chart representing dye classifications built on dye chemical constituents (A. Houas et al., 2001; F. Gosetti et al., 2004).

The textile industries widely use synthetic colors in the coloring and printing process (Kehinde and Aziz, 2014). The synthetic colors represent the main part of our lives because it's broadly used by different industries (Kehinde and Aziz, 2014). Many of the synthetic dyes, particularly azo dye, were found to be harmful, carcinogenic and mutagenic and are accordingly restricted all through the world (Kehinde and Aziz, 2014). Azo dyes have been categorized as (Mishra G and Tripathy M, 1993): anionic, cationic as well as non-ionic dyes. Numerous treatment process has been considered for the removal of dye, running from conventional techniques to the most developed advanced oxidation process (Yasar and Yousaf, 2012). Fig.2 shows the various method for removal dyes. Conventional strategies generally require high cost, and constrained by the creation of an extensive amount of sludge and only transform liquid organic compositions to solid, which request additional treatment or deposition (Yasar and Yousaf, 2012). Hence, reported as, to have low efficiency in removing the color from effluents.

Hence the degeneration of dye from industrially textile effluent is given more consideration to improving treatment efficiency techniques. Chemical techniques, particularly advanced oxidation process (AOPs) like photocatalytic oxidation, processes appear to be more favorable for the degeneration of azo dye (Gözmen et al., 2009) due to the capability of the techniques to totally degrade a target contaminants (Nasirian et al., 2017).



**Fig.2** Various method for removal dyes from wastewater effluents

Photocatalysis is one of the different types of AOPs, ecologically friendly processes have major advantage over certain current techniques; it terminates contaminations instead of exchanging them to another phase without the utilization potentially harmful oxidants, that involves the activities of semiconducting metal oxides, for example SrTiO<sub>3</sub>, WO<sub>3</sub>, ZnWO<sub>4</sub>, BiTiO<sub>3</sub>, ZnO, CuS/ZnS, Bi<sub>20</sub>Ti<sub>20</sub>, ZnS, Ag<sub>2</sub>CO<sub>3</sub>, Bi<sub>2</sub>WO<sub>6</sub>, Nb<sub>2</sub>O<sub>5</sub>, Fe<sub>2</sub>O<sub>3</sub>, TiO<sub>2</sub>, and so on (Zangeneh et al., 2015). The semiconductors

photocatalyst structures include valence band and conduction band which are separated thru the band gap energy (Khaki et al., 2017).

Among different AOPs, the heterogeneous photocatalytic procedures can effectively reduce a wide range of contaminant at surrounding temperature and pressure without producing hazardous intermediates. The processes are started with the excitation and transfer of an electron from the valence bands, which is full of electrons to the empty conduction bands.

Among the photocatalysts experiment, titanium dioxide (TiO<sub>2</sub>) has been observed to be the maximum effective due to the photostability, obtainability, rather biologically inert, little operation temperatures, little energy consumption, wide photo-catalytic effectiveness, appropriate flat band potential, wide chemical steadiness, water insolubility in maximum ecological state then prevention the creation of unwanted by-products (Zangeneh et al., 2015). In spite of the whole advantages of TiO<sub>2</sub>, two main limits in the photocatalytic activity which are as follow:

- 1) It's activation just in the UV amount under 387 nm (3.2 eV)
- 2) A significant amount of electron-gap recombination.

To overcome limitations of TiO<sub>2</sub> as a photocatalyst, different technique can be used to enhance its photocatalytic activity. These enhancing strategies include hydrogenation, modifications by conductive materials, organic dyes surface sensitization or metal complexes, metal deposition of surface noble, surface fluorination, metal or nonmetal ion doping, coupling with a narrow-band-gap semiconductor, combining of various semiconductor photocatalysts, photosynthesizing composites, and the adding of certain oxidant species; every technique has its own strength and weakness (Nasirian et al., 2017). Moreover, some study aimed on the generation of high-activity photocatalysts which able to absorb UV light and the visible light. So as to increase their activity, photocatalysts have been doped with many metals, non-metals, and noble metals. Through a different metal was used for this aim, silver (Ag) suggested to be the utmost attractive in relations of photocatalytic production, cost-effectual, facilities of preparing, the lifetimes of the electron-hole pair, and anti-microbes activities (Chung et al., 2018). Consequently, in this study, an Ag-supported TiO<sub>2</sub> nanoparticle catalyst was synthesized from Ag, TiO<sub>2</sub>, (denoted as Ag/TiO<sub>2</sub>), for removal of reactive red 195 from aqueous solution. Physicochemical properties and features were thoroughly examined using various analytical techniques such as X-ray diffraction (XRD), Scanning Electron Microscopy (SEM) and EDX.

## **2. MATERIAL AND METHOD**

### **2.1. Materials that are used**

Nano-sized TiO<sub>2</sub> titanium (IV) oxide (Degussa P25, 50 m<sup>2</sup>/g, 75% anatase and 25% rutile), silver nitrate (AgNO<sub>3</sub>) and ammonium hydroxide (NH<sub>4</sub>OH, 30% v/v aqueous solution) were purchased from Sigma Aldrich.

### **2.2. Photochemical deposition of Ag**

In an exemplary synthesis of Ag-doped TiO<sub>2</sub>, (TiO<sub>2</sub>, P25) particles were dispersed in 50 mL AgNO<sub>3</sub> solution. Then the mixture left to vigorously stirring. NH<sub>4</sub>OH added to set the pH of the solution approximately to around 10-11 then stirred for 10 min. The produced mixture was irradiated by using a black light blue UV lamp (GE, 15 W) with stirring for 4-5 h in the dark at room temperature. Ag loaded TiO<sub>2</sub> was rinsed with distilled water frequently was then dried at 80°C approximately 12 h. Lastly dark purplish Ag-doped TiO<sub>2</sub> composite powders were produced as reported by Ko et al. (2011).

### **2.3. Characterization of the photocatalysts**

For this study, X-ray diffraction analysis was performed with (Bruker D8 Advance X-Ray Diffractometer) which is located in Selçuk University Advanced Technology Research and Application Center which used for the structures examination of the prepared catalysts. Diffraction peaks were recorded in the 2θ range between 10-90 and were used to determine the structures of the samples. The surface morphology of the prepared catalysts was investigated using scanning electron microscope (SEM).

### 3. RESULT AND DISCUSSION

#### 3.1. Phase identification by X-Ray diffraction analysis and EDX analysis

The phase confirmations regarding the doped catalysts are carried out using XRD instrument. Figure 3 shows XRD diffraction patterns of prepared Ag/TiO<sub>2</sub>, a shift towards right indicates that doping is taken place in the TiO<sub>2</sub> molecules (Sowmya et al., 2018). The silver deposition on TiO<sub>2</sub> lattice is further confirmed by the peak at  $2\theta = 37.35^\circ$  and  $63.07^\circ$  crystal phases of Ag (Zhang et al., 2016; Tang et al., 2018). From the Figure 3, the  $2\theta$  diffraction angles at the range of  $10^\circ$  and  $80^\circ$  shows four dominant peaks at  $25.66^\circ$ ,  $38.14^\circ$ ,  $48.38^\circ$  and  $62.38^\circ$  which are associated with distinct diffraction planes attributed to anatase phase of P25 TiO<sub>2</sub> (Zhan et al., 2014; Sowmya et al., 2018). Peaks at  $27.79^\circ$ ,  $36.44^\circ$ ,  $41.5^\circ$ ,  $54.27^\circ$  and  $69.18^\circ$  with distinct diffraction planes attributed to rutile phase of TiO<sub>2</sub> (Sowmya et al., 2018; Tang et al., 2018).

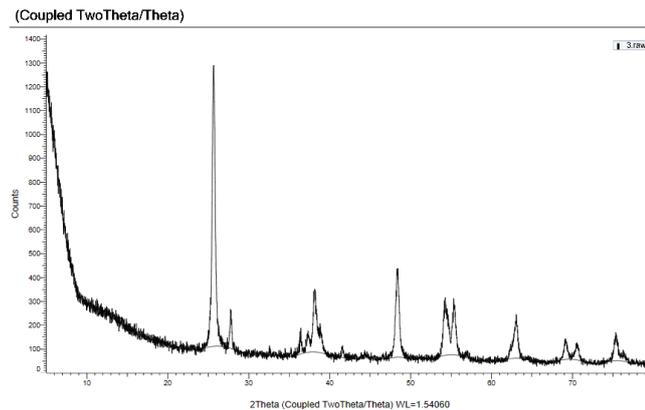


Fig.3 XRD patterns of Ag/TiO<sub>2</sub> catalysts

In the Fig.4 EDX analysis of prepared Ag/TiO<sub>2</sub> by a photochemical deposition method, shows the proportion each of Ag, Ti, and O<sub>2</sub> as 3.00%, 54.94% and 42.06% this indicated to the presence of Ag nanoparticle in the sample.

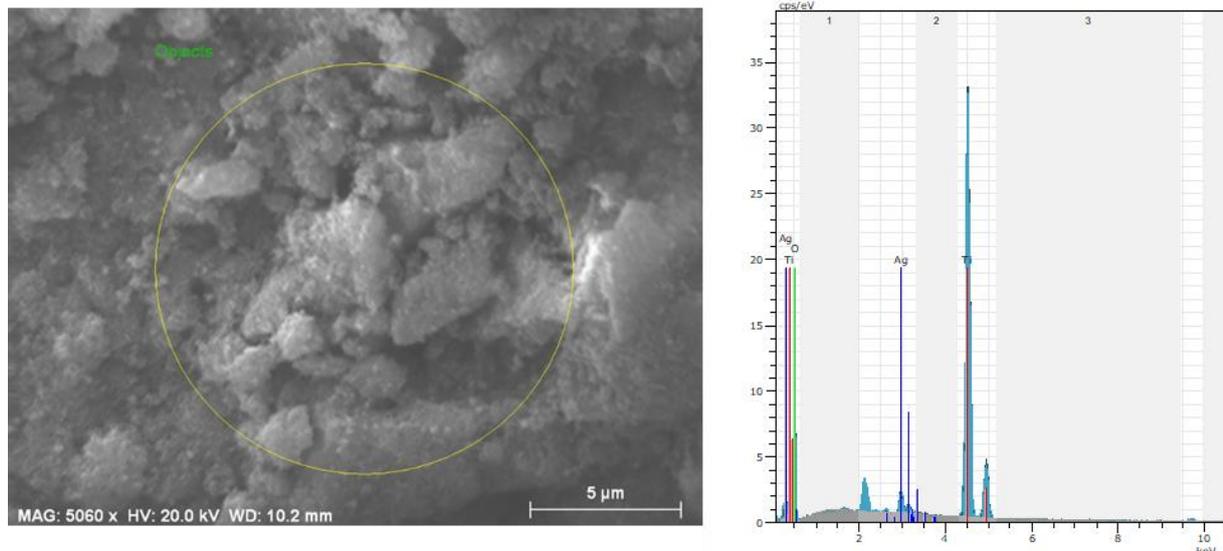
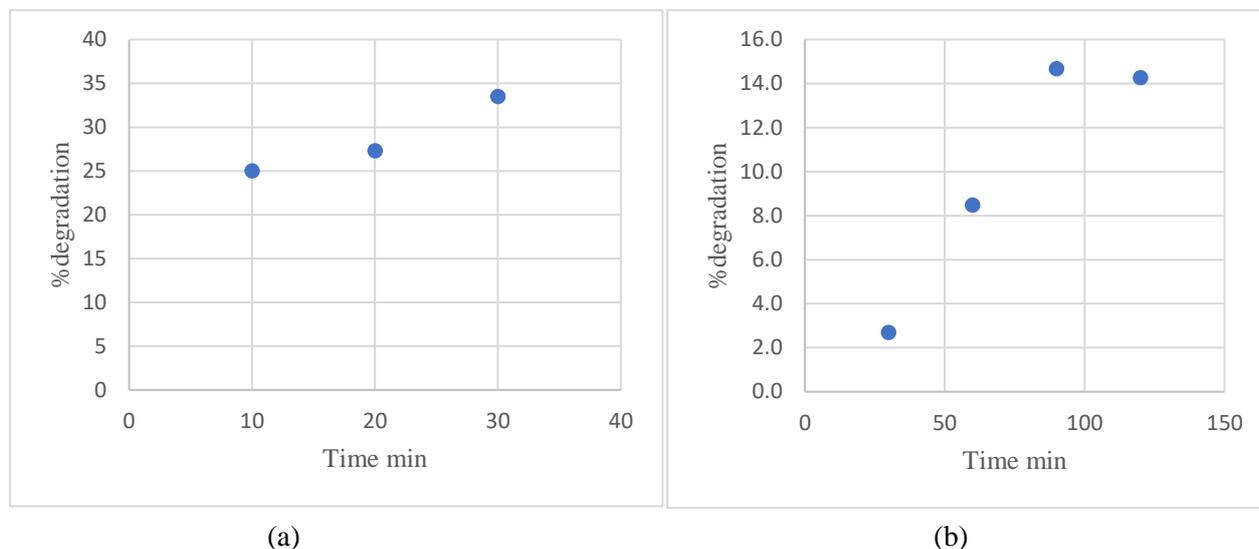


Fig.4 EDX analysis of Ag/TiO<sub>2</sub> catalysts

#### 3.2 Time effect on photodegradation

The photodegradation of reactive red 195 has been studied at different irradiation time by using both visible light and UV-A light with Ag/TiO<sub>2</sub> as catalyst. The photocatalytic degradation of RR195 was

increased with increase of irradiation time. In case of visible light, the photodegradation was found 14.3% at 120 min irradiation but in case of UV-A 33% at 30 min photodegradation was observed.



**Fig.5.** The photodegradation of RR195 using Ag/TiO<sub>2</sub> under a) UV-A, b) visible light sources at 25°C, pH 6 and intensity for both light 27 W.

The effect of irradiation time on photodegradation of reactive red 195 is showing in Figure 5. Moreover, in case of UV-A the dye was degraded at short time compared with visible light because of the dye was reactive under UV light; so to made it reactive under visible light was doped by Ag. Consequently the photodegradation efficiency of photocatalyst was increased with increasing irradiation time (Azad and Gajanan, 2017).

#### 4. CONCLUSION

Ag doped TiO<sub>2</sub> composite photocatalyst has been prepared by a UV photochemical reduction process and was investigated for enhanced photoactivity under UV and visible solar radiation. The prepared catalyst used for degradation of reactive red (RR195) dye at various time duration and room temperature. 33% of RR195 was degraded under UV-A only at 30 min while 14.3% of dye degraded when irradiated with visible light. Thus, because of dye reactive in UV region, so, Ag was doped on TiO<sub>2</sub> to increase its activity in both UV and visible light. The effect of catalyst dose, light intensity, pH and RR195 concentration to photodegradation must be investigated for increasing degradation rate.

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**O 21. DYNAMIC PERFORMANCE OF A HYDRAULIC SYSTEM DRIVEN BY A VARIABLE SPEED AC ELECTRIC MOTOR WITH ELECTRO-HYDRAULIC LOAD SENSING**

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**ABSTRACT:** Hydraulic systems, transforming the mechanic energy into hydraulic energy to transfer it to a different mechanic system, are one of the most important R&D fields regarding energy saving. Many studies are carried out regarding energy saving in hydraulic systems, thus relatively more efficient system designs are improved step by step. In this study, a hydraulic test rig is used to simulate a 500 kN press brake metal forming machine driven by a variable speed with the aim of energy saving. In the drive system of the press brake machine, variable speed-controlled AC electric motor is used to drive a constant displacement a gear pump. By means of an electro-hydraulic load sensing method, the load pressure and flow rate under the specific operation condition are measured and send to this information to the control system for varying speed of the electric motor. Thus, the gear pump can provide the system requirements not more. This method can reduce to energy consumption. However, the dynamic performance of this drive system must be analyzed and compared to that of a proportional valve controlled conventional constant speed drive system to recognize the dynamic capability of the proposed variable speed drive method in the press brake machine. For this aim, the cycle phases of the press brake machine are simulated in experimental test rig to compare the dynamic performances of both drive options under different part load conditions. According to obtained results, prospective suggestions are presented.

*Keywords: Hydraulic systems, press brake machine, energy saving, variable speed drive, dynamic performance*

## **1. INTRODUCTION**

Hydraulic systems are mainly used in many mobile machine and industrial applications. Because these systems have got a huge power density accordingly to their structure and it is easy to distribute such huge powers via a hydraulic system. The hydraulic pump which converts the mechanical energy to the hydraulic energy is generally driven by an electric motor in industrial applications (i.e. presses, casting machines etc.). After the flow is generated by a hydraulic pump the flow, the pressure and the direction of this flow are controlled by hydraulic valves. Finally, the hydraulic energy reconverted to the mechanical energy by hydraulic actuators as hydraulic motors or hydraulic cylinders. It is possible to occur many energy losses during this transmissions. There are a lot of different points that these loses are seen in a hydraulic system. They are generally caused by volumetric and mechanic loses on pumps and hydraulic actuators, the flow leakages in the pipelines and valves, the pressured drops especially in connection fittings and valves etc. The system efficiency is described the difference between input power and output power. Generally, overall efficiency of a hydraulic system is about % 40 (Stelson, 2011). On the other hand, these loses cause not only the low efficiency but also over heating problems. To increase the energy efficiency and prevent the overheating problems, the people who design the hydraulic systems in the field have been working on by designing smarter circuits, making proper pipe installation, using more efficient circuit elements etc. Besides, component and system producer companies spend considerable effort to improve their components and increase the performance and efficiency. Moreover, they make researches for more efficient and smarter system concepts and solutions by integrating different disciplines such as engineering with hydraulic engineering. Historically, for energy efficiency purpose, by-pass valves, hydraulic accumulators, multi pump systems and variable displacement hydraulic pumps are used. Today, the variable speed drive systems as the most recent concept have been started to be used.

There are a lot of different concepts to control the speed in a hydraulic system for the energy efficiency. There are mainly two options. The first one producing all capacity of the system then controlling the

speed of hydraulic system by the help of hydraulic valves. The second one is producing how much it is required. The second option is always friendly for energy saving but it is not same for the dynamic performance aspect (Çalışkan, 2018; Demirkesen, 2017; Lovrec, 2008). There are basically two different way to implement the second concept. First one is variable displacement pumps. These pumps work with hydraulic load sensing principle. There is always a hydraulic signal from the load line and there is always an internal hydraulic signal for pump and the pump always compares these signals and produce the flow accordingly the pressure differences between them. The second one is variable speed electric motors. These motors work with electro-hydraulic load sensing principle. There is always an electric signal from a pressure transmitter in the load line and there is always another electric signal from another pressure transmitter in main pressure line for motor driver and the motor driver always compares these signals and makes the motor rotate accordingly the pressure differences between them.

As it is known there are two different electric motor for such these applications. The first one is servo motors. They provide energy efficiency and the required dynamic performance. But their costs for investments, services and spares are too expensive to be implemented often. The second one is AC electric motors. They provide also energy efficiency but the required dynamic performance. Generally, it is experienced that the dynamic performance of the variable speed AC electric motors with electro-hydraulic load sensing do not correspond the required dynamic performance without some applications. In this study, a hydraulic test rig is used to simulate a 500 kN press brake metal forming machine driven by a variable speed with the aim of energy saving. In the drive system of the press brake machine, variable speed-controlled AC electric motor is used to drive a constant displacement a gear pump. By means of an electro-hydraulic load sensing method, the load pressure and flow rate under the specific operation condition are measured and send to this information to the control system for varying speed of the electric motor. A real working scenario of 500 kN press brake machine was handled in order to prove that the variable speed AC electric motor not only saves the energy buy also corresponds the required dynamic performance for this application. A test rig was built to make experimental study to search the energy consumption and the dynamic performance of a hydraulic system which is driven with fixed and variable speed. Then the results will be evaluated.

## 2. MATERIAL AND METHOD

### 2.1. Characteristics of the Press Brake Machine

The press brake machines basically include a moveable table connected mechanically to two hydraulic cylinders which work simultaneously. This structure is a big part of stable main body which includes electronic and hydraulic systems. A press brake machine is used to press and shape the steel sheets for the others manufacturing process.

In this study, a press brake machine whose capacity is 500 kN is considered to investigate. The main reason behind this selection is there are approximately 5000 quantities press brake machines manufactured annually in Turkey (Machine Magazine, 2018). The characteristic of the considered press brake machine are given in Table 1.

**Table 1** The technical characteristic of the considered press brake machine

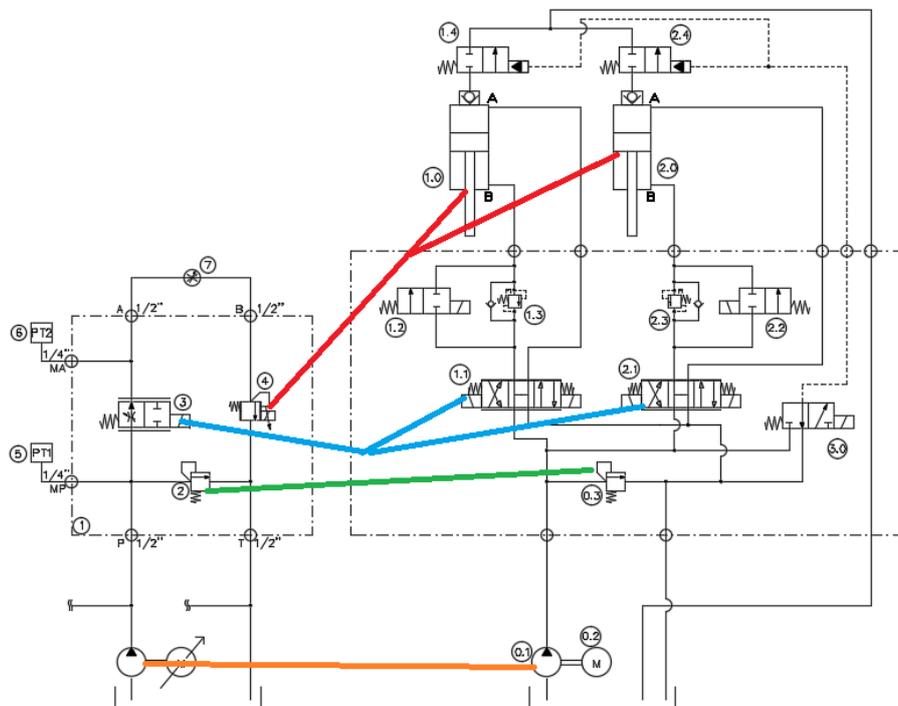
Technical Features	Symbol	Value	Unit
The Diameter of Piston Rode	$\varnothing D$	125,00	mm
The Diameter of Piston Bin	$\varnothing d$	120,00	mm
Cylinder Quantities	SS	2,00	Adet
Working Pressure	P	200,00	Bar
The Force of Pressing	FA	500,00	kN
The Flowrate	QP	34,00	l/dk.
Stroke	S	220,00	mm
The Velocity of Pressing	Va	21,00	mm/s
The Load Weight	M	1000,00	Kg

In this study, the operation scenario for the minimum thickness steel sheet that the press brake machine is able to press is handled. This operation scenario is given in Table 2. Basically, there are 6 different process in a pressing operation scenario. The first one is the waiting process which is needed to take out the pressed steel sheet and put the new one. The second one is free fall process which the moveable table falls till the level that the pressing process will begin. The third one is pressing process which the steel sheet is pressed. The fourth one is the ironing process which is needed to keep the pressed steel sheet in the same position for a while to give it a better shape. The fifth one is the decompression process which is an important step to decrease the high pressure just a little bit. The sixth one is the back process which the moveable table gets back to the beginning position. All of these processes take 30.8 minutes when a steel sheet is pressed.

**Table 2** The operation scenario of the press brake machine

No	Process	Time (minute)	Speed (centimeter/minute)	Flow (liter/minute)	Flow Assumption (liter/minute)	Pressure (bar)
1	Waiting	t1 15	0	0	0	0
2	Free Fall	t2 0,8	15	220,78	34	70
3	Pressing	t3 9,2	1,03	15,2	15,2	100
4	Ironing	t4 2	0,25	3,68	3,68	90
5	Decompression	t5 2	0	0	0	70
6	Back	t6 1,8	2	33,85	33,85	85

In a press brake machine, there are basically three different main systems that are i) mechanic, ii) hydraulic and iii) electronic systems. The hydraulic system is one of the most important system for a press brake machine. Because this system provides all required power for pressing and the remaining movements. The electronic system is the other important system which controls the hydraulic system. There are a number of researches that are stued on to improve the efficiency of the hydraulic systems (Bostan, 2011; Obut, 2009). The hydraulic system of the press brake machine which is considered in this study is given within Figure 1.



**Figure 1** The hydraulic system of the considered press-brake machine (right side) and the hydraulic test rig (left side)

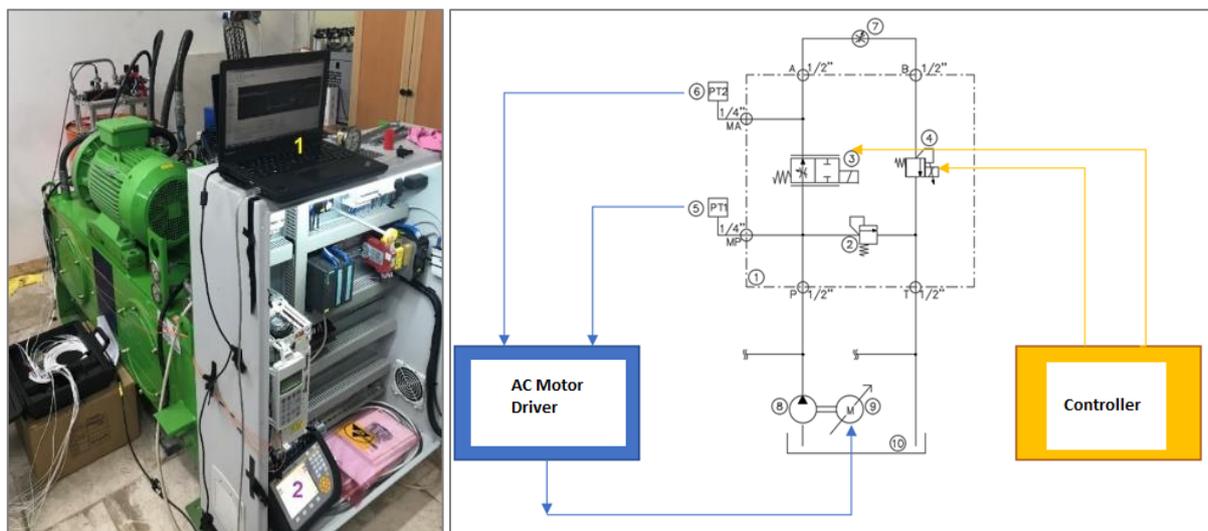
In the hydraulic system of the press-brake machine, there is a fixed displacement gear pump (0.1) driven by an AC electric motor (0.2) which is fixed speed. There are two proportional directional control valves (1.1; 2.1) to control the movements of the cylinders. There are two hydraulic cylinders (1.0, 2.0) to provide required power to moveable table for the processes. The maximum required power is calculated according to the pressing process because this process needs the maximum power for pressing and shaping. This process is only %18 of the total process. It means that the system always produces %100 capacity for only single %18 part. This is the critic point the energy loses are caused.

## **2.2. Hydraulic Test Rig**

To implement a comparative experimental study, a hydraulic test rig has been used. The hydraulic test rig can represent the considered press-brake machine in the perspective of hydraulic system. Therefore, the hydraulic cycle of the press-brake machine was simulated by the hydraulic test rig which is composed of a number of components numbered as 1) hydraulic manifold, 2) pressure relief valve, 3) proportional flow control valve, 4) proportional pressure relief valve, 5-6) pressure sensors, 7) flowmeter sensor, 8) gear pump, 9) AC electric motor and 10) hydraulic reservoir as shown as Figure 1. In order to simulate the considered press brake load, proportional pressure control valve was used. For maintaining and setting the drive speed of the electric motor, a control system was used. In the control system of the test rig, motor frequency driver, an external controller and a computer were utilized.

## **2.3. Test Method and Set-up**

To search if the variable speed control concept with AC electric motor provides not only energy efficiency but also the required dynamic performance, two different experiments were carried out. The first one was fixed speed method. To implement this, the scenario was loaded into the external controller. And the motor frequency driver was set to turn at 1500 RPM. After that, the second one was variable speed method. To implement this, the same external controller was used without any differences. Because the scenario is the same for both options. But in that time, the motor frequency driver was set to turn accordingly the pressure differences. To provide this, a PID logic was loaded into the motor frequency driver. To get the results a computer was used. That computer has got a system to get the results from sensors. The complete experiment structure and its diagram are seen in the Figure 2.



**Figure 2** Hydraulic test rig, data acquisition and controller mechanism

The scenario of the press brake machine which was handled is for the steel sheet with minimum thickness which the press brake machine presses ever. There are six different processes for a single material which will be pressed. In that scenario, there is only one assumption made for the decompression process. In reality while the decompression process, the pump is not used, because the aim of this process to make the system relax. In the ironing process, there is a high pressure in the

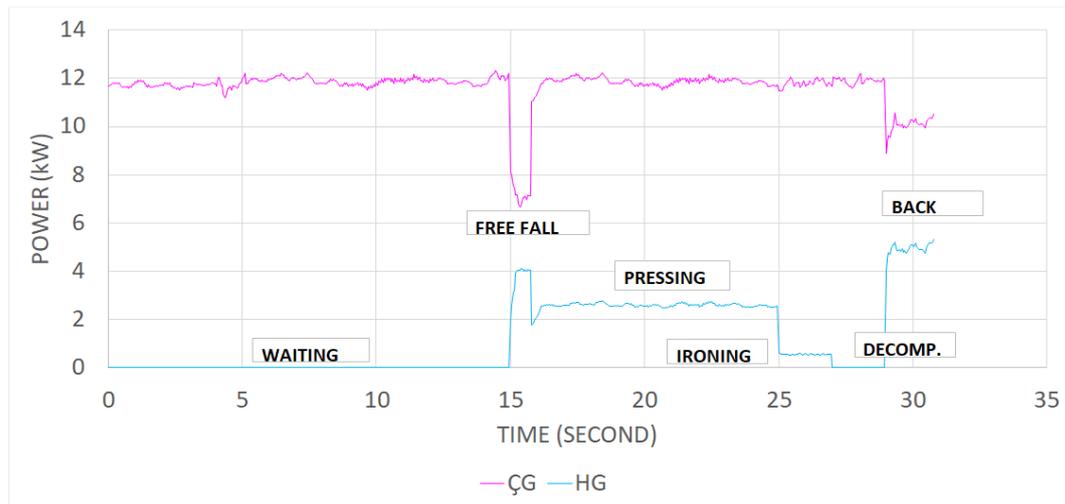
cylinder and before setting this high pressure free, it is better to reduce it. That is the reason why in decompression process the only action was made to open the valves. Because of this reason, the assumption was made for decompression process is acceptable.

To make a speed control with electro-load sensing, it is required to define a load sense pressure. To define it, the catalogues of proportional valves were searched, and this pressure was set as 10 bar (Eaton, 2009). To make the first test with fixed speed control, the command signal was given to both external controller and the motor frequency driver. The complete process is 30,8 minutes. After it was completed, the results are captured in the computer. To make the second experiment with variable speed control, the command signal was given to the same components. The complete process is 30,8 minutes. After it was completed, the results are captured in the computer.

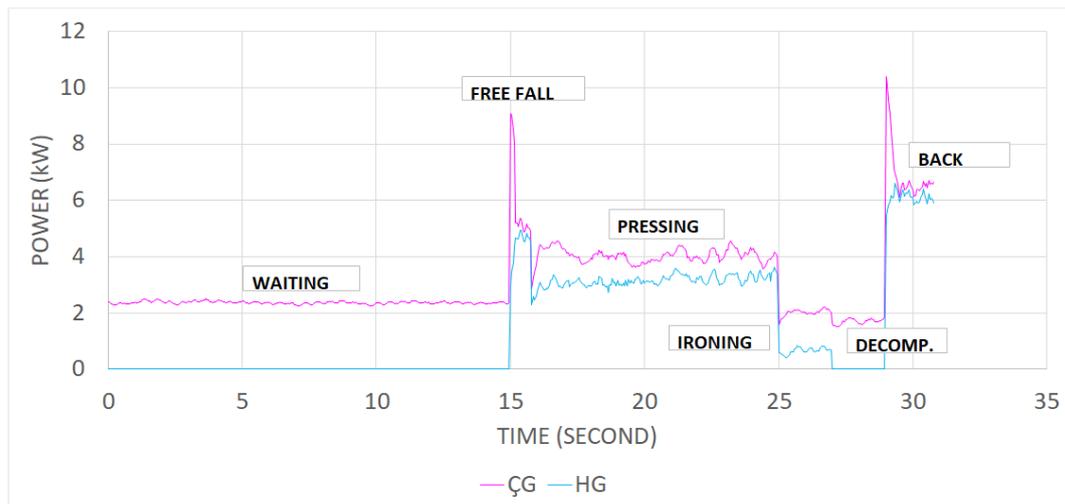
### **3. RESEARCH FINDINGS**

#### **3.1. Power Consumption Performance**

The results for the energy consumption are given in the Figure 5 and Figure 6. When the results are considered, it seems that the system nearly consumed the maximum energy independently from the required energy in fixed speed control method. However, when the results for variable speed control method are considered, the system always try to consume how much it is required.



**Figure 5** Power consumption graph for fixed speed control

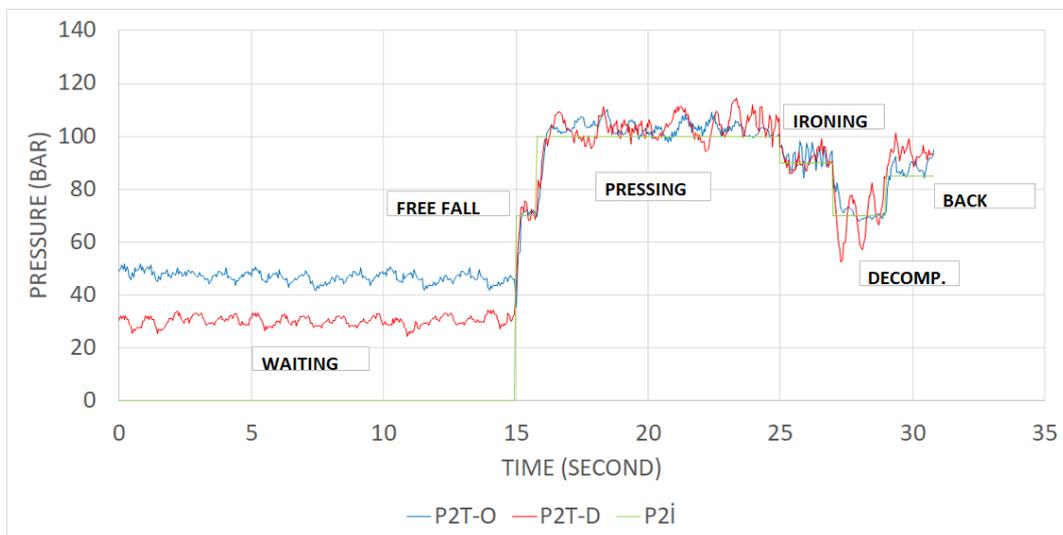


**Figure 6** Power consumption graph for variable speed control

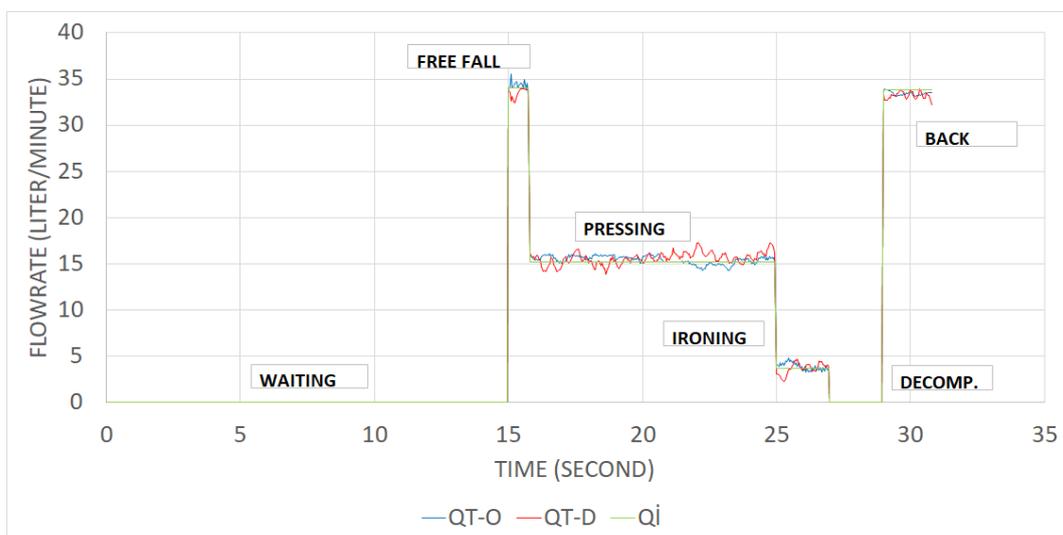
#### **3.2. Dynamic Performance**

When the graphs within Figure 7 is considered, it is seen that dynamic performance of the variable speed control method displayed as that of the fixed speed control method in the context of pressure. In the graph the red one belongs to variable speed control method and the blue one belongs to fixed speed control method. The only big difference between two methods seems in decompression process. However, this difference can acceptable because the process cannot affect the pressed sheet metal material in the press brake machine. As it is remembered, this process exists only to reduce the pressure of the system. To understand if the dynamic performance of variable speed control method is enough for the real system, it should be compared with the dynamic performance of fixed speed control method. Because in reality, it is often seemed that fixed speed control method is used for press brake machines. When the characteristics of graphs are considered, it can be said that the dynamic performance of variable speed control method is convenient for the required dynamic performance.

The only criteria of dynamic performance is not the pressure. The flow is also an important criterion of dynamic performance. When the graph within Figure 8 is considered, it is clearly seen that dynamic performance of variable speed control method is convenient. There are some little differences between two methods. Especially the red graph belongs to the variable speed control method followed more floating way when compared the one of fixed speed control. This is caused by changing the electric motor rotate period according to the pressure difference.



**Figure 7** Pressure-time graph for two methods



**Figure 8** Flow rate-time graph for two methods

#### **4. DISCUSSIONS AND CONCLUSIONS**

When the methods are compared according to their average power consumptions (Table 3), the variable control speed method consumed % 70 less energy than that of fixed control speed. Furthermore, the variable speed control method increased the system efficiency from % 10 to % 46. By the help of these results, it is obviously proved that variable speed control method is more useful than that fixed speed control method in the aspect of energy consumption and efficiency.

**Table 3** Energy efficiency of the methods

No	Method	Process Time (minute)	Input Power(kW)	Output Power (kW)	Energy Efficiency
1	Fixed S.C	30,8	11,6189	1,2016	10%
2	Variable S.C	30,8	2,6965	1,2439	46%

According to the results of the conducted experiments, the variances of two different methods according to the ideal scenario are given with in Table 4. When the results given in Table 4 are considered, there are not such big differences between the variable speed method and the fixed speed method.

**Table 4** The variances of two methods according to ideal

No	Method	Avarege Variance Over ideal	Avarege Variance Below ideal	Compared Values
1	Fixed Speed	4%	5%	Pressure
2	Variable Speed	6%	6%	
3	Fixed Speed	4%	2%	Flowrate
4	Variable Speed	6%	4%	

As a final conclusion, variable speed control method can provide not only energy saving and better efficiency, but also the required dynamic performance. As a future work, a real mechanic structure of a press brake machine can be added to the experiment structure and made a real pressing cycle with a real steel sheet in order to prove if the dynamic performance of variable speed control is convenient for a real pressing cycle or not.

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**O 22. ENVIRONMENTAL SOUND RECOGNITION WITH VARIOUS FEATURE  
EXTRACTION AND CLASSIFICATION TECHNIQUES**

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**ABSTRACT:** This paper proposes “An Environmental Sound Recognition with various feature extraction and classification techniques” for environmental sound recognition. Study in Environmental Sound Recognition has become popular topic in recent years. In the past decade, research on the Environmental Sound Recognition area has accelerated. ESR has important role on intelligent computer systems and robots for the purpose of identification, recognition and discrimination. In this survey, I will put forward a survey on which various feature extraction and classification techniques is better to recognize environmental sounds. It includes these parts: (i) basic environmental sound-processing, (ii) feature extraction techniques, (iii) classification techniques, and (iv) performance comparison of selected techniques. Finally, concluding remarks and future research and development trends in the ESR field will be given.

*Keywords: Environmental sound recognition, feature extraction techniques, classification techniques*

## **O 24. WHERE TO START THE PREVENTION OF FOOD WASTE**

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**ABSTRACT:** Food waste have been stated food spoilage or turning to waste, food used for consumption. Food wastes are usually directly proportional with nutrition and purchasing habits. This work have been conducted primary school children studying that foundation and public school the purpose of creating awareness against food waste. Investigative have been made 5-8 age group students who foundation school (FS) and public school (PS) studying situated in Konya that random sampling method selected and with total 46 student to survey development (11 question). Applied survey have been found as 0,718 validity and credibility. 36 % of the FS students participating in the survey stated that the most money was wasted, PS have been stated 71.4 % in proportion as of factors money, food, time and energy. While at FS have been found that plate waste was not PS have been detected the same. Food waste have been found students who studying FS 40 % wasting cereals while PS 33.3 % has been identified all nutrients. However, general knowledge is inadequate about food waste though has been detected waste can be prevented known by the majority. Accordingly, there are requirements intended for applications food waste to reduce, awareness have been determined should be started at early age.

*Keywords: Food waste, education, waste*

### **1. INTRODUCTION**

A regulation has been issued in order to contribute to nature and recycling giving priority to reuse by minimizing waste by giving sustainability the idea of “Zero Waste” in Turkey 2018 According to the regulation, it is aimed food waste in biodegradable wastes and to prevent food waste (Sıfır atık yönetmelik taslağı, 2018). In accordance with, “food and kitchen waste” has considered as the perfect source with high organic content existing in every corner of the (World (Sindhu et al., 2019). If food loss; has occurred after consumption of suitable materials for human consumption with extinction, degradation or disposal (Parfitt et al., 2010). The resulting losses has covered the entire process from field to table (Parfitt et al., 2010; Lipinski et al., 2013; Demirbaş et al., 2017). Generally, half of all foods in the world has wasted or destroyed before or after consumption (Parfitt et al., 2010). “Food waste” has evaluated as animal feed and fertilizer in the industry with renewed legislation, regulations, standards and rules. Recently has seen substantial increases in food alternative waste management system in Turkey (Demirbaş and Evren 2018). Food loss has composed the important part of the food expenditures of the population (Buzby and Hyman, (2012). According to the data estimates of Food Agriculture Organization (2013), production of food for individuals to consume almost 1/3 has disappeared or discarded every year.

According to zero waste regulation: food waste; means any substance or materials that are disposed to or discontinued by the natural or legal person holding the producer (Sıfır atık yönetmelik taslağı, 2018). If food loss, food to be consumed has expressed as a decrease in the amount of during the supply chain (Artık et al., 2011). In both definitions, it refers to the unused parts of foods and the parts left to nature. The terms has differentiated the amounts of food thrown. In developed countries, the amount waste or

loss of food has not considered “throw is cheaper than reusing” with principle (Sıfır atık yönetmelik taslağı taslağı, 2018).

Arrangements including student-family-school management and teachers should be given children who constitute the future of the society. In order to establish nutritional awareness among the students in early childhood (Şanlıer et al., 2019). The aim of this study is to raise awareness of waste in early childhood by teaching what food waste is. In addition, it was planned to develop a questionnaire by measuring the readiness levels of children by means of the survey method. The importance of food waste on questions and how to reduce the practical information is seen as a sub-goal.

## **2. MATERIAL AND METOD**

The research was conducted with descriptive research model. The universe has comprised of students at the primary education level of the 5-8 age group who are studying in Konya private(PS) and state schools(SS) depend on the Ministry of National Education. Among these schools, a list of (PS) and (SS) in Konya was made; The students who were randomly selected from a state and a private school (46 students) was composed sample of research. The questionnaires were applied to the classes of the teachers who accepted to participate in research in the 2018/2019 academic year by obtaining permission for the survey. The questionnaire used as data collection tool was developed by the researchers and has enriched with visuals for students to understand. The validity reliability of the developed questionnaire was tested and factor analysis was performed. The obtained datas were determined with statistical program by comparing the readiness levels of SS and PS students.

### **2.1. Research Findings**

The data collection tool used in the research has consisted except demographic features from 11 questions. Factor analysis of the questions was found as 5.

As for the demographic characteristics, because of the fact that was small the age scale of the group information was taken from their teachers. According to this, there are students participating in the study 21 in SS and 24 in PS. It is seen that 80% of the students are 7 years old and there are more men in PS (n:12) than women in SS (n:13). Validity reliability of the questionnaire while was found in the preliminary assessment 0.718 (in 25 randomly selected students) sampling applied was found as 0.572 ( $\alpha$ ). According to (George and Mallery 2003) the survey was continued to be questionnaire acceptable.

**Table 1.** Waste food survey results in Private (PS) and State (SS) schools (n:46) percentage and averages

Questions	Private School		State School	
	Percent%	Mean±SS	Percent%	Mean±SS
<b>1: What do you think of when it comes to waste?</b>				
Money	36		4.80	
Energy	16		4.80	
Time	4	2.72±1.59	0.00	4.09 ± 1.6
Food	28		19.00	
Entire	16		71.40	
<b>2: What is waste food?</b>				
Waste	36	1.6±0.48	14.30	1.85±0.35
Plate residue	64		85.70	
<b>3: How do you leave your plate after eating?</b>				
Clean	100	1.00±0	85.70	1.14±0.35

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Dirty	0		14.30	
<b>4: Increased meals garbage?</b>				
Yes	4	1.96±0.2	19.00	1.8±0.40
No	96		81.00	
<b>5: What foods would be wasted?</b>				
Vegetable Fruit	12		0.00	
Sea foos and meat	20		33.30	
Grains	40		4.80	
Milk and dairy product	4	3.2±1.57	26.80	3.61±1.28
Entire	4		33.30	
Unknown	20		0.00	
<b>6: Which would waste more?</b>				
Vegetable Fruit	4		9.50	
Sea foos and meat	8		47.60	
Grains	20	4.16±1.24	4.80	3.04±1.53
Milk and dairy product	4		4.80	
Unknown	64		33.30	
<b>7: In your opinion, which food can you waste?</b>				
Market-place	0		19.00	
Distribute	4.0		14.30	
Store	0		0.00	
Storege	0		0.00	
Cooking	4.0	7.5±1.32	0.00	6.52±2.76
Service	0		0.00	
Plate	12.8		0.00	
Entire	80.0		66.70	
<b>8: Are food wastes harmful to the environment?</b>				
Yes	68		23.80	
No	28	1.36±0.56	66.70	1.85±0.57
Unknown	4		9.50	
<b>9: Can food waste be used in different areas?</b>				
Fuel	8		19.90	
Kompos	4		14.30	
Animal nutrition	16	4.16±1.31	19.00	3.42±1.66
Food	8		0.00	
Entire	64		47.60	
<b>10: Can food be produced from food waste again?</b>				
Yes	88		76.20	
No	8	1.16±0.47	9.50	1.38±0.74
Unknown	4		14.30	

<b>11: Can food waste be avoided?</b>				
Yes	100		71.40	
No	0	1.00±0	14.30	1.42±0.74
Unknown	0		14.30	

When Table 1 data were analyzed, significant differences has observed of PS and SS students in between answers of some questions (question 5 and 6). Students participating in research “what do you think of when you say food waste” of question; while there was no significant difference between the answers of the students in the PS money, time food waste and energy all of the factors has stated what wasting (71.40 %). PS students said that they did not leave any food residue in their plates if 14.30% of the SS said that left of dirty their plates.

To being different in education in private and public schools with eating at school it is thought that affects the way students leave their plates. In the question of the different uses of food waste (question 9), the level of knowledge of students in private 80% and public schools 66.7% was found to be similar.

**Table 2.** Comparative ANOVA analysis intended for food waste of private (PS) and state (SS) of schools (n:46)

<b>Questions</b>	<b>Means</b>	<b>±SS</b>	<b>F</b>	<b>Sig.</b>
Ides	3.37	1.73	8.42	0.006
Waste	1.74	0.44	2.84	0.99
Plate	1.06	0.25	3.98	0.52
Increased food	1.90	0.31	2.70	0.107
Waste food	3.43	1.50	0.58	0.447
Mare waste food	3.65	1.50	7.37	0.009
Food waste	7.06	2.14	2.54	0.117
Nature effect	1.58	0.61	8.66	0.005
Uses fields	3.82	1.51	2.78	0.102
Food production	1.26	0.61	1.50	0.227
Prevent	1.20	0.54	8.30	0.006

SS and PS (Table 2) compared to ANOVA, it was found that they did not know of food was more wasted despite they know of waste food (question 6) ( $F=7.37$ ;  $p<0,005$ ).

“What is your mind about wasting?” and “Can food waste be avoided?” the answers to the question of student between there has not difference as statistically. In the application of the questionnaire, it is considered that the students are given answers by conscious in the last questions.

### 3. DISCUSSION

Nutrition is one of the most important factors affecting growth and development in childhood (Çelikoyar, 1988). Early childhood is a period in which children started putting signs and definite stand against food. This period which children choose food too much is a difficult but temporary period for their parents and teachers (Kutluay Merdol, 1999). It should be the target of teachers and families to plan meals, improve eating behavior and gain positive eating habits in early childhood (Ada, 1998). Therefore, in our study, students are dealt with primary school first grade 6-8 age group. It is thought that the wastes, which are one of the cases where parents and teachers complain the most, are caused by the food selection of the students. Therefore, awareness is needed against waste. Because early childhood period before the transition to school is known as the period of eating habits (Ünusan, 2001; Terzi, 2005; Kobak and Pek, 2015). During the time spent at the school, students consume an average of 15% of their daily nutrition. A legal basis of the students' nutrition application has not been established

in our country. In our research, there is generally eating time application in this student age group (Güneyli, 1986). 50% of the sample of our research is female and 50% is male. When the effects of nutrition on gender are examined, it is thought that it may affect the responses. According to Demirezen, male students often eat more fatty and sugary foods than female students and eat more fast-food type foods. In addition, there are differences between the genders in the direction of adding salt to foods, consumption of veal, mutton, salami, sausage and eating fruits, vegetable food, dried legumes (Demirezen and Gülhan, 2005). According to the 2014 report of the World Health Organization (WHO), around 1 billion people in the world suffer from hunger shortage; 1.4 billion people suffer from overweight and about 2.8 million people die each year due to their excess weight. In addition, it is estimated that at least 2 billion people become ill as a result of food poisoning due to contamination during the food supply phase (World Bank [WB], 2015). In 2008, according to the total consumer and retail food loss analysis in the United States, at the first three, meat, poultry and fish (41%); vegetables (17%); and dairy products (14%) determined to be wasted (Buzby ve Hyman, 2012). According to Premanandh, almost one-third of every food purchased in developed countries is a source of waste as household food waste. These loss rates are stated as 15% of total production in cereals and legumes and 35% in fruits and vegetables (Premanandh, 2011). It is reported that 5% of the food in consumption and household stage are waste or loss in Turkey (Tatlıdil et al., 2013). It is detected that although the students know about the waste, they did not know which food was wasted (PS %64). The reason is thought to be related to the age ratios of the students applied to the survey. . Although schools are selected as full-time schools, it is thought that the differences between the private school and the public school may be reason that they are not ate meal in public school (Although there is eating time). Meal time, snack number and waste reason is also an important factor in terms of waste. It is known that children do not like products with sugar-free food and create waste on their plates (Ünüsün, 2001; Terzi, 2005; Kobak and Pek, 2015). According to FAO's report, 95% of food losses occur at the stage of transport of products (FAO, 2013). In the questionnaire applied to students, 80% of the students in the private school, 66,70% of the students in the public school, answered the question of "which food can be wasted". Their answers were "all of them". With this question, it is concluded that students think that the products are waste in many areas such as transportation, storage, cooking, dish, service. In our study, the students think of waste as food, but those who read in private school think as money ( $p < 0.05$  Table2).

According to the studies, many measures are taken to reduce food waste. Reducing waste with zero-waste regulations are planned in Turkey. "Inviting women with zero waste contact", "Environmental consciousness for generations on the way to 2023" ,"Zero waste", "Waste of bread," "food loss and waste food in food sector", "Zero waste in the table" such as projects with the aim to prevent has studied prepared and supported by the coordination of the Ministry of Environment and Urbanization in our country 2018 years. Many countries or regions, state policies are organized non-governmental organizations are working on the issue and taking measures together with the private sector such as in our country in order to reduce or eliminate the negative effects of this problem almaktadır (Sıfır atık yönetmeliği taslağı, 2018) (Figure 1).



**Figure 1.** Waste visuals (Sıfır atık yönetmelik taslağı, 2018)

Effective use of factors production and consumption, awareness raising of consumers, promotion of food production, promotion of local foods and minimization of losses should be supported by international funds. States has taken decisions to prevent food waste in their internal laws. For example in France, food is consumed by supermarkets thrown away but has taken measures (Artık et al., 2011). According to the results of the survey, although the knowledge level of children is limited about wastage according

to question 11 they think that food waste can be prevented ( $F = 8.3$ ;  $p < 0.05$ ). Furthermore, students of answer about whether of waste food is harmful to nature has created the perception that waste should be avoided (question 9) ( $F = 8.66$ ;  $p < 0.05$ ).

#### **4. RESULT AND SUGGESTION**

Accordingly, to reduce food waste;

- There may be wastes in every area should be taught in schools starting from early childhood,
- The implementation education curriculum should be taken to ensure that is the same in the State and Private schools,
- Food waste should be explained of people and nature; social, cultural and psychological as impacts,
- How the assessment to do in waste management should be supported by practical training,
- The menus should be planned by taking into consideration the hygiene rules when was made of food recycled,
- In this respect, it is thought that many fields such as national education, university, local administrations and media should work by supporting each other.

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## **O 25. HOMEMADE DIP COATING MACHINE FOR THIN FILMS**

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**ABSTRACT:** In recent years, the use of thin films for several purposes has been increased rapidly. The performance of thin film coated on the material is related to the sensitivity of electronic dip coating devices. Especially, the differences in production techniques and production conditions reveal many features in thin films. With the development of technology, new production technologies and techniques that may be alternative to each other in the production of thin films have been emerged and developed. Although the sol-gel dipping method does not have a very old history, it has been an important technique for gaining new properties to glass and ceramics.

In this study, the production, software, design and sensitivities of the device used in dip coating technique, which is one of the sol - gel coating techniques, were taken as the main issues. A new device has been developed to coat glass sheets of 50 cm long and produce substantially transparent conductive layers. In this new device, glass carrier arm is used to dipping them into a solution at a certain speed, waiting certain time period and removing them at the same speed in order to coat the surface with the colloidal suspensions formed by the solid particles in the prepared liquid named as sol. The device has been designed in laboratory environment, the software has been developed for arranging speed and waiting time period with manual and Bluetooth control. The performance of homemade dip coating device was evaluated according to optic and atomic force microscopy images and thin film thickness determined with special equation. According to the results, the film thickness of coated samples was almost 7 micrometres and the surface of the films was observed smooth with cracks.

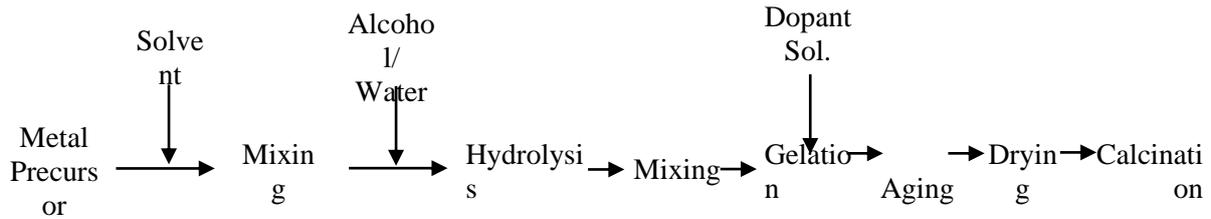
*Keywords: Dip coating, dip coater, thin film, sol-gel*

### **1. INTRODUCTION**

Surface coating; is the process of obtaining a new surface layer by coating the surface of the main material of a metal or alloy known in a chemical composition different from the main material (URL 1; Muğla, 2010). Coating technologies developed to provide a new and more functional characterization beyond the existing properties of the base material contribute not only to architecture but also to many areas. It is applied to prevent wear, tear, impact, corrosion and scouring, as well as to improve decor, optical, thermal, electrical, mechanical and chemical properties (URL 1; Özel, 2013).

#### **1.1. Sol-Gel Process**

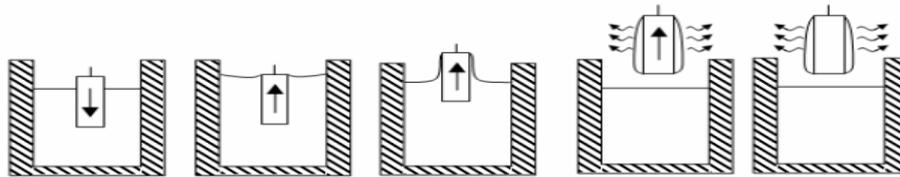
The concept of “sol-gel” is formed by the abbreviation of solution-gelling. Thanks to sol-gel technology, which provides a versatile approach in the synthesis of inorganic polymers and organic-inorganic hybrid materials, homogeneous inorganic oxide materials with desired properties can be obtained at room temperatures without the need for high temperatures required for conversion to inorganic glasses (Karasu, 2018). General steps of sol-gel method; hydrolysis of the precursor, alcohol or water cohesion of sol-gel active species, gelation, aging, drying, high temperature process (Özler, 2007; Akıncı, 1995). Coating procedure mainly applied in the gelation step of sol-gel method and dip coating is one of the mostly applied method for thin film preparation. Dip coating has been extensively utilized for research purposes owing to the positive features of the method such as convenient and facile approach. In Figure 1 the sol-gel method basic nano material production steps were given.



**Figure 1.** Sol-gel basic steps for nanomaterial production

### 1.2. Dip Coating

Dip coating method is the most important and widely used method among the coating methods to be made by using so-gel solution. The method is a film coating process which is carried out by dipping the prepared solution into a container and dipping the material to be coated in a solution without being subjected to vibrations at a certain and constant speed (Evcin, 2006; Evcin, 2016).



**Figure 2.** Dip coating process stages

Dip coating occurs in five stages. These are immersion, startup, deposition, drainage and evaporation. In immersion stage the substrate is dipped into the coating solution at a constant speed. The substrate remains in the solution for a designated time (30 seconds are recommended.), and then it is withdrawn with a same speed during startup. In deposition stage while the substrate is being pulled out, the thin film coating starts to be deposited on it. The thickness of the coating is directly dependent on the speed by which the substrate is being pulled out. The slower pull, the thinner the coating layer. In drainage step, excess liquid is drained from the substrate surface. Finally, solvent starts to evaporate from the surface of the substrate to form a thin film during evaporation. If the solvent is volatile, this step might happen in step 3 (Kakaei et al., 2019; Aegerter & Mennig, 2004). Figure 2 shows these steps respectively.

After the coating process, Equation 1 is used to calculate the thickness of the coating. The thickness of the film formed after the coating process; the density and viscosity of the prepared solution, the speed of dip, surface tension and gravity may vary (Brinker,2013; Güngör & Güngör, 2015).

$$h = c \cdot \frac{(\eta U)^{\frac{2}{3}}}{\gamma^{\frac{1}{6}} (\rho g)^{\frac{1}{2}}} \quad \text{(Equation 1)}$$

(h: Thin film thickness, c: Constant (0.944),  $\eta$ : Viscosity, U: Dipping speed,  $\gamma$ : Surface tension,  $\rho$ : Density, g: Gravitational acceleration)

Because of the high prices of the dip coating devices, the lack of product in the market which is able to coat long materials, easy to apply procedure and the construction prices with cheaper than the market, developing a new dip coating device to coat glass sheets of 50 cm long and produce substantially transparent conductive layers was conducted in laboratory environment.

In this study, the design of the Dip Coating system based on the use of manual and bluetooth controlled step motor driver unit and the associated mobile unit will be explained. Owing to this system designed in the laboratory, thin films were coated on both sides by dipping the glass material into the prepared solution.

## 2. MATERIAL AND METHOD

There have been 4 steps followed to design dip coating device. These are provision of carrier arm, software development, construction of outline profile and construction of bottom platform.

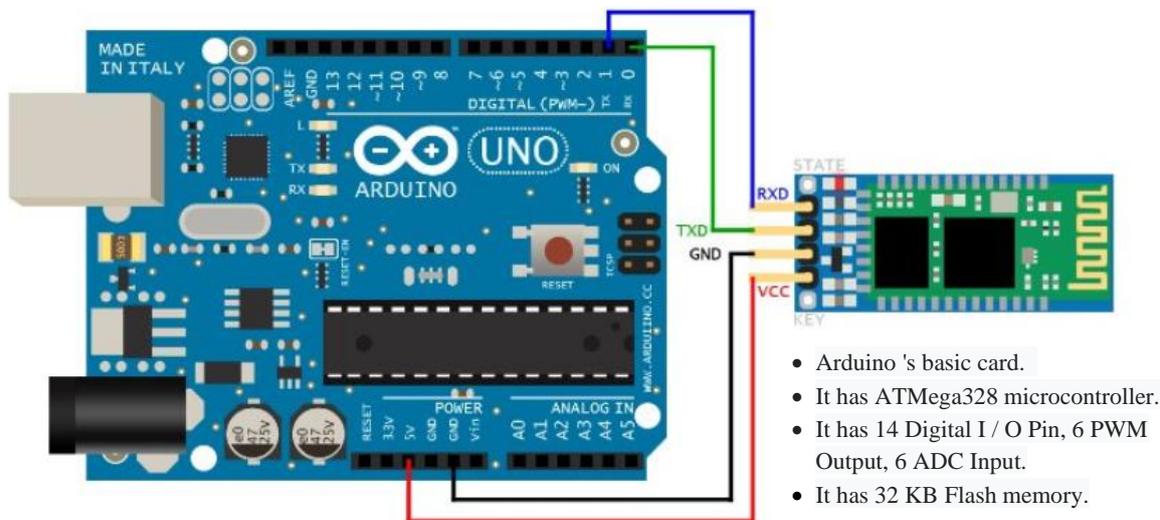
### 2.1. Provision of Carrier Arm

Linear actuator of 500 mm long was provided as a carrier arm which is mainly designed for lifting and pushing movements of any objects. Actuator with the features given below was supplied:

- Operation Voltage: 12/24V
- Load Capacity: 6000N
- Speed: 2 mm/s for 12 V, 4mm/s for 24 V
- Stroke: 50 mm to 500 mm
- Operation Temperature: -20 to +40 °C
- Limit Switch: Built-in, Factory Preset

### 2.2. Software Development

Arduino uno programming platform was used for controlling of actuator. In Figure 3 basic diagram of Arduino uno is given. Arduino is a physical programming platform consisting of an I / O card and a development environment that includes an application of Processing / Wiring. In the hardware of Arduino, one microcontroller such as ATmega328, ATmega256 and ATmega32u4 and other auxiliary parts for programming and connection with other circuits is placed. Each Arduino board has at least one 5 volt regulating integrated and a 16MHz crystal oscillator (some with ceramic resonator). Arduino cards do not need an external programmer for programming, because the microcontroller on the card is pre-written with a bootloader program (URL 2).



**Figure 3.** The schematic diagram of Arduino Uno (URL 2)

Arduino development environment (IDE), Arduino bootloader (Optiboot), Arduino libraries, AVR Dude (Arduino remote microcontroller programming software) and compiler (AVR-GCC) constitutes the basic structure of Arduino.

Arduino software consists of a development environment (IDE) and libraries. The IDE was written in Java and is based on the environment of processing. The libraries are written in C and C ++ and they are compiled with AVR-GCC and AVR Libc. Arduino source codes are available in here. The Optiboot component is the bootloader component of Arduino. This is the component that enables the programming of the microcontroller on Arduino cards (URL 2).

The most important component that makes Arduino so popular is the Arduino libraries, which enable everyone to program without having to have detailed knowledge of the microcontroller. A list of Arduino libraries is available here. Arduino libraries come with the development environment and are located under the "libraries" folder. By examining the code, you can see how the microcontrollers are programmed and the structure of the libraries. Finally, it is used to program the compiled code in the AVRDUde component (URL 2).

In this study, for programming of Arduino C language was used and speed arrangement was conducted with regulating of the voltage receiving by actuator. When the voltage was adjusted to 12 V, the actuator moved with a speed of 2 mm/s. The designed machine can be controlled with manual keypad and Bluetooth of mobile phone. There are four options defined with programming such as stop, downward, upward and wait 30 seconds before going upward. Small part of a code used for the downward movement of the carrier arm is given in Figure 4.

```
void loop() {  
  key = keypad.getKey();  
  veri = Serial3.read();  
  
  if (key){ Key represents  
manual control  
    Serial.println(key);  
  }  
  
  if(veri){ Veri represents  
bluetooth control  
    Serial.println(veri);  
  }  
  
  if (veri == 'd' || key == '*')  
  {  
    lcd.clear();  
    lcd.setCursor(0, 0);  
    lcd.print("Going DOWN");  
  }  
}
```

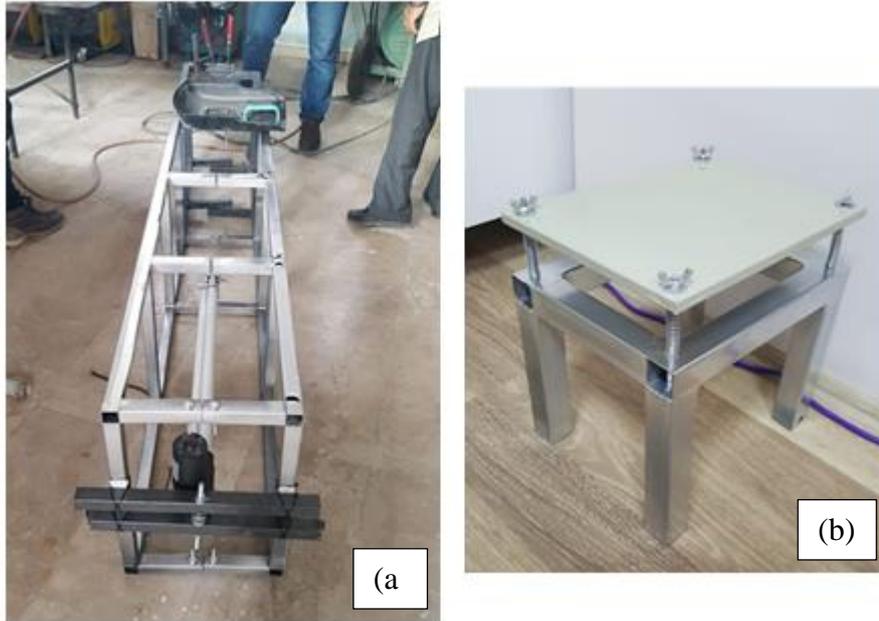
**Figure 4.** A small part of code used for the downward movement of the carrier arm

### **2.3. Construction of Outline Profile**

Outline platform appropriate for length of material which will be coated was constructed from iron rods with 2 m long. In Figure 5 the construction process of outline profile was shown.

### **2.4. Construction of Bottom Platform**

A bottom platform was made to ensure balance between dipping arm and dipping container with screws. In Figure 5 the picture of bottom platform is given. The AutoCAD drawing and the final picture of the device is given in Figure 6.



**Figure 5.** (a) Construction of outline profile of dip coater and (b)the picture of bottom platform



**Figure 6.** (a) AutoCAD drawing of dip coater and (b) the picture of final device

## 2.5. Performance Experiment

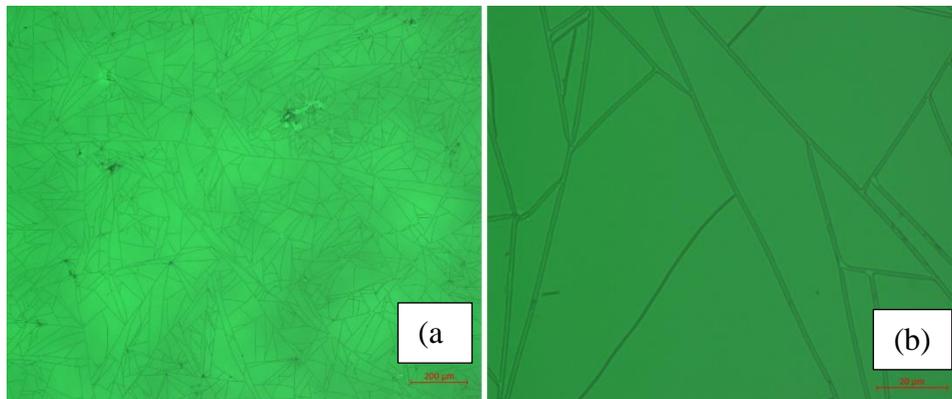
To Determine system performance, three experiment was conducted with different sols prepared with sol-gel method. The experiments were carried out with the procedure given below:

1. Substrate, which is glass sheets of 500 mm long, was cleaned with 2-propanol and purified water
2. Plates were immersed into sol with 2 mm/second velocity.
3. The plates were waited for 30 seconds into the sols before pulling out.
4. The plates were withdrawn from the sol with same speed (2 mm/second).
5. They were dried in a desiccator for 1 hour at room temperature.
6. Finally, they were subjected to heat treatment in an oven for 1 hours at 600 °C.

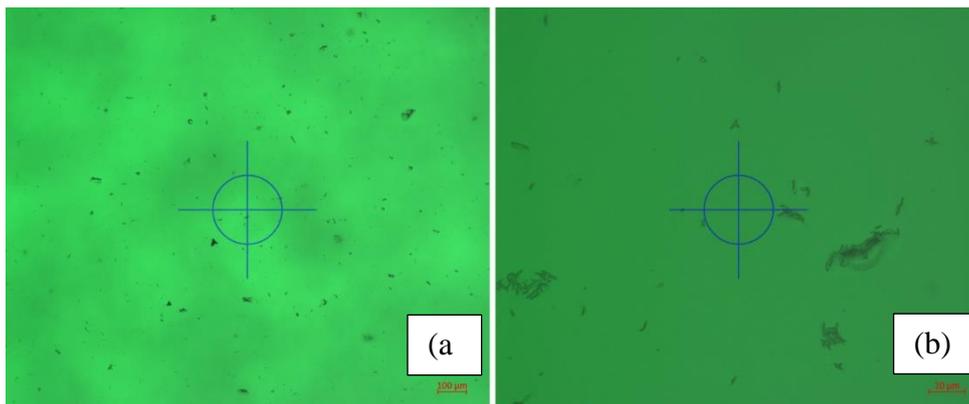
The performance of device to produce thin films was evaluated according to the optic and atomic force microscopy images of this experiment and thin film thickness determined with equation 1.

## 3. RESULTS AND DISCUSSION

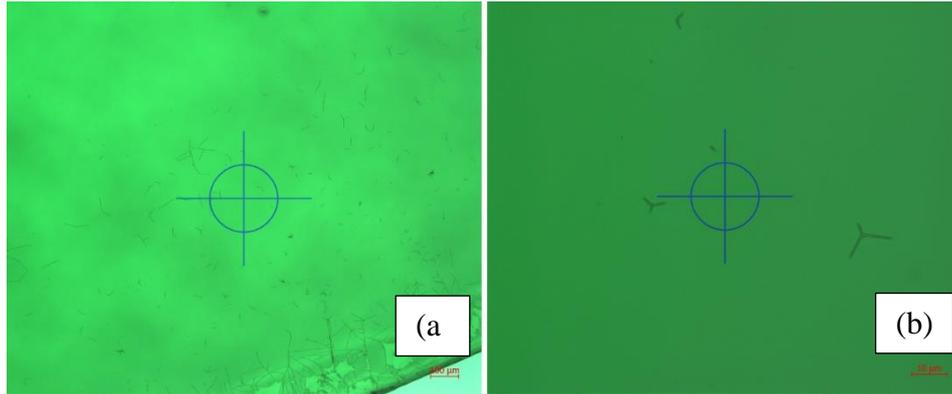
Totally 3 samples were prepared with dip coating experiments. Optic microscopy images of samples are given in the Figure 7, 8, 9. Different extension rates were used to take these images. 200 $\mu\text{m}$ , 100  $\mu\text{m}$ , 20  $\mu\text{m}$  and 10  $\mu\text{m}$  are the zoom in ranges used for these samples



**Figure 7.** Optic microscopy images of samples (a) image of sample 1 with 200 $\mu\text{m}$  zoom in, (b) image of sample 1 with 20  $\mu\text{m}$  zoom in

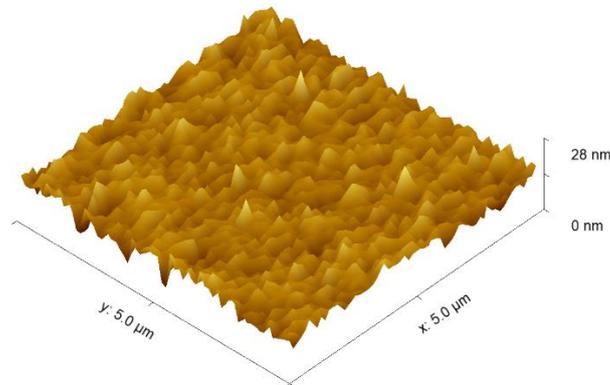


**Figure 8.** Optic microscopy images of samples (a) image of sample 2 with 100 $\mu\text{m}$  zoom in, (b) image of sample 2 with 10  $\mu\text{m}$  zoom in

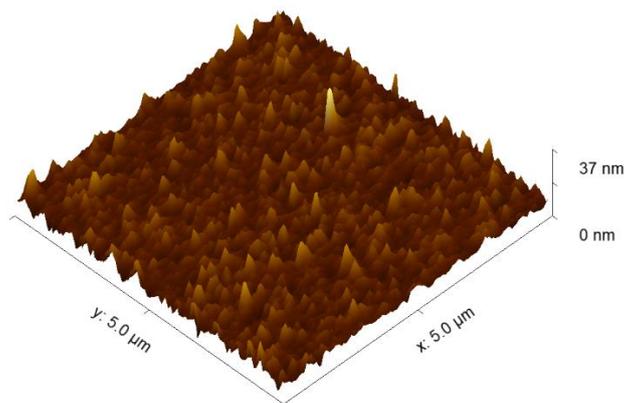


**Figure 9.** Optic microscopy images of samples (a) image of sample 3 with 100µm zoom in, (b) image of sample 3 with 10 µm zoom in

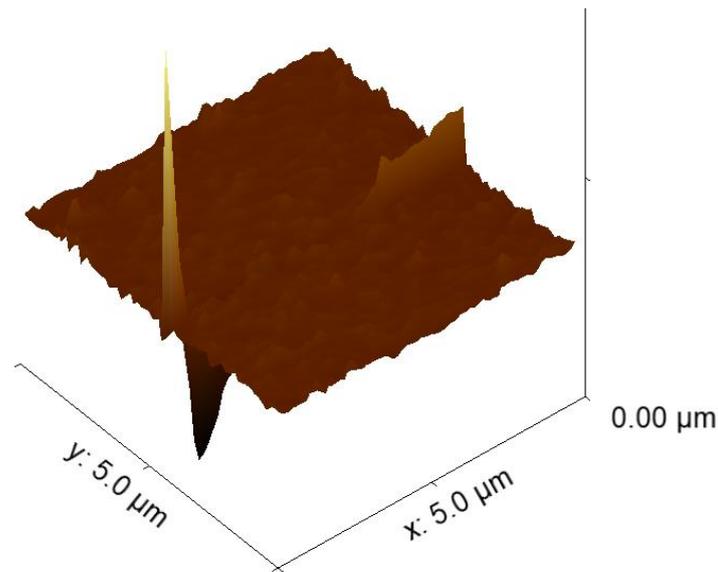
According to optic microscopy images, there were cracks formed on the surface of sample 1. In the other samples, cracks are not so apparent. The main reason of these cracks may be the heat treatment at high temperatures. Atomic force microscopy image of samples is given in Figure 10, 11, 12. Moreover, from atomic force microscopy images roughness of the samples were calculated. The average roughness value of samples is 1.797 nm for sample 1, 1.98 nm for sample 2 and 1.678 nm for sample 3. These images show that the surface of the samples is smooth with a few peak points. Especially in sample 3, peaks are less than the other samples. When the roughness values of samples were evaluated, they are acceptable and show that the surface of thin films produced with this machine are very smooth (Mardare and Hones, 1999).



**Figure 10.** Atomic force microscopy image of sample 1



**Figure 11.** Atomic force microscopy image of sample 2



**Figure 12.** Atomic force microscopy image of sample 3

Also, thin film thickness was calculated according to Equation 1 and it was measured with profilometer. In Table 1, results of calculated and measured film thickness values and parameters used for calculation are given. These results are acceptable because the coating layer thickness is getting thicker closed to uncovered area of the glasses. Therefore, measured film thickness was found smaller than the thickness calculated with equation 1. The features of the sol are one of the main factors affecting the thin film. The dilution of chemicals and solvents used for the preparation of sol may affect the thin film thickness. Furthermore, the withdrawal speed is also important, the smaller speeds reduce the thin film thickness.

**Table 1.** Calculated and measured thin film thickness values of samples

Samples	Parameters	Values	Calculated Thin Film Thickness (μm)	Measured Thin Film Thickness (μm)
<b>Sample 1</b>	Viscosity (mPa.s)	1.5	6	0.5
	Surface Tension (dyn/cm)	23.5		
	Density (g/cm <sup>3</sup> )	0.83		
	Dipping speed (mm/s)	2		
<b>Sample 2</b>	Viscosity (mPa.s)	2	7.2	0.5
	Surface Tension (dyn/cm)	23.5		
	Density (g/cm <sup>3</sup> )	0.84		
	Dipping speed (mm/s)	2		
<b>Sample 3</b>	Viscosity (mPa.s)	2.5	8.3	0.5
	Surface Tension (dyn/cm)	21.7		
	Density (g/cm <sup>3</sup> )	0.88		
	Dipping speed (mm/s)	2		

#### 4. CONCLUSION

Dip coating is an industrial coating process to manufacture bulk products such as coated fabrics and specialized coatings for example in the biomedical field. Moreover, it is one of the mostly used method to prepare coated materials with thin films especially for research purposes. By the help of this process, it is possible to produce thin films on any object. In this study, the homemade dip coating device, which has an ability to coat long objects up to 500 mm, was designed and built in laboratory environment with

very cheap cost. The cost of this device is 10 times lower than similar products in the market and all equipment used for this device was very easy to find. According to optic and atomic force microscopy images, thin film thickness determination and roughness measurements, performance of this new machine was found successful and suitable to use for coating of long materials.

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## O 26. OVERVIEW OF ENERGY EFFICIENCY FOR PUBLIC BUILDING IN ALBANIA

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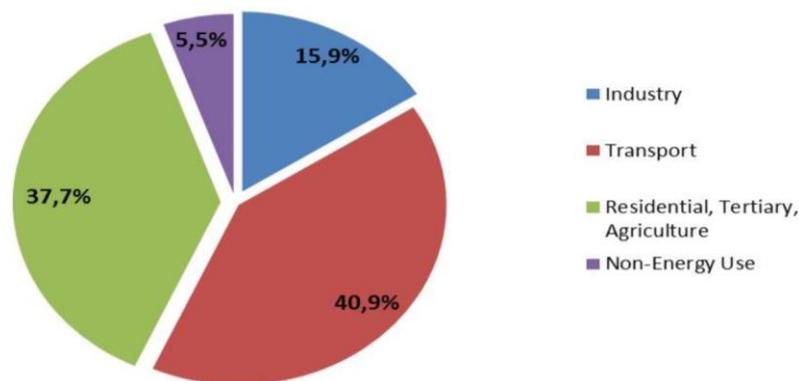
E-mail: adorri@fim.edu.al, altinbidaj@yahoo.com, 6d.plan@gmail.com

**ABSTRACT:** This paper tends to give a general overview regarding the situation of energy efficiency for public building in Albania. As first attempt, will be their classification based on energetic viewpoint. Classification is based in many factors like: destination, users, time of operations, thermal comfort, etc. Based on this analysis 6 type of public buildings are distinguished: hospitals, kindergarten, schools, universities, dormitories, institutions of central and local government. Also an analysis of their energy behaviors is made in order to highlight their weaknesses. Analysis put in evidence that due to the design and construction the existing building stock is not in compliance with the laws and their regulatory, regarding energy performance. Electricity represent the main primary energy source since this sector has a highest electricity dependence and consumption. Other identified primary energy sources are: diesel oil, pellet and natural gas, used mostly for heating during winter season or domestic hot water production. Most of buildings do not meet minimal thermal comfort standards and suffer from a poor thermal insulation, so most of energy is consumed for heating or cooling. Another problematics was building operation and management, which is poor or inexistent. Due to this heat losses from air infiltration represent 20÷40% of total heat losses in the building. At the end some conclusions and recommendation are given in order to improve energy efficiency and thermal comfort in public building.

*Keywords: Public buildings, energy efficiency, building typology, thermal comfort, thermal insulation.*

### 1. INTRODUCTION

Albania faces challenges to face in the short term on the issue of energy performance in buildings. As a candidate country for membership in the European Union, Albania must follow the overall European policy orientation by adapting its legislation and other development orientation instruments. Albania today faces the challenges of development and a constant transformation of the economic, social, cultural and environmental context. In Albania there is a phenomenon different from other European countries, which have a lower energy consumption in the building sector compared to the industrial and service sectors (see Figure 1) [AEA 2017]. In Albania, the building sector is one of the largest consumers of electricity and especially electricity. This sector in 2017 recorded a total consumption by households of 54% of final electricity consumption where the largest percentage goes for space heating, 60% of it and the remaining 25% goes for water heating [AKBN 2016].



**Figure 1.** Final energy consumption by sector in Albania

As we can see the electricity consumption from the buildings and services sector is dominant over the industry sector. This means that there are great opportunities for increasing efficiency in these sectors,

with the aim of reducing energy consumption. Therefore, attention should be paid to energy efficiency. In this case, the construction sector holds great potential for savings and may turn to a low carbon sector. Although there are many opportunities to improve energy efficiency in the public buildings sector, overlapping and not clearly defined policies to guide these opportunities in Albania remain to be significantly improved. Designing intelligent policy packages is not a simple process, but requires setting energy performance standards for end users. It is also not known how the building sector should be structured for the purpose of policy making, in the sense of the great potential for energy savings to reduce carbon emissions, and where this potential is concentrated in public buildings. Finally, it is necessary for the Government to know the cost of achieving savings and achieving energy performance standards in public buildings with a view to procuring "green" during the reconstruction of these buildings.

Main objectives of this paper are:

- ✓ Classification of public buildings based on energetic viewpoint. Factors that influence this classification.
- ✓ Analysis of their energy behaviours, in order to highlight their weaknesses.
- ✓ Identifying primary energy sources.
- ✓ Recommendation to improve their energy efficiency and thermal comfort.

## **2. MATERIAL AND METHODS**

Public buildings in general were built here before the 1990s. Unlike private residential buildings after the 1990s, there were no new construction booms. As far as the physical situation is concerned, they are in a bad situation (they need deep and non-partial reconstructions). Regarding the thermal side the situation is even worse (very few have thermal insulation, efficient windows, etc.). In Albania, public buildings constitute one of the most troubling social and economic problems in the country, which have emerged especially after the 1990s.

The basic material used for the construction of the bearing structure in these buildings was full brick clay or silicate 25-38-51-64cm thick, with masonry brick dividers of 8-10-12cm thickness and structures horizontally made with soles, concrete / reinforced or ceramic reinforced. Roof or roof covering (especially in cold areas) with concrete / gun soles and modest thermal insulation with penobetonite coating, with thermal conductivity coefficient ( $\lambda = 0.35 \text{ W / m}^\circ\text{K}$ ). In the old stock of public buildings, the windows were generally of wood or metal frame glass with a transmission coefficient of 4.1-5.9  $\text{W/m}^2\text{K}$ . The windows in today's construction are better than the old stock because of the quality of the materials and materials used in them. The most commonly used material in the cassette composition is duralumin and less PVC. The stock of public buildings is being replaced by double glazed windows as an efficient measure to reduce energy consumption. The transmission coefficient of these windows has values from  $U = 2.8 \text{ W/m}^2\text{K}$  to  $1.1 \text{ W/m}^2\text{K}$ . The basic structure for the new building stock is a monolithic trans-pillar element, with 20-25cm thick brick walls, finishes being more acceptable and modern. Many of these buildings have used thermal insulation materials enhancing the thermal properties of the building. The cover made in the new stock is with terraces or roofs (especially in cold areas) with concrete/reinforced soles and thermo-insulated with polystyrene coating with coefficient of thermal conductivity ( $\lambda = 0.035\text{-}0.040 \text{ W/m}^\circ\text{K}$ ).

For the classification and compilation of the stock typology of public buildings we have relied on several factors, such as:

- ✓ Destination of the building,
- ✓ Building structure of the building,
- ✓ Users of the building and their number,
- ✓ Hours of use and use of the building,
- ✓ Requirements for thermal comfort of the building,
- ✓ Specific requirements mainly related to the function of the building (security level, etc.),
- ✓ Building technical systems

So at the end of all this analysis regarding the factors that influence the classification of public buildings typology regarding its energy behaviour we can say that these factors are intertwined. But normally the typology determinant is the destination of the building as we can say that it includes little of the other

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factors mentioned. Based on these justifications we can distinguish several types of buildings, with destination:

- education and education (including schools, kindergartens, universities). These are distinguished by their high concentration and number of users and relatively high energy consumption. They work mainly during the day and not throughout the day. Mainly during the summer season they are closed or have very limited activity (eg. for staff).
- health (hospitals, health centres, ambulances, polyclinics, etc.). Here, especially, hospitals are distinguished for continuous function 24 hours a day, 7 days a week and no annual breaks. Depending on the size, they have specific requirements for technical systems and are sensitive energy consumers.
- cultural and sports (museums, galleries, cinemas, sports halls, etc.). They are distinguished for limited time activity and limited human presence. Even in the case of activities they are limited to 2-4 hours.
- accommodation and hotel services (dormitories, asylums, shelters, etc.). Distinguished for use 24 hours a day. They have significant consumption for SHW but also for energy for air conditioning.
- local and central government institutions (municipalities, ministries, agencies, etc.). Distinguished for limited use during the day, there are no high requirements for SHW.
- warehouses, no air conditioning requirements.
- different destinations (military, law enforcement, prisons, etc.). In addition to air conditioning, they have specific requirements for lighting to ensure their safety.

So based on all the above justifications and relying mainly on destination in harmony with other factors: users and thermal comfort requirements, the team of specialists concluded that public buildings can be classified into 6 (six) representative types of stock, like below:

- ✓ Hospitals
- ✓ Dormitories
- ✓ School
- ✓ Kindergarten and nurseries
- ✓ Universities
- ✓ Buildings of public institutions (municipal and government)



Hospitals



Dormitories



Schools



Kindergartens



Universities



Public institutions

**Figure 2.** Photos from 6 different building typology

For the selection of buildings that would then be the subject of energy auditing we were guided by the following selection criteria:

- a. Typology of the building (hospital, school, boarding house, etc.)
- b. Climatic zone where the building is located (zone A, B or C, see Fig. 3)
- c. Condition of the building (whether reconstruction interventions have been carried out in the last year or not)
- d. Level of cooperation with building managers and managers,
- e. Availability of data on the structure of the building and its energy consumption,
- f. Impact of buildings in the area (size, number of people attending, working hours, etc.)



**Figure 3.** Climatic zones of Albania

In total 60 buildings were studied from all 6 typologies and from 3 climatic zones.

### **3. FINDINGS AND RESULTS**

In this paragraph are given shortly main findings from 6 buildings typology:

#### **3.1. Hospitals**

This building typology is more complex both in terms of structure and function but also in the complexity of energy consumption. There are facilities that run 365 days a year, 7 days a week and 24 hours a day, so they never close. Distinguished for consumption in all six services: 1) Heating; 2) Cooling; 3) Hot water; 4) Cooking; 5) Electrical appliances, 6) Lighting. All hospitals have different constructive characteristics and do not present analogies with each other. They were mainly built in the 1960s-1990s and a small part were built in the 2000s. Hospitals generally suffer from poor thermal insulation of buildings resulting in significant high heat loss of the overall heat transfer coefficient  $U = 1.3 \div 1.6 \text{ W} / \text{m}^2\text{K}$ . The windows are almost entirely of glass with a duralumin frame, where the glass is often single and some are double glazed. They operate with central heating systems with diesel fuel boilers and in a few cases, especially in recently renovated spatials, there are also pellet boilers. There is no ventilation system but it is mainly carried out through a natural vent (opening windows or doors). For the production of hot sanitary water in some of them where there are central boilers is produced through boilers. In most cases, hot water is produced through independent electric boilers mounted on toilets. Almost entirely they have efficient lighting systems avoiding halogen and incandescent lamps.

#### **3.2. Dormitories**

Dormitories just like hospitals are big energy consumers because of their long operating time, both during the day (24/24 hours a day) and during the week (7/7 days a week). Outside services are: 1) Heating; 2) Cooling (partially); 3) Hot water; 4) Cooking; 5) Electrical appliances, 6) Lighting. The buildings were mainly built in the 1970s and 1990s and some of them have undergone partial renovations

in the 2000s. They probably represent the typology of the worst construction and thermal comfort conditions. Heating systems were mostly central with diesel fuel boilers but largely non-functional. The lighting was not at the proper levels due to damage but also due to the lack of proper lighting. It lacks almost thermal insulation and has moisture problems. Hot water is mainly provided only by electric boilers and only in toilets for showers.

### **3.3. Schools**

Schools constitute an important part of the stock of public buildings in terms of their quantity and territorial distribution. They have a very extended time span of their construction from the 1950s to the 2000s. They are distinguished for consumption in five services: 1) Heating; 2) Cooling (partially); 3) Hot water; 4) Electrical appliances, 5) Lighting. They are characterized by different typologies in terms of construction structure and capacity of students. Mostly the walls are of brick, while the earliest and stone constructions with high values of the overall heat transfer coefficient  $U = 1.3 \div 1.7 \text{ W / m}^2\text{K}$ . Heating for the most part is provided by central boiler systems running on diesel fuel or pellets. Generally, the lighting in the classrooms was at the right levels while the corridors were lowered. Mechanical ventilation is missing. The hot water is mainly supplied through electric boilers installed in the toilets.

### **3.4. Kindergarten**

One of the most important typologies evaluated during this process has been kindergartens, this for their social impact and the fragility of their users who are children from 0 to 6 years. Even this building typology is characterized by different types of construction structures and different number of their users. Consume energy in all six services: 1) Heating; 2) Update; 3) Hot water; 4) Cooking; 5) Electrical appliances, 6) Lighting. The period of their construction is extended over the period '70 ÷ 2000. Most of the reconstructions have mainly affected the exterior facade and partly the installation of technical systems (boilers, air conditioners, etc.). The windows are made of single or double glazed aluminium frames. Heating is mainly accomplished by central heating systems with boilers and radiators, which operate with diesel fuel or pellets. Warm sanitary water is provided mainly by electric boilers and toilets only. While summer cooling needs only in some recently remodelled gardens are air conditioners installed for separate spaces and in other cases the cooling is done by natural ventilation (leaving doors and windows open).

### **3.5. Universities**

These buildings have different characteristics regarding the structure of the building and their main needs are for heating in winter but also for cooling, these relatively small as in hot season universities operate with a very limited capacity. Just as schools have a high concentration and large number of users, so they have significant energy consumption. Have energy consumption in five services: 1) Heating; 2) Refresh (partially); 3) Hot water; 4) Electrical appliances, 5) Lighting. They are mostly built during the 1960s-2000s. Most of them are adopted so the original destination was not for university. Regarding heating they are mainly with central systems with diesel fuel boilers. Whereas the recently refurbished ones also have central air conditioning systems (both for heating and cooling). Lighting systems are generally at acceptable levels and there is a trend in the use of LED lamps, especially in any new refurbishment or new construction. In most cases, hot sanitary water is missing, and in cases where it is carried out through electric boilers in the toilets. Here too, ventilation is done naturally through the opening of doors and windows. There is a massive use of split air conditioners and partially for certain areas of central chiller building systems.

### **3.6. Public Institutions Building**

This type of typology encompasses almost all central level public institution buildings (ministries, national agencies, police stations, prisons, etc.) but also local ones (subordinate to municipalities). Their use coincides with the official working hours of 8/24 hours a day and 5/7 days a week and almost year-round. Requirements are for both winter heating and summer cooling. This makes the requirements for technical systems complex. They consume energy in five services: 1) Heating; 2) Update; 3) Hot water; 4) Electrical appliances, 5) Lighting. Constructions are mainly of brick wall and the roofs are mainly of

flat soles. They are characterized by high heat transfer coefficients high  $U = 1.2 \div 1.7 \text{ W / m}^2\text{K}$ . The windows are mainly of single or double glazed aluminium structure. In the case of large-scale buildings, central heating and cooling systems are installed. In the case of heating systems, they are mainly diesel fuel and rarely pellets. Recent refurbished buildings mainly install central systems with chillers or VRFs to provide both heating and cooling in the summer. In small buildings, heating and cooling is carried out by means of individual heat pumps for each room. Hot sanitary water is missing or supplied through electric boilers mounted on toilets. The lighting system is at acceptable levels and there is a tendency to install LED lamps.

In Table 1 are given briefly the most common heat losses factors.

**Table 1.** Heat losses from building envelope

Factors	Impact in heat losses
Air infiltration	25% ÷ 45%
External walls	20% ÷ 30%
Terrace/roof	5% ÷ 10%
Floor	2% ÷ 5%
Windows + doors	20% ÷ 30%
Thermal bridges	3% ÷ 8%

Figure 4 below represent an image from thermal camera for a building façade.



**Figure 4.** Image from thermal camera

Main energy source is electricity (almost all typology are highly depended on electricity). Another source is oil, especially for heating (boiler) during the winter or Domestic Hot Water (DHW) production. Rarely are find gas boiler. In the last years' pellet is another fuel alternative for heating or DHW production. In cold zones wood stove are still in use.

Physical and thermal situation of the existing stock of public buildings (new and old stock) is generally not good. For this reason, this stock represents a great potential for energy saving by taking energy efficient measures (thermal insulation, efficient window/door). Many public buildings do not have a central heating system and especially do not have cooling systems. Even when there is a central system, there is usually no automatic regulation. Automatic regulation system is missing or outdated, so it is difficult to measure the use of energy. With the exception of buildings constructed in the last decade, buildings in Albania are without isolation or have limited isolation. In Albania, only one part of the building is heated, to save energy and to have lower costs.

#### **4. CONCLUSIONS AND RECOMANDATIONS**

While there are many opportunities to improve energy efficiency in the public buildings sector, overlapping and not clearly defined policies to guide these opportunities in Albania need to be significantly improved. Designing intelligent policy packages is not a simple process, as the energy efficiency potential is distributed among different types of buildings and fragmented among end users. Also below are some general recommendations:

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- Deep renovation for existing building, including: thermo-insulation (thickness of insulation varies according climate zones), double or triple glazing windows; tents and shutters.
- Replacement lighting system with more efficient one.
- Increasing the level of Building Management System (especially for complex buildings like hospitals).
- Regarding technical system: renewal or replacement of old boiler systems with gas or pellet boilers.
- Use of Renewable Energy Systems
- Use of Solar Thermal Panel for DHW production

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**O 27. ASSESSMENT OF THE WATER BUDGET BY USING A CONCEPTUAL MODEL: THE CASE OF ÇARŞAMBA BASIN**

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**ABSTRACT:** Hydrologic models are crucial to detect, understand and improve water resources and their behaviour. The Hydrologiska Byråns Vattenbalansavdelning (HBV) model which is deterministic, lumped, daily rainfall-runoff model, was implemented to the headwater of Çarşamba Basin, located on Konya Closed Basin in Turkey. The basin is in a region data-scarcity hence we used the data of Seydisehir and Hadim meteorological stations nearby. We aimed to understand the hydrological processes and obtain information that will facilitate the identification of water management strategies. Initially, the model was calibrated using the Generalized Reduced Gradient (GRG) nonlinear solving method for optimization, and at this stage, the HBV model showed an adequate performance. For daily runoff, the HBV model has performed at Kling-Gupta efficiency coefficient (KGE)=0.676 and Nash-Sutcliffe efficiency coefficient (NSE)=0.501. In this study, we also calculated the water budget as annual and seasonal to appraisal temporal performance of the model. Consequently, the best results have been achieved for spring months while achieving worst for summer months.

*Keywords: Generalized Reduced Gradient, The HBV Model, Hydrological Modelling, Water Budget*

## **1. INTRODUCTION**

Water has always been indispensable for the regions that have hosted civilizations. Therefore, the cautious use of water resources is important for the welfare of societies and for the continuity of civilizations. Hydrologic models allow us to develop strategies for problems and improve water resources.

Assessment of the water budget is part of the developing strategies. In order to calculate the water budget, meteorological data and model outputs such as precipitation, evapotranspiration, soil moisture, runoff, process of capillarity can be used.

In the literature, studies have been achieved to calculate the water budgets of basins by using hydrological models Hydrologiska Byråns Vattenbalansavdelning (HBV), Soil and Water Assessment Tool (SWAT), Water Evaluation and Planning System (WEAP), Système Hydrologique Européen (SHE), Hydrologic Engineering Center Hydrologic Modeling System (HEC-HMS).

Hydrological models can be variously classified. One of the classification methods, used by Singh (1988), basically divided hydrological models as two sections. These are material (also called a physical model) and formal (can be empirical, conceptual and theoretical). Physical-based models create an equality in the computer environment for each natural process. A formal model is idealized and simplified version of the structural conditions of the original system. Conceptual models contain parameters that have no equivalent in the original system. These conceptual parameters are expected to help the model to simulate the original process. The HBV model, used many times in literature, is one of the conceptual models established especially for the snow routine. The HBV model uses precipitation, evapotranspiration and temperature data to make daily soil moisture and flow estimates.

The HBV model is widely used all around the world. Tecklenburg et al. (2012), applied HBV-D REG (enhanced version of HBV) to the Ötztal catchment, Austria. They investigated the impact of climate change on the water balance. Their study showed that mean areal snow coverage decreased with time, whereas runoff in winter and spring increased. Jia and Sun (2012), first time applied HBV model for Liao river Basin, China. In their study, the HBV model significantly simulated the typical year's flood runoff and that of typical arid year. Bruland and Killingtveit (2002), in general, the HBV model has been tested in arctic regions since 1991. In their study, some aspects of the model developed for arctic

regions have been tested. These aspects are the soil moisture routine with variable field capacity, the glacial melting routine, the snow routine, and the snow cover discharge curves for the simulation of the dispersed snow deposits. Their  $R^2$  values are between 0.7 and 0.9. Normand et al. (2010), established the HBV model to Tamor Basin, in Eastern Nepal. They calibrated and validated the model for bigger and gauged basins, because of unavailable discharge data at the study area. The model applied to the Tamor basin showed good results at low flows. However, in the pre-monsoon and monsoon seasons, they noticed that there was a flaw in the model performance. Brink (2009), used simplified version of the HBV. Nine years of daily data are used as input for the model. As a result, the model predicted the discharge well. During extreme peak flows, relatively more errors were obtained.

Although it is difficult to find examples of the HBV model applications in Turkey, of course there is carried out successful studies. Sürer (2015), applied the HBV model to upper Euphrates basin, in Turkey. The model was calibrated by using the Multi-Objective Shuffled Complex Evolution (MOSCEM) algorithm. Thus, individual sensitivity of the parameters is analysed.

As far as we know, a conceptual model has not been applied to this region before. The purpose of this study is simulate the hydrological processes of the region well enough by using conceptual daily rainfall-runoff model. So, the model results, including water budget, can be evaluated and water management strategies can be developed in the headwater of the Çarşamba Basin, located on Konya Closed Basin, Turkey.

## **2. MATERIAL AND METHOD**

### **2.1. Study Area and Data**

To calculate the water budget by model-dependent values, the HBV model was implemented to the Çarşamba Basin, Turkey. The location map of the region is presented in Figure 1.

The headwater of the Çarşamba Basin, located on Konya Closed Basin, has 153.87 km<sup>2</sup> drainage areas. The elevation of the highest point of the study area is 2400 m while the lowest point is 1100 m. The region is located between 37°14' to 37°01' north latitude and 31°58' to 32°11' east longitude. Mean annual precipitation is 785 mm, mean maximum and mean minimum temperatures are 17.5 °C and 6.1 °C, respectively. According to long-term annual measurements, the highest observed flow was 6.329 m<sup>3</sup>/s and the lowest observed flow was 0.385 m<sup>3</sup>/s (Koycegiz and Buyukyildiz, 2019).

The standard HBV model requires precipitation potential evapotranspiration and temperature data. In this study, since the snow routine was ignored, no temperature data was needed. Potential evapotranspiration estimated by using Penman-Monteith equation. Study area is in a data-scarcity region, the meteorological station in the region does not have sufficient period observations hence we used the data of Seydisehir and Hadim meteorological stations nearby. The data of these stations were transformed into meteorological data of the region using Thiessen method. In this study, the HBV model, established to the region, was simulated from 2006 to 2015.



**Figure 1.** Study area map

## **2.2. The Hydrologiska Byråns Vattenbalansavdelning (HBV) Model**

The HBV, daily rainfall-runoff conceptual model, was first time applied successful in the spring of 1972 (Bergström, 1972). The general water balance can be conceptualized as in Equation (1).

$$P - E - Q = \frac{d}{dt} [SP + SM + UZ + LZ + \text{Lakes}] \quad (1)$$

Where

P= Precipitation

E= Evapotranspiration

Q= Runoff

SP= Snow

SM= Soil moisture

UZ= Upper groundwater

LZ= Lower groundwater

Lakes= Lake volume

Model can generate the runoff based on daily precipitation, evapotranspiration and temperature data. Different countries have developed and used the model according to their climatic conditions. Therefore, there are many versions of the model. The model is used for calculating water budget, flood forecasting, analysing level of drought and evaluate water resources.

The model consists of phases that snow routine, interception routine, soil routine and response routine. Every routine uses mathematical equations that contain conceptual parameters. (Bergström, 1992)

The snow routine of The HBV model, based on temperature, has a snow cover capable of holding water. This snow cover delays runoff. Interception routine is a process of water retention temporarily. Gradually, this water held in the recesses releases. Soil routinesymbolizes water processes in the soil. Soil has a limited water held capacity. Runoff response routine represents groundwater flows. The HBV model structure is exhibited schematically in Figure 2.

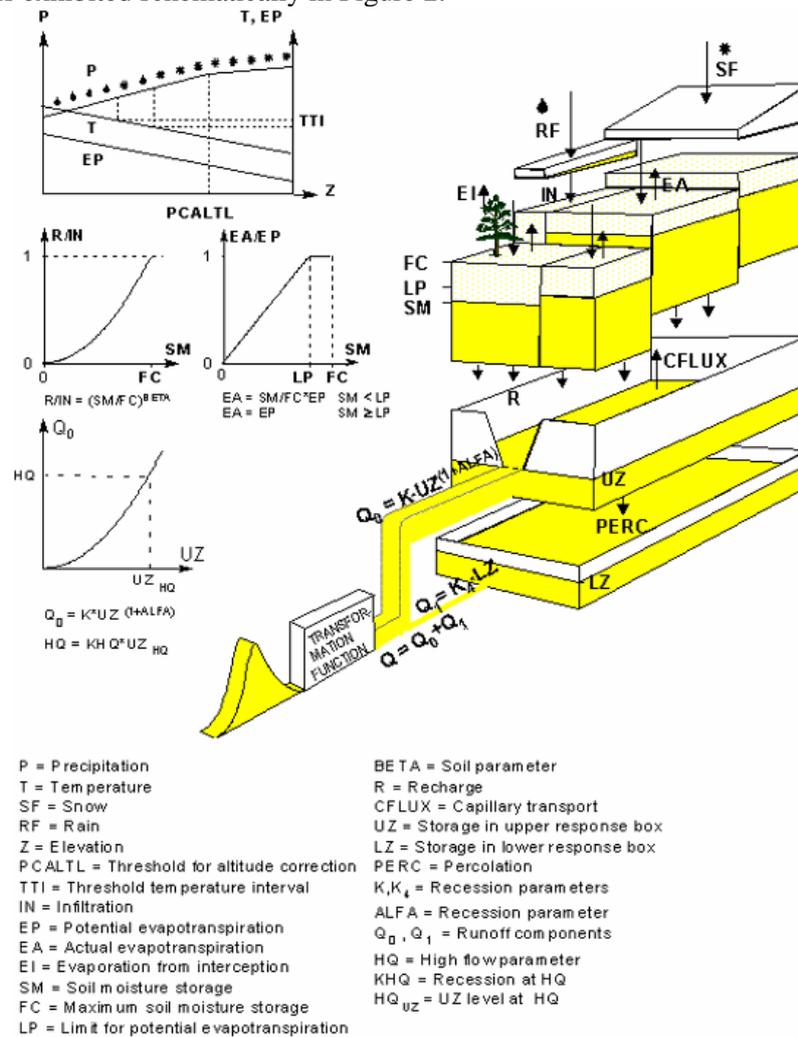


Figure 2. Schematic structure of the HBV-96 model (Lindström et al., 1997)

### 2.3. Calibration and Performance Metrics

The HBV model has conceptual parameters and there are boundary conditions which are recommended to keep these parameters between that values. In this study, model was calibrated using the Generalized Reduced Gradient (GRG). GRG, an algorithm for solving problems and calibrating models, allows nonlinear limitations and optional boundaries on the variables.

Nash-Sutcliffe Efficiency Coefficient (NSE), determination coefficient ( $R^2$ ), percent bias (PBIAS) and Kling-Gupta efficiency (KGE) were used to evaluate model performance during the calibration stage (Nash and Sutcliffe, 1970; Gupta et al., 1999; Legates and McCabe, 1999; Halefom et al., 2018). These are as follows:

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$$NSE = 1 - \frac{\sum(OBS_i - SIM_i)^2}{\sum(OBS_i - mOBS)^2} \quad (2)$$

$$R^2 = \left( \frac{\sum(OBS_i - mOBS) \times (SIM_i - mSIM)}{\sqrt{\sum(OBS_i - mOBS)^2} \sqrt{\sum(SIM_i - mSIM)^2}} \right)^2 \quad (3)$$

$$PBIAS(\%) = 100 \times \frac{\sum(SIM_i - OBS_i)}{\sum OBS_i} \quad (4)$$

$$KGE = 1 - \sqrt{(CC - 1)^2 + \left(\frac{OBSd}{SIMd}\right)^2 + \left(\frac{mOBS}{mSIM}\right)^2} \quad (5)$$

Where

OBS: Observed data

SIM: Simulated data

mOBS: Mean observed data

mSIM: Mean simulated data

OBSd: Standard deviation of observed data

SIMd: Standard deviation of simulated data

CC: Pearson coefficient value

### 2.4. Water Budget

Water budget is an analysis of relationship between inflow and outflow in a region. The water budget gives us the amount of water held in the area. This knowledge provides us to develop water management strategies and brings the predictions of future evapotranspiration and drought closer to accuracy. Water budget equation is as follows:

$$\Delta S = P - AEP - Q_{dr} - R - C \quad (6)$$

Where

P: Precipitation

AEP: Actual evapotranspiration

Q<sub>dr</sub>: Direct flow

R: Recharge flow

C: Capillarity

### 3. RESEARCH FINDINGS

In this study, GRG algorithm was used to calibrate 8 parameters and additionally we examined the seasonal behaviour of the model. The results obtained from the calibration are given in Table 1. The NSE closest to 1 was obtained for the parameter values in the table.

**Table 1.** The parameters and values used in the calibration.

Parameters	Parameter Definitions	Unit	Values
FC	Maximum soil moisture storage	mm	141.53
$\beta$	Soil parameter	-	0.207225
LP	Limit for potential evapotranspiration	-	0.1
$\alpha$	Recession parameter	-	0.1
Kf	Recession parameter	1/d	0.0076966
Ks	Recession parameter	1/d	0.0005
PERC	Percolation	mm/d	0.586523
CFLUX	Capillary flux rate	mm/d	8.65E-07

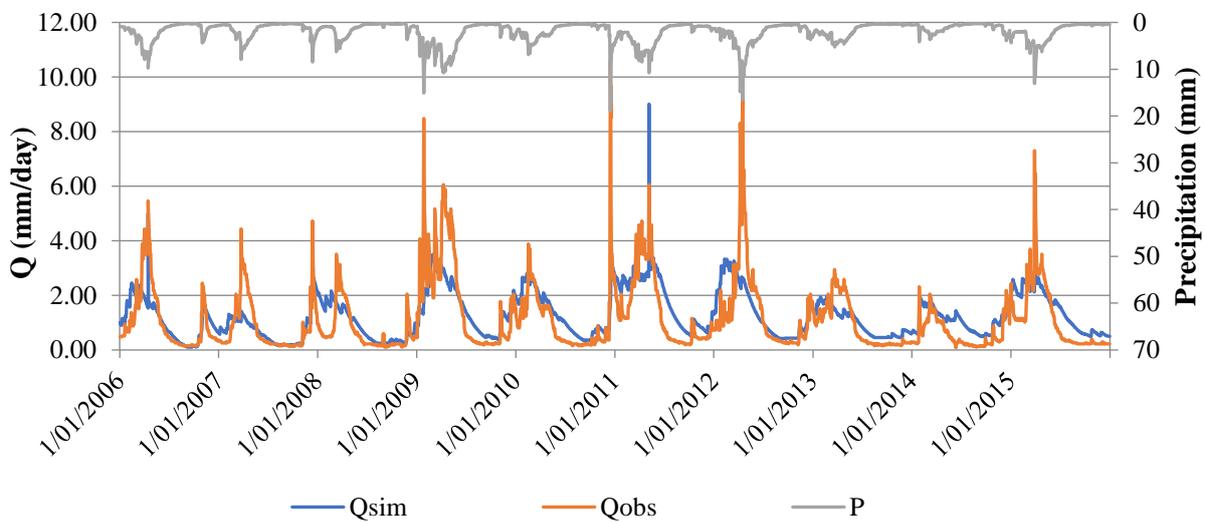
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Performance values based on the results obtained from the calibration performed with the GRG algorithm are given in Table 2. The HBV model showed an adequate performance. According to Table 2, the results obtained for  $R^2$  and NSE are satisfactory while PBIAS is good. For the KGE, it can be interpreted as sufficient level (Moriassi et al., 2007).

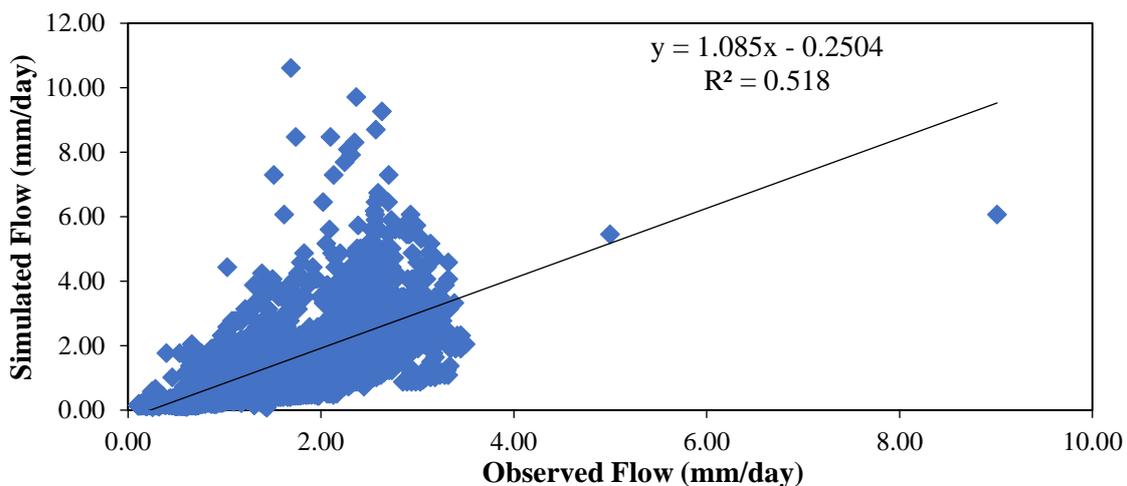
**Table 2.** The results of the calibration

Performance Metrics	Calibration Stage
NSE	0.501
$R^2$	0.518
PBIAS	11.454
KGE	0.676

The precipitation data and time series of comparison of simulated and observed data are represented in Figure 3. The scatter plot of the model is given in Figure 4.



**Figure 3.** Time series graph for calibration stage

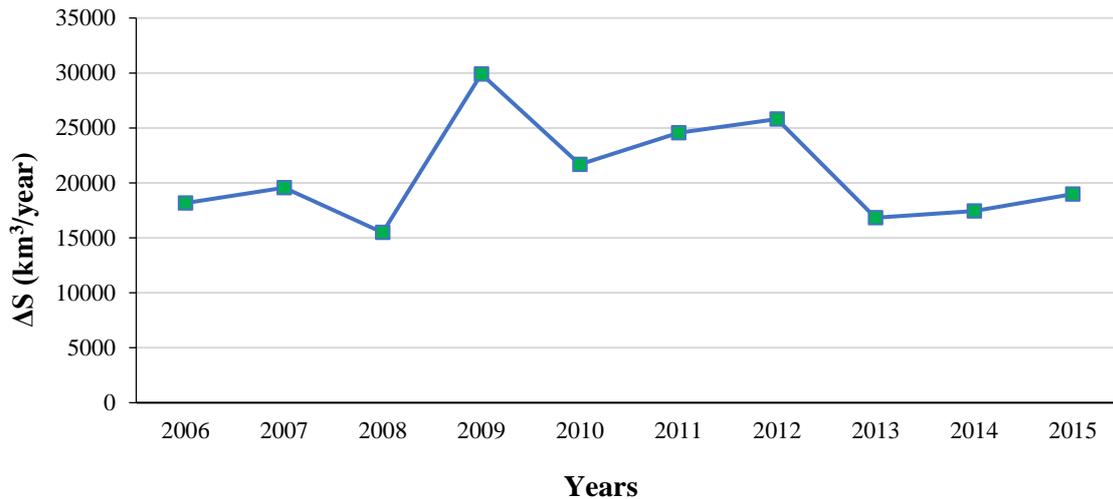


**Figure 4.** Scatter plot for calibration stage

The model was more successful at the low flow values than peaks. Sudden convective rainfall due to the geographic location of the region may mislead the model.

This situation may also be related to meteorological and climatic conditions of the region. In winter, frost occurs and receives snowfall. As the summer comes, snow and frozen water which in the soil turns into water suddenly and this water passes into flow. Assessment of seasonal behaviour of the model shows us the same implication. In the summer, the model could not exhibit results as good as the other seasons. That because the snow is melting and the flow reaches its peak abruptly.

In this study, the water budget was calculated by the model-dependent values annually. Water budget results by years are given in Figure 5. According to Figure 5, similar amounts of water accumulate in the watershed every year. But especially, in 2008 and 2013, amount of water held is lower than the other years. The reason of this would be temperature changes in the region. Temperature affects evapotranspiration i.e. the amount of water retained.



**Figure 5.** The water budget results

Also, it should be noted that the region has snowfall. Rainfall in the region may remain as snow cover. On the other hand, the precipitation waters may be removed from the area by undetected ground waters. The presence of these conditions should be investigated.

#### **4. CONCLUSION**

In this study, we established the HBV, daily rainfall-runoff conceptual model, to data-scarcity region, headwater of Çarşamba Basin. We evaluated the model results during calibrating stage. Additionally, seasonal behaviour of the model was examined.

The HBV model performed more successfully at low flows than high flows. Taken data from a meteorological station within the region will be played an important role in the development of the results. Unfortunately, there is no station in the catchment. In addition, the model's performance can be improved by adding snow routines to the model and examining groundwater resources in the region.

The water budget assessed shows that a similar amount of water is kept in the basin each year. However, it should be kept in mind that the water budget is calculated based on the model data. It is useful to examine how much of the water accumulated in the region remains as snow cover. Also, there is benefit in determining the water consumption of the people of the region.

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## **O 28. DROUGHT ANALYSIS WITH STANDARDIZED SOIL MOISTURE INDEX USING HYDRO-METEOROLOGICAL DATA**

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**ABSTRACT:** The drought, which directly affects the agriculture of a region and the living standards of the indigenous people, is an important climate event. In this study, it was aimed to interpret the drought periods in the headwater of the Çarşamba Subbasin of Konya Closed Basin by using the Hydrologiska Byråns Vattenbalansavdelning (HBV) model, which is a conceptual rainfall-runoff model. For this purpose, the standardized soil moisture index (SSI), which is a simple drought index, was used depending on daily soil moisture. Firstly, the HBV model to solve optimization problems was calibrated using the Generalized Reduced Gradient (GRG) code. The success of the HBV model for a region with data scarcity is sufficiently accurate with the percentage bias ( $P_{bias}$ ) = 11.454% and the coefficient of determination ( $R^2$ ) = 0.518. In this study, based on daily soil moisture data, years were divided into drought periods to better understand and interpret region drought. As a result, almost the same number of dry days was obtained in all years.

*Keywords: Generalized Reduced Gradient, The HBV model, Hydrological modelling, Standardized Soil Moisture Index*

### **1. INTRODUCTION**

The hydrological cycle is one of the building blocks of the environmental process. Furthermore, it is indispensable for the life of all living things, including human beings. Therefore, it is extremely important to observe, understand and model this cycle. In this context, many hydrological models have been developed and some of them are used in order to simulate this process.

Drought, which is one of the most important climatic events, is very dangerous for environmental life. Being able to do drought analysis thanks to the hydrological models developed contributes to the formation of future strategies.

The Hydrologiska Byråns Vattenbalansavdelning (HBV), conceptual daily rainfall-runoff model, used in many different studies to estimate runoff. Van Loon et al. (2009), they investigated how successful the model would be to simulate propagation of drought in European catchment. They found that the model had some conceptual problems in simulating groundwater during dry periods. Liden and Harlin (2000), they examined the HBV model in different climate conditions. According to this study, the magnitude of the water balance components had a significant impact on the model performance. Xu et al. (2018), purpose of their research is to develop a soil moisture index which can give drought notice. Sridhar et al. (2008), they model soil moisture and examined the importance of soil moisture in quantifying drought through the development of a drought index. The results showed that the soil moisture influence was undoubtedly a quantitative indicator of drought.

To best of our knowledge, drought analysis has never been done using a conceptual model in the region. The aim of this study is to establish a conceptual model to the headwater of the Çarşamba Basin, located on Konya Closed Basin and to perform drought analysis using an easily interpretable index.

### **5. MATERIAL AND METHOD**

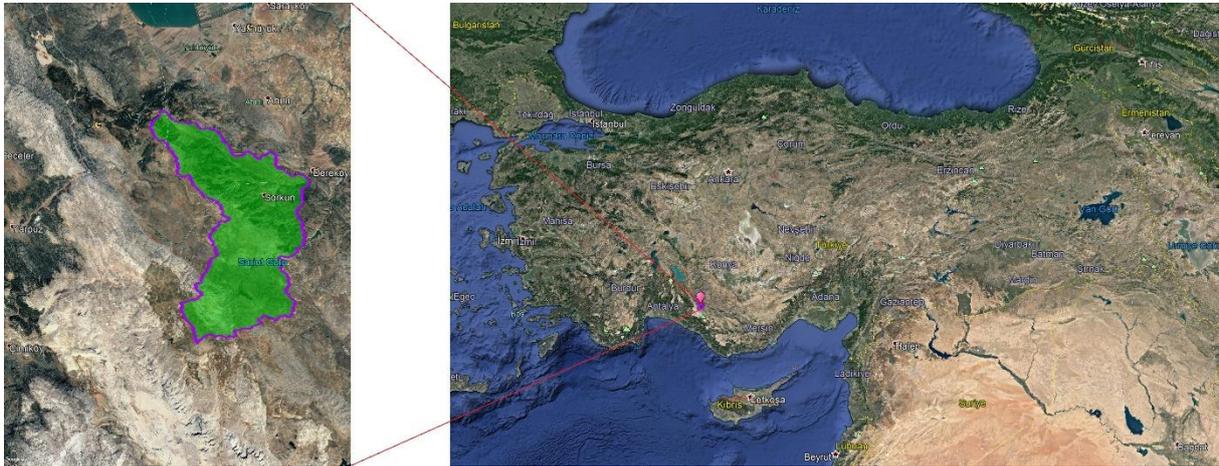
#### **5.1. Study Area**

The model was established to determine the model-dependent drought level in the Çarşamba Basin, Turkey. The map of the region is exhibited in Figure 1. The headwater of the Çarşamba Basin, located on Konya Closed Basin, have 153.87 km<sup>2</sup> drainage areas. The elevation in the region is between 2400

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m and 1100 m. The region is located between 37°14' to 37°01' north latitude and 31°58' to 32°11' east longitude (Koycegiz and Buyukyildiz, 2019).

In this study, potential evapotranspiration was predicted by using Penman-Monteith equation. Study basin is in a data-scarcity region hence we used the data of Seydisehir and Hadim meteorological stations nearby. The precipitation and potential evapotranspiration data, from 2006 to 2015, were transformed into meteorological data of the region using Thiessen method. It should be noted that snow routine was ignored.



**Figure 1.** Study area map

### **5.2. Hydrological Model**

The HBV, daily rainfall-runoff conceptual model, can produce the runoff when fed with daily precipitation, evapotranspiration and temperature data. In summary, the model tries to simulate the hydrological process in an area by using inputs and conceptual model parameters. The HBV model can also be used to analyse the drought level (Bergström, 1992).

### **5.3. Calibration and Performance Metrics**

In this study, the HBV model to solve optimization problems was calibrated using the Generalized Reduced Gradient (GRG). GRG code.GRG algorithm tries to synchronize the simulated and observed flow values by changing the model parameters.

In this study, Nash-Sutcliffe Efficiency Coefficient (NSE), determination coefficient ( $R^2$ ), percent bias (PBIAS) and Kling-Gupta efficiency (KGE) were used to gauge model performance (Nash and Sutcliffe, 1970), (Gupta et al., 1999), (Legates and McCabe, 1999), (Halefom et al., 2018).

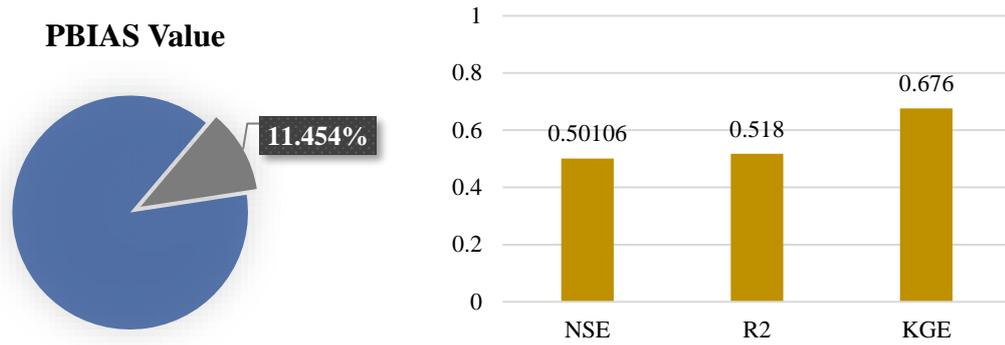
### **5.4. Standardized Soil Moisture Index (SSI)**

SSI is an agricultural drought index which dependent on daily soil moisture values of the model. This index is calculated by using 3 soil moisture values. These are daily soil moisture (SMi), annual mean soil moisture (mSM) and standard deviation of annual soil moisture (stdvSM). This index is as follows;

$$SSI = \frac{SMi - mSM}{stdvSM} \quad (1)$$

## **6. RESEARCH FINDINGS**

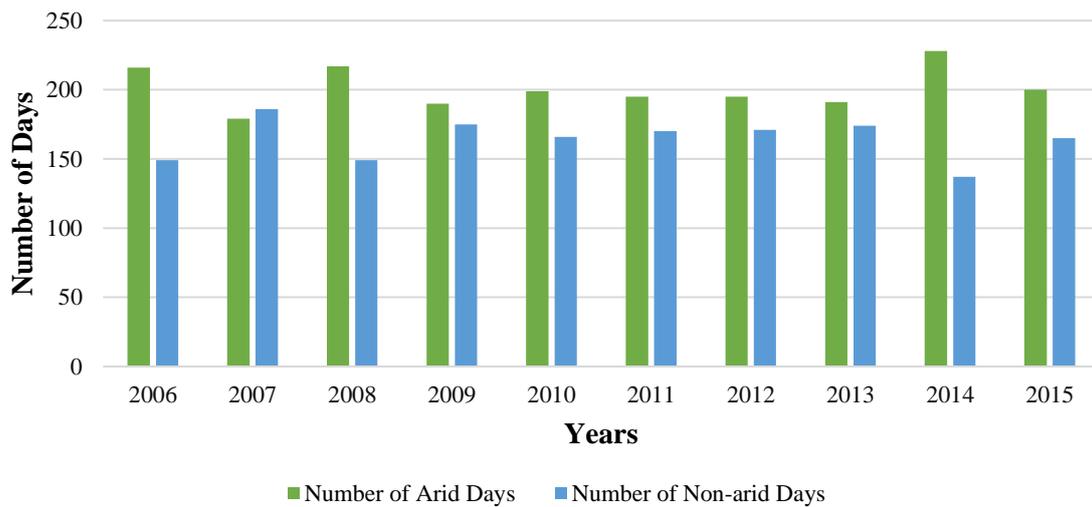
In this study, GRG algorithm was used to calibrate the HBV model. Performance of the model was evaluated using performance metrics. The model performance values are given in Figure 2. The success of the HBV model for a region with data scarcity is sufficiently accurate. The results obtained for  $R^2$  and NSE are satisfactory while PBIAS is good (Moriassi et al., 2007).



**Figure 2.** Results of the calibration

The model was more successful at the low flow values than peaks. Meteorological and climatic conditions of the region may mislead the model. Such that sudden melting snow create an unpredictable flow.

In this study, the SSI was calculated by the model-dependent soil moisture values annually. Drought analysis results are given in Figure3. According to Figure3, almost the same number of dry days was obtained in all years even if the most arid year is 2014. In addition, the model showed that on average, 55% of each year is arid. Bu it should be noted that this is an agricultural drought.



**Figure 3.** The drought analysis results

Figure 4 shows the change in mean amount of soil moisture by months. According to Figure 4, with the end of the spring months, rapid water loss occurs in soil. The dry season occurs in the second half of the year.

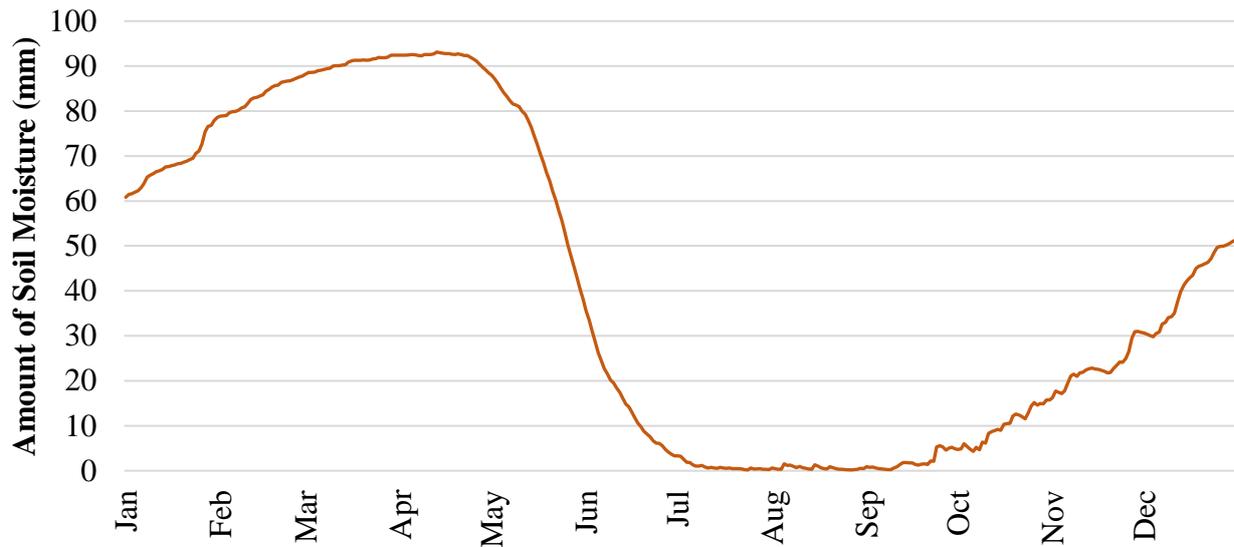


Figure 4. Mean amount of soil moisture by months

## 7. CONCLUSIONS AND DISCUSSION

In this study, the HBV, daily rainfall-runoff model, established to headwater of Çarşamba which is in a region data-scarcity. GRG algorithm was used to calibrate to model. Model performance is adequate. Standardized soil moisture index was calculated based on the daily soil moisture taken from the model. As a result, the model showed that about 55% of each year is arid. It should be noted that this is an agricultural drought.

To avoid drought, the region should be observed and measures such as afforestation. Afforestation is vital to avoid drought. About the importance of afforestation can be highlighted in 3 main headings. These are as follows;

- ❖ Trees reduce evaporation by protecting soil and water surfaces from sunlight. Decreasing evaporation will increase the soil moisture will occur.
- ❖ Convective precipitation increases since there will be more snow and rain held.
- ❖ Afforestation will create a rougher surface than the bare land. Therefore, the flow will be low. This means that the water will remain in the basin and soil moisture will increase.

On the other hand, we used an agricultural index based on soil moisture average and standard deviation. It means that in some short periods the soil moisture is well above average.

Plants that demand plenty of water for a period of the year and do not need it afterwards or easy-to-grow plants are recommended to individuals or organizations considering agricultural activities. If easy-to-grow plants are selected for harvest at the end of spring, dry plants may be preferred for the rest of the year.

In addition, long-term data connected to a meteorological station in the region will increase the success of the model and improve the results of drought analysis.

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## **O 29. EVALUATION OF THE AKSARAY PROVINCE AIR QUALITY: CONDITIONAL BIVARIATE PROBABILITY FUNCTION AND K-MEANS CLUSTERING**

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**ABSTRACT:** This study addresses the three major questions: (1) what are the emission sources of PM<sub>10</sub> and SO<sub>2</sub> which are affecting the study area; (2) where do these emission sources come from; and (3) is there any temporal variation in the emission sources. In the current work K-means clustering techniques were applied directly to bivariate polar plots to identify and group similar features. The technique is analogous to clustering applied to back trajectories at the regional scale. When applied to data from a monitoring site with high source complexity it is shown that the technique is able to identify important clusters in ambient monitoring data. In Aksaray PM<sub>10</sub> values follow a seasonal trend. The average PM<sub>10</sub> concentration was recorded higher in the summer season and lower in the winter. It is observed that 50 µg m<sup>-3</sup>, which is the 24-hour limit value of PM<sub>10</sub>, was exceeded in both summer and winter months. The average SO<sub>2</sub> concentrations also was detected higher during the winter months due to domestic heating and there was a decrease in concentration in summer. The winter and summer SO<sub>2</sub> average concentrations were calculated as 7 and 2 µg m<sup>-3</sup>, respectively. Looking at the SO<sub>2</sub> distribution over the months, it was seen that the normalized values are below 0.5 and the higher values were recorded in the period between November and February. Cluster analysis has been carried out for the PM<sub>10</sub> and SO<sub>2</sub> surface for clusters between 2 and 10. The choice of the number of appropriate clusters is heuristic and is best determined by post-processing the data according to cluster. 5 and 4 clusters were considered for PM<sub>10</sub> and SO<sub>2</sub>, respectively. PM<sub>10</sub> clusters were determined as 1 and 2- suburban emission, 3-traffic emission, 4-urban emission and 5-industrial emission. SO<sub>2</sub> clusters were identified as 1- suburban emission, 2- industrial emission, 3- urban emission and 4- mix of urban and suburban emission.

*Keywords: PM<sub>10</sub>, SO<sub>2</sub>, temporal variation, CBPF, k-means clustering*

### **1. INTRODUCTION**

PM are solid and liquid particles suspended in the atmosphere. It is released into the atmosphere both by natural (volcanic eruptions, seismic activities and forest fires) and anthropogenic sources (all kinds of man-made combustion and some industrial processes). PM is one of the most important air pollutants that adversely affect human health. The chemical content and size of the particulate matter are important parameters that determine possible health effects. Particulate substances are divided into two according to their aerodynamic diameters; those whose aerodynamic diameters are less than 10 µm are classified as PM<sub>10</sub> and those whose aerodynamic diameters are less than 2.5 µm are classified as PM<sub>2.5</sub>. PM compositions vary as well as changes in size. This variation in the composition of particulate matter emerges as a result of the release of many different sources and the photochemical reactions observed in the atmosphere (Teixeira et al., 2012). According to the Air Quality Assessment and Management Regulation which came into force in 2008, PM<sub>10</sub> limit values are determined as 50 µg m<sup>-3</sup> (not exceeding 35 in one year) and 40 µg m<sup>-3</sup> in 24 hours and annually, respectively.

Another important pollutant is SO<sub>2</sub> which is product of the combustion of sulfur compounds. Volcanoes and oceans are the main natural resources of SO<sub>2</sub> (Pereira et al., 2005; Carmichael et al., 2002; Garg et al., 2006; Reddy and Venkataraman, 2002). The anthropogenic sources of SO<sub>2</sub> are the burning of fossil fuels, especially coal and biomass, and the melting of sulfur-containing ores. SO<sub>2</sub> and its oxidation by-products are removed from the atmosphere by dry and wet precipitation. In addition to these transformation and removal processes, SO<sub>2</sub> can be transported over long distances, leading to global pollution. Many studies have been carried out to reduce SO<sub>2</sub> emissions. According to the Air Quality Assessment and Management Regulation which came into force in 2008, hourly, 24 hour and annual SO<sub>2</sub> emission limit values are 350 µg m<sup>-3</sup> (cannot be exceeded more than 24 in 1 year), 125 µg m<sup>-3</sup> (3 in

1 year) and  $20 \text{ mg m}^{-3}$ , respectively.

In this study,  $\text{PM}_{10}$  and  $\text{SO}_2$  values of Aksaray were investigated. Aksaray is in a position to provide access to important cities and has borders to Konya, Ankara, Nevşehir and Niğde. In addition, geographical features also has a special place in Central Anatolia such as Turkey's second largest lake, Salt Lake and Hasan Mountain, Melendiz Mountains and Ekecik Mountain which are the old volcanic mountains.

## **2. MATERIAL AND METHOD**

### **2.1. Sampling location**

Air quality monitoring station operated by the Ministry of Environment and Urban Development were used in the study. Aksaray has a station representing the city center. The urban and the industrial zone, which is considered as the center of Aksaray, are almost side by side. In the NE of the station, there is an industrial zone, in the east there is city center, in the south and SW regions there are partly residential areas, a bus terminal and a university campus.

$\text{PM}_{10}$ ,  $\text{SO}_2$ , wind speed and wind direction data have been taken from the National Air Quality Monitoring Stations website of the Ministry of Environment and Urbanization includes hourly data between March 1, 2017 and March 1, 2018. In order to make comparisons, data of border provinces (Ankara, Konya, Niğde and Nevşehir) were also used.

### **2.2. Conditional bivariate probability function**

The ordinary conditional probability function (CPF) estimates the probability of the measured concentration exceeding a specified threshold criterion for a given wind sector (Ashbaugh et al., 1985).

$$KOF = m_{\Delta\theta} / n_{\Delta\theta} \quad (1)$$

Here,  $\Delta\theta$  represents each wind sector,  $n_{\Delta\theta}$  represents the entire number of hourly winds blowing from the wind sector and  $m_{\Delta\theta}$  represents the number of hourly winds blowing from the wind sector by exceeding the specified threshold concentration.

The conditional bivariate probability function (CBPF) combines ordinary CPF and wind speed data into a third variable. The pollutant concentration is allocated to cells defined by wind direction and wind speed ranges rather than only wind direction sectors.

$$CBPF = m_{\Delta\theta, \Delta u} / n_{\Delta\theta, \Delta u} \quad (2)$$

Here,  $m_{\Delta\theta}$  represents the number of hourly winds blowing in the wind speed range from the wind sector through the specified threshold concentration.  $n_{\Delta\theta, \Delta u}$  indicates the number of winds per hour in the wind direction-speed range. The two-variable function provides more information about the nature of sources because different types of sources may have different wind speed dependencies. The use of a third variable can therefore provide more information about the type of source. The third variable may be another variable which will provide a radial approach such as temperature independent of the wind speed. Bivariate polar plots show how a pollutant concentration changes in polar coordinates along with wind speed and wind direction. Polar drawings are an effective way to see how a pollutant is dispersed and to see the effects of specific pollutant sources. Wind direction is a method that can be used to decompose different emission sources with wind speed (Uria-Tellaetxe and Carslaw, 2014).

### **2.3. K-means clustering**

K-means clustering is a method in which two-variable polar plot properties can be defined and grouped. The main purpose of this grouping of data is to aggregate the data in the original time series data to enable post-processing to better understand potential source characteristics. At the center of the clustering idea of data is the concept of distance, that is, similarities or differences between points. The similarities of the concentrations presented in the CBPF plots are defined by three variables:  $u$  and  $v$  components of wind and pollutant concentration. Basic k-means algorithm for k-clusters is obtained by minimizing;

$$\sum_{k=1}^K \sum_{x_i \in C_k} \|x_i - \mu_k\|^2 \quad (3)$$

$\|x_i - \mu_k\|^2$  is selected distance, average of cluster-  $\mu_k$   $c_k$   
The distance measure is defined as the Euclidean distance.

$$d_{x,y} = \sqrt{\sum_{j=1}^J (x_j - y_j)^2} \quad (4)$$

x, and y are two J-dimensional vectors, standardized by subtracting the mean and dividing by the standard deviation. In the operations performed, J defines the length of the wind components u, v and concentration C, each is standardized. Standardization is necessary because u and v are located at different scales relative to C.

### **3. RESULTS AND DISCUSSION**

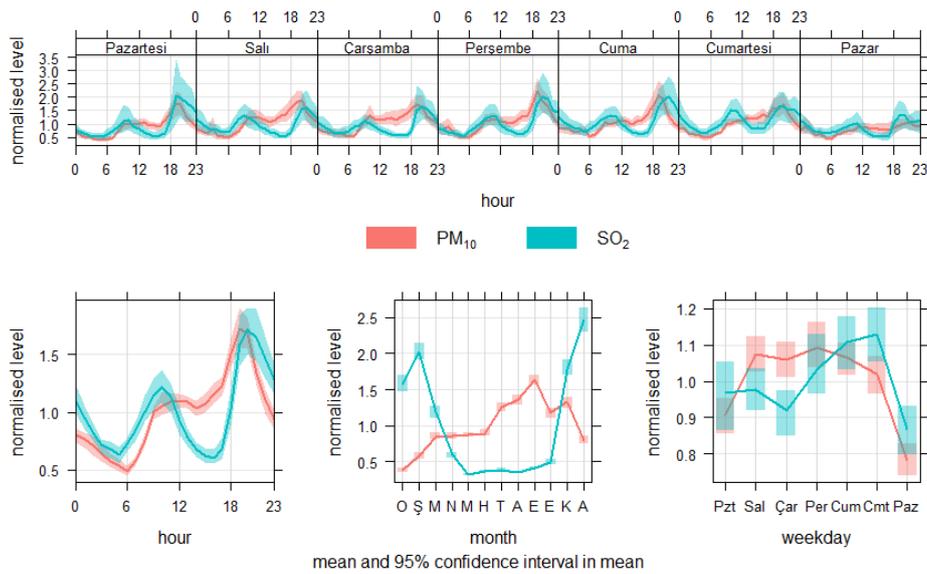
#### **3.1. Temporal variations of PM<sub>10</sub> and SO<sub>2</sub>**

Aksaray PM<sub>10</sub> values follow a seasonal trend. Higher values were recorded in summer and lower values were recorded in winter. This is due to atmospheric scavenging in the winter and the removal of particulate matter and its reflection to the sampling. In the summer, because of stable weather conditions and suspended particulate matter, it is more collected in the sampling compared to winter months (Gramsch et al., 2006). Thus, median values of summer months were recorded as 57  $\mu\text{gm}^{-3}$ , while winter median values were recorded as 37  $\mu\text{gm}^{-3}$ . This effect can also be explained by the wind speed. Wind speed was high between 12:00 and 18:00, while low between 20:00 and 06:00. As shown in Figure 1, a decrease in PM<sub>10</sub> concentrations is observed along with faster wind speeds, while there is an increasing trend in PM<sub>10</sub> concentrations at low wind speeds. Looking at the distribution of weekdays and weekends, the expected trend is seen and Sat.-Sun. decline continues on an increasing line during the week.

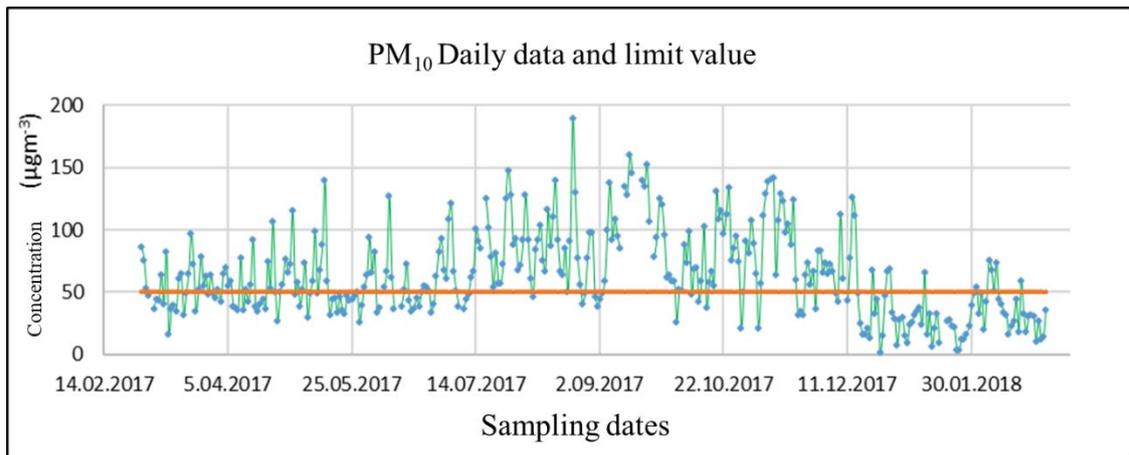
High values for SO<sub>2</sub> concentrations were recorded in winter, while low values were recorded in summer. Winter and summer SO<sub>2</sub> median values of Aksaray province were calculated as 7 and 2  $\mu\text{gm}^{-3}$ , respectively. When SO<sub>2</sub> emission sources are evaluated, this result is expected especially with the domestic heating factor. Looking at the distribution of SO<sub>2</sub> over the months, it is seen that the normalized values are below 0.5 between May-October and high values are recorded until February. Looking at the distribution of weekdays and weekends, there is a trend similar to PM<sub>10</sub> and decreasing values of the Sat.-Sun. increased with the beginning of the week.

When hourly PM<sub>10</sub> and SO<sub>2</sub> changes are examined, a decrease is observed after midnight. PM<sub>10</sub> values increase during the hours of morning traffic and in the afternoon traffic decreases with decreasing values. PM<sub>10</sub> and SO<sub>2</sub> concentrations are increased with the inversion of the atmosphere after 18:00 and the increase in emissions from domestic heating in winter. This increase in values decreases over time as the inversion loses its effect in the following hours and the emissions caused by domestic heating decrease.

The 24-hour PM<sub>10</sub> limit value of 50  $\mu\text{gm}^{-3}$ , which is determined in the regulation, is exceeded in both summer and winter average values (Figure 2). While 46% of data exceeded the limit value in winter months, this value increases to 64% in summer months.



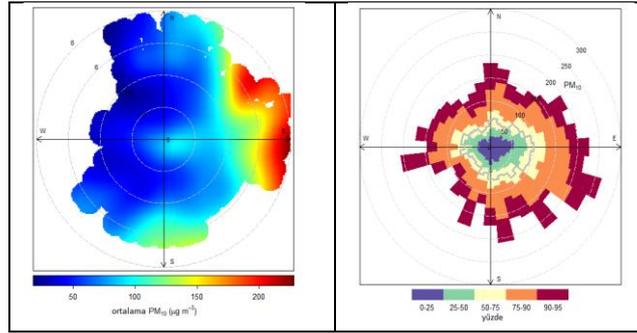
**Figure 1.** Temporal variations of PM<sub>10</sub> and SO<sub>2</sub>



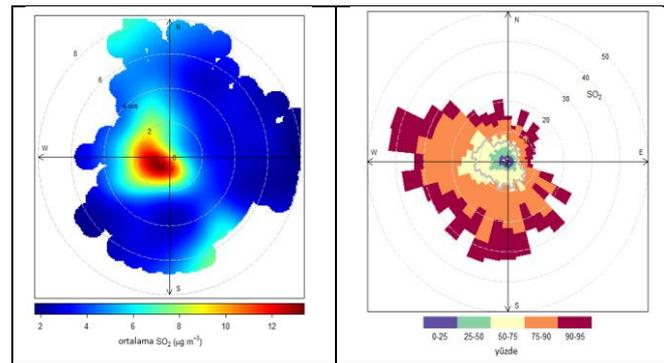
**Figure 2.** Aksaray-PM<sub>10</sub> daily data and 24-hour PM<sub>10</sub> limit value specified in the regulation

### 3.2. Conditional bivariate probability function results

2017-2018 PM<sub>10</sub> and SO<sub>2</sub> values and pollution percentage plots and CBPF plots are shown in Figures 3 and 4. It is observed that PM<sub>10</sub> concentrations of 150 µgm<sup>-3</sup> and above are mainly caused by pollutant emissions from east side of the station and PM<sub>10</sub> concentrations in the 100-150 µgm<sup>-3</sup> range are caused by pollutant emissions coming from south side. Especially when looking at the eastern part of the station, it is seen that there is Ankara-Adana road and urbanization. Therefore, it can be concluded that there is a PM<sub>10</sub> transport to the station in this direction with high wind speeds. When the percentage pollution plot is considered, it is seen that most of the PM<sub>10</sub> is carried by eastern winds. When the SO<sub>2</sub> CBPF plot is examined, it is seen that SO<sub>2</sub> transport (>9 µgm<sup>-3</sup>) is from the pollutant sources in the west direction with low wind speeds. The low wind speed and the SO<sub>2</sub> transport at these concentrations can be explained by the fact that the emission sources are very close and the emission is high. It could be concluded that SO<sub>2</sub> emissions from the organized industrial zone near the station contribute to this result. It is also seen that 5-7 µgm<sup>-3</sup> SO<sub>2</sub> transport in the NNW and SSE direction is at high wind speeds.



**Figure 3.** PM<sub>10</sub> CBPF and percentage pollution plot



**Figure 4.** SO<sub>2</sub> CBPF and percentage pollution plot

### 3.3. K-means clustering results

In this study, the clustering study was conducted for PM<sub>10</sub> and SO<sub>2</sub> pollutants with one year data. To determine the appropriate number of clusters, different clusters were used in the range of 2-10. Different methods to determine the optimum number of clusters have been presented in the literature (Everitt et al., 2011). However, these methods do not give effective results when applied to CBPF plots. At this point, it is best to select the appropriate number of clusters by selecting the appropriate number of clusters by post-processing the data with different clusters and evaluating the possible emission sources. There are two important clusters to be detected for PM<sub>10</sub> in the east and south directions. Figure 5 shows the clusters between 2-10 and k-means clustering plots prepared for PM<sub>10</sub>. Looking at the figure showing the result of 5 clusters, it is seen that the east and south clusters are splitting and this feature does not change as the number of clusters increases. When the results of the 5 clusters were examined, it was concluded that clusters 1 and 2 originated from the background emissions of the city, cluster 3- traffic emissions, cluster 4-city center emissions and cluster 5- industrial emission.

To determine the optimal number of clusters for SO<sub>2</sub>, attention should be paid to the south, south-west and north-west directions, which carry highly concentrated pollutants, especially at low wind speeds. When the clusters numbers 2-10 and k-means clustering plots prepared for SO<sub>2</sub> are examined in Figure 6, it is seen that the number of clusters 2 and 3 could not separate the sources effectively. With the 4 clusters, it is seen that both the emission source belonging to the low wind speed and the emission source in the direction of SSE are separated. There is no change in the cluster structure formed in the low-speed region from the number of clusters 5 and more. In the number of clusters 9 and 10, it is seen that this region is also divided into two. Since the aim of the clustering study was to keep the number of clusters at the optimum number, the cluster number for SO<sub>2</sub> was chosen as 4 for this study. When we look at the distribution for the number of clusters selected, cluster 1 represents the city's background emission profile. It was concluded that cluster 2 represents the emission profile arising from the industrial zone close to the station, cluster 3 points to the city center emission profile, and lastly cluster number 4 represents the emission profile caused by atmospheric transport from the city and also from the surrounding provinces (especially Niğde).

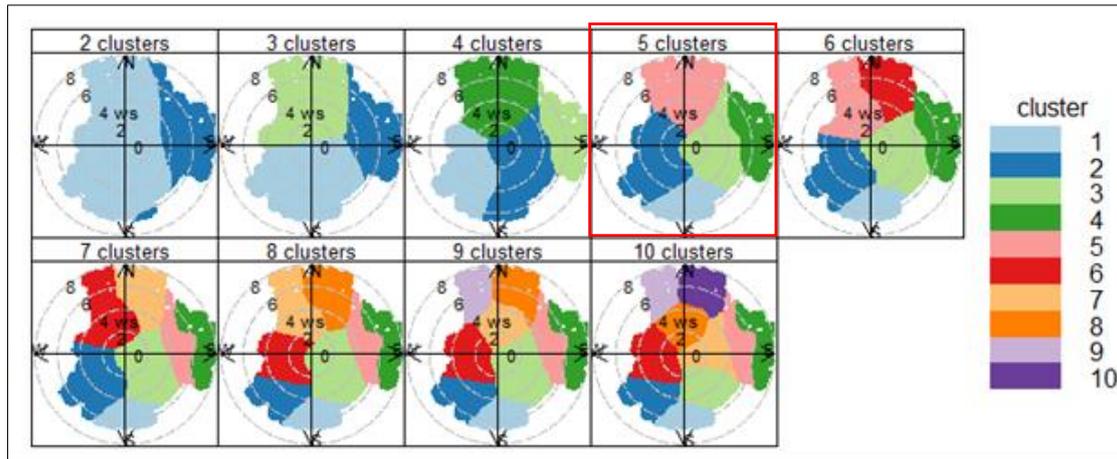


Figure 5. Clusters identified at Aksaray for PM<sub>10</sub> concentrations for 2 to 10 clusters

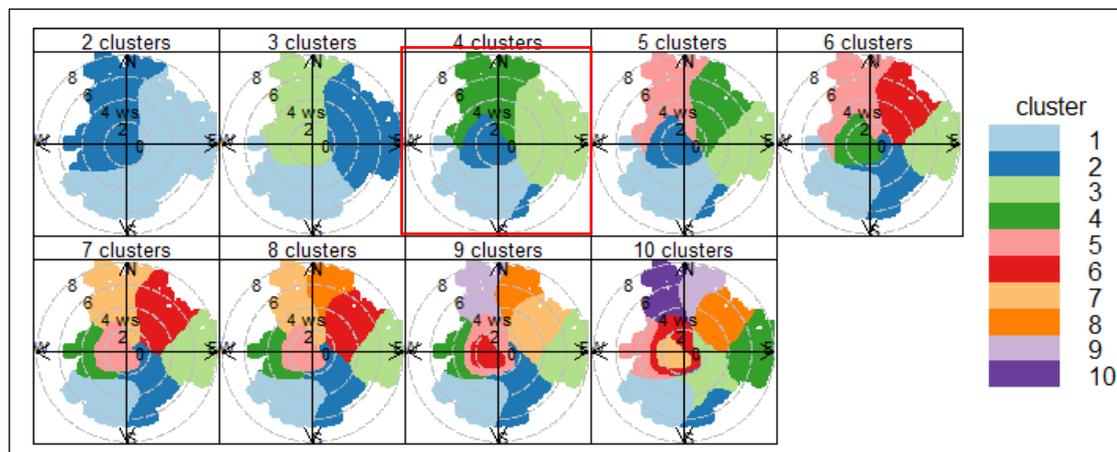


Figure 6. Clusters identified at Aksaray for SO<sub>2</sub> concentrations for 2 to 10 clusters

### 3.4. Correlation results of PM<sub>10</sub> data with neighboring provinces

Due to its geographical location, Aksaray province is open to particulate pollutants caused by local-anthropogenic pollutants and regional transport. The 24-hour limit, 50  $\mu\text{g m}^{-3}$ , was frequently exceeded. As the correlation factor  $R^2$  value increases, it could be said that PM<sub>10</sub> emission is regional. In the light of the findings, the strongest correlation was found with Nevşehir and the lowest correlation was with Ankara. In this case, the contribution of PM<sub>10</sub> emission with atmospheric transport from Nevşehir can be mentioned. Considering that only the correlation factor remains at a maximum of 0.37, it is seen that the PM<sub>10</sub> emission source of Aksaray Province is local pollutant.

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**O 30. KONYA SYNERGY IN THE FIELD OF COMPOST AND BIOGAS PLANTS**

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**ABSTRACT:** Storage of livestock waste on inappropriate conditions; creating visual pollution and various gases resulting from waste stack affect the air quality of the region negatively. Uncontrolled landfilling of waste threatens human and environmental health, as it destroys both the soil and groundwater since it destroys the biological structure of the soil. It is necessary to get rid of the contradiction of evaluating organic waste, important source of energy and fertilizer, when environmental problems caused by organic waste and external dependence on energy and chemical fertilizer are taken into consideration. Energy can be obtained from organic waste which is renewable energy source for protection of environmental pollution and at the same time the fertilizer, product of compost or biogas plants, can be recycled to soil as nutrient element source which is very necessary for plants by evaluating organic wastes in compost or biogas plants. The assessment of organic waste is an environmentalist, social and economic project that brings together strategic approach. Global warming requires that the energy used today must be "Renewable and Sustainable". Turning towards renewable energy sources is of great importance in terms of national, political and economic interests. Nowadays energy is the one of the most expensive inputs in production. Energy generation from waste emerges as an economical and environmental-friendly method when depleted conventional energy resource, rising energy prices and recycling and recovery of waste are taken into consideration. This study will contribute to the establishment of plants which will produce 430,800 tons of pellet organic fertilizer per annum, 234 GWh electrical energy in low efficiency scenario and 514 GWh electrical energy in high efficiency scenario in biogas plants in Konya which have significant organic waste potential.

*Keywords: Sustainability, biogas, renewable energy, organic waste, organic fertilizer*

**O 31. EVALUATION OF CAPACITY AND SEISMIC PERFORMANCE OF BRICK MASONRY BUILDINGS WITH AND WITHOUT STRUCTURAL INTERVENTIONS**

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**ABSTRACT:** Unreinforced masonry [URM] is the dominant structural type for low to moderate-rise buildings in the Albania. Its dynamic response is highly inelastic, and generally shows high vulnerability to earthquake loading. Also many buildings of these type in Albania have structural interventions like added floors, or wall openings, especially in the first floors of the buildings, which are near main roads, because of great demand for shops and stores. In literature, there are a number of methods available to evaluate the seismic performance of these buildings. The choice of the proper model to use is a matter of paramount importance, as many aspects must be taken into account in order to reach a good approximation of the structural behavior. Within this context, this paper aims to make seismic performance assessment by following the equivalent frame approach based on macro-element modeling. Due to the resource and time efficient computations, this approach is becoming more popular among the practitioners and field experts in this area and allows simulating the non-linear behavior of masonry buildings. This method will be applied to three old masonry buildings from the Albanian construction practice that are representatives of low- and mid-size residential buildings. These buildings are of the same template but some of them have structural interventions. It must be said that in Albania, masonry buildings have been built using templates all over the country, so both models with and without intervention are common. Capacity curves of the investigated building will be determined to assess the most probable seismic response of the investigated housing construction in the region. Also the Finally, estimated results will be used to evaluate the seismic performance of the tested structures.

*Keywords: Unreinforced masonry buildings, Macro-element approach, seismic vulnerability, TREMURI software, unreinforced masonry buildings*

## **1.INTRODUCTION**

### **1.1 History of masonry structures**

Albania in all of history has known many different developments in engineering and architecture. Nowadays, the most common type of residential buildings and when the major part of the population lives, are of principal masonry materials. Masonry as a cheaper material was the most used and mostly used as unreinforced masonry, with building up to 5 story high, especially in the 45-90s era. Building codes also, have played a significant role. KTP-1963, KTP-1978 and KTP-1989 have significant changes within one another, but also very verified deficiency. This comes from lack of knowledge of the time especially on seismic calculations, compared to nowadays accepted worldwide codes like EC and ASTM. Lacking of seismic analysis in KTP-63 and low considered demand of KTP-78, implies that the entire stock of pre 89s era to be reconsidered and reanalysed with today updated codes.

### **1.2 Basics of analysis**

From the stock are choosen three buildings, from the most used templates of each era, reffering here to code of design. Bricks and mortar samples are extracted from these buildings and six tests are performed to evaluate the mechanical properties of the materials used and masonry bearing walls. Three dimensional models of buildings are prepared for modal, pushover and performance analysis by a user-friendly software as 3muri, specialized for masonry buildings. This software uses macro-modelling technique with pier and sprandels and takes in consideration the non-linear phase of the masonry material, as in EC normative. Pushover analysis is performed, for 24 cases of loading in both direction, eccintrency, and shapes. The spectrum approach for seismic design is a very useful and easy solution

comparing to more complicated analysis as time history analysis or fragility analysis. It gives a limited solution, but its data is acceptable for most of the cases. Seismic loads in this approach are represented by response spectrum function which are derived from the time history records of earthquakes in a specific area. Performance evaluation as N-2 normative and EC, gives a view of the seismic risk for each building.

### **1.3 Various common interventions on masonry buildings**

For many buildings especially those that are near main roads serious problems can be noticed. The subfloors were intended for magazines, with small openings, but due to commercial request for shops, stores etc, in many times interventions are done. Even though masonry structures are designed with load bearing walls This not only weakens the structure, but seriously affects seismic resistance. Examples like this, and of similar intervention on Albanian masonry structures are very widespread. Since lots of time has passed since the time of construction of these structures, all types of damage effects like physicals, chemicals, and from human intervention are present in these buildings. walls are demolished on the first floor and replace with two columns and a beam sustaining all the loads coming from above. Another very wide spread intervention in Albanian building stock is the phenomenon of added stories. After the collapse of the communist regime in the 90s, because of the great demand in cities for housing, in many times stories were added in various buildings using light materials. These additions were done in a hurry and without design and projects during this time. But later at the 2000s due to the policies of the time, these additions were legalized and still exist nowadays. In this study buildings with this intervention will be studied and compared with the design and project of original template.

## **2.CASE STUDIES**

### **2.1 Brief history**

The housing problem in the socialist state could only be solved through multi-story buildings built on projects based on template section designs. The first template section archived was two story adobe building in 1949. The beliefs of the regime were also projected in the buildings body. The institutes and government made laws for equality and standardization. So buildings were made by combination of standard apartments approved. Since these buildings, have been built in a long time, around 45 years, their diversity is very wide. Although the use of template sections, facilitates the process of classification, still diversity is noted, and affects directly structural efficiency.

### **2.2 Classification of masonry buildings stock**

The basis of classification for masonry structures are denined by four pillars: time of construction, height of building, material used and building location. From time of construction buildings can be classified as:

- Buildings constructed before 1963: Based on prior experience, no seismic evaluation
- Buildings constructed from 1964 to 1978: Based on KTP-63, very low seismic consideration
- Buildings constructed from 1979 to 1990: Based on KTP-78, low seismic consideration
- Buildings constructed after 1991: Based on KTP-89, small population of buildings with load bearing masonry walls.

The classification of height is based on the number of stories each building has. The Albanian building stock has maximum 6 story buildings with load bearing masonry walls. Most of the buildings prior of KTP-63, were no more than 4 stories, and later up to 5. In many buildings problem are the added stories, that impies an increased seismic demand, with all the deficiency that KTP-78 itself has. The tallest buildings are the ones, in wich is expceted more damage and risk in seismic scenario.

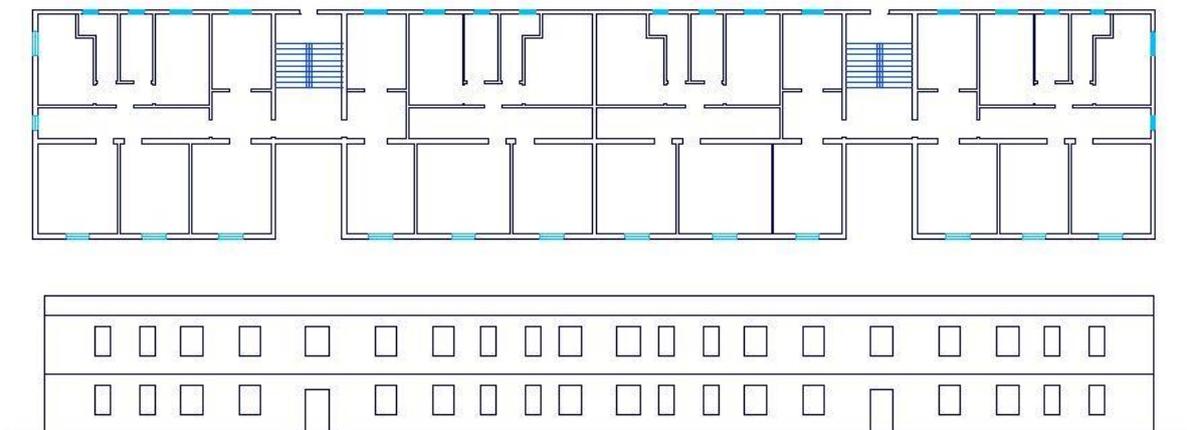
By the materials used these buildings can be classified in two major groups: unreinforced masonry and confined masonry. Unreinforced masonry are most common and before KTP-78, very few buildings had confinement columns, on the load bearing walls. These buildings are of both clay bricks masonry and silicate brick masonry. Buildings with clay brick masonry perform more resistant to atmospheric agents comparing to silicate ones. For the compressive strength of the bricks used on most of the stock the clay bricks are with  $f_k = 7.5MPa$ , meanwhile the silicate bricks used have more compressive strength  $f_k = 10MPa$  on most of the buildings. Mortar strength also varies and mostly are used cement or lime mortar

with  $f_k = 2.5MPa$  and  $f_k = 5MPa$ . The bonding between clay and mortar is better than silicate-mortar, giving so a greater value of  $f_{vk}$  shear strength of masonry. The confined masonry buildings are of the 1978 to 1990 era, and have perimeter columns of C12/15 for increasing lateral resistance of the shear walls. Also the slab types varies on buildings and era of construction but most of them are rigid slabs of reinforced concrete. Foundation are constructed with stoned of  $M>200$  and are calculated for  $[\sigma]=2kg/cm^2$ .

Location of the buildings affects many factors of the performance of the buildings. Site conditions, climatic effects and seismicity of the zone as the most governing factor. Albania can be divided in three zones, from the seismic risk, where the intensity scale of projection varies VI, VII and VIII. Also some zones where considered with lower seismic intensity in KTP-63 and KTP-78, implying a lowered seismic consideration on projection.

### 2.3 Selected buildings

The buildings chosen from the stock are of template A1 wich is very used all around the country, especially in Tirana. This template and building is of the oldest in Albania of 1940s, but the buildings are near the "ish blloku" zone in Tirana, and they are buildings with good maintenance so no severe damage is observed. The buildings has plan dimensions of (56.65\*11.65)m. Building has two entrances and four apartments and is symmetric. Building has two stories of 2.8m height. In some of the buildings of these template are built extra stories later in the after 90s period (in two of these building also known as MOSKAT). Inside and outside walls of the building are 25cm and non load bearing walls are 12cm. For masonry are used clay bricks of strength 5MPa as given in the project. The mortar used is lime mortar as defined in the project with ratio 1:3 (lime : sand). Specifications of the mortars and the procedure of preparing are given in [K.Cika 1969].For  $1m^3$  sand is used  $0.333m^3$  lime and 200liters water.



**Figure 1.** Building A1 plan view and facade view

### 3.MECHANICAL PROPERTIES OF BUILDINGS

The basics characteristics for modeling masonry structures are:

- Characteristic compression strength  $f_k$
- Elastic module in vertical shear  $E$
- Elastic module in tangential shear  $G$

Values and recommendations are given for correlation between material and element properties. These are based on compressive brick strength and compressive mortar strength. Below is given a summary of the basic parameters and their calculation, from EC and some other recommendations

Compressive strength of masonry

$$f_k = K * f_b^{0.7} * f_c^{0.3} \text{ (values of } f_b \text{ and } f_m \text{ are normalized with } \delta \text{ factor)}$$

Young modulus

$$E = 1000 * f_k$$

Compressive fracture energy

$$G_{fc} = 15 + 0.43 * f_k - 0.0036 * f_k^2$$

Tensile strength

$$f_t = 0.05 * f_k$$

Tensile fracture energy

$$G_f = 0.1MPa$$

Shear strength  $f_{vk} = f_{vko} + 0.4\sigma_d$   
 $f_{vko} = 0.2$  when clay bricks are used or silicate bricks M-10  
 $f_{vko} = 0.15$  when silicate bricks M-7.5 used as recommended in EN,  
the maximum value of  $f_{vk} = 0.065f_b$   $\sigma_d = 1\text{MPa}$   
 $f_{xk1} = 0.035f_b$  with filled and unfilled perpendicular joints  
 $f_{xk2} = 0.035f_b$  with filled perpendicular joints  $f_{xk2} = 0.025f_b$  with unfilled perpendicular joints  
Shear modulus  $G = 0.25E$   
Poisson ratio  $\nu = 0.2$

Values taken by the project blueprint are revised after the laboratory tests on the selected buildings. The laboratory tests are done to the guidance of ASTM codes. They are divided in three basic sections:

- the brick tests
- the mortar tests
- the masonry prism tests

The tests are done to compare the values of the project with the real values from the tests. This because many buildings are built before 50 or more years and materials are degraded with time. EC and ASTM give formulas and correlations for defining masonry characteristics from the brick and mortar properties, but prism test are also done to verify this values.

### 3.1 Brick testing

For the determination of the solid brick compressive strength the procedure in ASTM C67-09, five full specimens of dimension (250\*125\*60) mm should be tested. The test specimens should consist of dry half bricks, full height and width of the unit, with length equal to one half the full length of the unit.



**Figure 4.** Brick compression and tensile flexural test

Compression strength of bricks  $f_{bt}$  is derived from this test. Tensile strength for bricks is obtained by the brick tensile flexural strength ASTM C67-10. Tensile strength is tested on a series of single bricks supported by steel roller bearings, simple beam system. Load is applied gradually through steel rod on top of the bricks acting like a concentrated load. The samples are of dimensions (40\*40\*160) mm.

### 3.2 Mortar testing

For the mortar tests, for unreinforced masonry, samples of mortar are collected in the areas where the connection between solid bricks units and mortar has failed. Due to the irregular shape of the samples, capping is required to be done according to ASTM C109/C 109M-02 regulations [ASTM,2008]. The depressions at the samples are filled with mortar composed of 1 part by weight of cement and 2.75 parts of sand. The specimens are aged at least 48h before capping them. In this perspective, samples of mortars with (500\*500)mm dimensions are prepared in the moist closet or moist room. The average compressive strength of the 5 samples is taken as the compressive strength. When it is impossible to take samples of the mortar the strength is taken according to the project and KTP. The same procedure is for the flexural strength of mortar samples. The samples are constructed of dimensions 40\*40\*160mm. Tensile strength

is tested on a series of mortar samples supported by steel roller bearings, simple beam system. Load is applied gradually through steel rod on top of the bricks acting like a concentrated load.



**Figure 5.** Mortar samples compression and tensile flexural test

### 3.3 Mortar testing

Prism testing is a laboratory test for calculating the compressive strength of a masonry prism. A minimum of three prisms should be constructed, using the same materials and workmanship as used in the project. The mortar bedding, joint thickness, joint tooling, bonding arrangement and grouting pattern should be the same as in the project. No structural reinforcement should be included, however, metals wall ties may be included if used in the project. The prism thickness should be the same as that of the actual construction. The prism length should be equal to or greater than the prism thickness. The height of the prism should be at least twice the prisms thickness or a minimum 375mm.



**Figure 6.** Prism masonry test and triplet shear test

The ultimate compressive strength of a prism is calculated by dividing the maximum compressive load by the cross-sectional area of the prism. The strength of masonry is related to the strength of prism with the formula:  $f_k = C_f * f_{prism}$   
where  $C_f$  is correction factor varying from h/t ratio

**Table 1.** Correction factors for different h/t ratios<sup>1</sup>

Correction factors for different h/t ratios							
Ratio of height to thickness (h/t)	1.3	1.5	2.0	2.5	3.0	4.0	5.0
Correction factors for prism	0.75	0.86	1.00	1.04	1.07	1.15	1.22

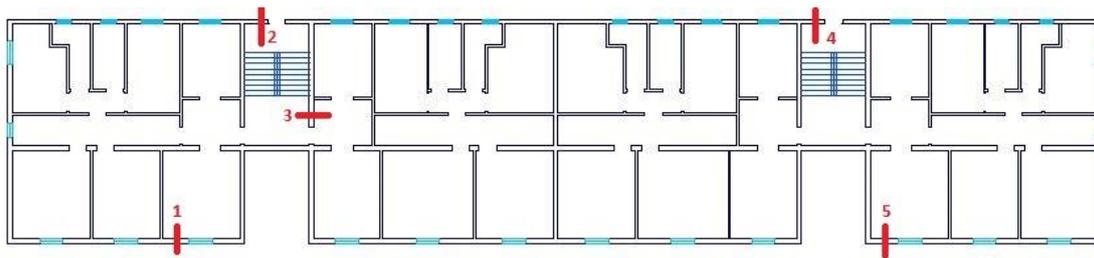
<sup>1</sup> Standard Test Method for Compressive Strength of Masonry Prisms ASTM C1314-12 ASTM international, INC., 2012

Triplet testing of masonry is a test for determining the shear strength of masonry walls. The shear strength of masonry triplets was obtained as described in EN 1052-3:2002.

The specimens consist of three bricks bonded with mortar of same recipe and workmanships as in the original projects. Three sets of triplets are tested under no compressive force for determining  $f_{vko}$  value. Then three others sets of triplets are tested with the presence of compressive test as given in the Code. Two load cells were used to carry out the shear tests. One load cell was used for applying the shear force and the other applying the compressive force acting perpendicular to the shear force.

### 3.4 Investigated building and test results

The investigated building A1 is located near "ish Blloku" in Tirana In the figure below are shown the positions where the samples were extracted.



**Figure 7.** Locations on plan where samples are extracted from masonry

Below are given the test results and the derived mechanical properties from them using the correlations given above.

**Table 2.** Revised brick and mortar properties for analysed building

Building	Brick properties			Mortar properties		
	Type	$f_b$ [MPa]	$f_{bt}$ [MPa]	Type	$f_m$ [MPa]	$f_{mt}$ [MPa]
A1	Clay	5	1.1	Lime	2.3	0.45

**Table 3.** Revised masonry wall properties for analysed building

Building	$f_k$ [MPa]	$f_{vk}$ [MPa]	$f_{vko}$ [MPa]	$f_t$ [MPa]	$f_{xk1}$ [MPa]	$f_{xk2}$ [MPa]	$E$ [MPa]	$G$ [MPa]	$G_{fc}$ [MPa]	$G_f$ [MPa]	$\nu$
A1	1.43	0.3	0.15	0.072	0.180	0.129	1430	358	2.38	0.1	0.2

## 4. BUILDINGS MODELS AND PUSHOVER ANALYSIS

Modelling of masonry structures has always been a difficult problem because of the presence of joints as the major source of weakness and also nonlinearity and discontinuity of the material. A proper model must take in consideration both the behaviour of brick and mortar units and the interaction between them.

In this paper is used a macro-modelling technique. The materials are not modelled as divided elements, but with equivalent elements (like plates for example) that have equivalent properties. 3muri is based on a finite element methodology for modelling masonry structures. The software proposes the line finite element, which is represented by its axis. The non-linear macro-element model, representative of a whole masonry panel, proposed by Gambarotta and Lagomarsino (1996), permits with a limited number of degrees of freedom (8), to represent the two main in-plane masonry failure modes, bending-rocking and shear-sliding (with friction) mechanism, on the basis of mechanical assumptions.

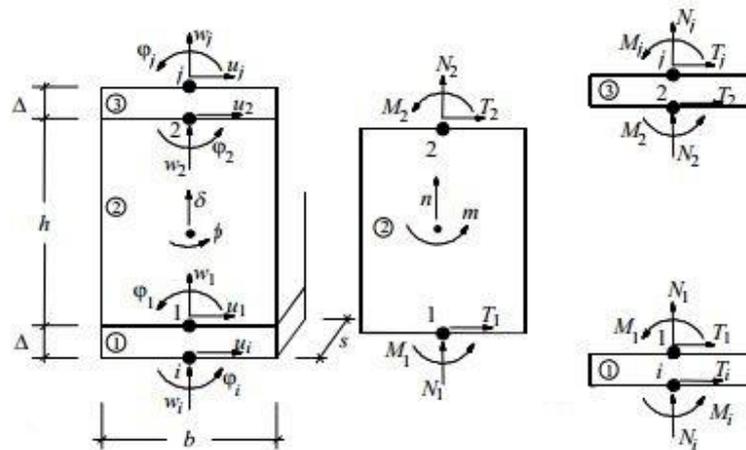


Figure 8. 3Muri finite element view<sup>2</sup>

The static pushover analysis is based on the assumption that the response of the structure is controlled by the first mode of vibration and mode shape. The shape remains constant throughout the elastic and inelastic response of the structure. This allows, theoretically, transforming a dynamic problem into a static one for easier solution. The response of the MDOF is related to the response of an equivalent SDOF. A non-linear incremental static analysis of the MDOF structure can now be generated, to determine the force-deformation characteristics of the equivalent SDOF.

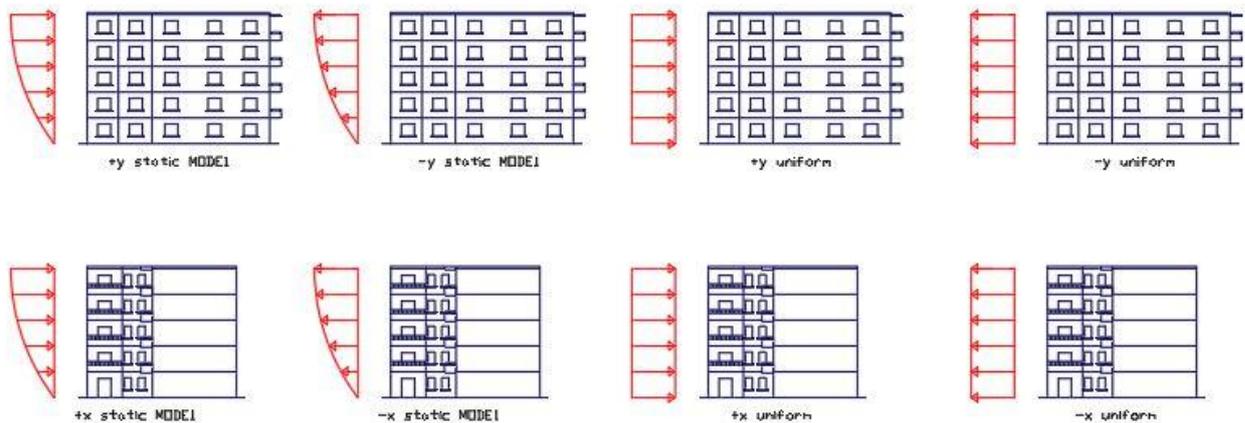


Figure 9. Load patterns and different cases of pushover analysis of template B4

The outcome of the pushover analysis is the diagram of the global force versus top displacement curve or capacity curve. In order to perform a pushover analysis for a MDOF system, a pattern of increasing lateral force needs to be applied to the mass points of the system. In 3muri approach are 2 load pattern applied: first mode shape distribution (static), based on the fundamental mode shape of the structure, and an uniform load distribution to all stories. The two are performed in two directions X and Y and with positive and negative values. So in total 8 analysis: +x MF1, +x uniform, -x MF1, -x uniform, +y MF1, +y uniform, -y MF1, -y uniform. These analysis are done for 3 more combination. Without eccentricity of gravity load and with eccentricity of two different levels. For every building, are computed 24 analysis, for all load combinations, earthquake direction, with and without eccentricity. The worst cases are chosen as representing the pushover curves for both x and y direction of buildings.

#### 4.1 A1 buildings

This building is symmetric and are separated from one another, only half of the building, is considered.

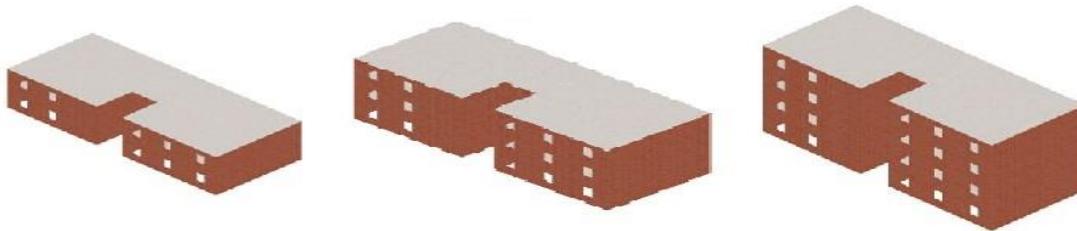
<sup>2</sup> Seismic assessment of masonry structures by non-linear macro-element analysis. A.Penna, S.Cattari, A.Galasco S.Lagomarsino

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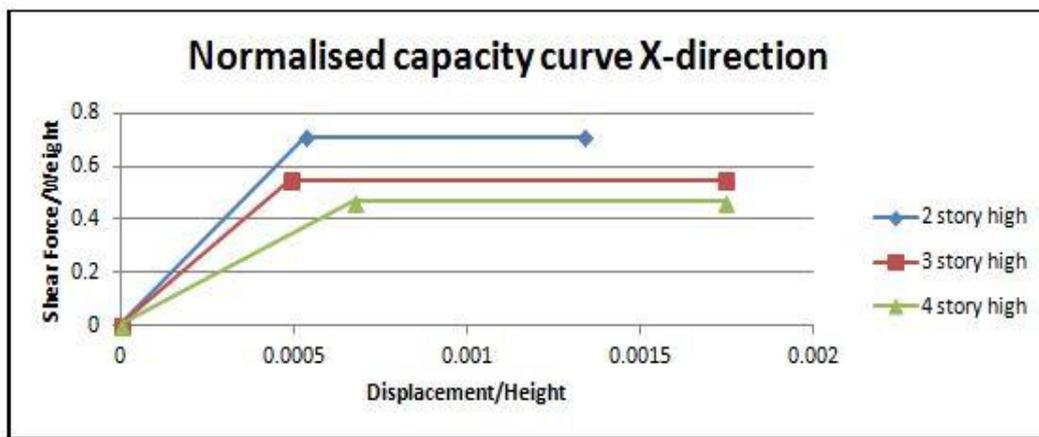
Loads are considered as below:

Dead gravity loads  $= 4kN/m^2$   
 Probable live load  $= 2kN/m^2$

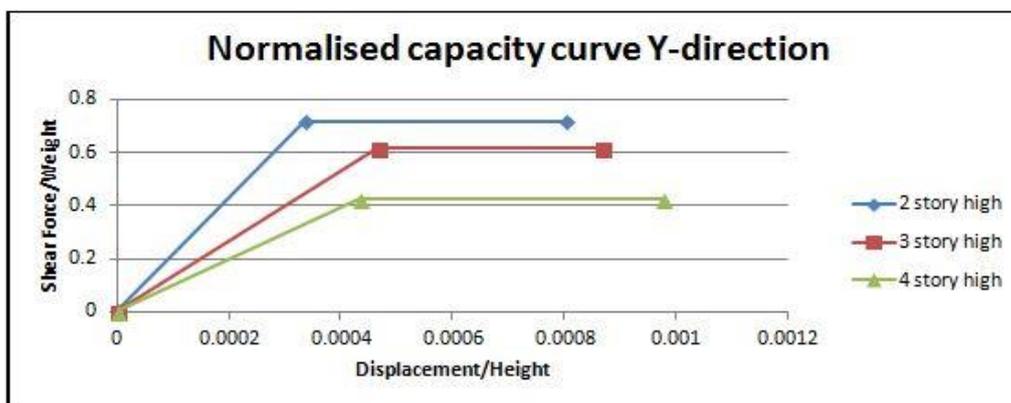
Also two more buildings are modelled with one story and two story plus, since some of these buildings have these added stories. For the added floors the joints connections between the original stories and the added one are modelled as rigid joints because this interventions are done before many years and are consolidated. The walls are modelled as non-linear materials, with brick strength  $f_b = 7.5MPa$ , mortar strength  $f_m = 5MPa$ , density of wall  $\rho_{wall} = 1200 kg/m^3$ , masonry strength  $f_k = 2.5MPa$ , shear strength  $f_{vk} = 0.4$  and  $f_{vko} = 0.2$ . Modulus of elasticity of masonry is taken as  $E_m = 2500MPa$  and  $G = 700MPa$ . the same as the typical plan of the building.



**Figure 10.** A1 buildings models



**Figure 11.** A1 buildings normalised capacity curves in x-direction



**Figure 12.** A1 buildings normalised capacity curves in y-direction

If we compare the parameters from the pushover curves, the shear force / weight ratio decreases significantly, while the ductility index increases with the addition of stories. Also the initial stiffness of the buildings decreases with height addition. If the fail mechanism are compared, in the buildings with more stories, in the upper stories walls have more from shear damage and some parts shear failure.



**Table 7.** Performance evaluation and P.G.A level for each building in both directions

Building	dy (m)	dm (m)	Fy (kN)	a <sub>g</sub> DL (m/s <sup>2</sup> )	a <sub>g</sub> SD (m/s <sup>2</sup> )	a <sub>g</sub> NC (m/s <sup>2</sup> )	dt DL (m)	dt SD (m)	dt NC (m)
A1x	0.0021	0.008	1883	1.863	2.970	3.533	0.00269	0.00446	0.00623
A1y	0.002	0.008	1893	1.846	2.299	2.641	0.0026	0.0044	0.0062
A1x 3fl	0.0044	0.0157	2022	1.264	2.386	2.975	0.00553	0.00892	0.01231
A1y 3fl	0.0042	0.0078	2260	1.377	1.866	2.180	0.00456	0.00564	0.00672
A1x 4fl	0.0081	0.0209	2201	1.068	1.831	2.365	0.00938	0.01322	0.01706
A1y 4fl	0.0052	0.0117	1998	0.967	1.525	1.878	0.00585	0.0078	0.00975

## 5.2 Conclusions

If we compare the P.G.A values from Albanian seismic map, it can easily be spotted that some of these buildings have serious risk even of collapse if an earthquake with RP=475years happens. Especially the buildings of template A1 with 2 added floors, have no capacity of bearing a higher P.G.A than 2.0m/s<sup>2</sup>. it must be said that similiar cases of buildings with added stories are spread all around the country so each should be checked for the zone P.G.A level. A retrofiting technique should be implemented on these buildings.

**Table 8.** Risk evaluation of each building for different P.G.A levels

Building	0.15g	0.2g	0.25g	0.3g	Risk
A1	DL	SD	SD	NC	low
A1 3fl	SD	SD	NC	-	moderate
A1 4fl	SD	NC	-	-	high

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APPENDIX

Section A  
 Building A1

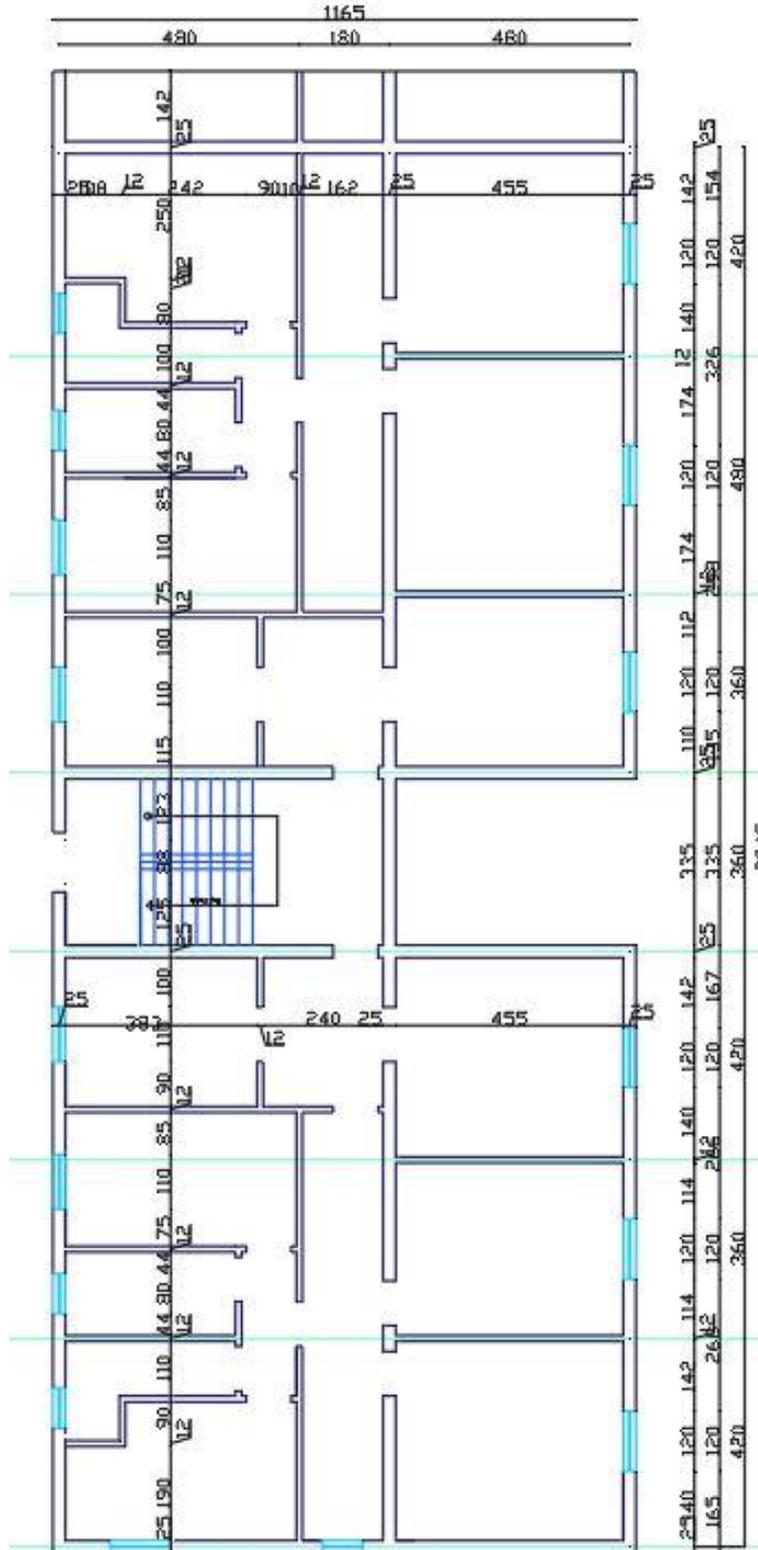


Figure 19. Plan view of building A1

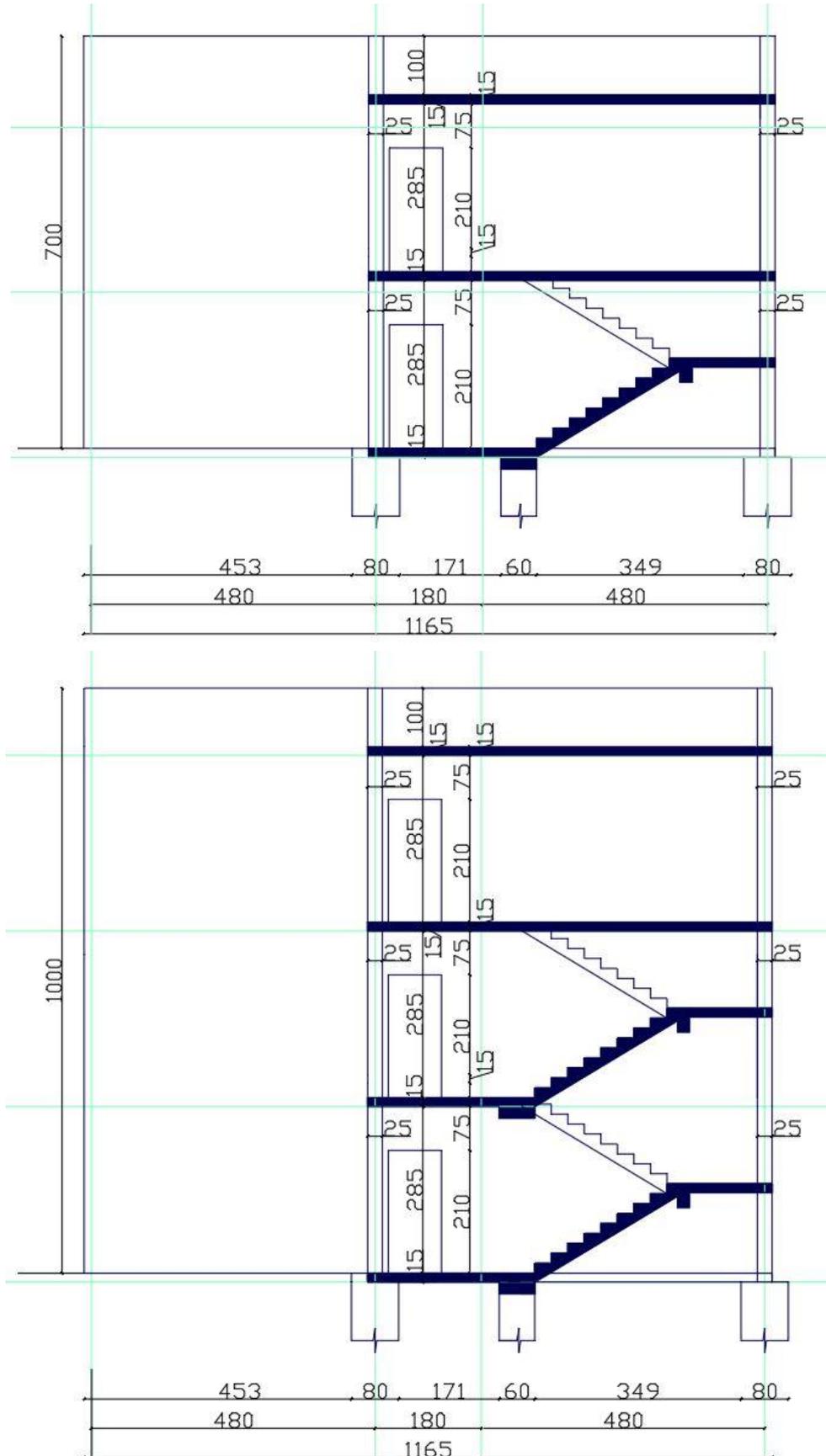


Figure 20. Cut view of building A1 for original building and building with one added story

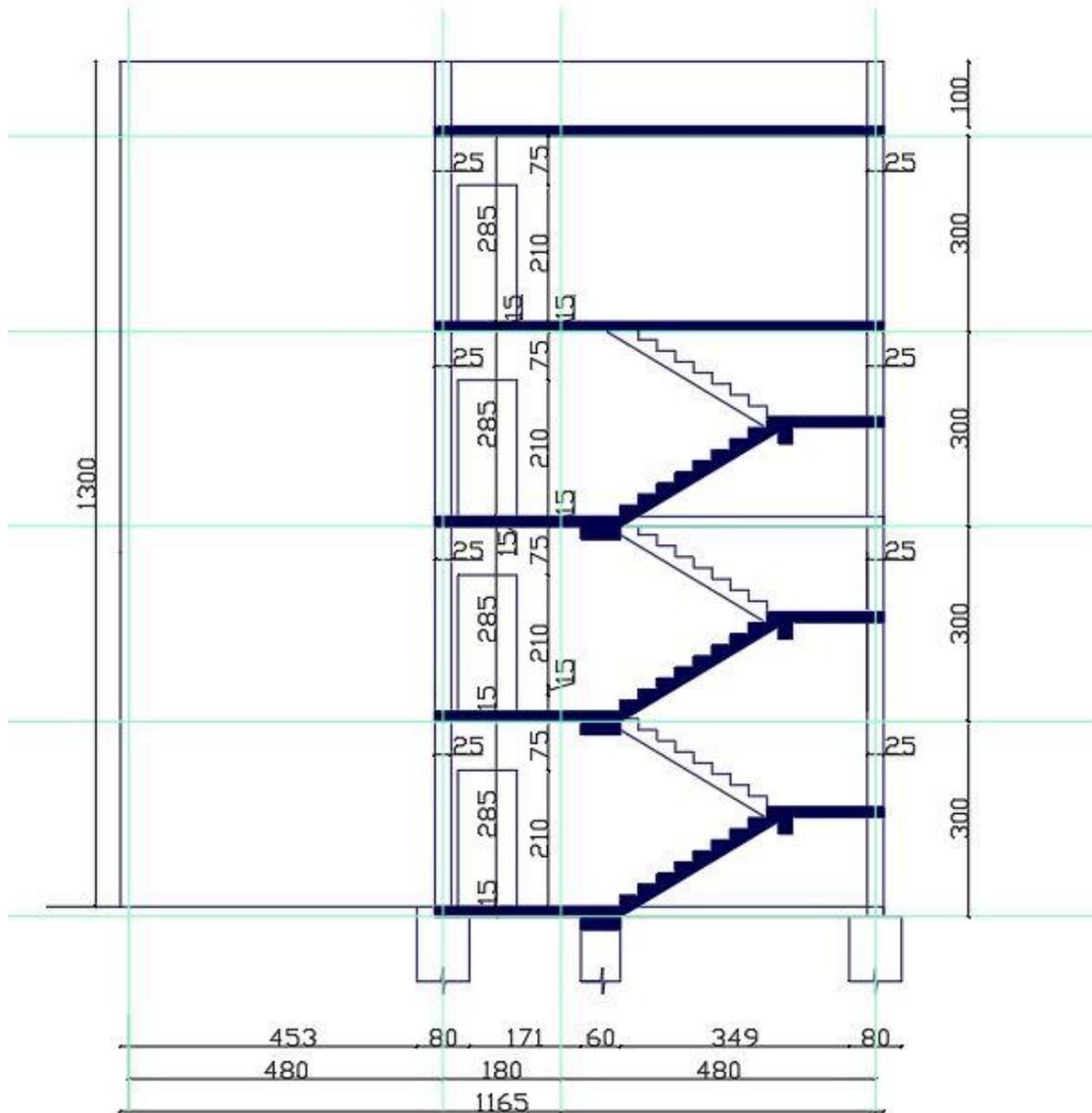


Figure 21. Cut view of building A1 with two story added

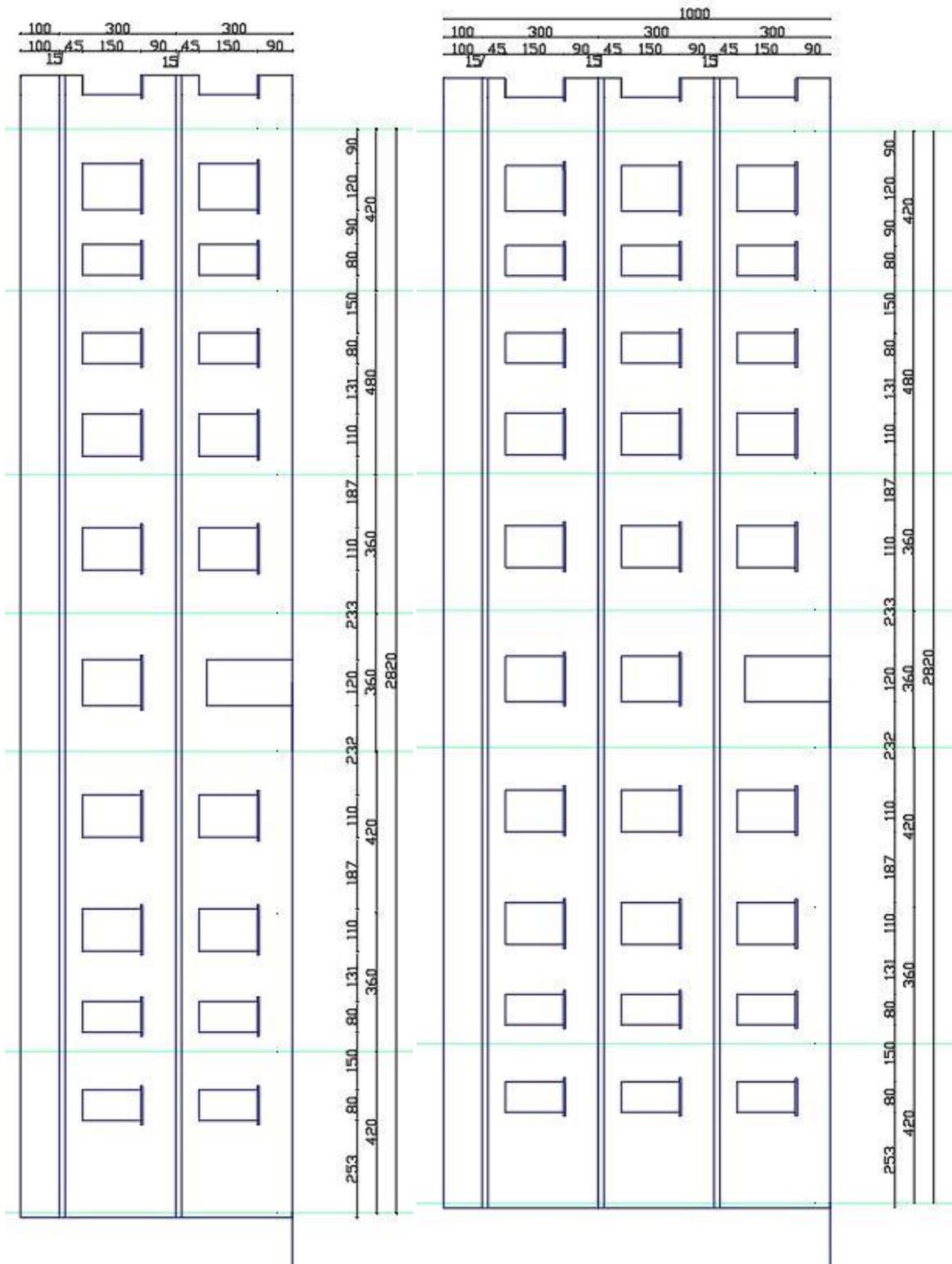


Figure 22. Facade view of building A1 for original building and plus one story building

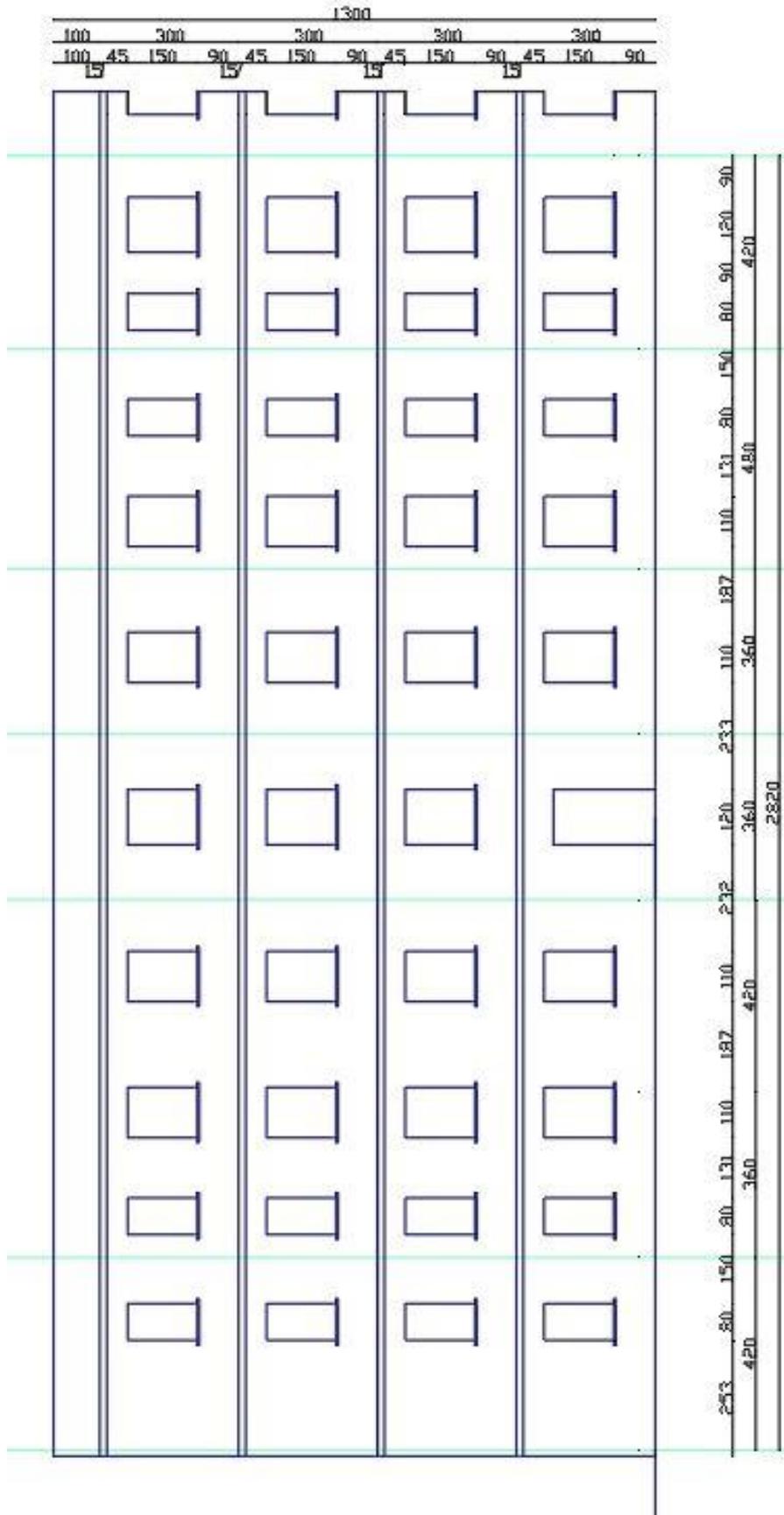


Figure 23. Facade view of building A1 for building with plus two stories

**Section B**

**Test results for Building A1**

**Table 9.** Compressive test of solid bricks

Compressive test of solid bricks (clay bricks)								
Sample	Sample dimensions				Fracture force (kN)	Compressive strength (MPa)	Sample weight m (gr)	Sample density (kg/m <sup>3</sup> )
	Length L(mm)	Width B(mm)	Height H(mm)	Area A(mm <sup>2</sup> )				
1	247	120	65	14820	72.3	4.88	2864	1486.557
2	246	118	64	14514	73.1	5.04	3100	1668.648
3	247	119	66	14696.5	74.2	5.05	2980	1536.132
4	248	119	64	14756	72.9	4.94	3012	1594.69
5	250	119	66	14875	75.7	5.09	2856	1454.545
<b>Average</b>						5		1548

**Table 10.** Brick density and water absorption tests

Tensile flexural test of solid bricks (clay bricks)						
Sample	Sample dimensions				Fracture force W (kN)	Tensile strength (MPa)
	Length L(mm)	Width B(mm)	Height H(mm)	Area A(mm <sup>2</sup> )		
1	247	120	65	7800	8.6	1.102564
2	246	118	64	7552	8.3	1.099047
3	247	119	66	7854	8.9	1.133181
4	248	119	64	7616	8.2	1.076681
5	250	119	66	7854	9.1	1.158645
<b>Average</b>						1.11

**Table 11.** Tensile flexural test of solid bricks

Compressive and tensile flexural test of mortar samples								
Sample	Compressive test				Flexural tensile strength			
	Dimensions LxBxH (mm <sup>3</sup> )	Area A (mm <sup>2</sup> )	Fracture Force F (kN)	Compressive strength (MPa)	Dimensions LxBxH (mm <sup>3</sup> )	Area A (mm <sup>2</sup> )	Fracture Force F (kN)	Tensile strength (MPa)
1	50x50x50	2500	6.35	2.54	160x40x40	1600	0.7	0.44
2	50x50x50	2500	5.75	2.3	160x40x40	1600	0.9	0.56
3	50x50x50	2500	5.65	2.26	160x40x40	1600	0.7	0.44
4	50x50x50	2500	5.55	2.22	160x40x40	1600	0.6	0.38
5	50x50x50	2500	5.45	2.18	160x40x40	1600	0.5	0.31
6	50x50x50	2500	5.85	2.34	160x40x40	1600	0.9	0.56
<b>Average</b>				2.3	<b>Average</b>			0.45

**Table 12.** Compressive test of mortar samples

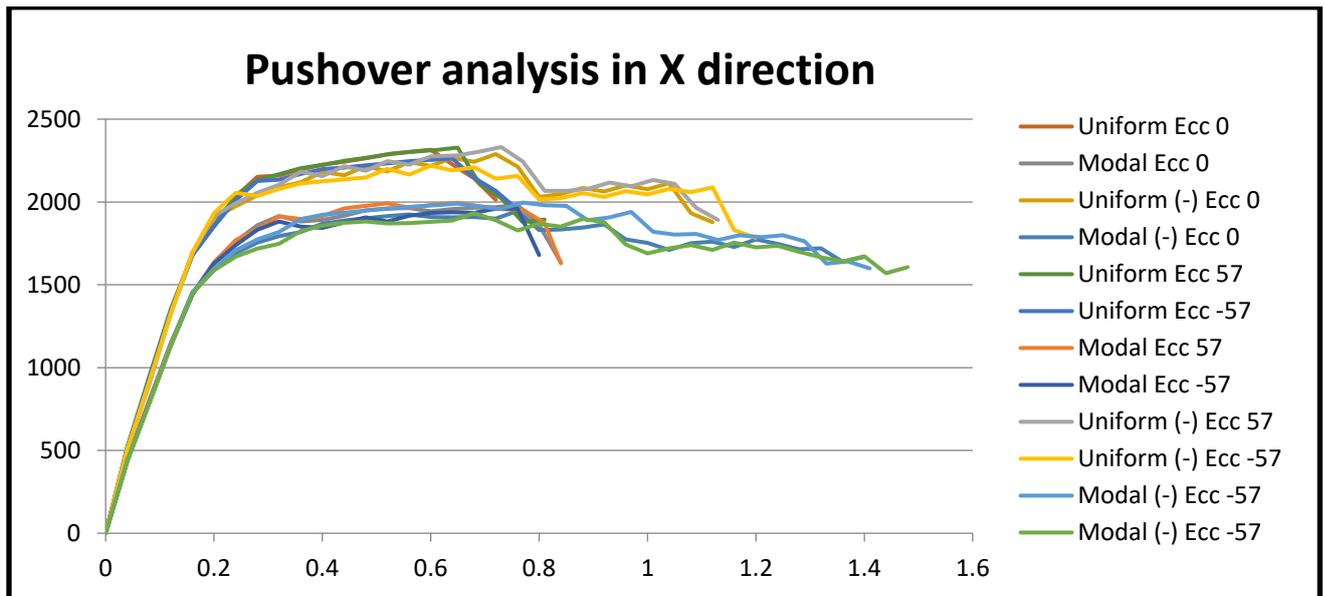
Compressive test of masonry prism samples									
Sample	Sample dimensions				Fracture force W (kN)	Compressive strength R (MPa)	Prism ratio H/B	Correlation factor	Compressive strength f <sub>k</sub> (MPa)
	Length L(mm)	Width B(mm)	Height H(mm)	Area A(mm <sup>2</sup> )					
1	248	242	401	60016	95.7	1.595	1.657	0.904	1.442
2	249	242	401	60258	95.5	1.586	1.657	0.904	1.434
3	250	240	401	60000	94.5	1.575	1.67	0.908	1.43

4	249	240	400	59760	93.8	1.57	1.667	0.907	1.424
5	248	241	403	59768	95.03	1.59	1.672	0.908	1.452
							<b>Average</b>		1.437

**Table 13.** Triplet test of the samples with and without compressive test

Triplet test of masonry samples						
Sample	Sample dimensions				Fracture force Q (kN)	Shear strength $f_v$ (MPa)
	Length L(mm)	Width B(mm)	Height H(mm)	Area A(mm <sup>2</sup> )		
1	202	119	250	29750	9.2	0.154202
2	201	119	250	29512	9	0.153348
3	200	119	249	29382	8.8	0.145296
					<b>Average</b>	0.15
1'	201	119	250	29750	18.4	0.31
2'	199	118	250	29880	16.8	0.28
3'	200	119	250	29750	19	0.32
					<b>Average</b>	0.3

**Section C**  
**Pushover curves for building A1**



**Figure 32.** Pushover analysis in x-direction, 12 load patterns

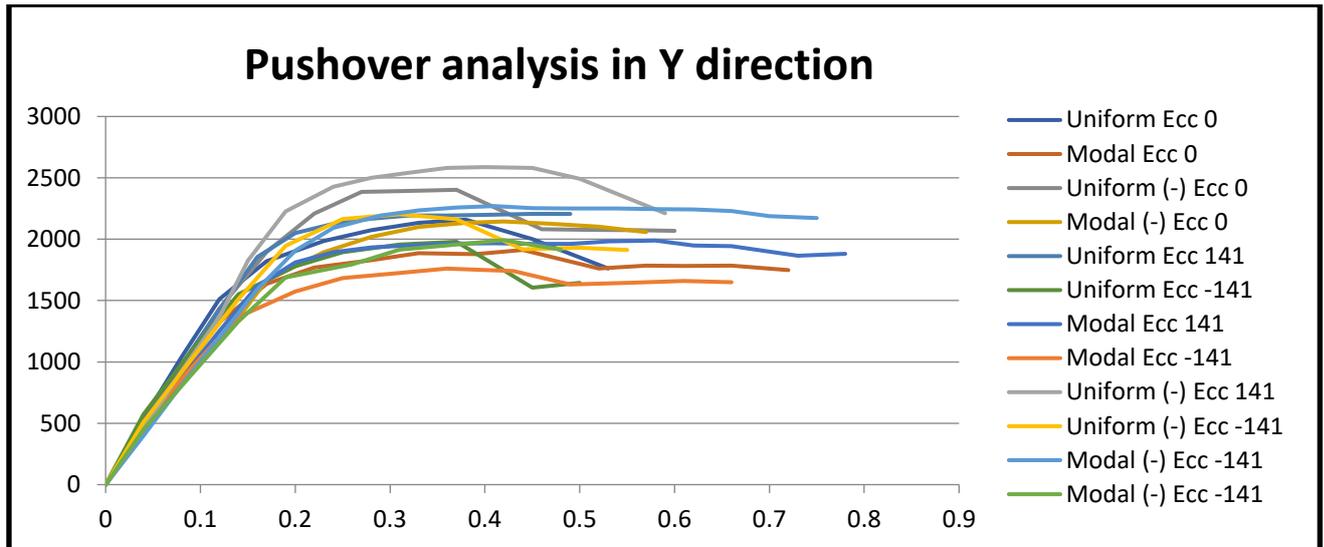


Figure 33. Pushover analysis in Y-direction, 12 load patterns

**Pushover curves for building A1 3floors**

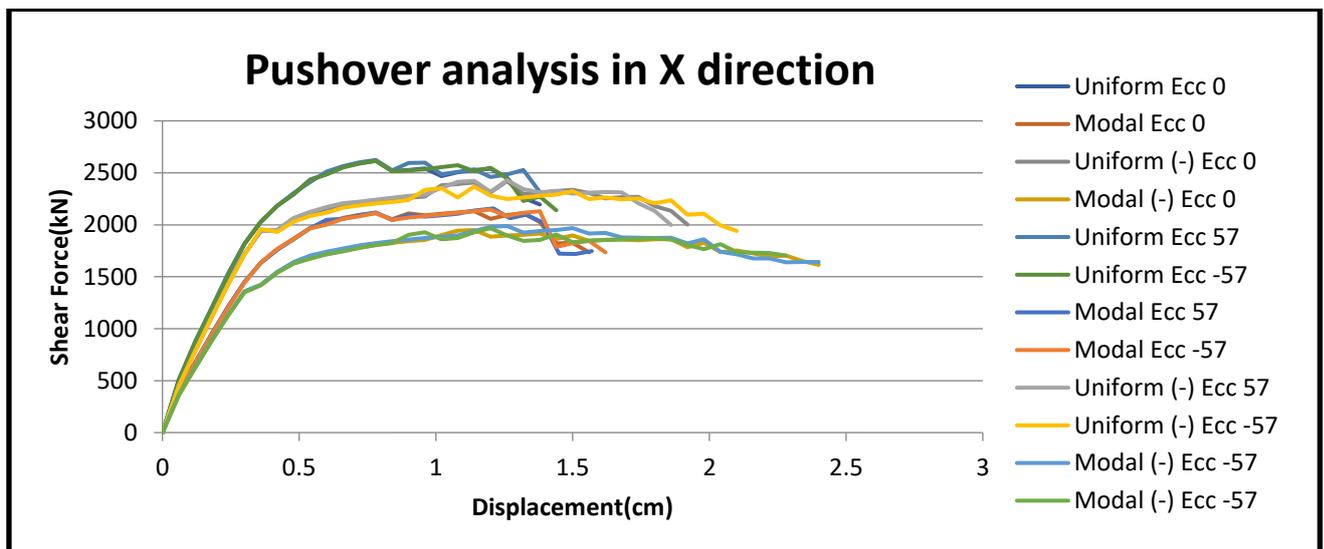


Figure 34. Pushover analysis for x-direction, 12 load patterns,

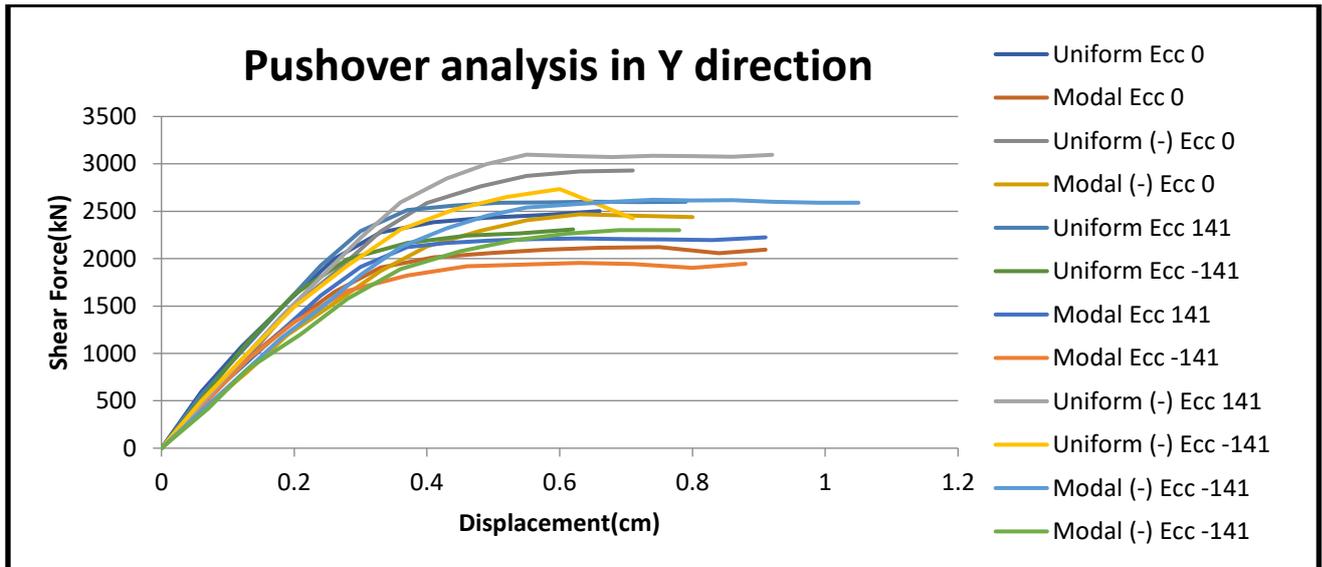


Figure 35. Pushover analysis for y-direction, 12 load patterns

**Pushover curves for building A1 4floors**

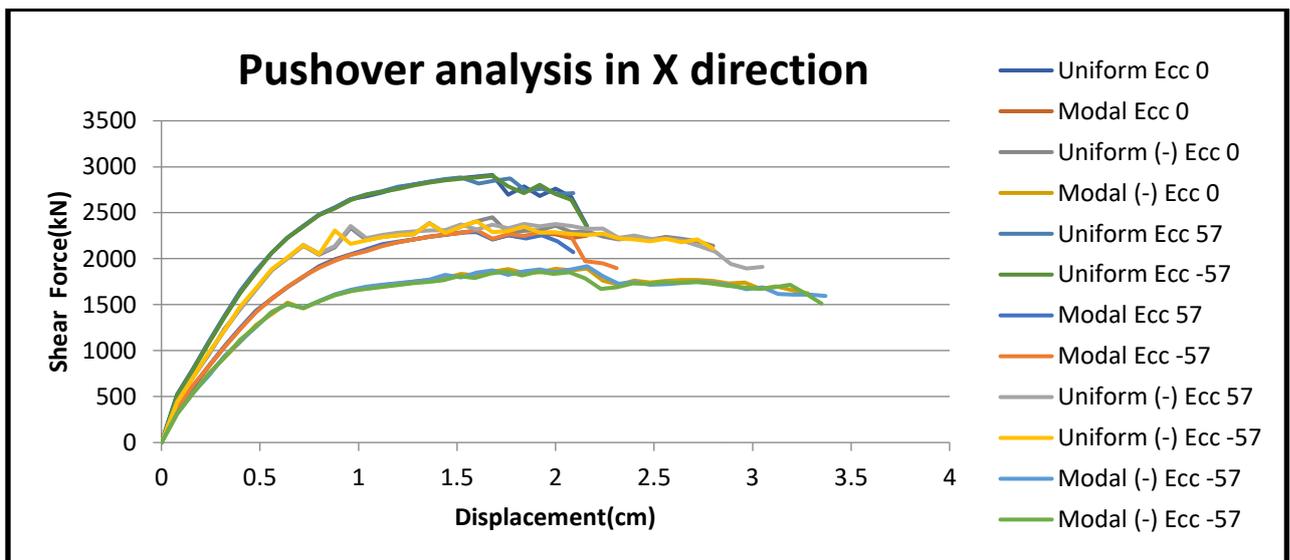


Figure 36. Pushover analysis in x-direction, 12 load patterns

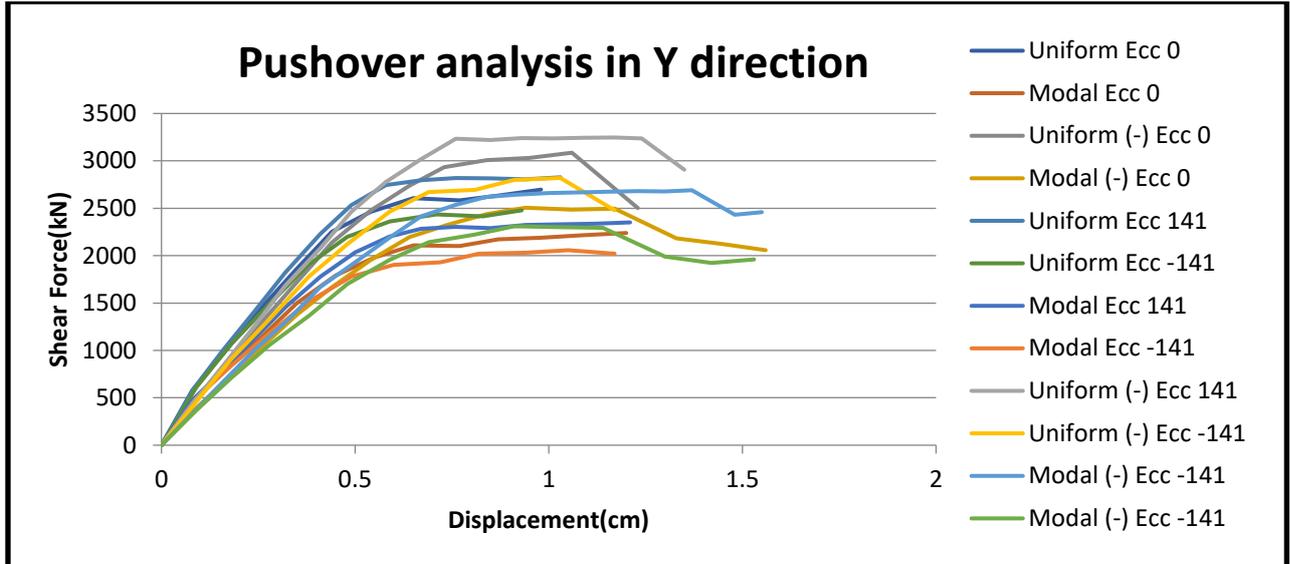


Figure 37. Pushover analysis in y-direction, 12 load patterns

**O 32. AN EVOLUTIONARY FRAMEWORK ON MALADAPTIVE CONSUMPTION  
BEHAVIOURS**

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**ABSTRACT:** There is no disputing the fact on the Historic of the Immunology originated from the study of Immunity. The study of Immunity itself had little scientific basis until the investigations of Louis Pasteur in the second half of the 19<sup>th</sup> century. It was at approximately this time that techniques were being developed to recognize, cultivate, and attenuate the microbes that caused certain infectious diseases. Pasteur genius allowed him to capitalize on these developments. To add to them his own knowledge from his background in chemistry and biology, and to emerge as the father of Immunology. The groundwork of immunology as a science probably originated in ancient China, where the inhalation of dried smallpox crust was practiced as a prevention of this disease. Presumably the viral agent of this disfiguring and lethal disease lost some of its infectivity in drying, so that is was a mixture of inactivated and active viral particles that was actual inhaled. In Turkey a different form of variolation (smallpox was then known as variola) was Observed by Lady Montagu, wife of the British Ambassador. There pustular material was taken from the lesions of a person with a mild case of smallpox and transferred by a common needle into a vein or tissue of the person desiring the Immunization. Hopefully a mild form of smallpox would be developed and apparently did enough regularity for Lady Montagu to have her own children vaccinated in this manner. In 1718 she introduces this procedure in England, and she is credited with introducing the Method to the Western World. Obviously, these earlier methods of Immunization had inescapable risk there was no assurance that variolation would result in only a mild case of smallpox and there also a possibility of transferring Syphilis, Leprosy, Hepatitis or most any other diseases of the donor. Jenner system of a smallpox vaccination, advanced by him in the 1789 as a result of his study of Cowpox and smallpox in English milkmaids avoided this problem and began to place immunity on a firm scientific footing.

*Keywords: Immunity, Louis Pasteur, infectious, diseases, lesions, Jenner system*

**O 34. IMPACT OF TWO IRRIGATION SYSTEMS; SPRINKLING AND DRIP ON  
CULTIVATED SOIL MOISTURE AND IN OUARGLA REGION- ALGERIA**

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**ABSTRACT:** The study highlights the evolution of cultivated soil moisture under two different irrigation systems: sprinkling and drip in Ouargla region. The approach adopted consists of the area prospection and then choose of the study site. This study focused mainly on an assessment of irrigation water quality, characterization of irrigation parameters and soil characterization in situ and in laboratory, and survey of some stages and the yield of Quinoa, for each irrigation system. Soil samples were collected before and after each irrigation for each system and at different depth levels (10, 15, 20, 25, 30 and 35 cm), with a control sample of bare soil (non-irrigated and uncultivated). The water and soil study showed that irrigation water is highly saline with basic pH, and had a sulphate sodium and chloride chemical facies. The soil is slightly calcareous, slightly gypsum, with a low organic matter content, slightly alkaline, not very salty, and has a silty sandy texture. Soil moisture increases with depth under spray system and decreases depth under drip. The complete random block tracking of some stage of Quinoa showed that there is no significant difference between the two systems. The statistical test indicates that drip system presents the best system compared to the spray.

*Keywords: Sprinkling, drip, soil moisture, quinoa, Ouargla*

### **O 35. ASSESSMENT OF LEAD CONCENTRATION IN THE AEROSOL SAMPLING USING DIFFERENT ANALYTICAL TECHNIQUES**

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**ABSTRACT:** Object of this study were the aerosol samples collected in Tirana and Elbasan cities. The population of our country is concentrated in the capital city of Tirana. It has a continuous development of industrial commercial and construction activity. Elbasan was chosen not only for the high population, but also and for the activity of the former Metallurgical Combine. Instrumental methods of analysis with destructive and non-destructive used to determine metals concentration in aerosol samples. The aim of this study is to determine the lead concentration in aerosol samples using different analytical techniques. We have selected 8 aerosols samples, which are divided in two parts and only one in four parts. We have analysed a total 18 filter aerosol samples. Aerosol samples are collected in Tirana and Elbasan cities and were analysed for lead content by using Graphite Furnace Atomic Absorption Spectrometry, Flame Atomic Absorption Spectrometry and X-ray Fluorescence in the Institute of Applied Nuclear Physics, University of Tirana, Albania. From the results obtained show that the level of lead in the aerosol samples that are collected in Elbasan is higher than in samples are collected in Tirana. By the use of various techniques in the measurement of lead in aerosols it is noticed that the more information is obtained from the technique of X-ray while for the presence of lead in low concentrations, GFAAS technique has the highest accuracy and sensitivity.

*Keywords: Lead, aerosols, analytical techniques.*

#### **1. INTRODUCTION**

Pollutants in air can exist in the form of gases or aerosol particles depending on temperature, humidity and other parameters. There are several hundred specific pollutant compounds that are found in the air from a mixture of different sources. As main sources of pollution in the atmosphere, may be considered: urban areas, industrial plants, automotive roads, energy plants.

Air pollution represents one of the main problems of environmental pollution, especially in urban and industrial areas. Both natural and anthropogenic sources contribute to air pollution. The development of technology and production of primary products also, produces secondary production, solid, liquid and gaseous waste, whose presence is associated with significant environmental impacts (Alushllari *et al.* 2014). Quality of air is very important to ecosystems and human health. Atmospheric pollutants are responsible for both acute and chronic effects on human health (WHO, 2000). Trace metals, are the most common components in atmospheric particulate material. Different studies have shown that low concentrations of metals in particulate material significantly influence on environment and human health. These health effects are more noticeable in the elderly and children (US EPA, 2006). Clean air is a basic health requirement for every human being. However, air pollution across the globe is constantly threatening human health. Presence of heavy metals in environment above maximum concentration level causes toxic effects in environment and on human's health. They enter the human body through food, water, and air. Lead and its compounds are toxic; they can enter the human body through food, water, and air (Alushllari & Civici 2014). Also, the presence of lead causes anemia and damage of nervous system (Bastawyet *et al.* 2006). Cadmium is an extremely toxic metal, is commonly found in industrial areas, especially where ore is processing and smelting. Exposure to cadmium can cause a number of harmful health effects due to the ability to induce disturbances in several organs and tissues following either acute or chronic exposure (Marisela, 2006). Chromium is a steely grey and non-oxidation hard metal that is in basic state malleable and lustrous (Costa & Klein, 2006). The purpose of this study is to determine the lead concentration in aerosol samples using different analytical techniques.

## **2. MATERIAL AND METHOD**

Samples were collected in four stations in the cities of Tirana and Elbasan. There were selected 2 points in Tirana as follows: Station 1: on the terrace of the building of the Ministry of Environment at a height of about 15 m from the road. At this station sampled aerosols were representative of the centre of Tirana. Station 2: It was set on Mount Dajti building near the former Pioneer Camp. Pumps at this station were placed at about 3 m above the ground level. These aerosol samples were representative of a clean area. Also there were selected 2 points in Elbasan as follows: Station 3: on the building of the Public Health Centre, samples were collected at 15 m height from ground level. Station 4: near the station Metallurgical Combine, most of samples were collected near the Metallurgical Combine in height about 4 m from ground level.

Other samples were collected at the entrance and inside area of the Complex. In Table 1 the date for the analysed samples is presented. Represented aerosol samples analysed using Atomic Absorption Spectrometer, Analyst 800 Perkin Elmer with Graphite Furnace Atomic Absorption Spectrometry (3 analytic methods). Air filter samples are digested according Analytic Method Atomic Absorption Spectrometry. Instrumental conditions for lead are based on the Analytical Methods of Atomic Absorption Spectrometry, from Perkin Elmer. During this study are collected in total 23 aerosol samples and 8 blank filters. For digestion of samples were used three different analytic methods. Lead concentration in samples is measured using three instrumental analytic techniques, Flame Atomic Absorption Spectrometry, Graphite Furnace Atomic Absorption Spectrometry and Fluorescence of X-ray.

Instrumental conditions for lead are based on the Analytical Methods of Atomic Absorption Spectrometry, from Perkin Elmer. Three applications were carried out for the measurement of calibration standards and the measurement of samples. For each element calibration curve equation is linear and passing through point zero. To check the instrumental drift, an aqueous standard solution was analysed after every three samples.

## **3. RESULTS**

During this study are analysed in total 23 aerosol samples and 8 blank filters. We have selected 8 aerosols samples, which are divided in two parts and only one in four parts. For digestion of samples were used three different analytic methods. Lead concentration in aerosol samples is measured using three instrumental analytic techniques, Flame Atomic Absorption Spectrometry, Graphite Furnace Atomic Absorption Spectrometry and Fluorescence of X-ray at the Institute of Applied Nuclear Physics, University of Tirana, Albania.

From the results obtained is shown that the concentration of lead in aerosols samples are ranged from 2.1 ng/m<sup>3</sup> to 2705 ng/m<sup>3</sup>. Lead concentration for each method is compared between each other; relative standard deviation was 4.3 %. The values of lead in Tirana are ranged: 2.1 -10.4 ng/m<sup>3</sup>. The values of lead in Elbasan are ranged: 20.7-2705 ng/m<sup>3</sup>.

From the results obtained show that the level of lead in the aerosol samples that are collected in Elbasan is higher than in samples are collected in Tirana. By the use of various techniques in the measurement of lead in aerosols it is noticed that the more information is obtained from the technique of X-ray while for the presence of lead in low concentrations, GFAAS technique has the highest accuracy and sensitivity.

In the table 1 are presented the sampling points, code and amount of aerosol that has passed in paper filter. In the table 2 are presented the lead concentration for the analyzed samples according 3 techniques analyses.

**Table 1.** Sampling points, Tirana and Elbasan Cities.

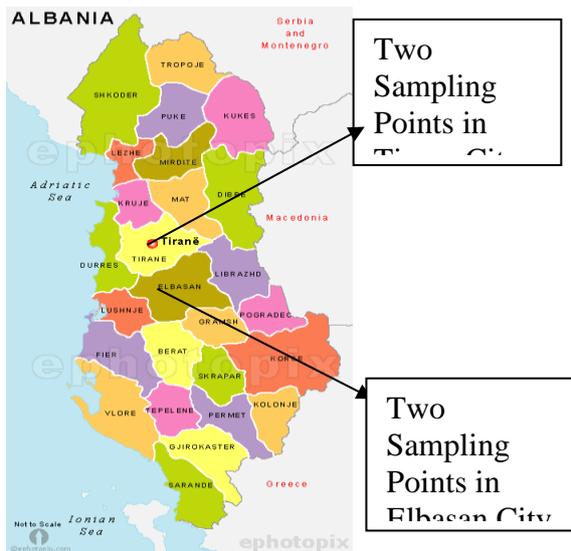
<b>Nr of Filter</b>	<b>Stations</b>	<b>Vol (m<sup>3</sup>)</b>	<b>Code of Samples</b>
118	Elbasan, Metallurgy	49.7	1M
111	Elbasan, Metallurgy	75.2	2M
107	Elbasan, Metallurgy	4.6	3M
110	Elbasan, Metallurgy	56.3	4M
95	Elbasan, Centre	68	8M

105	Elbasan, Metallurgy	22.7	9M
109	Elbasan, Metallurgy	31.9	10M
85	Tirana, Centre	79.5	11M
53	Tirana, Centre	56.6	12M
52	Tirana, Centre	57.3	13M
80	Tirana, Centre	85	15M
69	Tirana, Centre	96.3	17M
51	Dajti Mountain	142.7	14M

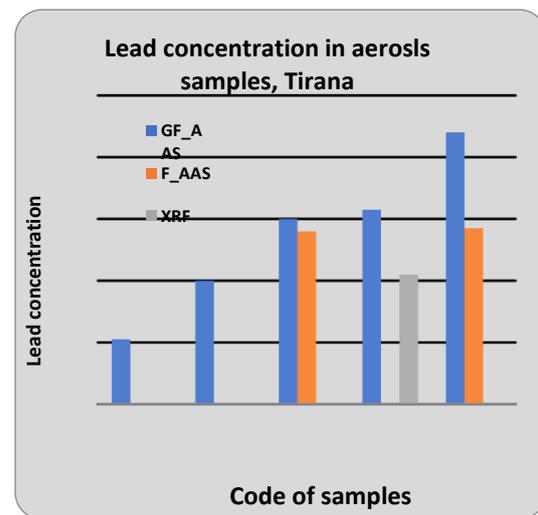
**Table 2.** Sampling points, Tirana and Elbasan Cities.

Nr of Filter	Code of Samples	GF_AAS	F_AAS	XRF
51	M14	2.1	0.0	1
80	M15	4.0	0.0	1
52	M13	6.0	5.6	1
69	M17	6.3	0.0	42
53	M12	8.8	5.7	1
85	M11	10.4	8.2	69
95	M8	20.7	11.7	1
110	M4	147.1	161.5	120
105	M9	472.5	379.5	371
109	M10	610.6	465.5	640
111	M2	680.4	552.0	635
118	M1	932.0	804.0	994
107	M3	2705.3	3054.0	2811

In figure 1 is presented map of Albania where are selected 2 cities Tirana and Elbasan. In figure 2 and 3 are presented in graphical form the level of lead respectively in Tirana and Elbasan cities. In figure 4 is presented compare of lead concentration in Tirana and Elbasan. In figure 5 is presented Compare of Lead level using three techniques, while in figure 6 is presented the Line plot of lead according three techniques and in figure 7 is presented Concentration of lead by different techniques.



**Figure 1.** Sampling points, Tirana and Elbasan Cities



**Figure 2.** Lead concentration in Tirana City

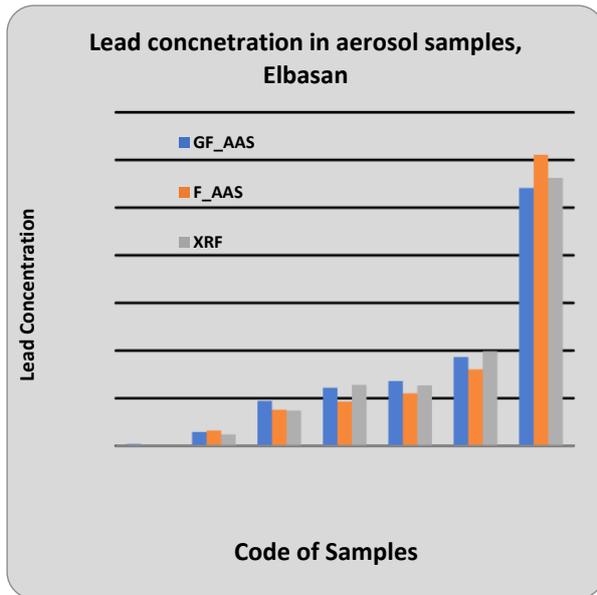


Figure 3. Lead concentration in Elbasan City

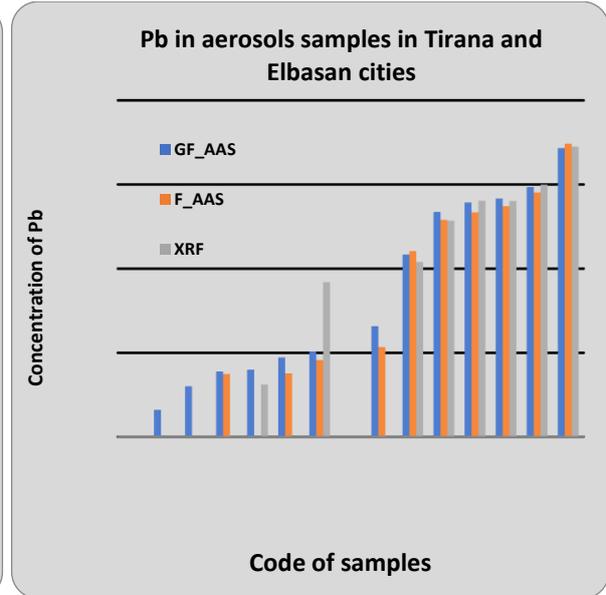


Figure 4. Lead concentration in Tirana and Elbasan City

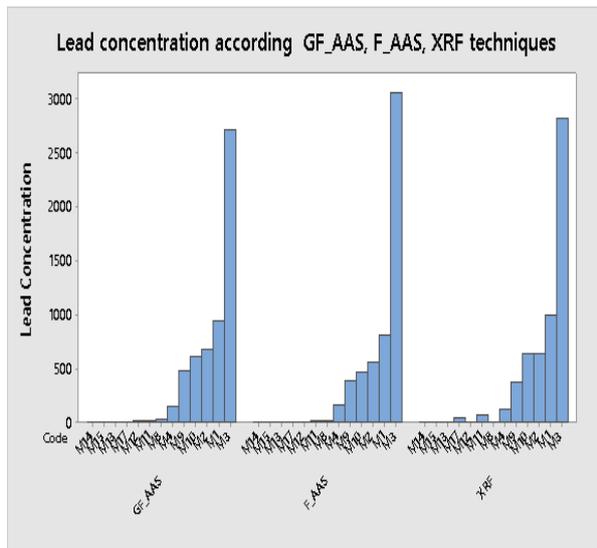


Figure 5. Compare of Lead level using three techniques

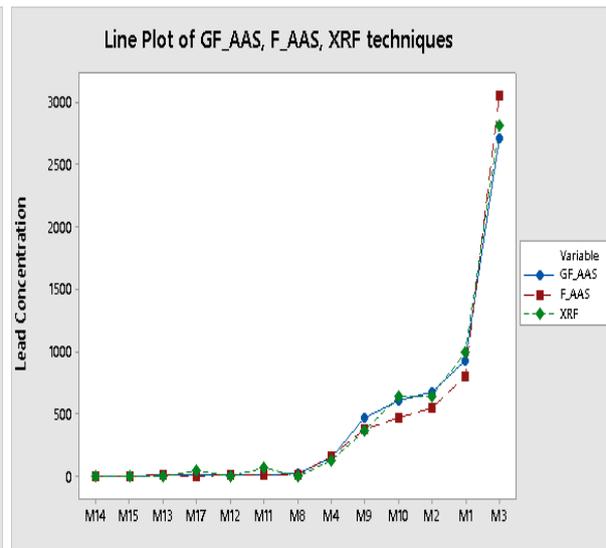


Figure 6. Line plot of lead according three techniques

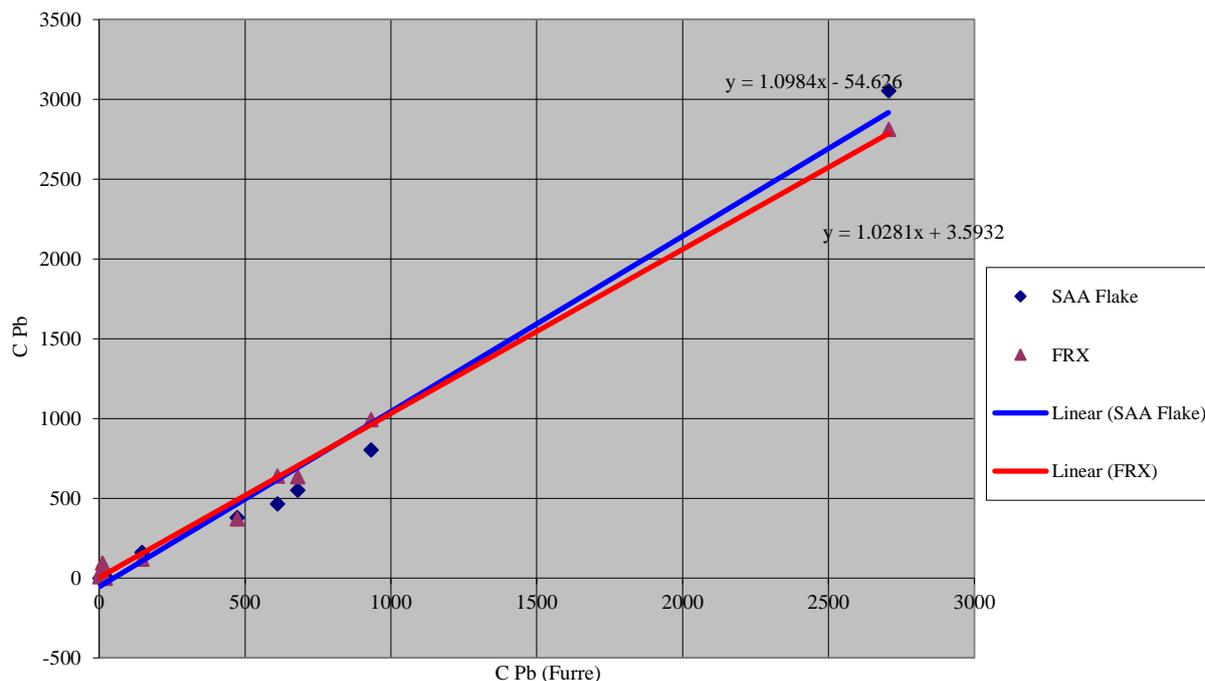


Figure 7. Concentration of lead by different techniques

#### 4. CONCLUSIONS

In the descending order of content in aerosols, lead analyzed in selected sampling stations, were ranked as: Elbasan metallurgical > Elbasan Centre > Tirana Centre > Dajt Mount. Our obtained results have shown that the concentration of Pb in aerosols in the city of Elbasan was higher than in Tirana. The most contaminated area was near metallurgical area. The concentrations of lead determined in each method is comparable. It can be seen from the standard deviation of the values obtained for the lead in both methods was 4.3%. As the main sources of air pollution by metals in Elbasan and Tirana cities were emissions from, vehicles, burning of fuel and urban wastes, dust particles transported by wind, construction and inert materials, industrial pollution.

In the city of Elbasan partial work in Metallurgical Combine significantly contributes to the emission of gases and particle matter in the air and solid waste in the land. If the lead is present in high concentrations in the environment it presents not only negative impact on the environment but also the human health. In the descending order of sensitivity of techniques to measure lead concentration were ranked: Graphite Furnace Atomic Absorption Spectrometry > Flame Atomic Absorption Spectrometry > Fluorescence of X-ray. The low values obtained from the Flame Technique, was the reason of low sensitivity of the instrument used, also the calculations are done manually. The Graphite Furnace Spectrometer analyzes and determines very low levels of lead in the samples at ppb levels even at trace levels, so in relatively clean samples. To analyze lead concentration at low levels the best technique to use is GF\_AAS compare with Flame and X-ray techniques; it has the highest sensitivity.

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**O 36. GEOLOGICAL AND PETROGRAPHICAL INVESTIGATIONS OF THE GÜMELİ VILLAGE (ALAPLI-ZONGULDAK-TURKEY)**

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**ABSTRACT:** The study area covers around the Gümeli Village, located in the Zonguldak Basin which is the Turkey's most important coal basin, approximately 70 km west of the Zonguldak city centre and 20 km southeast of Alaplı District. In this study, it is aimed to investigate of the geological features of the region, stratigraphic sequence of rock units outcropping in the region, the lithological, mineralogical and petrographical properties of different units.

Sedimentary, metamorphic and magmatic units formed from Palaeozoic to today are exposed in the study area according to field and laboratory studies conducted in the region. The Lower Ordovician-Lower Devonian aged Hamzafakılı Formation which forms the basement of the study area, consists of clayey-quartzite, microconglomerates, metasandstone, arkose and conglomerates. Devonian aged Göktepe Formation, which is overlay on the Hamzafakılı Formation with low angular unconformity, is represented by chalc schist, phyllite, sandstone, siltstone and claystone. The Medium-Late Devonian aged Belen Granitoid is mainly composed of granite, granodiorites, quartz diorite and leucogranites cut the Hamzafakılı and Göktepe formations. The Late Cretaceous Alaplı formation overlying the older units with an angular unconformity is represented by marl, clayey limestones, limestones and tuff/tuffites. The Early-Middle Eocene aged Çaycuma formation overlying by the angular unconformity the on the Alaplı formation is composed of sandstone, siltstone, claystone, mudstone and volcanic sandstone alternation. All these units covered by the old and new alluviums.

*Keywords: Geology, Petrography, Alaplı, Zonguldak, Granitoid*

## **1. INTRODUCTION**

The study area covers an area of 60 square kilometers, located in and around Gümeli Village, 20 km southeast of Alaplı district, 70 km southwest of Zonguldak (Fig. 1). There are magmatic, metamorphic and sedimentary rocks in the study area. As is known, many metallic and industrial raw material deposits occur with volcanic and metamorphic rocks.

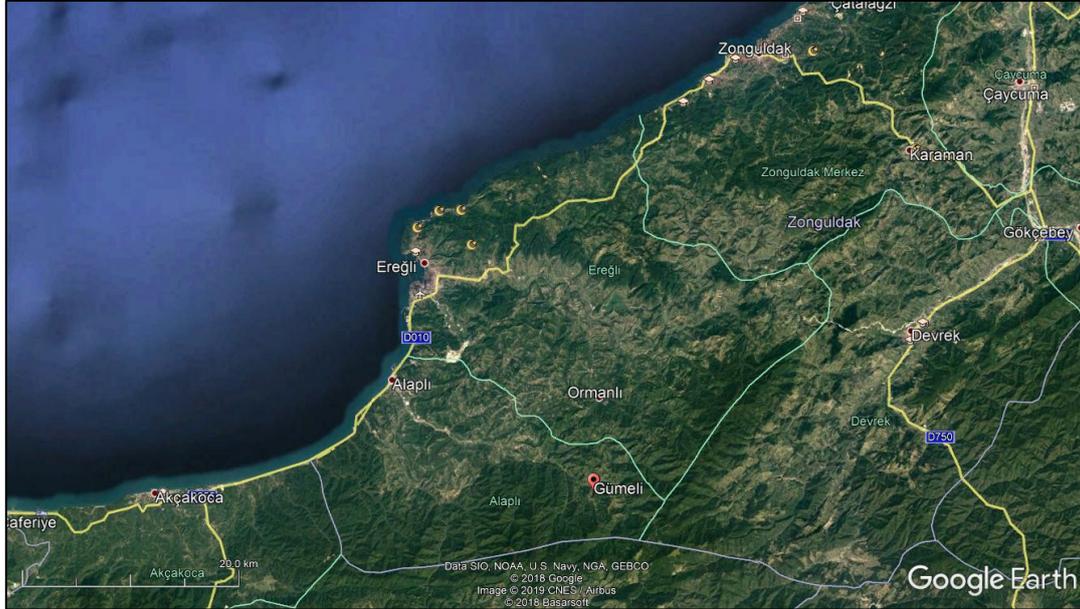
Many geological studies are conducted in the western and central Black Sea regions, including the study area and preliminary studies on geological, stratigraphic, structural geological and petrographic properties of the region was carried out by Tokay (1949, 1952, 1954), Bayramgil (1949), Altınlı (1951), Akartuna (1952), Ketin (1953), Fratschner (1953), Baykal (1954), Ketin and Gümüş (1963).

Including study area, numerous studies have been carried out in Zonguldak region to investigate mining exploration, reserve and technological properties. The vast majority of these studies are related to the coal deposits in the region and studies on topics like clay, chifon, sand, quartzite, iron, phosphorus, bauxite, etc. Nowak (1920) stated that there is a small amount of iron under the diabase outcrop located under the Devonian limestones between Ereğli and Bolu. Yergök et al. (1987) stated that in the south of Alaplı in the Hamzafakılı formation vessel-type hematite, magnetite and limonite-weighted iron enrichments are found.

Arni (1939), who studied the Zonguldak Kokaksu bauxite deposit, states that the formation of bauxite occurs with the re-washing of terra-rosas formed by lateritization of conglomerates and limestones in Cenomanian. Arni (1940) stated in Kozlu Valley that Upper Carboniferous, which is known as Karadon series, had an extremely deformed irregular fire-clay due to tectonic reasons. Göksu (1958) who was studying Kokaksu bauxites determined that the bauxites in the region were found between the base coal

limestones and the sandstones of the ground. Yergök et al. (1987) stated that bauxite formations are terrestrial enrichments and they show enrichment in the contacts of Velibey formation.

This study was carried out to investigate of the geological and petrographic features of Gümeli Village (Alaplı-Zonguldak) and its vicinity on an area approximately 60 square kilometers. In this study, petrographic and geochemical studies were carried out on the rock units exposed in the region, in order to find natural resources such as metallic mineral deposits and industrial raw materials which are likely to be found in different geological units in the region.



**Figure 1.** Location map of the study area (Google Earth Pro, 2019).

## **2. MATERIAL AND METHOD**

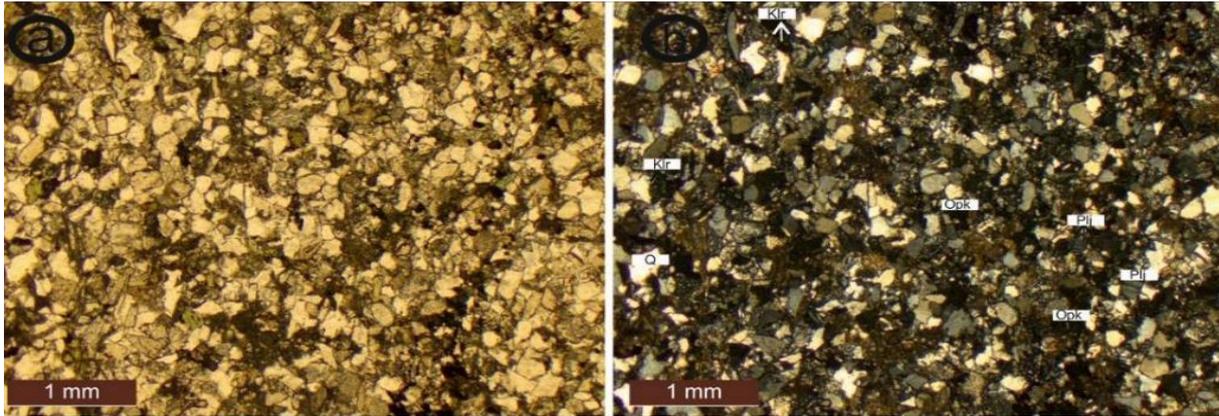
In order to carry out mineralogical petrographic analyzes of the rock samples collected during field studies, petrographical thin sections were made and the structure-texture and mineral paragenesis were determined by polarizing microscopy and the rock determinations were made.

## **3. RESEARCH FINDINGS**

### **3.1. Geology**

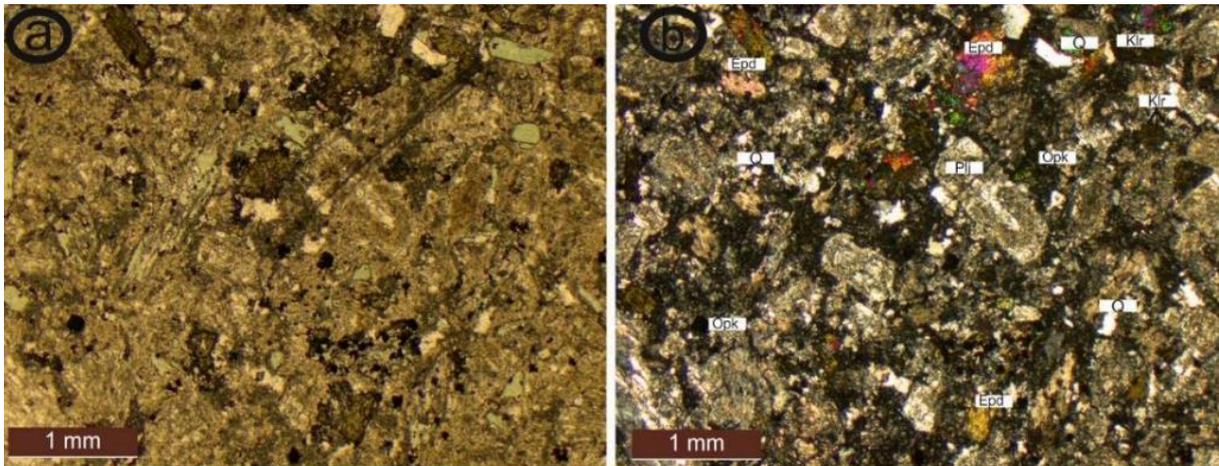
In the study area, sedimentary, metamorphic and magmatic units formed from Paleozoic to the present day are exposed (Fig. 2). The Silurian aged Hamzafakılı formation, which forms the basis of the study area, composed of purple, red, orange and yellow quartzite, metasandstone, microconglomerate, arkose and conglomerates and shale and limestone bands. The Devonian Göktepe formation, represented by laminated claystone, mudstone, siltstone, carbonated claystone, bituminous shale and carbonate sandstone alternation is gradually overlain by the Hamzafakılı formation. The Devonian age Belen Granitoid, which is composed of granite, granodiorite, quartz diorite and leucogranites, and semi-depth rocks such as quartz porphyry and diabase, cuts the Hamzafakılı and Göktepe formation. The Alaplı formation represented by Upper Cretaceous white, light green, light yellow, rarely pink, red and green colored limestone are unconformably and angularly overlying the other units. The Tertiary aged Çaycuma formation overlying the Alaplı formation with angular unconformity is composed of light yellow-white colored, thin medium layered sandstone, siltstone, claystone intercalation agglomerate, tuffite and marl intercalations. All these units cover alluviums (Deveciler, 1981; İplikçi, 1983, Fig. 2).





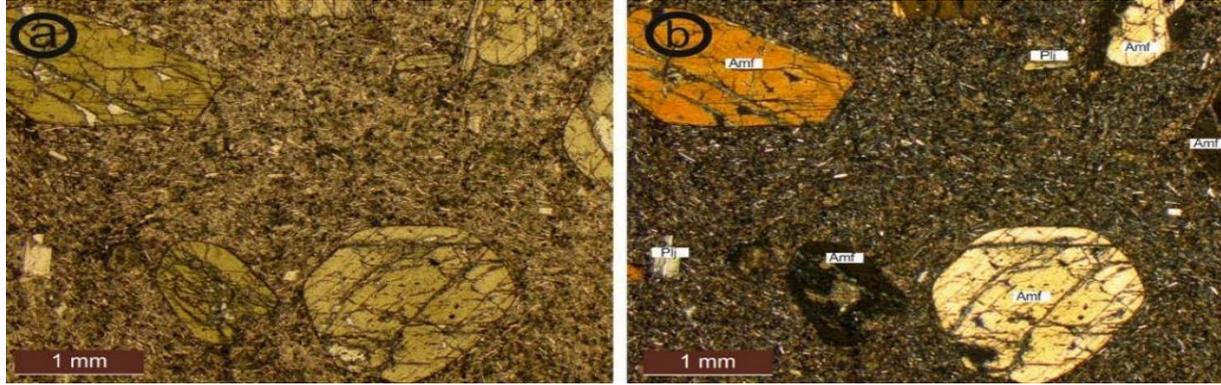
**Figure 4.** Plagioclase (plj), chlorite (clr), opaque minerals (opk), quartz (Q), minerals in the sandstone sample collected from Göktepe formation (a: //N, b: +N)

Petrographic investigations of the Belen Granitoid samples revealed that the rocks had holocrystalline porphyritic texture. The minerals present in order of multiplicity in the rock are plagioclase, amphibole, epidote, carbonate minerals, quartz, chlorite and opaque minerals. Plagioclases were intensely carbonized and partially epidotized, with very few specimens showing zoned tissue and polysynthetic twinning. Amphiboles in the rock are carbonated. Epidotes are euhedral and medium-grained. From amphiboles, there are intense chlorite formations. There are also small amounts of anhedral fine crystalline quartz. The sample examined according to mineralogical composition and textural properties is called diorite porphyry (Fig. 5).



**Figure 5.** Plagioclase (plj), chloride (klr), epidote (epd), opaque minerals (opk) and quartz (Q) in the diorite porphyries of the Belen granitoid; (a: //N, b: +N)

In the petrographic study of the sample taken from the siltstones of the Çaycuma formation, it was observed that the rock had clastic texture. The main minerals observed are sericite, plagioclase, amphibole, quartz, chlorite and opaque minerals. The rock contains 0.05 mm thick opaque + quartz + chloride veins and the rock are named as siltstone (Fig. 6).



**Figure 6.** Plagioclase (plj), amphibole (amf), sericite and quartz in siltstones of Çaycuma formation, (a: //N, b: +N)

#### 4. CONCLUSION

In this study, it is determined that different lithostratigraphic units formed from the Paleozoic to the present in the study area covering the Gümeli (Alaplı-Zonguldak) village and its environs. The Upper Ordovician-Lower Devonian aged Hamzafakılı formation at the bottom of the study area is composed of red, purple quartzite, microconglomerate and metasandstone. The Devonian aged Göktepe formation, which is gradually transitive, partially unconformably overlies the Hamzafakılı formation, consists mainly of laminated phyllite, calcschist, claystone and siltstone. Hamzafakılı and Göktepe formations are cut by Devonian aged Belen granitoid, consisting of light-colored granite, granodiorite, quartz diorite and leucogranites. Alaplı formation composed of Upper Cretaceous aged light-colored marls, clayey limestones and claystones unconformably covers older units. Çaycuma formation, which is represented by light yellow-white colored, thin medium layered sandstone, siltstone, claystone intercalation agglomerate, tuffite and marl interiors, covers other units with angular unconformity. All units are unconformably covered by the Quaternary-actual aged Alluvium.

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## **O 37. THE USE OF CROSS LAMINATED TIMBER IN STRUCTURES**

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**ABSTRACT:** Wood has been one of the most preferred building materials because of its durability, accessibility and workability since the first periods that people started to build a shelter. However, wooden structures were substantially left in the early 20th century, and concrete and steel construction systems were begun to be used. Today, the effects of environmental concepts such as sustainability, renewable energy sources, global warming and greenhouse gases on construction production have led to a reconsidering of building materials. Cross-laminated wood (CLT) panels, which have emerged for the last 20 years, enabled the use of the wooden base in multi-storey wood structures. The use of cross-laminated wood as an element of the load-bearing system removes the blind side of wood originating from its orthotropic structure. Poor quality trees are also brought to the sector thanks to these panels created. Sustainable environment could be created by performing tree farming with the purpose of using cross-laminated wood instead of existing tree sources in the construction sector, thus this will be more beneficial economically by minimising the importation of this material. This study provided information about the production stages, areas of usage and environmental features of cross-laminated wood as construction material, and design implementation of this new product as the element of the load-bearing system was carried out. Also, in this study, a multi-layered CLT beam was analysed theoretically in RFEM program as an application of CLT structural member.

*Keywords: Cross-laminated timber, multi-storey structures, panel*

### **1. INTRODUCTION**

Since the existence of mankind, timber has become the preferred building material in house construction due to its many features such as naturalness, strength, accessibility and processability. In addition, its being economical, healthy and sustainable have enabled to be used widely in places where access to raw materials is easy.

The timber was left in the early 20th century, and concrete and steel structural systems were begun to be used. Stronger, more high-rise buildings and fire resistance may be indicated as the reasons for this. Moreover, the decreasing of the timber compared to the population in the world and its becoming more expensive have led to the use of alternative materials.

The materials used in constructions have begun to be reconsidered with the emergence of the concepts of sustainability, global warming and renewable energy sources. While 30-40% organic materials were used in the constructions before, this ratio has decreased to 0-10%. The construction industry uses 40% of the world's total energy. The effective component in global warming is carbon dioxide. The timber continuously absorbs carbon dioxide in the air throughout its use in constructions since its growth and prevents its release into the atmosphere (Bostancıoğlu and DüzgünBirer, 2004).

The construction time is shortened due to easy design, manufacture and installation of the timber. It is easy to renew and has high energy efficiency. It is a more insulating material than steel and concrete and is preferred especially in countries with cold climates. What is more, the light weight of the building causes less damage to the building by reducing the load on the building during an earthquake.

### **2. CROSS LAMINATED TIMBER**

The timber material used by drying or without drying after sawn from the log is called solid timber. It consists of solid and pure wood that is not coating and logging. Generally, the new material, which is formed by the combination of timber material such as lumber, chip, fibre and sawdust with binder agents such as glue in different ways in the factory environment, is called industrial material. Industrial timber material has mechanical and technological properties with higher value than solid timber material.

Moreover, it is a high-quality material that does not hold the drawbacks of solid timber material. Industrial timber technology will please consumers by leading to the more rational use of decreasing forest resources in the world, and provides to achieve products meeting the necessary needs (Güzel and Yesüeyev, 2015). While the mechanical properties of the timber are high in parallel with its fibres, these values are not sufficient in the perpendicular direction to the fibres. This weakness caused by the orthotropic structure of the timber is removed by cross-laminated timber elements.

Cross-laminated timber panels, as an industrial timber material, are stiff elements with strong dimensional stability which have been generally glued to each other from their wide surfaces in the manner that the fibre directions of solid wood elements with 3, 5, 7 or more layers become opposite to each other (generally 90°) and in some cases glued at least 0.6 N/mm<sup>2</sup> with glue from narrow surfaces (Güzel and Yesüeyev, 2015).



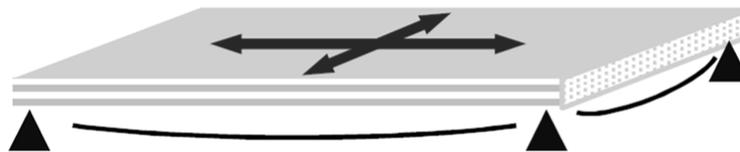
**Figure 1.** CLT concept and CLT panel (Pei, 2013)

### **2.1. Historical Development**

The cross-laminated timber, defined by various abbreviations such as CLT, BSP, KLH and X-lam and known in the world by different names, emerged in Switzerland in the early 1990s. The use of cross-laminated timber technology, developed in Austria with the effort of industry and academic research in 1996, became widespread in the early 2000s. It has become widespread in Europe, America and Canada with the effect of green building approaches and has led to the reorganization of timber building regulations. Nowadays, cross-laminated timber has also begun to be used in multi-storey buildings (Gagnon and Pirvu, 2013).

### **2.2. Advantages of Cross-Laminated Timber**

It significantly increases the segregation resistance of the parts of the CLT by providing a reinforcement effect on the cross-lamination system in the CLT. It ensures two-way mobility similar to the reinforced concrete floor. CLT systems can be easily integrated with steel, reinforced concrete and timber frame structures.



**Figure 2.** CLT panel with two-way load movement (Brenamann, 2017)

Bearing or non-bearing structural member can be produced from CLT material. Long spans are passed with these panel elements. Even if the panels have window and door openings, they can serve as bearings. They can be used as curtain wall construction elements due to their high axial load bearing capacities and very high floor cutting capacities. Wall panels are highly resistant to dynamic loads. It is 75% lighter than concrete by volume (Landreman, 2017). Its lightness makes the earthquake loads less effective on the construction.

CLT is made indispensable since the panels can be produced in a single piece and the timber material is a natural heat and sound insulation material. It is 15 times more efficient than concrete and 400 times more efficient than steel in terms of thermal efficiency (Waugh, 2018).

Continuity of flooring and panels is ensured by finger joints. Its thin layers provide convenience for determining and correcting the defective parts. Thus, structural defects are at the lowest level.

### 2.2.1. Fire Resistance of Cross-Laminated Timber

The fire resistance of CLT material was found to be higher than steel and concrete as a result of the tests. CLT panels protect structural capacity for a long time when exposed to fire due to the slow carbonization of timber elements during the fire (Gagnon and Pirvu, 2013).

Increasing the number of layers of panels used as wall, floor and roof elements; increasing layer thickness or covering their surfaces with gypsum enhance their resistance against fire. CLT panel in 7” and with 5 layers was used in ASTM E119 Fire Resistance Test by American Timber Council. It was predicted to resist for 2 hours according to the calculations, but it provided a better result by resisting for 3 hours and 6 minutes. After the tests conducted, CLT material received the necessary approvals for fire resistance (Gagnon and Pirvu, 2013).

### 2.2.2. Environmental Performance of Cross-Laminated Wood

The cross-laminated timber material has better properties than equivalent concrete and steel constructions in terms of environmental performance. It is renewable, recyclable and recoverable due to the timber used. It generates minimum waste during production processes and their application. The fact that it is a natural material and has a high degree of carbon storage makes it environmentally friendly.

### 2.3. Production Steps of Cross-Laminated Timber

Appropriate lumber is selected for CLT, and the strength of this lumber is checked. Lumber is grouped according to the productive lengths and widths that can be obtained. Planing process is applied to the surfaces to ensure the smoothness of the surfaces. The lengths are cut in equal lengths to form the panels. Glue is applied to the surfaces for the second layer following the first layer formed in horizontal position, and the joint process is performed by compressing the second layer vertically. Panels are packaged by opening door and window openings in accordance with the project measurements, thus it is made ready for transport.

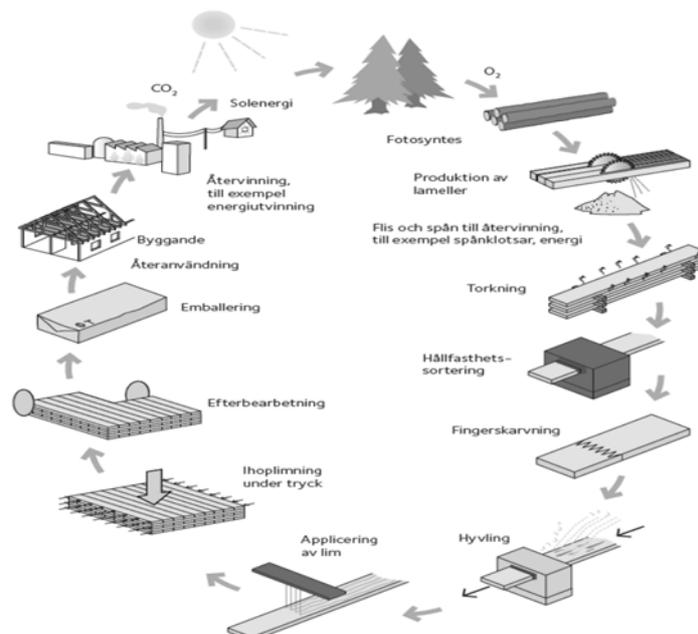


Figure 3. The manufacturing process of CLT products and carbon cycle (Danielsson, 2017)

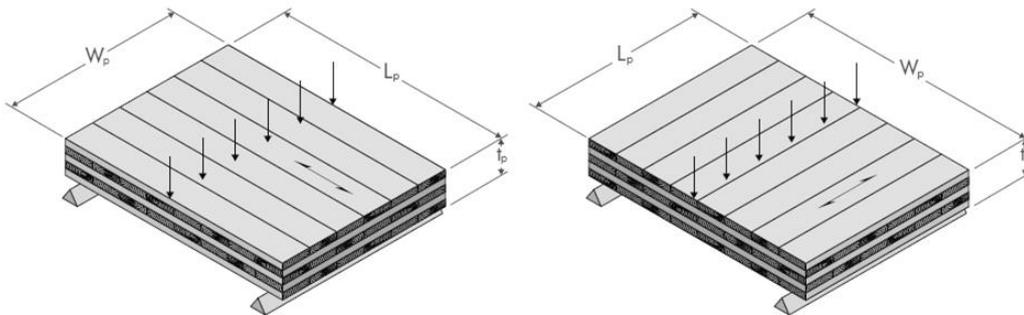
### 2.4. Standards

The current ANSI/APA PRG-320 (Standard for Performance-Rated CLT) product standard is used for mechanical properties and product performance of CLT material in the USA and Canada. This standard includes panel measurements, tolerances, component requirements, construction performance requirements and qualities. NDS(National Design Specification) and IBC (International Building Code) standards are used in constructional design in the USA and Canada. The NDS contains the required calculations for the design, limitations, joint material calculations. Some limitations have been given to the design in the IBC.

### 3. LOADING IN CROSS LAMINATED TIMBER PANELS

Wall and floor elements bear the load in CLT constructions. Producing panels as a single piece and finger joints in providing the continuity enable to pass long spans. Deflection calculation is made in the middle of the span in CLT floors as in reinforced concrete floor. Since deflection is a critical condition for floors, it is a factor to be considered in dimensioning CLT floors. In order to reduce deflection, the thickness or the number of layers is increased.

The strong axis trying to bend during the loading is called the major axis, and the axis trying to segregate is called the minor axis. While the strength values of the layers on the major axis are higher, this value is much less on the minor axis, and is often not included in the calculations.



**Figure 4.** Loadings on major and minor bending axes (ANSI/APA PRG-320, 2018)

The major and minor axes of the layers vary in different directions in a two-way operating floor. The strength values used in the calculation for these directions are provided by the CLT manufacturer. These values are given in Table 1 of PRG-320 for the USA and Canada.

**Table 1.** ASD reference design values for CLT (ANSI/APA, PRG-320 Table A2.)

CLT Grade	Lamination Thickness (in.) in CLT Layup								Major Strength Direction			Minor Strength Direction		
	CLT † (in.)	=	⊥	=	⊥	=	⊥	=	$F_c S_{eff,0}$ (lb-ft/ft)	$EI_{eff,0}$ (10 <sup>6</sup> lb-ft-in. <sup>2</sup> /ft)	$GA_{eff,0}$ (10 <sup>6</sup> lb-ft/ft)	$F_c S_{eff,90}$ (lb-ft/ft)	$EI_{eff,90}$ (10 <sup>6</sup> lb-ft-in. <sup>2</sup> /ft)	$GA_{eff,90}$ (10 <sup>6</sup> lb-ft/ft)
E1	4 1/8	1 3/8	1 3/8	1 3/8	1 3/8				4,525	115	0.46	160	3.1	0.61
	6 7/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8		10,400	440	0.92	1,370	81	1.2
	9 5/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	18,375	1,089	1.4	3,125	309	1.8
E2	4 1/8	1 3/8	1 3/8	1 3/8					3,825	102	0.53	165	3.6	0.56
	6 7/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8			8,825	389	1.1	1,430	95	1.1
	9 5/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	15,600	963	1.6	3,275	360	1.7
E3	4 1/8	1 3/8	1 3/8	1 3/8					2,800	81	0.35	110	2.3	0.44
	6 7/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8			6,400	311	0.69	955	61	0.87
	9 5/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	11,325	769	1.0	2,180	232	1.3
E4	4 1/8	1 3/8	1 3/8	1 3/8					4,525	115	0.53	180	3.6	0.63
	6 7/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8			10,425	441	1.1	1,570	95	1.3
	9 5/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	18,400	1,090	1.6	3,575	360	1.9
V1	4 1/8	1 3/8	1 3/8	1 3/8					2,090	108	0.53	165	3.6	0.59
	6 7/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8			4,800	415	1.1	1,430	95	1.2
	9 5/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	8,500	1,027	1.6	3,275	360	1.8
V2	4 1/8	1 3/8	1 3/8	1 3/8					2,030	95	0.46	160	3.1	0.52
	6 7/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8			4,675	363	0.91	1,370	81	1.0
	9 5/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	8,275	898	1.4	3,125	309	1.6
V3	4 1/8	1 3/8	1 3/8	1 3/8					2,270	108	0.53	180	3.6	0.59
	6 7/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8			5,200	415	1.1	1,570	95	1.2
	9 5/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	1 3/8	9,200	1,027	1.6	3,575	360	1.8

#### 4. DEFLECTION CALCULATION OF FLOOR SYSTEMS

In this study, deflection calculation was analysed with the help of manual solution and RFEM (version 5.18) program for a simply supported cross-laminated timber floor, and the results were compared.

##### 4.1. Analysis According to Elastic Method

The deflection calculation is carried out with simply supported beam logic in CLT floor coverings. The solution is applied for a width of 1 ft at the selected span. Equations required for deflection are obtained from the NDS 2018 Standard used in structural design. Strength values are taken for the selected section from PRG-320. These values are bending and shear stiffness values. The deflection value to be performed by the floor is found with the strength values involved in the equations. The obtained values are compared with the limit values valid for CLT in IBC 2018 to determine the conformity of the section.

Deflection values were calculated for a simply supported beam made of CLT. The 5-layer V1 section was selected from the PRG-320 as the CLT material and the total thickness of the layers used in this section was 6 7/8 inches (174.625 mm). The floor had an 18 ft (5.49 m) span. The design loads were given as follows: Dead Load = 50 psf (2.39 kN/m<sup>2</sup>), Live Load = 60 psf (2.87 kN/m<sup>2</sup>).



The strength values for the section in the thickness of V1 6.875 were obtained as bending stiffness above from PRG-320 Table 1,  $EI_{eff} = 415 \times 10^6 \text{ lb} \cdot \text{in}^2 / \text{ft}$  and shear stiffness  $GA_{eff} = 1.1 \times 10^6 \text{ lb} / \text{ft}$ . The shear deformation coefficient was accepted as 11.5 for one end simply supported in a uniform loading from  $K_s$  NDS 2018 Table 10.4.1.1.

$$EI_{app} = \frac{EI_{eff}}{1 + \frac{K_s EI_{eff}}{GA_{eff}}} = \frac{415 \times 10^6}{1 + \frac{11.5 \times 415 \times 10^6}{1.1 \times 10^6 (18 \times 12)^2}} = 379,69 \times 10^6 \text{ lb} \cdot \text{in}^2 / \text{ft} \quad (1)$$

$$\Delta_{max} = \frac{5}{384} \frac{wL^4}{EI_{app}} = \frac{5}{384} \frac{(\frac{60}{12})(18 \times 12)^4}{379.63 \times 10^6} = 0.373 \text{ in.} \quad (2)$$

The critical limiting state in floor members for IBC 2018 is experienced in the live loading of CLT floor members. The deflection limit for the live loading from IBC table 1604.3 should be smaller or equal to  $L/360$ .

Required deflection condition was met for the beam member when the control was performed for the critical conditions of  $\Delta_{max} = 0.372 \text{ in} (9.45 \text{ mm}) < \frac{18 \times 12}{360} = 0.6 \text{ in} (15.24 \text{ mm})$ .

##### 4.2. RFEM Analysis Results

In the RFEM (version 5.18) linear finite element analysis program, structural analysis of the considered beam shown in Figure 6 was performed. Analysis for NDS 2018 standard was conducted in live loading by selecting V1 6 7/8" CLT section for 18 ft (5486 mm) beam span. Maximum deflection values and the stress distribution on the beam obtained as a result of the analysis are shown in Figure 7 and 8, respectively. Accordingly, the maximum vertical displacement in the midspan of the beam was determined to be 0.372 in. (9.45 mm). This value was obtained as 0.3% different from the deflection value calculated according to the elastic method. The maximum stress values obtained in different layers as a result of the analysis are shown Figure 9.

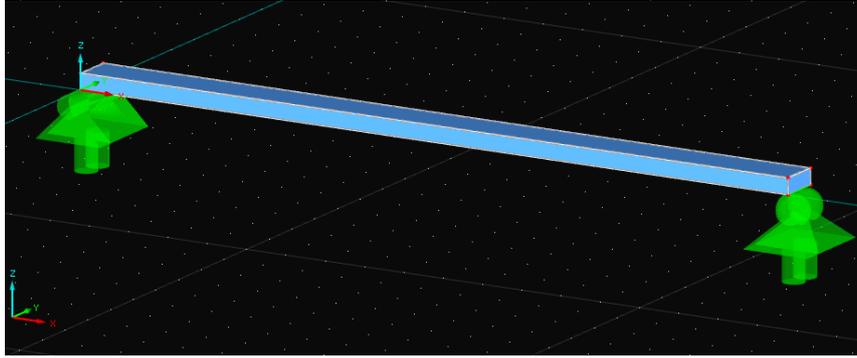


Figure 6. Simply supported beam modeling in RFEM 5.18 program

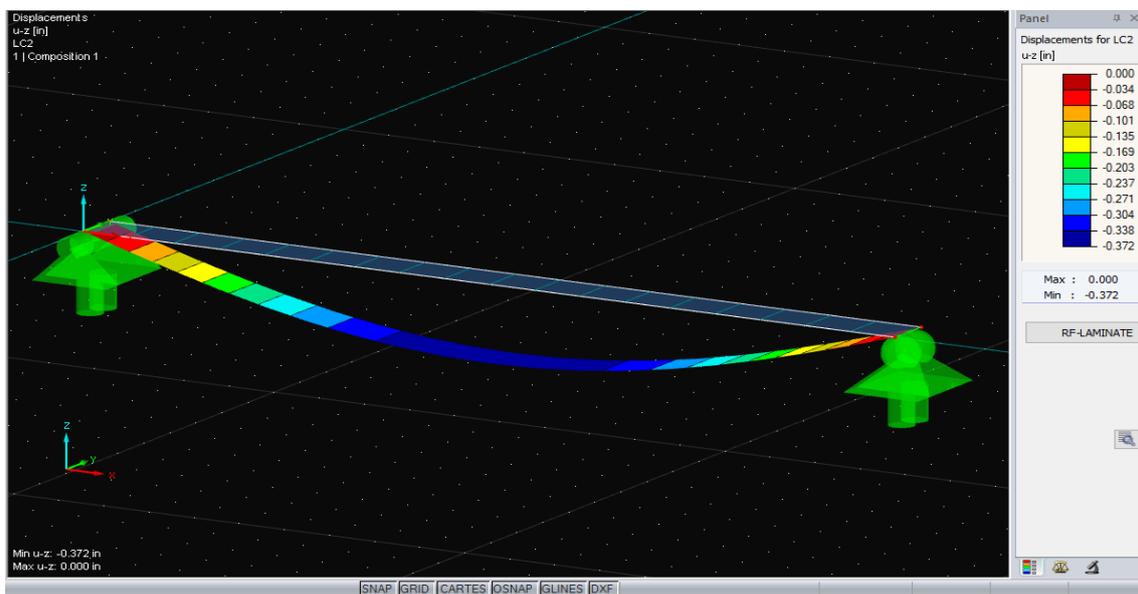


Figure 7. Deflection values of simply supported beam

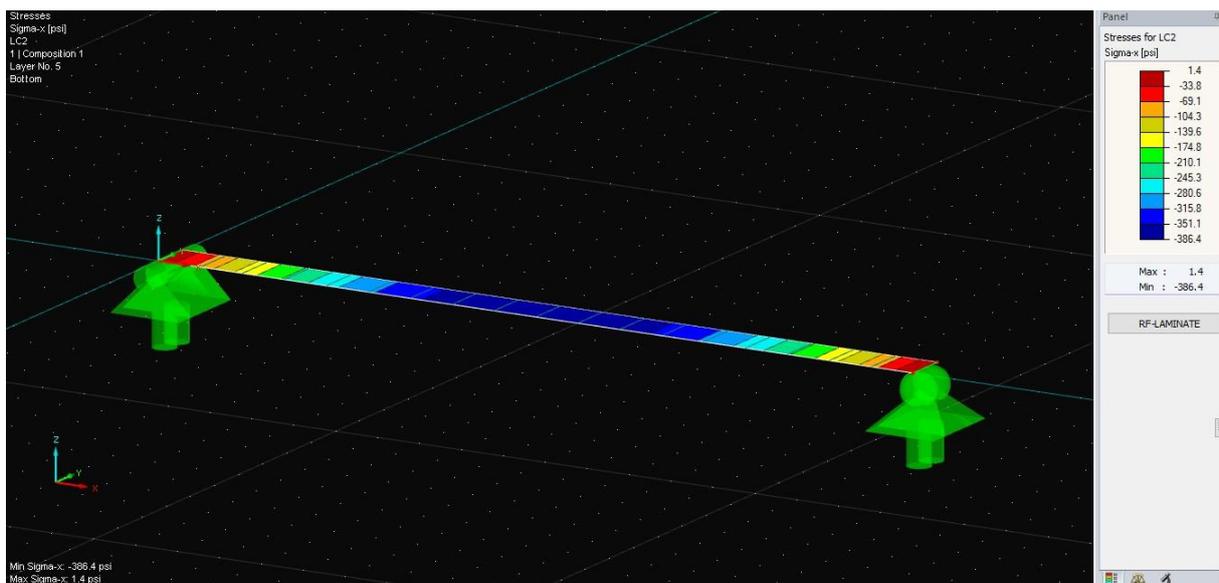


Figure 8. Stress distribution on simply supported beam

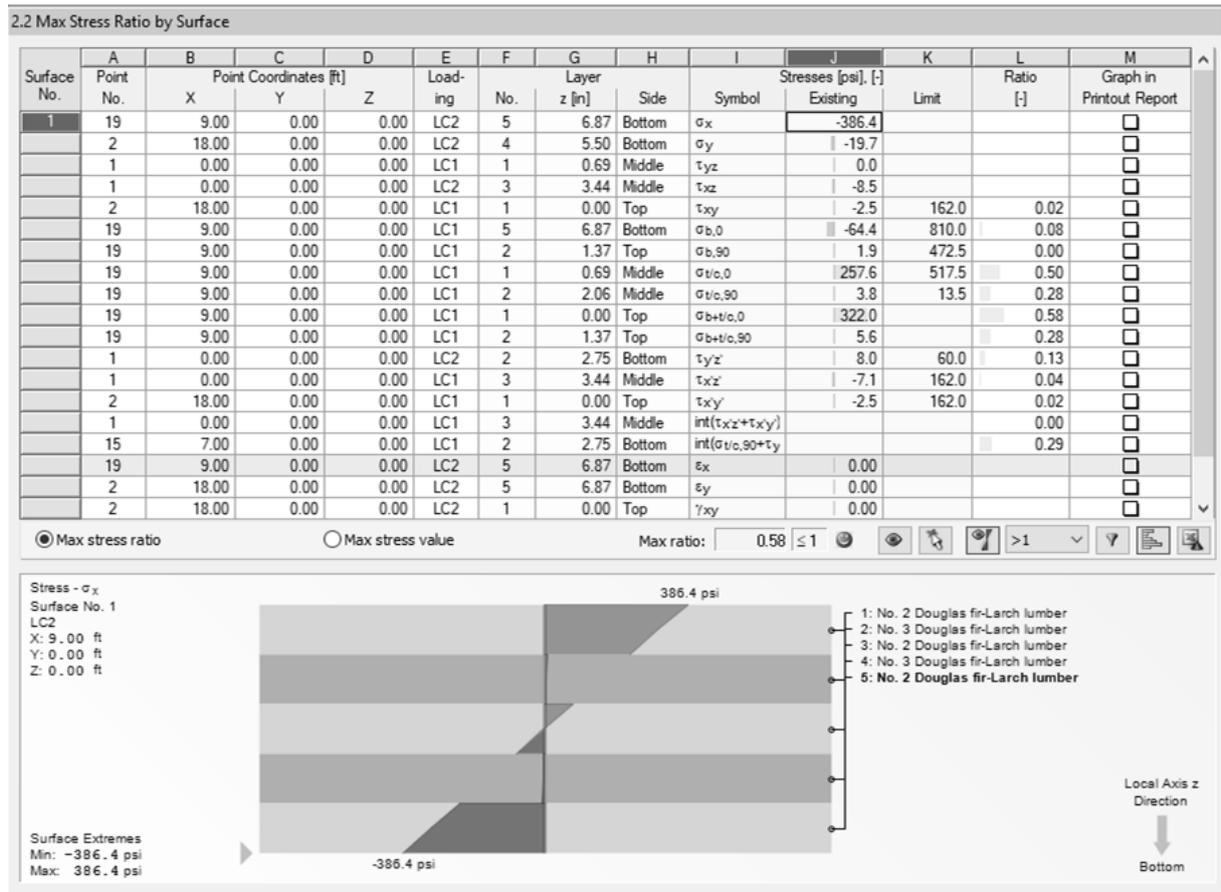


Figure 9. Stress values obtained as a result of analysis and maximum stress ratio

## 5. CONCLUSIONS

Cross-lamination structurally eliminates the weaknesses of the timber. The cross-laminated timber material has enabled the use of timber bearing systems in multi-storey constructions with its high strength, stability and stiffness. It minimizes the earthquake loads affecting the construction due to its being light in multi-storey buildings. Timber offers environmentally friendly solutions by storing carbon into its structure.

In this study, the mid-span deflection of a multi-layered CLT beam was analysed theoretically. The deflection value was obtained as 0.372 in (9.45 mm) for the considered beam mid-span using the PRG-320, NDS 2018 and IBC 2018 standards. The results were confirmed by founding the same displacement value as a result of static analysis in RFEM program carried out. What is more, surface stresses were determined in RFEM program, the highest value was found to be 386.4 psi (2.66 MPa) in the middle of the span. The ratio of maximum stress value to bearing stress strength was found to be 0.58.

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## **O 38. INDOOR AMBIENT PARTICLE MATTER MEASUREMENT AND MODELING IN FOUNDRIES**

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**ABSTRACT:** Rapidly increasing world population causes air pollution in urbanization and safety of raw materials. Air pollutants impress human and environmental health. With the development of our country, the industrial sector has progressed. Foundries have an important share in the development of industrial sector. The increase in industrialization in the world has brought together raw materials and together. It contains very high amounts of dust and particulate matter. This situation has a negative impact on worker health and work efficiency. The contaminated foundry was produced during the working hours and at different points. It is aimed to protect the indoor air quality and to be the worker health.

**Keywords:** *foundry, indoor air quality, particle measurement, air pollution*

### **1. INTRODUCTION**

Air pollution is a really important environmental problem not only in developed countries but also in developing countries (Bulgurcu, 2015). Approximately 3 million people are affected by air pollution each year (Altın, 2015; Babaroğlu, 2015). Air pollutants are present in various forms in the atmosphere, adversely affecting both human health and environmental health. Examples of air pollutants include carbon monoxide (CO), heavy metals, sulphur compounds, nitrogen compounds, organic substances and particles. Air pollutants are found not only outside but also indoors scale affected life quality. In both working and daily life, people had to spend time in closed environments for a long-time indoor place. In indoor environments, there are quite a lot of pollutants could be detected. They vary even in their environment including living in these environments. Some of the pollutants originate from the external environment enters aeration, while others are found produced direct in the indoor environment. High levels of pollutants reduce indoor air quality. The concentration of pollutants in the environment and the type of pollutants are effective. Decreasing indoor air quality poses short- or long-term problems on the health of the people in the environment. The deterioration of indoor air quality both affects workers' health negatively and decreases the work efficiency. Density of pollutant gases, dust, number of particles, temperature and humidity of the environment are also effective in poor indoor air quality (Bulgurcu et al., 2014). The gaseous pollutants are generally present in CO, NH<sub>3</sub>, NO<sub>x</sub>, SO<sub>2</sub>, H<sub>2</sub>S forms. Particulate contaminants (PM<sub>2.5</sub> and PM<sub>10</sub>) are present in solid and liquid form. Particulate matter sizes that are important for indoor air quality and human health are in the range of 0.1-10 µm. Particulate matter smaller than 0.1 µm is partially exhaled. Particulate matters larger than 10 µm are retained in the upper respiratory tract (Alptekin & Çelebi, 2015. Health Canada, 1995; Soysal & Demiral, 2007 Ünver Alçay & Yalçın, 2015). Internal health effects of particulate matter have been reported as eye, nose and respiratory tract irritation, asthma, bronchitis, lung damage, cancer, heavy metal poisoning, cardiovascular effects (Yurtseven, 2007; USEPA, 2012; Yurdakul, 2018). Dust particles can seriously affect human health in areas where ventilation is not working well. In this study, measurements were made in order to determine the amount of particulate matter in a foundry plant. As a result of the measurements, the effects of ambient air pollutants on the workers were evaluated.

### **2. MATERIAL AND METHOD**

The measurements were performed in a private foundry factory at two time periods by continuous sampling method on 26/03/2019 and 28/03/2019. Indoor particle measurements are carried out in the moulding section of the foundry, in the melting furnace, in the blasting section, in the core shop, in the grinding section and so on was made in parts such as dust. PCE - PC01 Particle Counter was used for

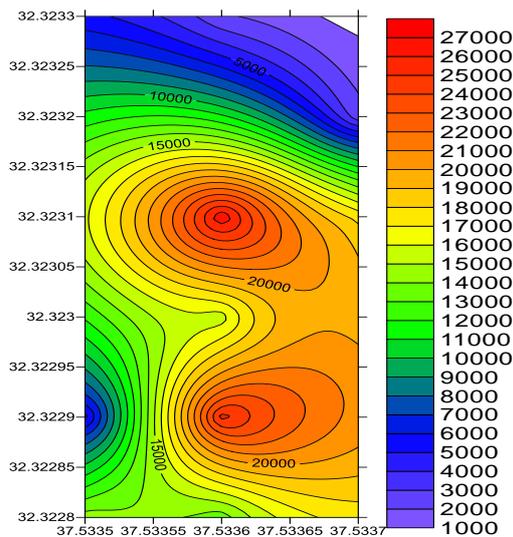
measurements. The device is capable of measuring and recording solid and liquid substances suspended in air in atmospheric environment and breathable by human. The device can measure existing particles in the air without the need for an air pump. The device could save the data obtained from the measurement points to its own memory. The device's memory can store 5000 data. It gives the measurement results in ppm. The instrument has a green, yellow and red colour scale (Figure 1).



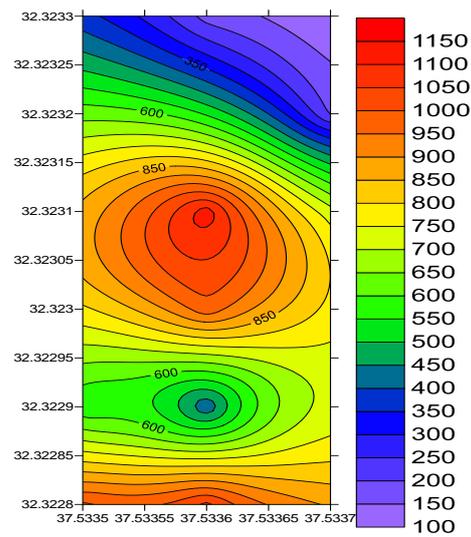
**Figure 1.** PCE – PC01 Particle Counter instrument for measurement of Particle matter

### 3. RESULTS

Particle matter measurements were performed at designated points of a foundry operating in Konya industry region on Tuesday, 26.03.2019 and on Thursday, 28.03.2019 at 09:00, 11:00, 14:00, 16:00 and the data was mapped according to the measurement points geographic coordinate (Figures 2-16). It was found that the lowest value was found to be 1.728 mg/m<sup>3</sup>, the highest value was 26.850 mg / m<sup>3</sup> and the average value was 12.414 mg/m<sup>3</sup> for PM<sub>2.5</sub> measurements at 10 different points on 26.03.2019.

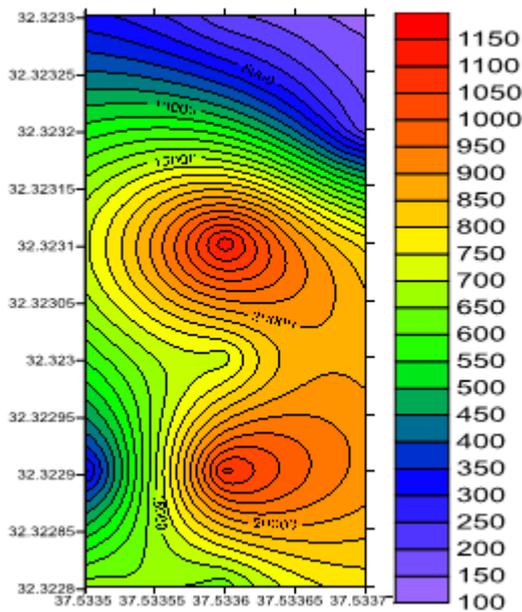


**Figure 2.** Distribution of 2.5µm size particle at 09:00 on 26/03/2019

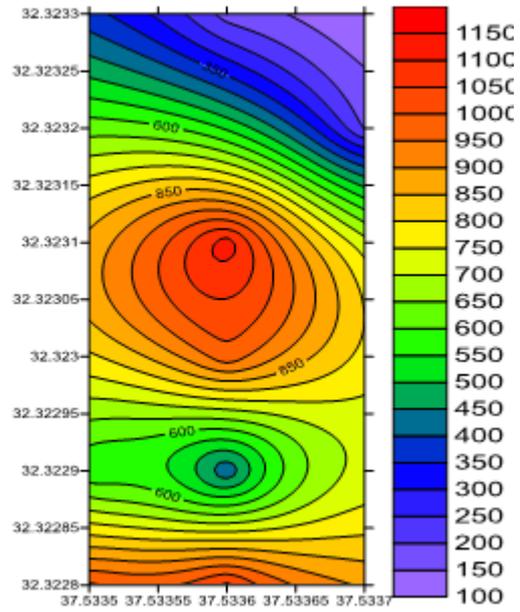


**Figure 3.** Distribution of 10 µm size particle at 09:00 on 26/03/2019

Distribution of the measurements at 10 different points on 26/03/2019 at 09.00 showed that the lowest value for 10µm was 0.105 mg / m<sup>3</sup>, the highest value was 1.126 mg / m<sup>3</sup> and the average value was 0.635 mg / m<sup>3</sup>. It was found that the lowest value was found to be 1.229 mg / m<sup>3</sup>, the highest value was 36.191 mg / m<sup>3</sup> and the average value was 10.304 mg / m<sup>3</sup> for 2.5µm measurements at 10 different points on 26.03.2019.

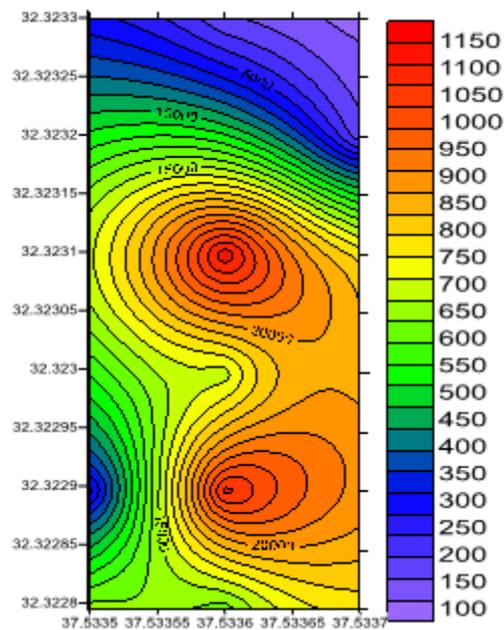


**Figure 2.** Distribution of 2.5µm size particle at 11:00 on 26.03.2019

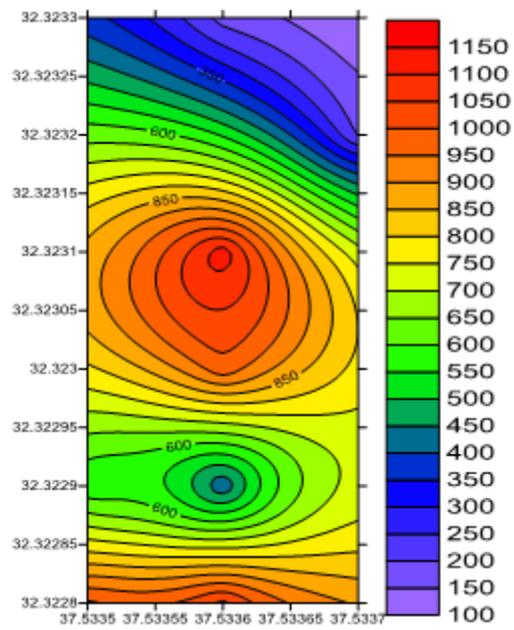


**Figure 3.** Distribution of 10 µm size particle at 11:00 on 26.03.2019

Distribution of the measurements at 10 different points on 26/03/2019 at 11.00 showed that the minimum value for 10µm was 0.152 mg/m<sup>3</sup>, the highest value was 1.216 mg/m<sup>3</sup>, and the average value was 0,608mg / m<sup>3</sup>. The measurements at 10 different points dated 26/03/2019 at 14.00 showed that the lowest value for 2.5µm was 3.329 mg / m<sup>3</sup>, the highest value was 40.721 mg / m<sup>3</sup> and the average value were 14.297 mg/m<sup>3</sup>.



**Figure 6.** Distribution of 2.5µm size particle at 14:00 on 26.03.2019



**Figure 7.** Distribution of 10µm size particle at 14:00 on 26.03.2019

It was found that the lowest value was 0.063 mg / m<sup>3</sup>, the highest value was 0,762 mg / m<sup>3</sup> and the average value was 0,487mg / m<sup>3</sup> for 10µ at 10 different points on 26/03/2019. It was found that the

lowest value was  $2.586 \text{ mg} / \text{m}^3$ , the highest value was  $154,776 \text{ mg} / \text{m}^3$  and the average value was  $22,621 \text{ mg} / \text{m}^3$  for  $2.5\mu$  measurements at 10 different points on 26/03/2019.

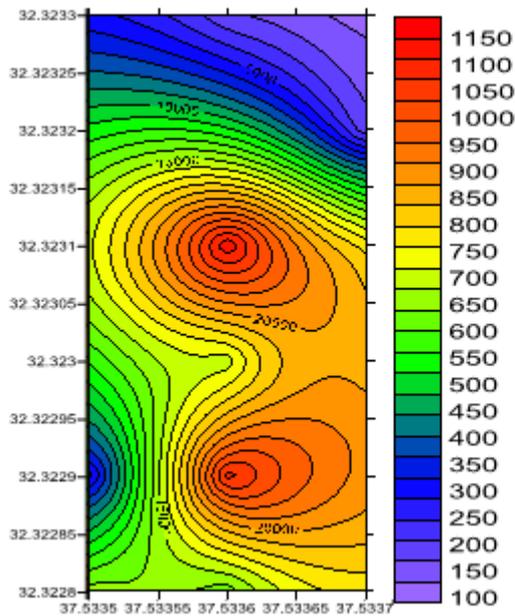


Figure 8. Distribution of  $2.5\mu\text{m}$  size particle at 16:00 on 26.03.2019

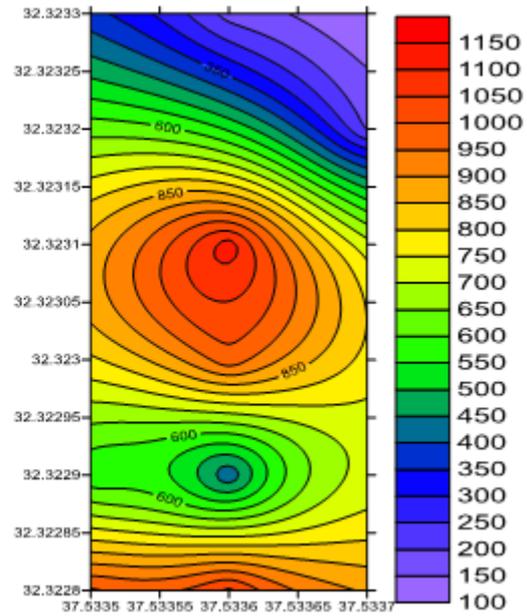


Figure 9. Distribution of  $10\mu\text{m}$  size particle at 16:00 on 26.03.2019

Distribution of the measurements at 10 different points on 28.03.2019 at 16.00 showed that the lowest value for  $10\mu\text{m}$  was  $0.105 \text{ mg} / \text{m}^3$ , the highest value was  $1.126 \text{ mg} / \text{m}^3$  and the average value was  $0.601 \text{ mg} / \text{m}^3$ . It was found that the lowest value was  $0.617 \text{ mg} / \text{m}^3$ , the highest value was  $13,702 \text{ mg} / \text{m}^3$  and the average value was  $6.411 \text{ mg} / \text{m}^3$  for  $2.5\mu$  measurements at 10 different points on 28.03.2019.

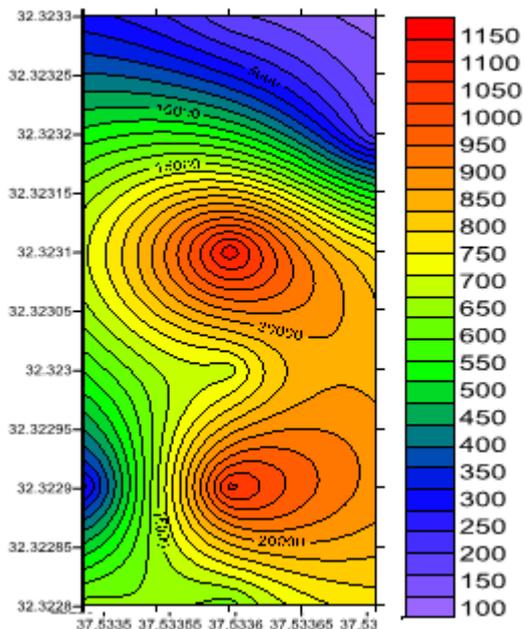


Figure 10. Distribution of  $2.5\mu\text{m}$  size particle at 09:00 on 28.03.2019

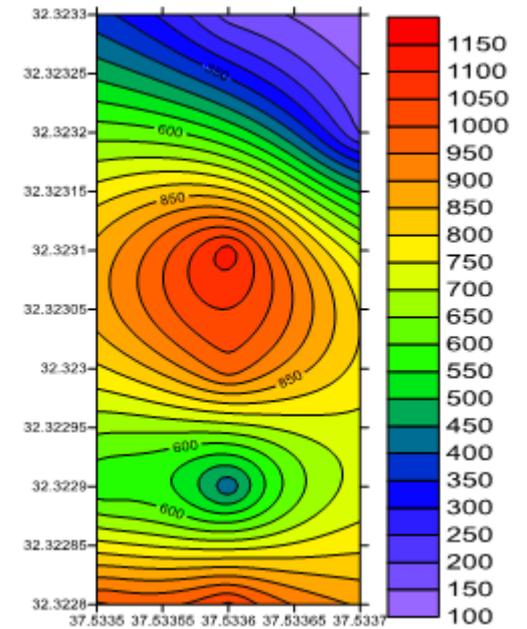
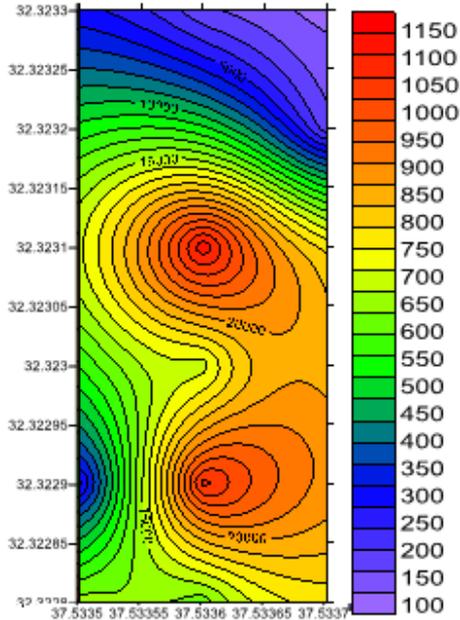


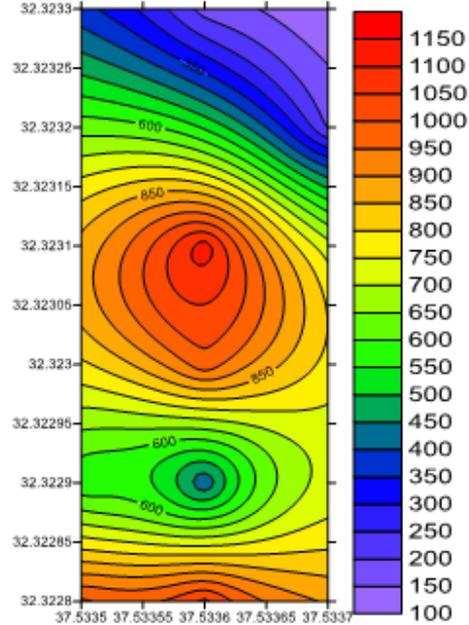
Figure 11. Distribution of  $10\mu\text{m}$  size particle at 09:00 on 28.03.2019

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The measurements at 10 different points on 28.03.2019 at 09.00 showed that the lowest value was 0.053 mg / m<sup>3</sup>, the highest value was 0.922 mg/m<sup>3</sup> and the average value was 0.441 mg/m<sup>3</sup> for 10 m. The measurements at 10 different points dated 28.03.2019 at 11.00 showed that the lowest value for 2.580 mg / m<sup>3</sup>, the highest value was 19.555 mg / m<sup>3</sup> and the average value were 6,629 mg / m<sup>3</sup>.

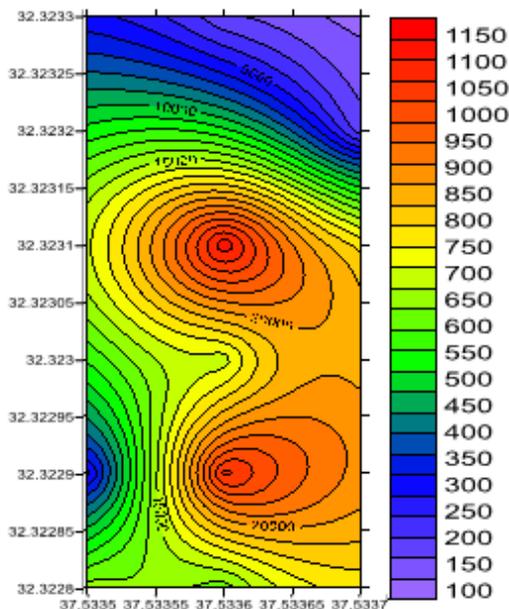


**Figure 12.** Distribution of 2.5µm size particle at 11:00 on 28.03.2019

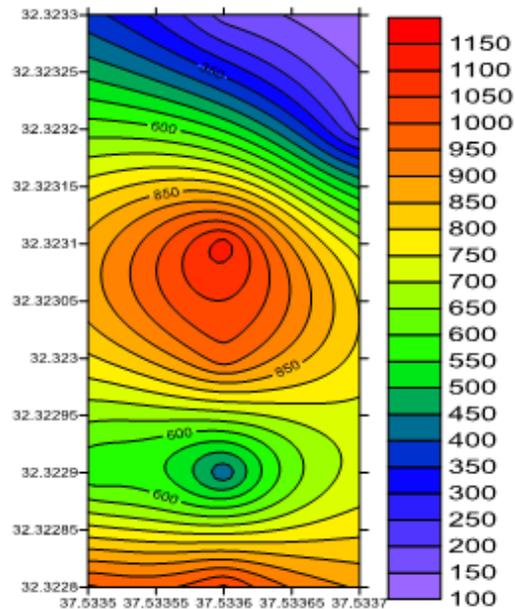


**Figure 13.** Illustration of a 10µm particle size made at 11.00 on 28.03.2019

Distribution of the measurements at 10 points on 28.03.2019 at 11:00 showed that the lowest value for 10µm was 0.340 mg/m<sup>3</sup>, the highest value was 0.849 mg/m<sup>3</sup>, and the average value was 0.510 mg / m<sup>3</sup>. The measurements at 10 different points on 28.03.2019 at 14.00 showed that the lowest value for 2.5µm was 1.197 mg / m<sup>3</sup>, the highest value was 31.229 mg / m<sup>3</sup>, and the average value was 10,235mg / m<sup>3</sup>.



**Figure 14.** Distribution of 2.5µm size particle at 14:00 on 28.03.2019



**Figure 15.** Illustration of a 10µ particle size made at 14.00 on 28.03.2019

The measurements at 10 different points on 28.03.2019 at 14.00 showed that the lowest value for  $10\mu$  was  $0.098 \text{ mg / m}^3$ , the highest value was  $0.582 \text{ mg / m}^3$  and the average value was  $0.369 \text{ mg / m}^3$ . The measurements at 10 different points on 28.03.2019 at 16.00 showed that the lowest value for  $2.5\mu$  was  $0.772 \text{ mg / m}^3$ , the highest value was  $23.496 \text{ mg / m}^3$  and the average value was  $11.816 \text{ mg / m}^3$ .

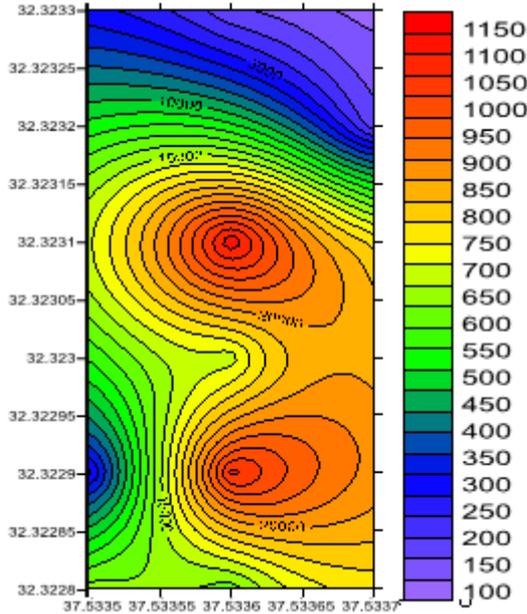


Figure 16. Distribution of  $2.5\mu\text{m}$  size particle at 16:00 on 28.03.2019

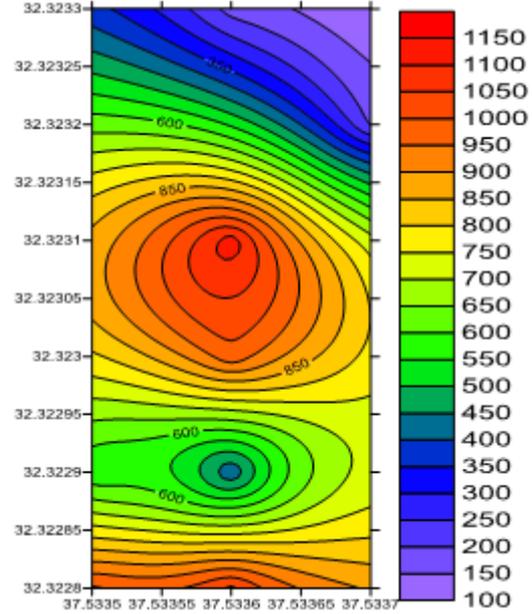


Figure 17. Illustration of a  $10\mu$  particle size made at 16.00 on 28.03.2019

In the measurements taken at 10 different points on 28.03.2019 at 16.00, the lowest value was found to be  $0.095 \text{ mg/m}^3$ , the highest value was  $0.746 \text{ mg / m}^3$  and the average value was  $0.409 \text{ mg/m}^3$ .

#### 4. DISCUSSION

Foundries produce a lot of dust due to their production processes. The resulting dust adversely affects workers' health. As a result of the measurements, it was observed that the values found were above the limit values. The measured area of the foundry is  $2000 \text{ m}^2$ . The highest particulate matter level in the foundry was found to be the core shop, sandblasting section and melting furnace. Ventilation was found to be insufficient in the foundry. Although this does not affect the workers working in the foundry in a short time, it will have a serious impact on their health in the long term. Particulate matter in the air causes especially upper respiratory diseases. The short-term effects of the powder cause irritation, cough, emphysema and asthma. Cancer and heart diseases are examples of the long-term effects of the powder (Çobanoğlu, 1994; Motör, 2011; Öztürk & Düzovalı, 2011; Karakaş, 2015; Dindar, 2018). In order to reduce the effects of this situation on workers' health, firstly, the ventilation of the environment should be very good. Dust collection system should be installed to reduce dust generated in the melting furnace and sand blasting section. Powder producing parts should be collected in a single section. All workers, not only those working in the quarry and in the sandblasting department, should be required to wear permanent masks. Ambient air quality should be monitored regularly. Workers should undergo regular health checks. Training should be provided to workers. Working hours and breaks should be set to expose to fresh air (Çalı, 2000; Gülen, 2013; Güllü, 2016; Işık E, Çibuk, 2015 Gönüllü et al, 2018).

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### **O 39. EVALUATION OF ANTIBACTERIAL ACTIVITIES OF NYLON 6,6 NANOFIBERS COATED WITH MINT OIL AND MINT EXTRACT**

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**ABSTRACT:** The aim of the study was to fabricate Nylon 6,6 nanofibers coated with essential oil and plant extract to create an antibacterial activity which can be used as a potential food packaging material or biomedical textile. Herein, the target antibacterial material was engineered by coating mint oil and mint extract on Nylon 6,6 nanofibers. Firstly, production of Nylon based nanofibers was performed by electrospinning technique. Then, mint oil and mint extract were decorated onto nanofibers via ultrasonication technique. The nanofibers were characterized using Scanning Electron Microscope (SEM) and Fourier-transform infrared (FT-IR) spectrophotometer. Antibacterial activities of surface coated nanofibers were evaluated using Gram-positive bacteria (*Staphylococcus aureus*) and Gram-negative bacteria (*Escherichia coli*). The inhibition zones were measured and recorded. Nanofibers coated mint oil showed better antibacterial properties as compared to mint extract.

*Keywords: Antibacterial, nanofiber, mint oil*

#### **1. INTRODUCTION**

Tremendous research interest has been directed toward nanofibrous designs generated by electrospinning technique, in the last 10 years. Electrospinning is a versatile method to fabricate nanoscale polymer fibers with diameter in the range of 3–5000 nm (Jiang et al. 2015). Nanofibrous structures obtained via electrospinning method have antimicrobial, anti-inflammatory, and anti-oxidant activity, which are attractive for biomedical applications and food packaging industries (Kohsari et al. 2016). In order to gain these properties to the materials, different types of agents (i.e. antimicrobials, antibiotics, plant extracts and essential oils) can be used (Zhang et al. 2017; Akia et al. 2019). Since ancient times, essential oils are well-known for their antimicrobial properties. The use of essential oils as an antibacterial agents leads to produce novel and eco-friendly nanomaterials. This types of oils can be incorporated into electrospun nanofibers and polymer films to be in a wide range of applications. With the advances in science it is possible to fabricate new materials at nanoscale level. Nanofibers are the member of this type of novel materials. Nanofibers are generally preferable due to having high area and controllable compositions.

The purpose of this study was to develop new nanomaterials having antibacterial activity to be used in different applications. In this respect, nanofibers were obtained using electrospinning technique, then they were coated with mint oil and mint extract. SEM analysis and FT-IR analysis were performed to characterize the structures of nanofibers. Antibacterial activities of materials were evaluated by agar diffusion method.

#### **2. MATERIAL AND METHOD**

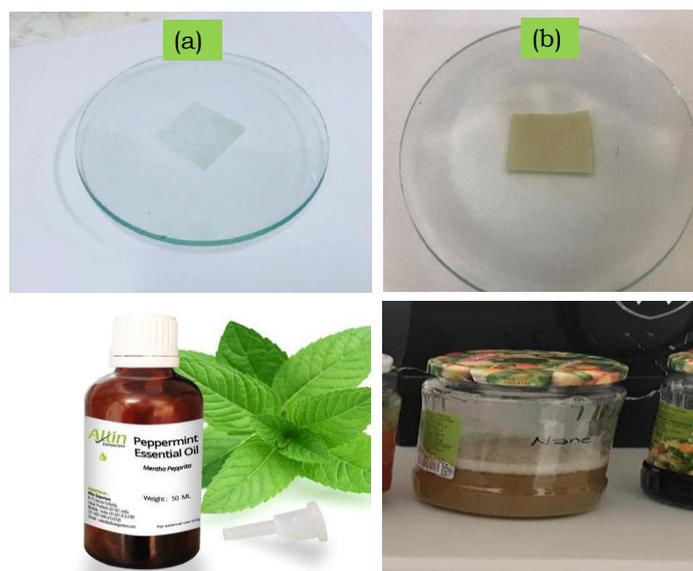
Nylon 6,6 and formic acid with purity of 99 vol% were obtained from Sigma Aldrich Company. Nanoclay (Cloisite 20A) was purchased from BYK company. Mint extract was prepared using mint plant. Mint oil used in this study, was purchased from local market.

##### **2.1. Preparation of nanofibers**

In brief, before fabricating of nanofibers, polymer was dissolved in formic acid. Polymer-clay solution was mixed by magnetic stirrer and ultrasonicator in order to achieve homogeneous solutions. Nanofibers were produced by spinning the polymeric solution with and without nanoclay. Nylon 6,6-formic acid solution was placed in a 10-ml syringe with 19-gage needle tip and electrospun onto a aluminum foil to

produce Nylon nanofibers. Similarly, Nylon 6,6-clay solution was electrospun with different parameters to determine the proper conditions. The distance between collectors and spinneret were maintained at 15 cm. Clay was incorporated into the Nylon 6,6 solution in order to improve the mechanical properties of fibers.

The fabricated nanofibers were coated with mint oil and mint extract by magnetic stirrer and ultrasonicator. The excess solution was removed and the samples were dried at room temperature overnight.



**Figure 1.** Nanofibers coated with mint oil (a) and mint extract (b)

## 2.2. Characterization of nanofibers

Fiber morphology was analyzed using Scanning Electron Microscopy (ZEISS evo LS10). FT-IR spectrum was recorded at range 400 to 4000  $\text{cm}^{-1}$  at 4  $\text{cm}^{-1}$  resolution using a Bruker Vertex FT-IR spectrometer.

## 2.3. Antibacterial Activity

Antibacterial studies were conducted on the developed Nylon 6,6 nanofiber mats, both including uncoated and mint oil and mint extract coated samples. Antibacterial activities of Nylon 6,6 nanofibers coated with mint oil and mint extract were tested against a Gram-positive (*Staphylococcus aureus*) bacterium and a Gram-negative bacterium (*Escherichia coli*) using agar diffusion method. Fibers cut into equal sizes were placed on nutrient agar plates previously seeded with 0.1 mL of the tested bacteria ( $\sim 10^8$  cfu/mL). After 24 hours of incubation at 37°C the diameter of inhibitory zones surrounding the samples were measured. Fibers lacking mint oil and mint extract were used as control.

## 3. RESEARCH FINDINGS

### 3.1. SEM analysis

Fig. 2 shows scanning electron micrographs of the fabricated bare Nylon 6,6 fibers. The average diameters were 200-300 nm. As seen from the figure, uniform bead-less fibers were achieved.

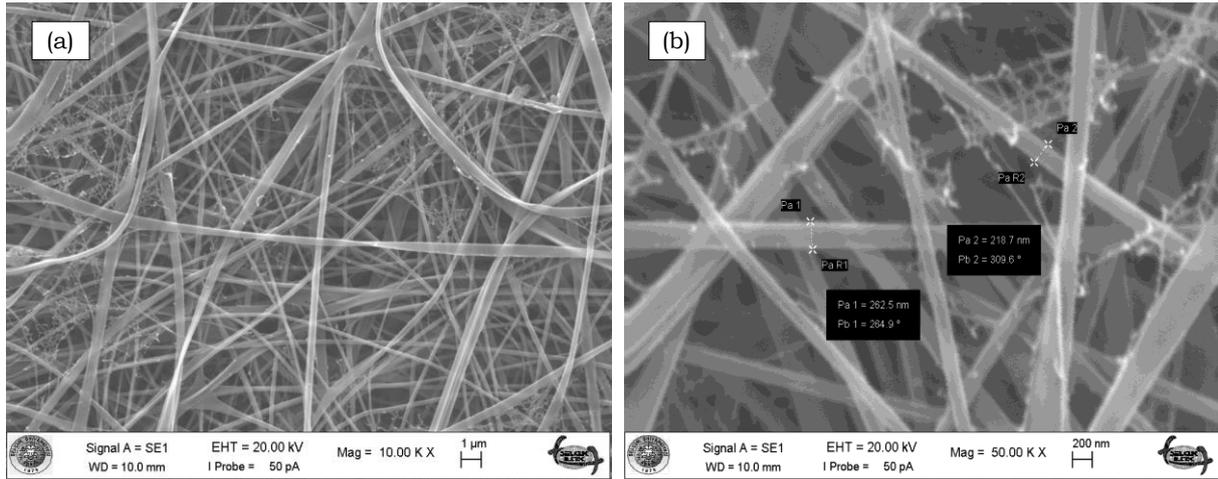


Figure 2. SEM micrographs of bare electrospun Nylon 6,6 nanofibers

Figure 3 and 4, show SEM images of nanofibers coated with mint oil and extract, respectively. As seen from the figure 3, a thin film layer was formed by networking between each fibers. In addition, no deterioration was observed in the structure.

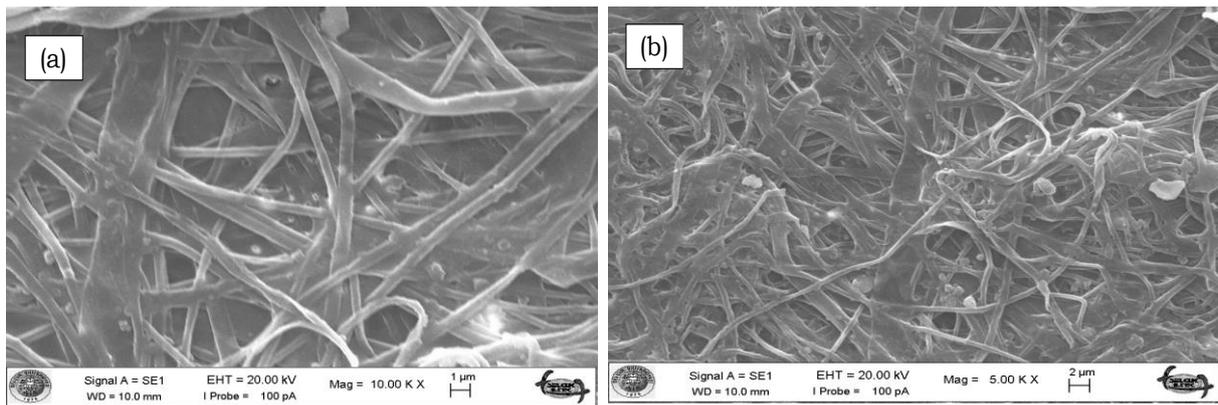


Figure 3. SEM micrographs of electrospun Nylon 6,6 nanofibers coated with mint oil

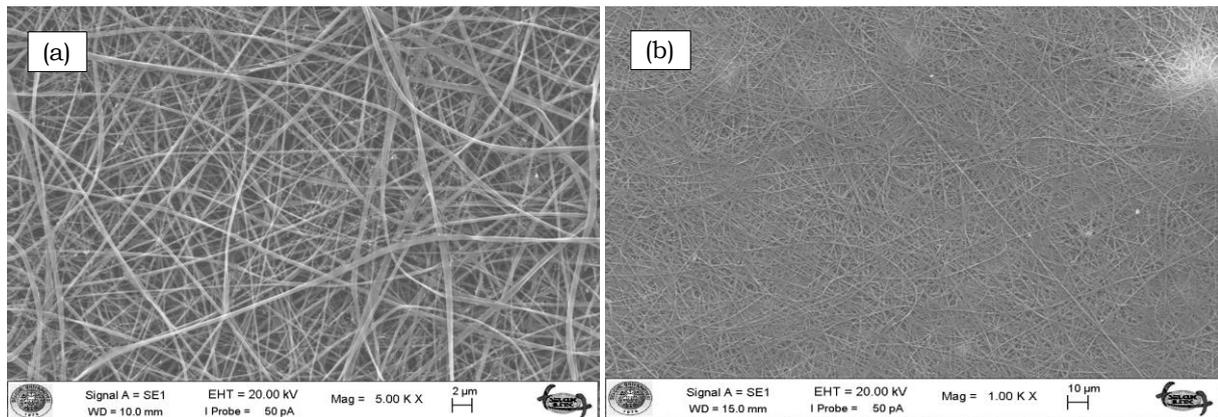


Figure 4. SEM micrographs of electrospun Nylon 6,6 nanofibers coated with mint extract

### 3.2. FT-IR analysis

Figure 5 shows the FT-IR spectra of obtained Nylon 6,6 and coated nanofibrous mats. Nylon 6,6 has some characteristic peaks at  $3300\text{ cm}^{-1}$ : (O-H deformation);  $2940\text{ ve } 2860\text{ cm}^{-1}$ : (C-H stretching and O-H groups);  $1640\text{ cm}^{-1}$ : (C=O deformation);  $1420\text{ cm}^{-1}$ : (C-O-H deformation);  $1256\text{ cm}^{-1}$ : (C-O

stretching). Oil immobilized nanofiber has some characteristic peaks at 3060, 3030, 1490, 1450, 1370 ve 1030, 758 ve 698  $\text{cm}^{-1}$ . However, many peaks of sample coincide with the main peaks of Nylon 6,6 fibers. The shift in the absorption values of the main peaks of the mint oil loaded fiber, indicates the presence of volatile oil on the fiber surface. New peak formation is not observed for fibers coated with mint extract. However, the intensities of peaks mainly decreased.

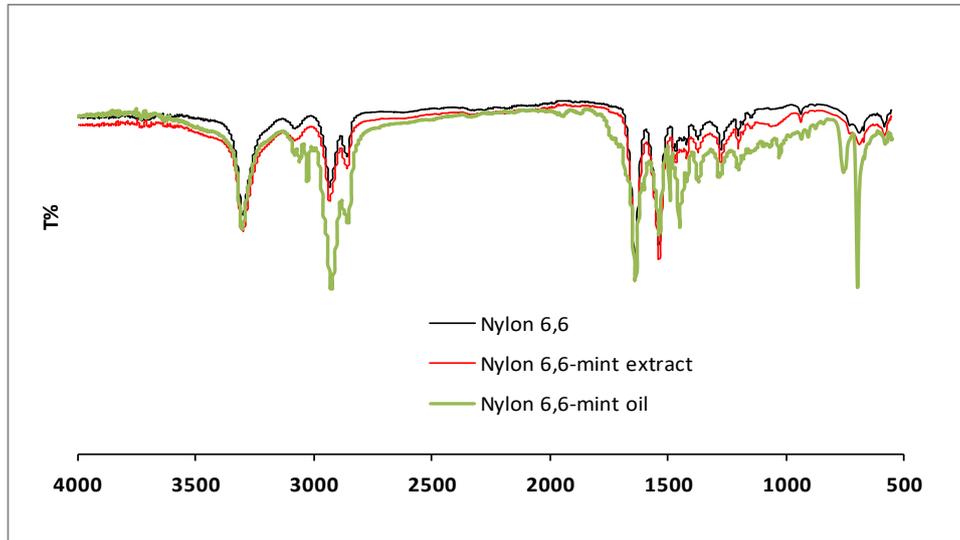


Figure 5. FT-IR spectrum of electrospun nanofibers

### 3.3. Assay of Antibacterial Activity

The results of antibacterial activity test were illustrated in Figure 6 and 7. The control samples exhibited no inhibitory effect on *E. coli* and *S. aureus*. Fibers coated with mint extract also showed no antibacterial activity against both of the test bacteria. Inhibitory zones around the fibers coated with mint oil was observed verifying the antibacterial effect of the fibers against both *E. coli* and *S. aureus*. The degree of inhibition was similar against both the Gram-positive and the Gram-negative bacterium. Addition of clay besides the mint oil or the mint extract resulted in disappearance of antibacterial activity of the fibers.

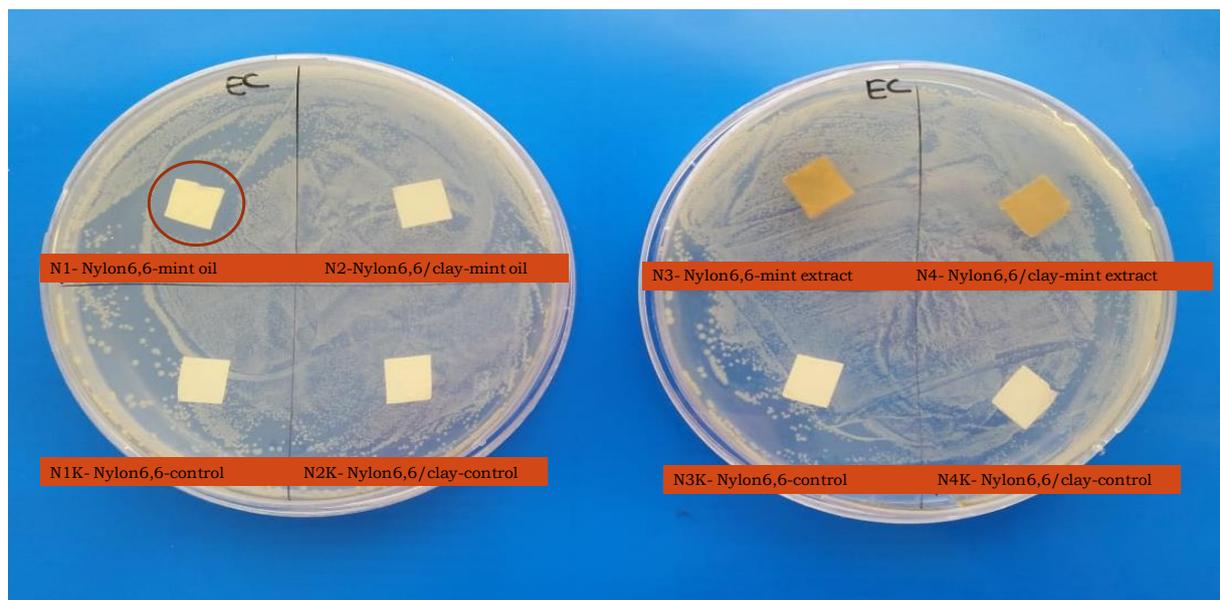
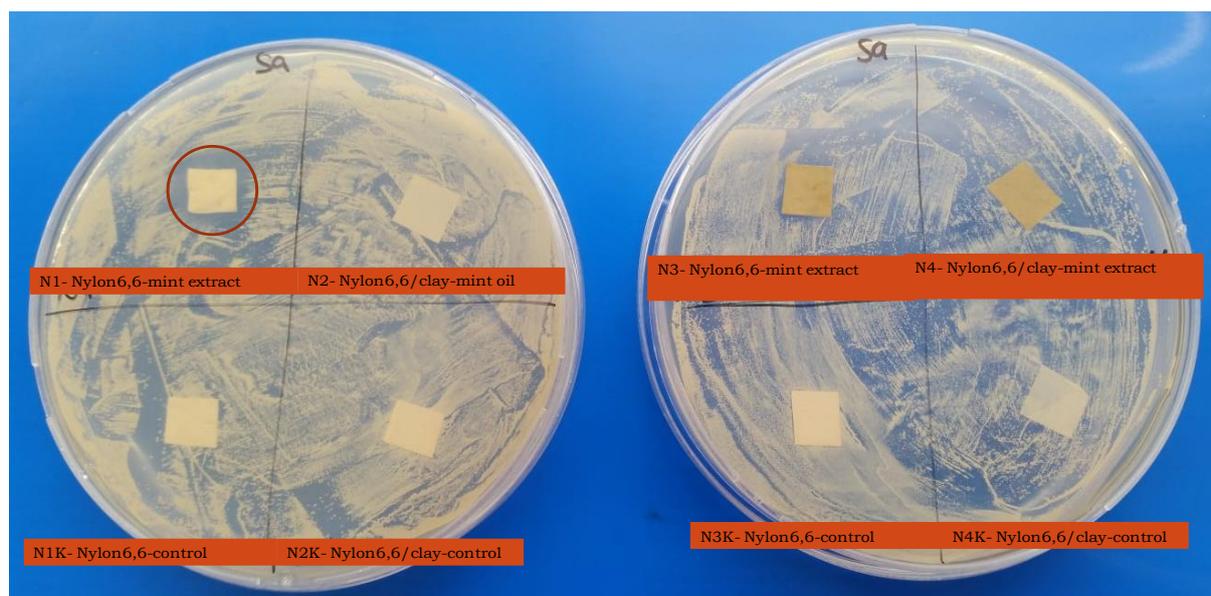


Figure 6. Inhibition zones for nanofibers against bacteria *Escherichia coli*



**Figure 7.** Inhibition zones for nanofibers against bacteria *Staphylococcus aureus*

#### 4. CONCLUSIONS

In this work, an environmentally benign material and process for antibacterial application was proposed. In the first step of the process, Nylon 6,6 nanofibers were developed utilizing a spinning process. Fibers with an average diameter of 200-300 nm were collected as nonwoven mats. The antibacterial activity against two pathogenic bacteria species, *E. coli* and *S. aureus*, was evaluated for the developed nanofiber mats. According to the results, mint oil provides an antibacterial activity to the fibers. However, this effect was not observed in nanofibers coated with mint extract. Furthermore, nanofibers including clay had no antibacterial activity. Consequently, this product would be used for various applications including self-sterilizing textiles and food packages.

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## **O 40. ANTIBACTERIAL PROPERTIES OF NYLON 6,6 NANOFIBERS CONTAINING SILVER NANOPARTICLES**

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**ABSTRACT:** The aim of this study was to develop antimicrobial nanofibers to be a candidate for potential applications. Nylon 6,6 nanofibers were fabricated via electrospinning technique, then the silver nanoparticles (AgNPs) immobilization was performed in order to gain an antimicrobial activity. In this method, generated electrospun Nylon 6,6 nanofibers were immersed into AgNO<sub>3</sub> solution for 2 hours and removed from the solution, treated with water, and then reduced using NaBH<sub>4</sub> for 2 hours. The formation of AgNPs was occurred through the NaBH<sub>4</sub> reducing agent. The obtained Nylon 6,6 nanofibers containing AgNPs were washed with water and dried. Fabricated nanofibers were characterized using Scanning Electron Microscope (SEM) and Fourier-transform infrared (FT-IR) spectrophotometer. Antibacterial activities of AgNPs immobilized nanofibers were evaluated using Gram-positive bacteria (*Staphylococcus aureus*) and Gram-negative bacteria (*Escherichia coli*). The inhibition zones were measured and recorded. According to the analysis, nanofibers showed better antibacterial activity against to Gram-positive bacteria (*Staphylococcus aureus*) as compared to Gram-negative bacteria (*Escherichia coli*).

*Keywords:* Antibacterial, nanofiber, silver nanoparticle, nylon 6,6.

### **1. INTRODUCTION**

In recent years, there has been an increasing interest on antibacterial products in a wide range of application areas such as water purification, protection, wound dressing, and textile industry etc (Kang et al. 2016). The products having antibacterial activity can be prepared in the form of beads, gels, films and fibers. Nanofibers are defined as fibers with diameters less than 1 micrometer. Nanofiber technology (fiber diameter less than 1 micrometer) is under development for the preparation of novel materials in nano-scale with multifunctional properties. Electrospinning is an elegant method for producing nanofibers with high porosity and high specific surface area (Huang et al. 2003). Electrospun polymer nanofibers containing silver nanoparticles has received much attention due to their antimicrobial properties. According to our knowledge, silver and silver compounds show excellent antimicrobial efficiency against organisms such as bacteria, fungi and viruses (Pant et al. 2012). AgNPs can damage the structure of the bacteria. Nanoparticles can also penetrate the cell membrane, where it interacts with phosphorous-containing DNA and attack thiol groups of respiratory chain enzymes, inhibiting cell division and respiration, finally leading to cell death (Jabur et al. 2017).

Main objective of this study was to prepare antibacterial (Nylon 6,6) nanofibers containing silver nanoparticles. Mechanical stirring and ultrasonic dispersion were used to prepare homogenous polymer-clay/nanoclay solutions. Then, the electrospinning technique was performed to achieve Nylon 6,6 nanofibers. Surface of the obtained nanofibers was loaded AgNPs using AgNO<sub>3</sub> salts. SEM, EDX and FT-IR spectra were utilized to focus on the morphology, surface elemental fiber mats, fibers and pore size diameters. Antibacterial activities of materials were evaluated by agar diffusion method.

### **2. MATERIAL AND METHOD**

Nylon 6,6 and formic acid with purity of 99 vol% were obtained from Sigma Aldrich Company. Clay (Tixogel VP) and nanoclay (Cloisite 20A) were purchased from BYK company. Silver nitrate (AgNO<sub>3</sub>, Sigma Aldrich) was used as a metal precursor.

#### **2.1. Preparation of nanofibers**

Before fabricating of nanofibers, polymer was dissolved in formic acid. Polymer-clay solution was mixed by magnetic stirrer and ultrasonicator in order to achieve homogeneous solutions. Nanofibers were produced by spinning the polymeric solution with and without nanoclay. Nylon 6,6-formic acid solution was placed in a 10-ml syringe with 19-gage needle tip and electrospun onto a aluminum foil to produce Nylon nanofibers. Similarly, Nylon 6,6-clay/nanoclay solutions were electrospun with different parameters. The distance between collectors and spinneret were maintained at 15 cm. Clay and nanoclay were incorporated into the Nylon 6,6 solution in order to improve the mechanical properties of fibers. Generated electrospun Nylon 6,6 nanofibers were immersed into  $\text{AgNO}_3$  solution for 2 hours and removed from the solution, treated with water, and then reduced using  $\text{NaBH}_4$  for 2 hours. The formation of AgNPs was occurred through the  $\text{NaBH}_4$  reducing agent. The obtained Nylon 6,6 nanofibers containing AgNPs were washed with water and dried (Figure 1b).



**Figure 1.** Electrospun Nylon 6,6 nanofibers and modified nanofibers with AgNPs

## 2.2. Characterization of nanofibers

Fiber morphology was analyzed using Scanning Electron Microscopy (ZEISS evo LS10). FT-IR spectrum was recorded at range  $400$  to  $4000\text{ cm}^{-1}$  at  $4\text{ cm}^{-1}$  resolution using a Bruker Vertex FT-IR spectrometer.

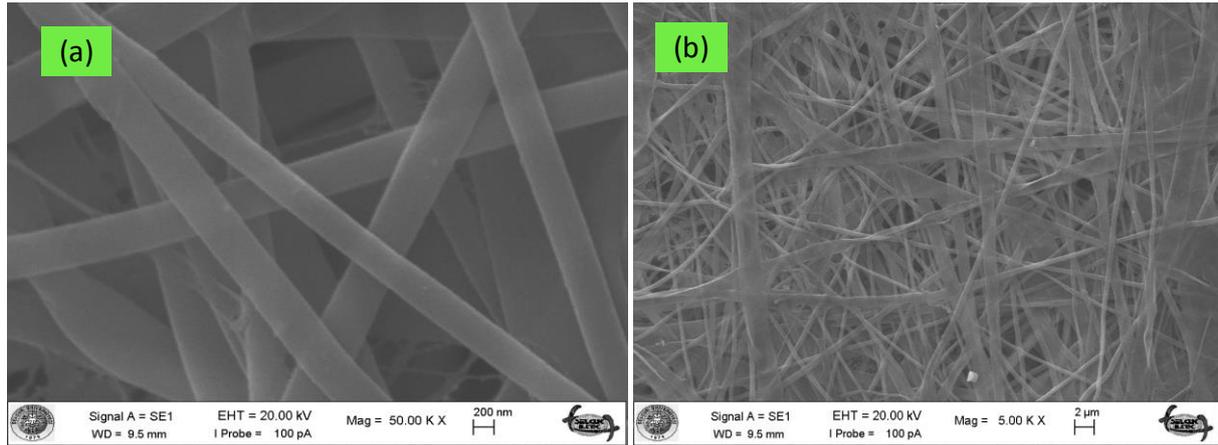
## 2.3. Antibacterial Activity

Antibacterial activities of Nylon 6,6 nanofibers containing AgNPs were tested against the Gram-positive bacterium, *Staphylococcus aureus* and the Gram-negative bacterium, *Escherichia coli* using agar diffusion method. Fibers cut into equal sizes were placed on nutrient agar plates previously seeded with  $0.1\text{ mL}$  of the tested bacteria ( $\sim 10^8\text{ cfu/mL}$ ). After 24 hours of incubation at  $37^\circ\text{C}$  the diameter of inhibitory zones surrounding the samples were measured. Fibers lacking AgNPs were used as control.

## 3. RESEARCH FINDINGS

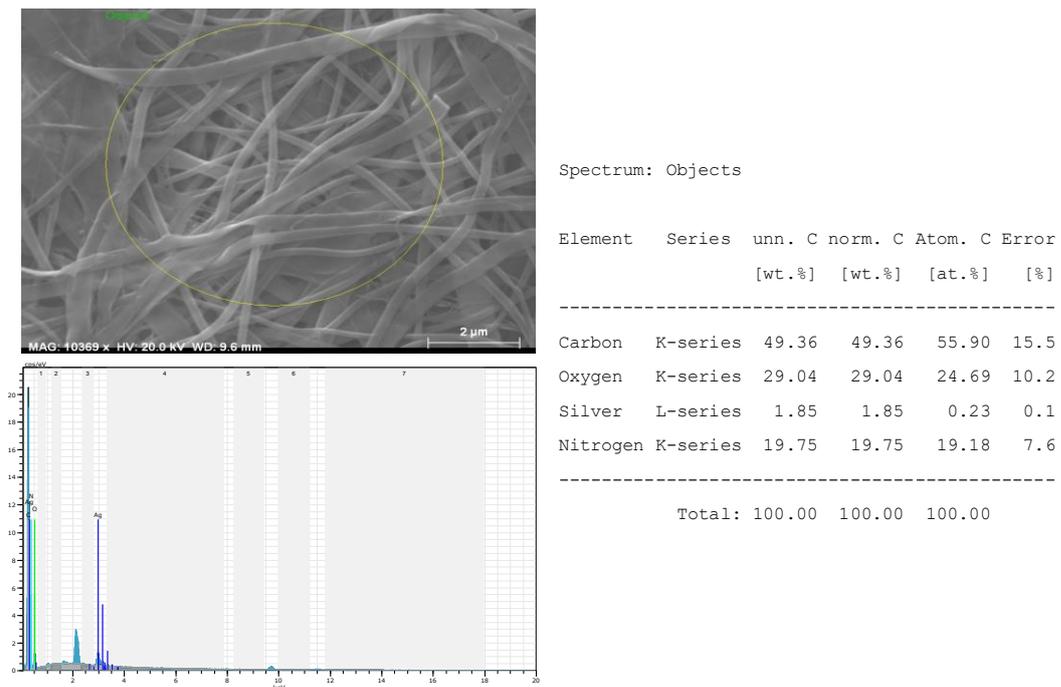
### 3.1. SEM analysis

Fig. 2 shows scanning electron micrographs of the fabricated Nylon 6,6-AgNPs fibers. The average diameters were  $200\text{--}400\text{ nm}$ . As seen from the figure, uniform bead-less fibers were successfully obtained. The formation of AgNPs was further confirmed by SEM-EDX analysis (Figure 3).



**Figure 2.** SEM micrographs of electrospun Nylon 6,6 nanofibers containing AgNPs

Energy dispersive X-ray (EDX) spectrum of AgNPs loaded Nylon 6,6 displayed in Fig. 3 shows strong carbon and oxygen peaks, which could be attributed to the surrounding Nylon 6,6 polymer. Three strong peaks of silver in the spectrum appeared around 3 keV indicate the existence of silver that was diffused into Nylon 6,6 nanofiber. The results obtained from EDX spectrum together with those of the SEM images are strong evidence of the deposition of AgNPs on the surface of nanofibers.



**Figure 3.** SEM-EDX analysis of nanofibers

### 3.2. FT-IR analysis

Figure 4 shows the FT-IR spectra of obtained Nylon 6,6 and nanofibrous mats coated with AgNPs. Nylon 6,6 has some characteristic peaks at 3300  $\text{cm}^{-1}$ : (O-H deformation); 2940 ve 2860  $\text{cm}^{-1}$ : (C-H stretching and O-H groups); 1640  $\text{cm}^{-1}$ : (C=O deformation); 1420  $\text{cm}^{-1}$ : (C-O-H deformation); 1256  $\text{cm}^{-1}$ : (C-O stretching). No additional peak formation was observed in the FI-IR spectrum of Nylon 6,6-

AgNPs fibers, suggesting that no chemical bond formation occurred between the polymer and AgNPs. The intensities of peaks silver loaded nanofibers decreased.

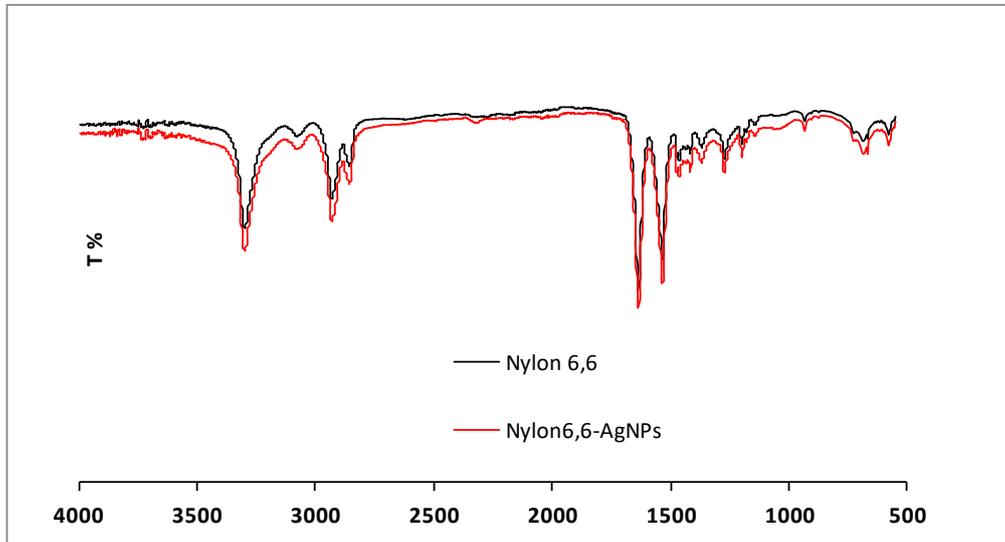


Figure 4. FT-IR spectrum of electrospun nanofibers

### 3.3. Assay of Antibacterial Activity

The antibacterial activity of AgNPs loaded nanofibers evaluated by diffusion method against two types of bacteria; Gram positive and Gram-negative (*S. aureus* and *E. coli* respectively) are shown in Figure 5 and 6. The control samples exhibited no inhibitory effect on the test bacteria. Nylon 6,6 nanofibers containing AgNPs showed low levels of inhibition against *E. coli*. Antibacterial activity of the fibers were greater on *S. aureus* compared to *E. coli*. Addition of clay/nanoclay to the fibers containing AgNPs resulted in a significant reduction/loss of antibacterial activity.

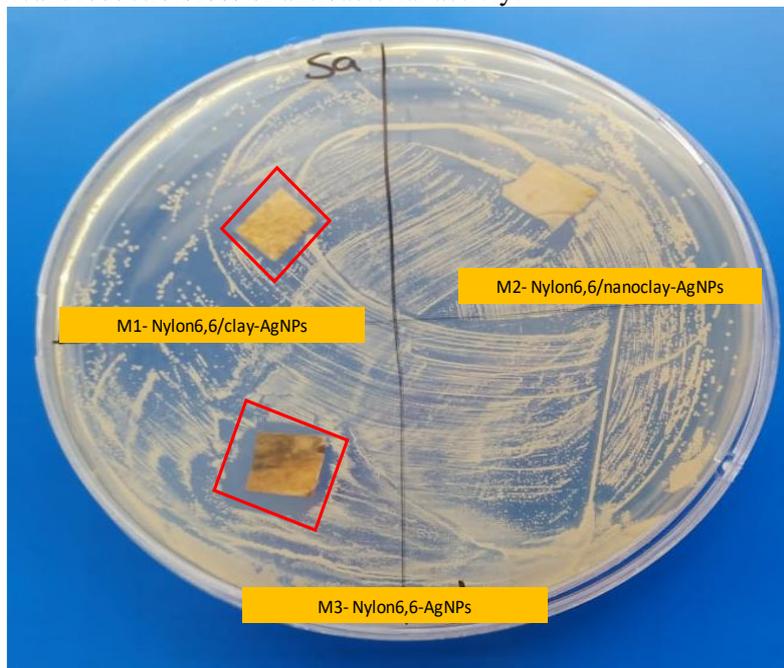
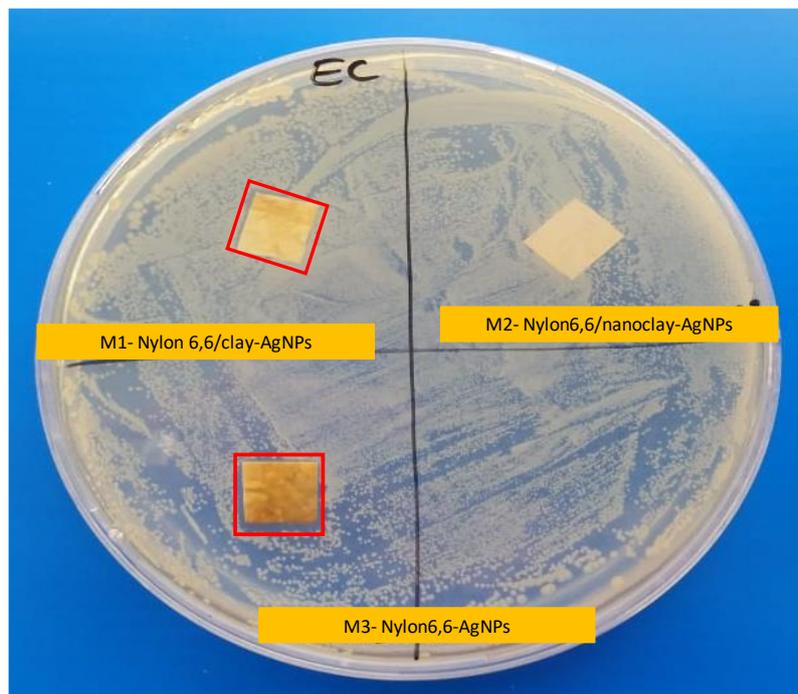


Figure 5. Inhibition zones for nanofibers against bacteria *Staphylococcus aureus*



**Figure 6.** Inhibition zones for nanofibers against bacteria *Escherichia coli*

#### 4. CONCLUSIONS

Antibacterial Nylon 6,6 nanofibers were successfully fabricated in two steps. SEM and SEM-EDX analysis indicated that AgNPs were decorated on the surface of nanofibers. The antibacterial test shows that Nylon 6,6-AgNPs nanofibers exhibit a superior antimicrobial activity compared with nanofibers having clay or nanoclay. Thus, the Nylon 6,6-AgNPs nanofibers would have potential applications in areas such as water treatment techniques, health care and self-sterilizing textiles.

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**O 41. DECORATION OF SILVER NANOPARTICLES SYNTHESIZED BY GREEN APPROACH ONTO NATURALLY COLORED NYLON 6,6 NANOFIBERS: INVESTIGATION OF ANTIBACTERIAL ACTIVITY**

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**ABSTRACT:** Since, organic dyes are non-eco friendly and expensive, recent researches have been focused on natural dyes. Natural dyes can be derived from natural sources. Most are of plant origin and extracted from roots, wood, berries, lichens, leaves, flowers, nuts, and seeds. Generally, they show various colors and contain several pigments which can be easily extracted and used as a coloring agent. However, studies regarding the dyeing process with natural dyes are very limited due to easy availability of cheap synthetic dyes. Hence, this research aimed to produce colored nanofibers using plant extracts. Metallic nanoparticles with physicochemical properties different from bulk materials are widely applied in various fields such as environmental remediation, photocatalysis, imaging, catalysis, biosensors and biomedical applications. Nanoparticles have emerged due to unique physical and chemical properties, high surface to volume ratio as novel antimicrobial agents. Among them, silver nanoparticles (AgNPs) show excellent antimicrobial efficiency against organisms such as bacteria, fungi and viruse. As a result of increasing interest in green chemistry, an eco-friendly nanoparticle synthesis that is simple, affordable, compatible with biomedical and pharmacological applications have been widely preferred. In this regard, the aim of the present work was to decorate the AgNPs synthesized by green method onto colored Nylon 6,6 nanofibers. Firstly, Nylon 6,6 nanofibers were fabricated by electrospinning method followed by dyeing process using reddish orange and onion peel extracts. During dyeing process of the nanofibers, vinegar was used as a dye fixative agent. Secondly, synthesis of AgNPs using water extract of *Alchemilla vulgaris* plant under ambient conditions was performed. The formation of AgNPs was analyzed by UV–visible spectrophotometer. Synthesized AgNPs were decorated onto nanofibers by ultrasonication technique followed by mechanical mixing. The nanofibers were characterized using Scanning Electron Microscope (SEM) and Fourier-transform infrared (FT-IR) spectrophotometer. The antibacterial activities of obtained novel nanofibers were investigated using Gram-positive bacteria (*Staphylococcus aureus*) and Gram-negative bacteria (*Escherichia coli*). The activity test shows that nanofibers showed better antibacterial activities against to Gram-positive bacteria (*Staphylococcus aureus*) as compared to Gram-negative bacteria (*Escherichia coli*).

*Keywords: Antibacterial, nanofiber, silver nanoparticle, nylon 6,6, green synthesis*

**O 42. RELATIONSHIP BETWEEN THE GEOLOGICAL UNITS AND SOIL GROUPS: A CASE STUDY AROUND THE HATIP-KAŞINHANI (KONYA-TURKEY)**

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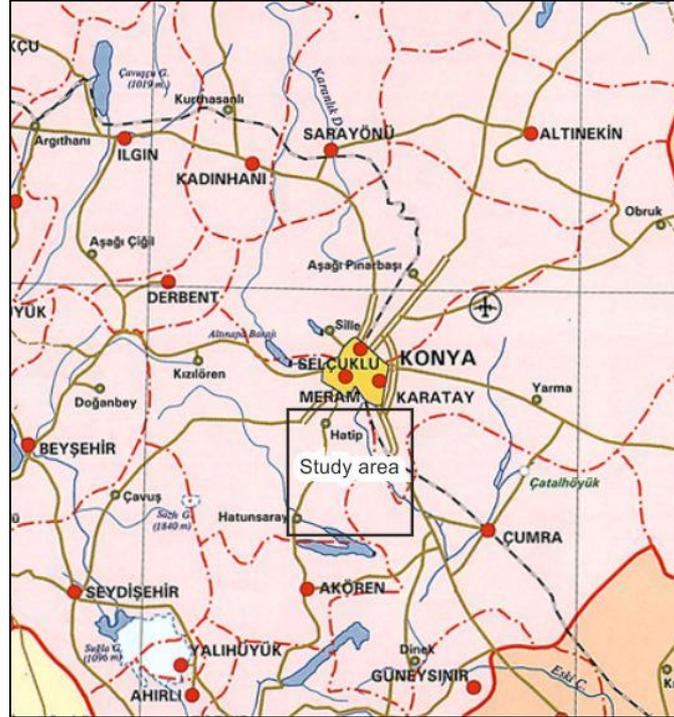
**ABSTRACT:** In this study, it is investigated whether the soil classes in the region between Hatip and Kaşinhani (Konya-Turkey) are related to geological units. The Upper Triassic-Lower Cretaceous Lorasdağı formation which is composed of limestone, dolomitic limestone and dolomites and the Upper Cretaceous aged Midostepe formation consisting of clayey limestone, radiolarite, shale and marl are the basement of the area between Hatip and Kaşinhani (Konya). These units contain tectonic contact with the Upper Cretaceous Hatip Ophiolitic Melange and Çayırbağı Ophiolite. The Upper Miocene-Lower Pliocene aged Sille and Ulumuhsine formations are unconformably overlying these all units. All these units cut by Upper Miocene-Pliocene Erenlardağı volcanites. The Quaternary - Holocene young sediments consisting of alluvial fan and the terrestrial clastics cover all the units underneath.

According to the classic soil classification, zonal and azonal soils are located in the study area. These soils formed generally depending on the geological characteristics of the host rocks based on the preliminary observations. While the area where Lorasdağı limestone seen is called as "Bare Rock", the soils located on the ophiolitic rocks are generally zonal soils such as "Red Brown Soils" and "Brown Forest Soils". The soils located on the Ulumuhsine formation with clayey limestone, sandstone and marl alternation correspond to "Red Brown soils" and "Brown Soils" classes from zonal soils. The soils located on the Erenlerdağ volcanites in the southwest of the study area are classified as "Limeless Brown Forest Soils" from zonal soils. Alluvium, which is composed of current terrestrial sediments, is classified as "Alluvial Soils" from azonal soils.

*Keywords: Hatip, Kaşinhani, soil, geology, soil classification*

## **1. INTRODUCTION**

The study area is in the region between Hatip and Kaşinhani to the south of Konya Province (Fig. 1). This study was conducted to determine whether there is a relationship between geological units and soil classification. The research area is in transition of Anatolides and Taurides described by Ketin (1966); According to Özgül (1976), it is in the "Bolkardağı unit" in the Taurides, According to Okay (1986), it is in the "Afyon - Bolkardağı zone". According to Özcan et al. (1988 ve 1990), the study area is located in the central part of the Kütahya - Bolkardağı Belt which forms the southern edge of the Anatolites.



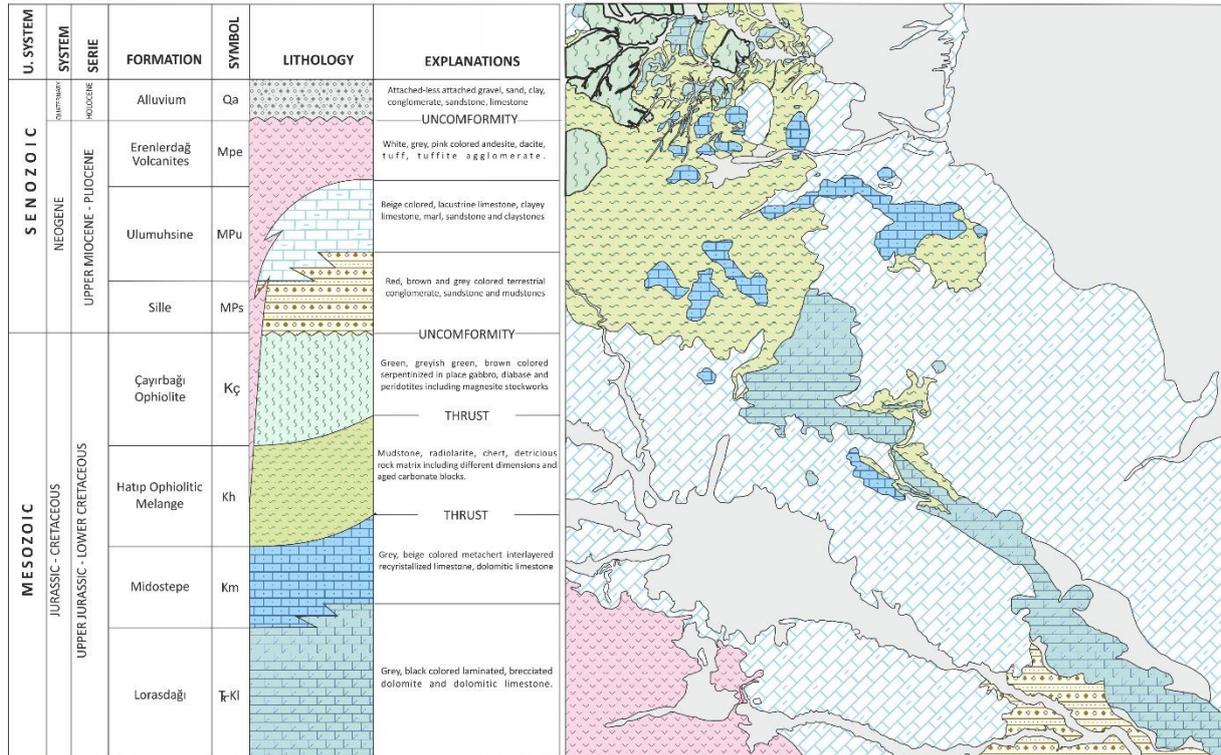
**Figure 2.** Location map of the study area.

## **2. MATERIAL AND METHOD**

In order to determine whether there is a relationship between geological units and soil classification, General Directorate of Rural Services (1987) map made according to Marbut (1928) was used.

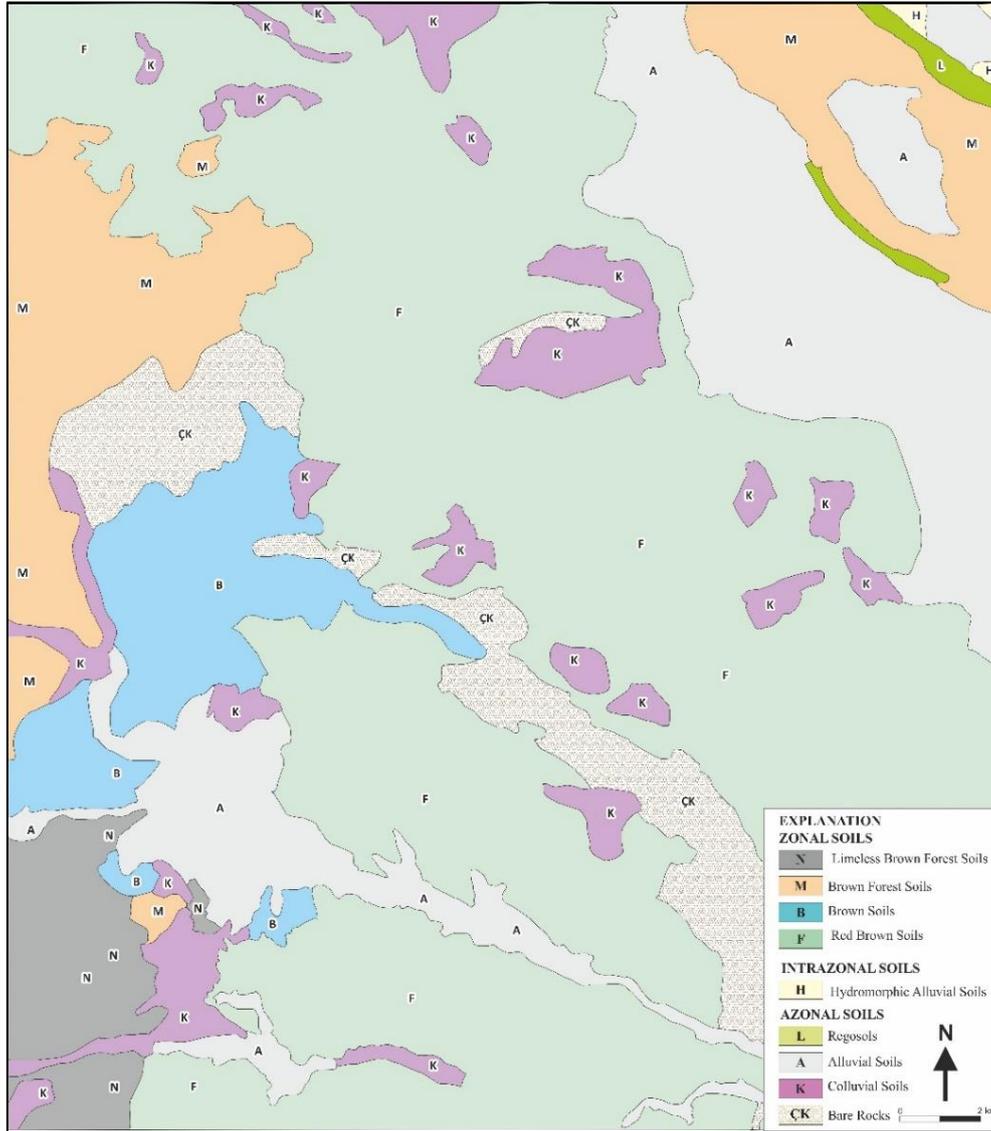
## **3. RESEARCH FINDINGS**

The Upper Triassic-Lower Cretaceous Lorasdağı formation which is composed of limestone, dolomitic limestone and dolomites and the Upper Cretaceous aged Midostepe formation consisting of clayey limestone, radiolarite, shale and marl are the basement of the area between Hatip and Kaşınhanı (Konya). These units contain tectonic contact with the Upper Cretaceous Hatip ophiolitic melange and Çayırbağı ophiolite. The Upper Miocene-Lower Pliocene aged Silile and Ulumuhsine are unconformably overlying these units. The Erenlardağı volcanites cut all these units. The Quaternary - Holocene young sediments consisting of alluvial fan and the terrestrial clastics cover all the units underneath (Fig. 2).



**Figure 2.** Simplified lithostratigraphic columnar section and geological map of the study area (modified after Yetiş, 2017; Yetiş and Arık, 2018)

As a result of the change of source material under different climates, topography and geological conditions, different soils belonging to Zonal and Azonal groups were formed. According to classical soil classification, it is seen that the soils in the study area are generally formed depending on the geological characteristics of the bedrock. “Reddish Brown Soils” are usually developed on carbonated rocks of Lorasdağı, Midostepe and Ulumuhsine formation. The soils on the ophiolitic rocks are “Reddish Brown Soils” and “Brown Forest Soils”, which are formed on the main material with high lime content. The soils on the Ulumuhsine formation consisting of limestone, clayey limestone, sandstone and marl correspond to the “Reddish Brown Soil” and “Brown Soil” classes with high lime content (Ca rich). The soils on the Erenlerdağ volcanites, which contain andesite, dacite, tuff, agglomerate, are classified as “Limeless Brown Forest Soils” consisting of lime-free soils where natural vegetation is bushes and grasses, and “Colluvial Soils” containing low-soil rough stones and debris. The soils on the alluvial deposits in the region are classified as “Alluvial Soils”, which are young soils formed on young unfixed or less attached units, and “Regosols”, which are over sandy, low water retention capacity and high permeable shallow soils formed on loose and unconnected units. The areas where the limestones of the Lorasdağı and Midostepe formations are defined as “Bare Rocks” (Fig. 3).



**Figure 3.** Soil classification map of the study area (modified from General Directorate of Rural Services, 1987).

#### 4. CONCLUSION

In this study conducted to determine whether there is a relationship between geological units and soil classification, it is observed that “Brown, Reddish Brown and Brown Forest Soils”, which have high lime content, are generally developed on carbonated rocks of Ulumuhsine, Sille, Lorasdağı and Midostepe formations. Non-soil areas containing dense rocky limestones belonging to Lorasdağı and Midostepe formations are defined as “Bare Rocks”. Soils on the ophiolitic rocks are classified as “Reddish Brown Soils” and “Brown Forest Soils” due to the Ca content in the ophiolitic rocks, which also contain dense limestone blocks. The soils located on Erenlerdağ volcanites containing andesite, dacite, tuff, agglomerate were defined as "Limeless Brown Forest Soils" located away from the carbonate rocks and "Colluvial Soils" containing coarse stones and rubble. The soils on the alluviums are classified as “Alluvial Soils” and “Regosols”, which are the soils formed on loose units. As a result, the lithological properties of geological units are effective in soil formation, and the relationship between soil classification and geological units is clearly seen.

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**O 43. PRELIMINARY DATA ON SCORPIONS (SCORPIONES) OF ALBANIA WITH NOTES ON THEIR TOXICITY**

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**ABSTRACT:** Scorpions (Arachnida Cuvier, 1812: Scorpiones C.L. Koch, 1837) are widely distributed all over the world, with an exception of Antarctica. The high diversity of the biotopes extends from the tropical rain forest, steppe, Mediterranean scrub, the deserts and the littoral zone, inhabiting all the habitats from the ground up to the tree layer. In the Balkan Peninsula, there are known 16 species of genus *Euscorpis* Thorell, 1876 and one species of genus *Mesobuthus* Vachon, 1950. Albania, as a Balkan country, has the proper climatic conditions and is very karstic, which make it preferable for the arachnid species, such as scorpions. In Albania the taxonomic situation of this group of animals is not clear yet and it is under study. At the moment only four safe species are recognized (*E. italicus*, *E. hadzii*, *E. beroni*, and *M. gibbosus*), plus at least two other populations awaiting clarification. The research field work, using the pitfall traps and the hand collection, confirmed the presence of three species, *E. hadzii* Di Caporiacco, 1950, *E. italicus* (Herbst, 1800) and *M. gibbosus* (Brullé, 1832). Large numbers of *E. hadzii* were identified (35 specimens) in comparison with the others two species. *M. gibbosus* is the only species found in Albania with a venom which is considered medically important for human. The latter scorpion has a body coloration orange-yellow and may be aggressive if disturbed. On the other hand, the brownish to blackish scorpions *E. hadzii* and *E. italicus* have a very lower toxicity. Sixteen cases of hospitalization after the sting of a scorpion, have been recorded in the last decade in the south-western Albania (Fier, Lushnje), all of them have resulted harmless to the health. As a preliminary research work, data on the field work and the hospitalized case studies will be described.

*Keywords: Arachnids, scorpions, habitats, dangerous animal, toxin, Balkans*

#### **O 44. THE CLASSIFICATION LOCAL AREA BASED CLIMATIC DATA USED**

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**ABSTRACT:** Bio climate concept is a wide concept and from ecologic angle it shows content elements combination that predominate or determinate the planted and animal life. The bio climate of one zone is considered as a combination between vegetation zone and climatic elements. The bio climate study on Korça - eco zone and the bioclimatic indexes give a view about the conception and using values of bio climate classification indexes. This study based on Emberger and FAO Model of learned Frenchman, which is the most quoted on studies with bioclimatic character on Mediterranean eco-zone for period 30 years. The Emberger Classification is known and applied, because it gives a detailed using about studied zone. The Emberger Classification is based on pluviometric index Q and vegetation index and gives a more detailed classification than others. After mathematic data processing and comparison of bioclimatic indexes according to respective classes is concluded that according to Emberger Korça – eco zone is classified on three respective bio climates: Micro zone with semiarid bio climate with coefficient  $Q < 60$  and annual precipitations 400-600 mm per year, in which take parts: Sheqeras and Gurshqipe; Micro zone with sub humid bio climate with coefficient  $60 < Q < 90$  and annual precipitations 600-700 mm per year, in which take parts: Dvorani, Zvirina, Bilishti, Liqenas (Korça); Micro zone with humid bio climate with coefficient  $90 < Q < 150$  and annual precipitations over than 700 mm per year, in which take parts: Shtylla, Korita, Gjonbabasi, Vithkuqi, Voskopoja. We have arrived in the following conclusions from this study: Bioclimatic classification in general of Southwestern eco zone Albania and in particular of eco zones must taken in consideration for cultivated plants regionalization; Using of bioclimatic maps for agro-ecosystems construction on Korça zone; The change of precipitations amounts per every 100 m is oscillated from 40 to 60 mm; The insolation report for Korça micro zones is oscillated from 0.50-0.

*Key words: local area, classification, climatic data*

#### **1. INTRODUCTION**

The production is a biologic index. When the cultivation conditions are optimal it is outcome of bio-chemic process at plants. The concept for production is related by the viewpoint of its and so, have the potential production, maximal production, biologic production, agronomic production etc. By practice viewpoint production is a plant, or part of its. Over them, production is result of eco climatic factors and human work impact.

Often production is converted with cultivated vegetation yield. This one varies from a year to another one in quantity and quality, even then the used techniques by persons are equal. So, this variability is a direct or indirect outcome of eco climatic factors impact, which aren't depended by person and could not repeated in an identical way from one year to another one, from one month to another one and from one day to another day.

Eco climatic sources are considerate decisive on cultivation plants, because they implicate plant development, and in consequence its production. These sources have a relation with eco climate of cultivated zone. The climate contents of an eco zone react in an interconnected way and influence by each of other revealing compensation effects. Some from more important eco climatic indicators are: Precipitations, the kinds of temperature, air relative humidity, the wind and the other atmospheric phenomena.

The case by case study of bio climate factors on time and space gave sufficient information for fruit agro ecosystem cultivation.

Plant species have definite ecologic distinction. These one are related with origin and biology. Ecology and climate determined the relationship between ecology and cultivated zones. This is verified by the presence of wild species in those climate zones. Eco climatic factors which influence on growth, yield, plants life cycles are:

#### **a. Sun light**

The sun light of an eco zone is a qualitative and quantitative factor. Light intensity during a day with solar time has a good influence on photosynthesis process. The quality of photosynthesis product is depended by intensity scale. The rhythm of this process for apples varies on whole day.

#### **b. Temperature**

The temperature has a priority influence on plants life cycle, but the influence of temperature on production and reproduction period is decisive.

It is known that temperatures  $< 7^{\circ}\text{C}$  influence on flowering apples process, the sum temperatures  $< 7^{\circ}\text{C}$  on over than 1070 hours indicate on flourishing and foliate differentiation report.

The presence of low temperatures under tree resistance caused frost phenomena on it. The frozen is physic and physiologic process and can damage drying of plant parts and on extreme cases can cause drying up plants.

High temperatures have a negative impact on physiologic and biologic process. A season with very highest temperatures during the vegetation influence, at first, on the reduction till blocking of plant photosynthesis rhythms, grows change-breath, increase water transpiration and, at last, plant can be wrinkled and drying up. The tolerance by temperatures different in confront of various plants.

On fruit-trees cultivation is taken in consideration another factor, change of minimal and maximal temperatures, which is temperature amplitude. This change is given in different parameters, so the plants react in different ways.

The apple is a kind of specie that caused reaction at wide changes of amplitude. This one is a considerable agro-ecologic index on dissemination of cultivated plants.

#### **c. Precipitations**

Precipitations are the chiefly source of water reserves on Earth. These reserves vary because of precipitation dissemination, which is given on temperature inverse: large amounts on winter, low temperature and small amounts on summer.

The plant has fixed reactions to precipitations amount. When the precipitations are in minimal amounts it is present air and soil drought. So, the apple will reduce metabolic activity, increase transpiration and was appeared plasmolysis and deplasmolysis. When the precipitations are present, fruit-tree reaction is positive, the metabolic process is realized normally and realized production is maximal. In a situation with abundant precipitations and on soils with swoon drainage, fruit-trees are incurred by physiologic disorder till asphyxia. By water absence the fruit-trees reacts with tardiness, while by remainder water reacts more quickly. The fruit-trees have a tolerance by presence or not presence of water on soil, but this tolerance is smaller than the presence of water is remainder.

#### **d. Air relative humidity**

Air humidity is an element of an eco zone climate. It shows that air is reach with water vapors' or not. The source of water vapors' in atmosphere is result of evaporation process and plant transpiration. The evaporation is a physic process for a plant, while the transpiration is a physic and physiologic process

for this one. The evaporation process and transpiration process are in content of plant evapotranspiration, which is part of water cycle in atmosphere.

On areas with precipitations and high temperatures the evapotranspiration values are higher, so the air relative humidity is great. The plants react to air relative humidity in different ways. The apples take part on plants group with affinity to air humidity. So, on these conditions where air relative humidity is on minimal values, the apples react on reducing metabolic process. It is realized by closing in maximum stomas. In this manner the entrance of CO<sub>2</sub> and O<sub>2</sub> is restrained and the metabolism will be reducing. When the air humidity is on high level is felt plant reaction. Air relative humidity is a climatic element with transversal impact. It takes part not in a direct way on life process but can accelerate or reduce them.

Air relative humidity determines opening and closing of stomas plants. The leaf surface with many stomas has need for refresh in conditions of a low air relative humidity, but it can happen closing process, with influence on physiologic and metabolic process.

## **2. MATERIAL AND METHOD**

### **Environmental study**

Albania is influenced by marine and continental presence, so it is finding Mediterranean and mountainous climate. This study belongs to cold areas, southeast area of Albania, eco zone – Korça and includes bioclimatic and agro-ecologic aspects, because this zone has a climate which is related in general by qualitative and quantitative apple production and its cultivars in particularly. Korça eco climate are determined by climatic factors and are related with them. Thermal regime, precipitations, air relative humidity, sunlight and other geographic elements give Korça eco climate panorama.

The eco zone – Korça is situated on southeast Albania, on latitude 40°27' at South of Kaltaj Mountain and Trebicka Mountain and 40°57' at Nord to Kallamas (Prespa) and on longitude 20°19'' at West Korbej Mountain (Zerec) and 20°54' at East (Cerje). By the level of sea side, it begins with Moglica micro zone on 785 m altitude and the biggest altitude is the top of Mali i Thatë (2516 m). The presence of some plains as: Korça plain, Maliq plain and Devoll plain is very important. The other parts are hilly and mountainous areas. The general surface of eco zone – Korça is 175.212 ha = 6,1 % of whole Albania surface. Mountainous relieve 59.7 % of Korça surface; Hilly relieve 22.8 % of Korça surface; Plain relieve 17.5 % of Korça surface; On Nord-South the plain relieve altitude is 35 km, on East-West it is 16 km.

Devoll river has a length by 193 km, where the part with length 107 km passed on eco zone – Korça.

The knowledge, studying and evaluation to eco climatic indexes of eco zone – Korça give a guaranty for agro-eco-systems construction and progressing on this area.

## **3. METODOLOGY**

The bio climate study on Korça - eco zone and the bioclimatic indexes give a view about the conception and using values of bio climate classification indexes. The interpretations are result of combination of three bioclimatic models: Emberger Method (1969), Rivas Martinez Classification (1996) and Bangloul & Gaussen diagram (1960).

The Emberger Classification is known and applied, because it gives a detailed using about studied zone. Klasifikimi Rivas Martinez ka perdorim orientativ per studime nga pikepamja globale. Climatic indexes and Bangloul & Gaussen diagram (1960) are used to identify the dry and wet period during a year.

Rivas Martinez Classification is based on climatic indexes:

Ic, Temperature amplitude (1)

$$Ic = T_{max} - T_{min}$$

It, thermo index (thermo-tip) (2)

$$It = (T + m + M) * 10$$

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Io, ombro-thermic index (ort ombro-tip) (3)

$$I_o = 10 \times P_p / T_p$$

where:

*T<sub>max</sub>*= maximal average temperatures on the hottest month;

*T<sub>min</sub>*= lowest average temperatures on the coldest month;

*P<sub>p</sub>*=average sum precipitations >0°C;

*T<sub>p</sub>*=sum temperatures with values over than T>0°C;

*T*= average sum of annual temperatures;

*m*= minimal average temperatures on the coldest month;

*M*= average temperatures on the hottest month.

Emberger clasification is based on pluviometric indexes and gives a detailed classification.

The pluviometric index Q is result:

$$Q = \frac{2000 P}{(M - m)(M + m)} \quad (4)$$

where:

*P*=precipitations sum;

*M*= average temperatures on the hottest month of year °K;

*m*= average temperatures on the coldest month of year °K.

### 3. RESULTS

#### Results and Emberger interpretation.

Basing on real indexes of climate for a many-years long period from 1980 to 2015, as maximal average temperature, minimal average temperature and the precipitations on micro zones areas studied, Q values are resulting in a wide limit. The minimal value of Q results on Sheqeras micro zone with 54,1 and maximal value results on Shtylla micro zone with 124,9.

Basing on these values we give a conclusion that Sheqeras micro zone is Semiarid, while Shtylla micro zone is humid. This different is result of precipitations amount that vary from 505,6 mm on Sheqeras zone and 1129,3 mm on Shtylla zone and by the high temperatures: for Sheqeras zone is 26,3°C and for Shtylla zone is 21,3°C. In total Korça zone is considerate as a sub humid zone, with precipitations during autumns, winter and spring season and with a dry climate during the summer season.

On plain micro zones Q values is oscillated from 54,1 to 74,3 which correspond with altitude of 1000 m over the sea level. The micro zones with altitude over than 1000 m have Q values from 76,4 to 124,9. The minimal temperature is permanent and varies from altitude under 1000 m, with about 4 to 6 °C.

**Table no. 1.** Q Values on Emberger Clasification

Nr.	Microzone	Mmax	m min	Pm/vj	Q
1	Bilisht	25.5	-5.2	614.4	70.6
2	Dvoran	26.7	-5.5	679	74.3
3	Gurshqipe	25.5	-5.2	565.5	59.3
4	Gjonbabas	23.6	-5.9	817.7	98.3
5	Korça	25.5	-6.3	651.6	72.5
6	Korita	24.2	-4.4	847.1	104.6
7	Liçenasi	25.3	-4.3	647.7	76.4

8	Sheqeras	26.3	-6.7	505.6	54.1
9	Shtyllë	21.3	-11.2	1129.3	124.9
10	Vithkuq	23.6	-6.8	850.9	99.4
11	Voskopojë	23.2	-10.7	735.9	77.7
12	Zvirinë	25	-6.5	687	77.2

The Source: Data basing Analyzing Emberger.

### Q Index Emberger Index

The micro zones are situated on three bioclimatic variants basing on Q index values.

- Micro zone with coefficient  $Q < 60$  in which take parts: Sheqeras and Gurshqipe.
- Micro zone with coefficient  $60 < Q < 90$  in which take parts: Dvorani, Zvirina, Bilishti, Liqenas (Korçë).
- Micro zone with coefficient  $90 < Q < 150$  in which take parts: Shtylla, Korita, Gjonbabasi, Vithkuqi, Voskopoja.

### Results and Rivas S. Martinez Interpretation

The Rivas S. Martinez bioclimatic evaluation is based on ecoclimatic indexes as average temperature, higher and lower month temperature during a year, annual sum precipitations without months precipitations with temperatures under 0 grade C and annual sum temperatures over 0 grade C.

**Table no. 2.** Bioclimatic index values by Rivass S. Martinez for some Korça- microzones

Micro zone	T	m	M	Tp	Pp	Ic	It	Io
Bilisht	14.4	-5.2	25.5	5235	563.6	30.7	347	1.07
Dvoran	10	-5.5	26.7	3633	581.3	32.2	312	1.60
Gurshqipe	10.2	-5.2	25.5	4034	498.8	30.7	305	1.23
Gjonbabas	9.1	-5.9	23.6	3261	722.3	29.5	268	2.21
Korça	9.8	-6.3	25.1	3541	568.2	31.4	286	1.60
Korita	10.6	-4.4	24.2	3846	759.6	28.6	198	1.97
Liqenasi	10.1	-4.3	25.3	3861	551.2	29.6	311	1.42
Sheqeras	9.4	-6.7	26.3	3403	414	33	290	1.21
Shtyllë	5.9	-11.2	21.3	1879	778.4	32.5	160	4.14
Vithkuq	8.8	-6.8	23.6	3139	784.7	30.4	256	2.49
Voskopoje	7	-10.7	23.2	2360	578.2	33.9	195	2.45
Zvirine	9.4	-6.5	25	3406	566.6	31.5	279	1.66

The Source: Data basing analyzing Rivas.S.M,

Korça- eco zones by Rivas Martiness has some characteristic which are related with micro zonal eco climate and are characterized by indexes values, which gave us the following information:

### Ic. Index, Continental index

Basing on this index values the micro zones are divided on three micro zones with continental bio climate (mountainous).

Micro zone with continental index under 30 °C, where takes part: Gjonbabas, Liqenas and Korita (Nizhavec) micro zones.

Micro zone with continental index from 30 °C to 33 °C, where takes part: Bilisht, Dvoran, Gurshqipe, Korçë, Vithkuq and Zvirinë micro zones.

Micro zone with continental index over 33 °C, where takes part: Sheqeras, Shtyllë and Voskopoja micro zones.

### It. Index, Thermo-tip Index

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Basing on this index values the micro zones are divided on three bioclimatic micro zones:

Micro zone with thermo-tip index, Supratemplado, under 180, where takes part Shtylla micro zone;

Micro zone with thermo-tip index, Mesotemplado, from 180 to 300, where takes part: Gjonbabas, Korça, Vithkuq, Zvirinë, Sheqeras, Voskopoja and Korita micro zones;

Micro zone with thermo-tip index, Termotemplado, over 300, where takes part: Liqenas, Bilisht, Dvoran and Gurshqipe micro zones.

**Io. Index, Ombrotipos Index**

***Basing on this index values the micro zones are divided on three bioclimatic micro zones:***

Micro zone with ombrotipos index, Semiarid, with coefficient under 2, where takes part: Bilisht, Dvoran, Gurshqipe, Korça, Korita, Liqenas, Sheqeras and Zvirina micro zones;

Micro zone with ombrotipos index, Seko with coefficient from 2,0 to 3,6 where takes part: Gjonbabas, Vithkuq and Voskopoja micro zones;

Micro zone with ombrotipos index, Subhumid with coefficient from 3,6 to 6,0 where takes part: Shtylla micro zone.

The evaluation of insolation indexes

Average insolation index values on three micro zones with different altitude over the sea level are resulted as follow:

Total insolation for Sheqeras (Zvirinë) micro zone, with altitude 815 m/d results as: 2220,8 hour/annual, numbers day without sun is 43;

Total insolation for Korça (Dvoran) micro zone, with altitude 894 m/d results as: 2329,3 hour/annual, numbers day without sun is 33;

Total insolation for Voskopoja micro zone, with altitude 1320 m/d results as: 2413,6 hour/annual, numbers day without sun is 33;

Maximal month insolation on July results as: for Sheqeras micro zone with 281,9 hours, for Korça micro zone with 224,3 hours and for Voskopoja micro zone with 313,8 hours.

Minimal month insolation on December results as: for Sheqeras micro zone with 63,8 hours, for Korça micro zone with 68,5 hours and for Voskopoja micro zone with 88 hours.

***The evaluation of ecoclimatic micro zones indexes***

Maximal month temperature values for these micro zones results 26,7 °C on July, at Dvoran micro zone;

Maximal and minimal month temperature values for these micro zones results –0.3 °C on February, at Shtylla micro zone;

Maximal annual temperature values for these micro zones results 15.7 °C on July, at Dvoran micro zone;

Maximal and minimal annual temperature values for these micro zones results 11.2 °C on February, at Shtylla micro zone;

Minimal month temperature values for these micro zones results –11 °C on January, at Shtylla micro zone;

Maximal and minimal month temperature values for these micro zones results 16,2 °C on July, at Nizhavec (Korita) micro zone;

Minimal annual temperature values for these micro zones results 0,6 °C on July, at Shtylla micro zone;

Maximal and minimal annual temperature values for these micro zones results 7,1 °C on July, at Nizhavec (Korita) micro zone;

Minimal average annual temperature values for these micro zones results 5,9 °C on July, at Shtylla micro zone;

Maximal average annual temperature values for these micro zones results 14.4 °C on July, at Bilisht micro zone;

Minimal average temperature values for these micro zones results 5,8 °C on July, at Shtylla micro zone;

Maximal average temperature values for these micro zones results 20,2 °C on July, at Nizhavec (Korita) micro zone;

Minimal month precipitations amount values for these micro zones results with 5 mm on August, at Sheqeras micro zone;

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Maximal month precipitations amount values for these micro zones results with 140 mm on November, at Shtylla micro zone;

Minimal annual precipitations amount values for these micro zones results with 505 mm at Sheqeras micro zone;

Maximal annual precipitations amount values for these micro zones results with 1129 mm, at Shtylla micro zone;

***The characteristic of micro zones groups by altitude over the sea level are:***

Temperature alteration for every 100 m altitude is from 3,5 °C to 4,5 °C.

Precipitations amount alteration for every 100 m altitude is from 40 mm to 60 mm.

#### **4. CONCLUSIONS**

Korça - eco zone is classified on three respective bio climates for period 40 years:

##### **By Emberger classification Q index**

Micro zone with semiarid bio climate with coefficient  $Q < 60$  and annual precipitations 400-600 mm per year, in which take parts: Sheqeras and Gurshqipe.

Micro zone with sub humid bio climate with coefficient  $60 < Q < 90$  and annual precipitations 600-700 mm per year, in which take parts: Dvorani, Zvirina, Bilishti, Liqenas (Korçë);

Micro zone with humid bio climate with coefficient  $90 < Q < 150$  and annual precipitations over than 700 mm per year, in which take parts: Shtylla, Korita, Gjonbabasi, Vithkuqi, Voskopoja.

##### **Korça - eco zone is classified on bio climates:**

##### **By Rivas S. Martiness. Classification It. index**

Supertemperate with coefficient It. 20-180, where is evaluated: Shtylla micro zone.

Mesotemperate with coefficient It. 180-300, where takes part: Zvirina, Vithkuq, Sheqeras, Koritë, Korçë, Gjonbabas and Voskopoja micro zones.

Termotemperate with coefficient It. 300-410, where is evaluated: Liqenas, Gurshqipe, Dvoran and Bilisht micro zones.

##### **By Rivas S. Martiness. Classification Io index**

Semiarid with coefficient  $< 2$ , where is valuated: Bilisht, Dvoran, Gurshqipe, Koritë, Korçë, Liqenas, Sheqeras and Zvirina micro zones;

Dry with coefficient 2-3,6 where is valuated: Gjonbabas, Shtylla, Vithkuq and Voskopoja micro zones.

##### **By Rivas .S. Martiness. Classification Ic index**

Bioclimatic index  $> 21$ , where takes part all micro zones:

Korça-eco zone is evaluated as a continental zone with cold climate, with index  $< 15^{\circ}\text{C}$ ;

Average humidity micro zones from 450-700 mm precipitations/year where takes part: Zvirina, Sheqeras, Liqenas, Bilisht, Gurshqipe, Dvoran and Korça micro zone;

High humidity micro zones with index 700-1100 mm precipitations/year where takes part: Voskopoja, Vithkuqi, Korita, Gjonbabasi;

A very high humidity micro zones with index  $> 1100$  mm precipitations/year where takes part Shtylla micro zone;

Micro zones which have minimal month precipitations amount values under than twice of average month temperatures, from May to September where takes part: Sheqeras, Gurshqipe, Liqenas, Bilisht, Korça and Dvoran micro zones;

Micro zones which have minimal month precipitations amount under than twice of average month temperatures, from June to August where takes part: Voskopoja, Vithkuq, Shtylla, Korita and Gjonbabas eco zones;

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**O 45. FIRE SCENARIOS-BASED ANALYSIS IN WATER SUPPLY NETWORK: CASE STUDY  
AKYURT, ANKARA**

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**ABSTRACT:** Water is an important need to realize fundamental activities of people. With the growth of the settlements, the combined pipeline systems that distribute water brought from natural sources to settlements have become complicated. Damage to water networks due to natural disasters creates many problems. Computer programs are frequently used to examine the impact of disasters on water networks. The EPANET developed by the United States Environmental Protection Agency is highly preferred for optimizing water networks, revealing behaviors under different scenarios and solving design problems. With the EPANET program, it is possible to observe hydraulic characteristics (flow rate, pressure, velocity etc.) easily under changing conditions. Akyurt district in Ankara, one of Turkey's crowded cities, has been chosen as the study area. In this study, 5 different fire scenarios were determined for the Akyurt district water network and the behavior of the system was investigated under these scenarios. The pressure and flow behaviors were evaluated under changing conditions in the water distribution network. The behaviors of common areas, public buildings and residential in terms of water transmission under fire scenarios were investigated.

*Keywords: Akyurt, EPANET, Fire Scenarios, Water Network*

## **1. INTRODUCTION**

Water is one of the basic requirements for a region to be suitable for life. The lack of fresh water means that its use, storage and transmission must be done with great importance. Network systems are used for the distribution of drinking water. Drinking water network is a system in which water is distributed over a main transmission line in order to meet the water needs of the people. With the development of technological possibilities, the ways of supply and transmission of water have improved. In addition, with the increase in population, the complexity of water networks necessitated the use of computer programs for network solutions.

One of the frequently used computer programs in water network solutions is EPANET. EPANET is a public water distribution system modeling software package developed by the Water Supply and Water Resources Department of the United States Environmental Protection Agency (Rossman and Van Zyl, 2009). EPANET is used to design and dimension new water infrastructure, to optimize the operation of tanks and pumps, to reduce energy use, to investigate water quality problems and to make scenario-based studies (Polat et al. 2018; Dunca et al. 2018; Stillwell et al. 2011; Davis et al. 2018).

Estimation and preparing for the disasters that may occur for the people reduce the loss of life and property. Fire is one of the most damaging disasters in the settlements. Fires have significantly negative effects on the living things and the balance of the environment.

In case of a fire in the drinking water network, serious damage to the network occurs. The fire must be extinguished before damage occurs. The required water is supplied from the water network to extinguish the fire (Sarptaş et al. 2017).

EPANET, which enables the solution of different hydraulic problems, was invented by Rossman (2009). Besides, it provides solutions water quality problems besides hydraulic. For Calabar Metropolis in South Nigeria, EPANET has simulated real-time hydraulic behavior for water distribution networks (Njoku et al. 2017). Thus, it is aimed to understand the movement and properties of water in the water distribution system (Sarptaş et al. 2017). With the help of EPANET program, the effects of the



### 2.3. Hazen-Williams

Hazen-Williams formula is one of the formulas that EPANET uses to find the head loss in pipes. In Equation 1, the Hazen Williams head loss formula is given (Eck and Mevissen, 2012).

$$h_f = 10.65 C^{-1.852} D^{-4.871} L Q^{1.85} \quad (1)$$

In Equation 1, organized according to SI unit,  $h_f$  is head loss (m);  $D$  is the inside diameter (m);  $Q$  is the discharge ( $m^3/s$ );  $L$  is the length of pipe (m),  $C$  is the friction coefficient of Hazen-Williams formula.

### 2.4. Fire Scenarios

In addition to the successful operation of the system, the network is required to operate stable in case of a disaster. In this study, various scenarios were tested to investigate the problems that may occur in case of fire (Table 1). Figure 2 shows the fire locations of the scenarios.

**Table2.** Fire Scenarios

Fire 1	Farthest points to reservoir
Fire 2	The lowest flow points
Fire 3	Points on the main pipes
Fire 4	The two furthest points on the East-West axis
Fire 5	The points where there are public buildings



**Figure 2.** Fire scenarios used in the study

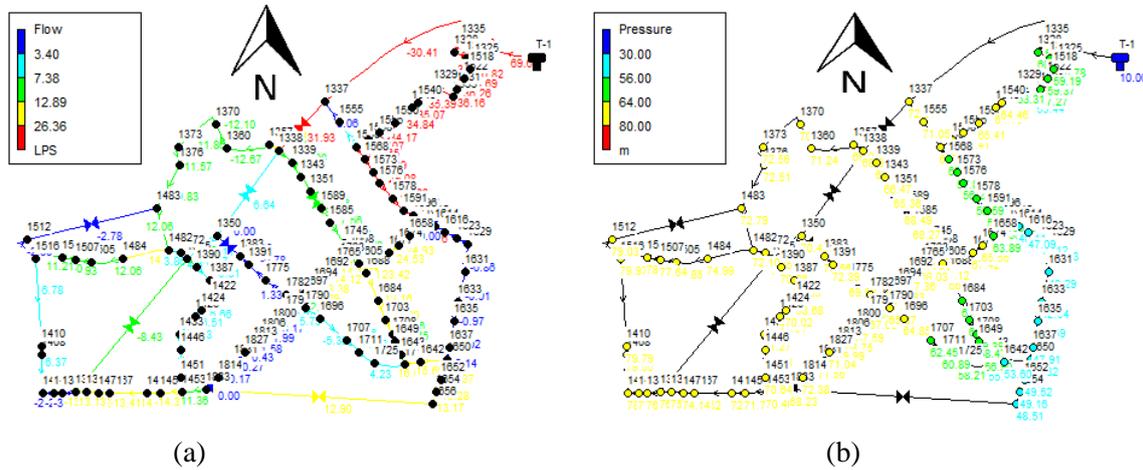
## 3. RESULTS AND DISCUSSION

Within the scope of the study, scenario based analysis was performed with EPANET program for a certain part of the water network of Akyurt district. The behavior of the system was investigated in case of 5 different scenarios for the water network against fire disaster causing loss of life and property. Sensitive zones were determined by observing the flow and pressure changes of the network. In Figure 3, flow and pressure values related to the present status of the water network of the study area are given. Figure 4-8 shows the flow and pressure values of the water network according to 5 different fire scenarios.

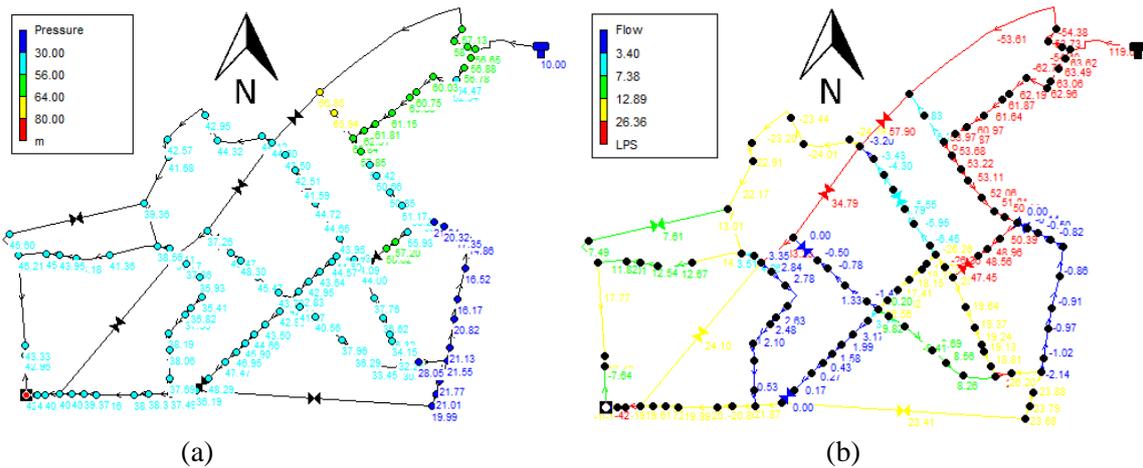
- In present status, since the north of the network is close to the reservoir, the flow values are above 30 l/s. As the usage towards the southern parts increased, the flow values decreased. It has been calculated that the pressure in most of the network is around 64 mss.

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- In the case of Fire 2 scenario, pressures in the eastern part of the network have been greatly reduced. Because there are many elbows around the points where the fire is simulated, the sensitivity of the region increases more.
- In the fire 3-4-5 scenario, although the flow directions within the water network change, the flow rates do not vary significantly. However, in Fire 5 scenario, greater pressure values were determined in the entire network compared to Fire 3-4.



**Figure 3.** (a)Flow and (b) pressure values of the present status



**Figure 4.**(a)Flow and (b) pressure values of Fire 1

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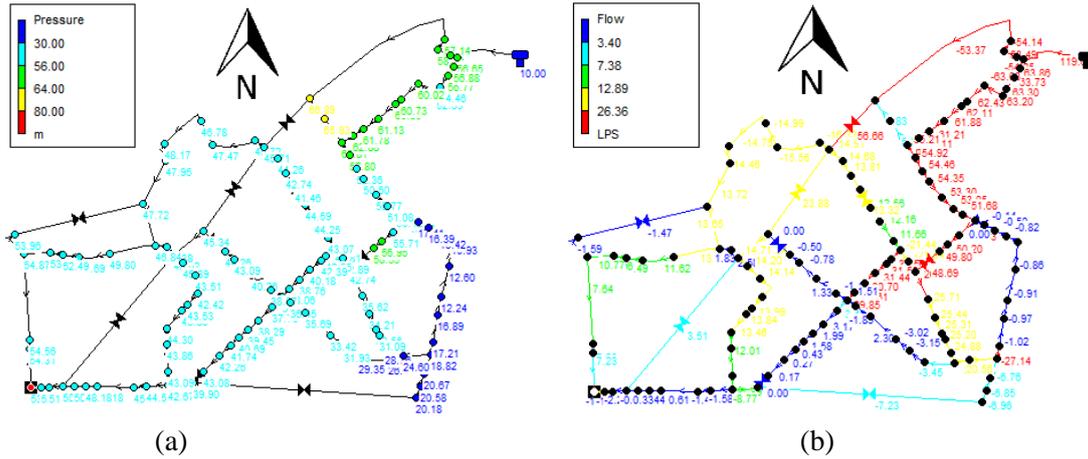


Figure 5.(a)Flow and (b) pressure values of Fire 2

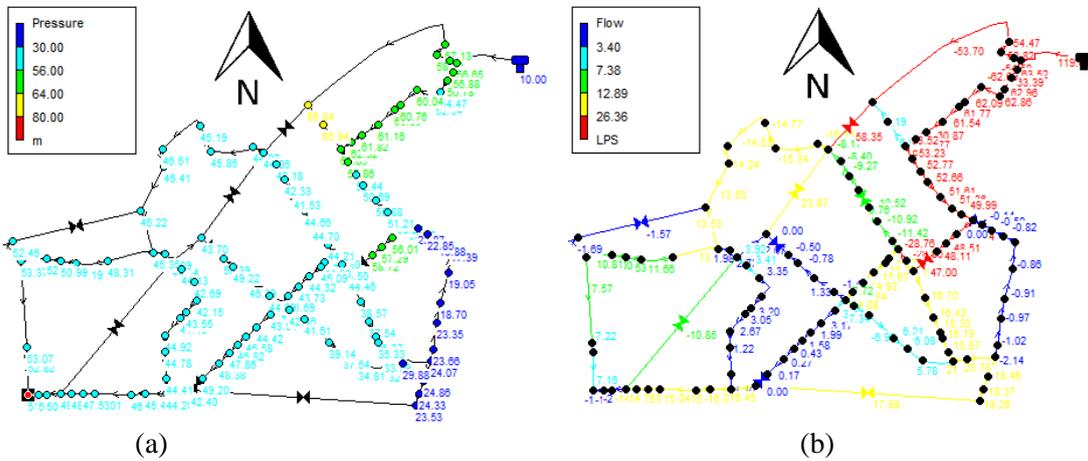


Figure 6.(a)Flow and (b) pressure values of Fire 3

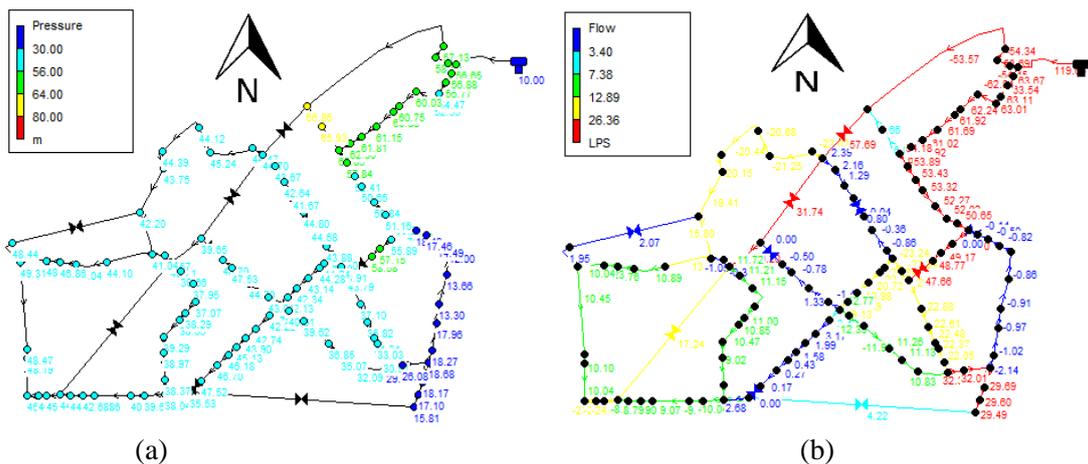


Figure 7.(a)Flow and (b) pressure values of Fire 4

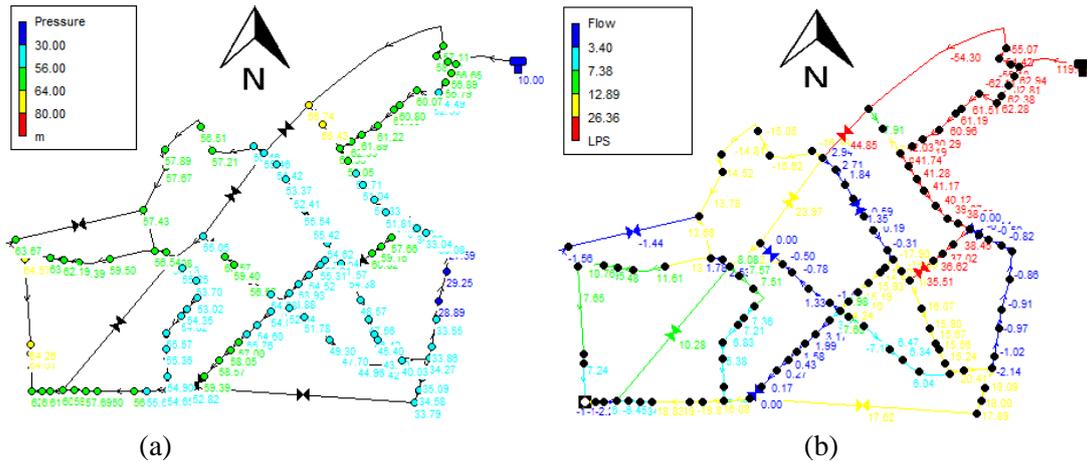


Figure 8.(a)Flow and (b) pressure values of Fire 5

#### 4. CONCLUSION

For Akyurt where rapidly growing population, the behavior of the water network against to a fire disaster was investigated based on the scenarios. EPANET was used to examine the change of flow and pressure characteristics of the system. For the present situation, pressure and flow values of the water network have been determined and changes have been observed according to fire scenarios.

In the Fire 2 Scenario, the lowest pressure values were observed. On the other hand, the highest pressure values were observed in the Fire 5 Scenario.

If the flow increases from anywhere in the network for fire, pipes near the reservoir carry high flow. If these pipes fail or become unable to function, alternative plans should be developed to solve the problems that may occur. It was also observed that in all fire scenarios, the pressures in the east of the network fell below critical values. In order to assess the capacities of water distribution system, it is recommended to evaluate their performance according to different disaster scenarios.

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**O 46. TREATMENT OF BIOGAS SLURRY BY MICROALGAE**

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**ABSTRACT:** : Global warming has become a current issue of concern in the world today. The main source of global climate change is the increasing amount of greenhouse gases released from fossil fuels that provide the energy needed for human activities. Scientists are seeking to find solutions to global warming through the mitigation of the greenhouse gases. Biofuels such as biodiesel, bioethanol and biogas have been considered as an environmentally friendly fuel source, are now being used and are intended to be widely used in the near future. Biogas slurry, also known as digestate during anaerobic processes, contains a significant proportion of nutrients. In recent years, numerous studies have been performed to treat biogas slurry, and to produce algal biomass, by removing nutrient from anaerobic effluents by microalgae-based technology. When micro algae are cultured in nutrient-rich effluents, this provides a source of food for the growth of microalgae. As a result, the produced biomass can be used for biofuel production. Furthermore, the biogas slurry with contaminants especially with nitrogen and phosphorus, which has the potential to contaminate underground and surface water resources can be treated by this way. In this study, the literature on biogas slurry and treatment of its by microalgae cultures have been reviewed taking into account the management of biogas slurry for water pollution and biomass production for biofuel.

*Keywords: Biogas slurry, Biomass production, Microalgae, Treatment, Water pollution*

## **O 47. ENVIRONMENTAL MODELLING OF SOIL WATER CHARACTERISTIC CURVE FOR TWO CONTRASTING SOIL TEXTURE**

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**ABSTRACT:** Recently, due to the growing concern about the quality of the environment for unsaturated subsoil, which is negatively affected by agricultural and industrial activities, it becomes necessary to increase knowledge about the mechanism of transmission and distribution of solute and pollutants in the soil environment by modeling their movement in the soil under different conditions. Predicting soil water characteristic curve from van Genuchten model was renowned for reducing the costs and time of measurement methods. The aim of this study was to determine the effect of two levels of compaction on the behavior of soil water characteristic curve of a sandy loam and clay soils, and then compare the measured results with the predicted results obtained from van Genuchten equation with using four different model classes of (m) parameters, then investigating the relationship between them. At the end of the incubation period, soil samples were sampled and thereafter compacted through soil core with known volume at soil bulk density (Pd) of 1.50 and 1.70 g cm<sup>-3</sup> for a sandy loam soil and 1.20 and 1.35 g cm<sup>-3</sup> for clay soil. The obtained results indicated that using van Genuchten equation to fitting water characteristic curve with variable (m) parameter had the highest correlation (R<sup>2</sup>), and lowest normalized root mean square error (NRMSE), as well as soil compaction significantly affected volumetric water content at the same observed section in both soil textures.

*Keywords: Environmental modelling, Soil compaction, Water characteristic curve*

### **1. INTRODUCTION**

The soil water characteristic curve (SWCC) is defined as the relationship between water content (gravimetric or volumetric) or degree of saturation under suction (matric or total) (Fredlund, 2012). Because of the effort and time consuming, as well as the high variability of samples to determine the SWCC by conventional methods, a lot of researchers developed various predicting and fitting models depending on other soil properties, which can be easily measured. Soil compaction can be associated with a majority field operation that often performed when the soil is wet. Heavy equipment and tillage implement can cause damage to soil physical properties and structure. Soil structure is important to determine the ability of a soil to hold and conduct water, nutrient, and air necessary for plant root activity (Mada et al., 2013). Compaction causes unfavourable changes in soil bulk density, porosity and penetration resistance (Soane et al., 1981). Aeration decreases as water content increases, with a concomitant reduction in soil resistance (Letey, 1985); and this, in turn, has a positive effect on plant development (Quiroga et al., 1999). The aim of this study was to determine the effect of two levels of compaction (low and high) on the behavior of soil water characteristic curve of a clay and sandy loam soils, and then, compare the observed results with the predicted results established with respect to four common van Genuchten (VG) SWCC model classes for investigating the relationship between them and determining the more accuracy model, which give us the best fitting for the soils of study area .

### **2. MATERIAL AND METHOD**

#### **2.1. Site description and soil sampling**

The first soil sample, clay textured soil was collected from the surface (0 - 20 cm) of a field located at Sarıcalar Research and Application Farm of Agriculture Faculty, University of Selçuk. The second soil sample, sandy loam textured soil was collected from the surface (0-20 cm) of a field located at Çumra Plain.

## 2.2. Soil preparation and incubation experiment

Soil samples from different selected points were sieved in the site by 4 mm sieve, and then transported to the laboratory whereby were passed through a 2 mm sieve after air-drying prior to the experimental establishment in the laboratory. Soil samples were placed in the pots, and then watered to field capacity, and subsequently incubated for 30 days at  $23\pm 2^\circ\text{C}$ .

## 2.3. Soil analysis

Soil texture was measured by Bouyouos hydrometer method according to (Gee and Bauder, 1986). Proctor Test to determine the level of maximum compaction, soil samples were compacted in the cores standard Proctor test according to (Mertoğlu, 1982). Soil water characteristic curve: Three methods were used to determine the relationship between volumetric water content ( $\theta$ ) and suction ( $\psi$ ), which is; Sandbox for pF of (0, 1, 1.5, 1.8 and 2), Pressure plate apparatus for field capacity FC (pF 2.52) (Klute, 1986), and for pF more than FC to near pF 6 (including permanent wilting point (PWP)) was measured through Dew point water potentiometer (WP4C) device. Soil pH and electric conductivity (EC) (1:2.5) were measured according to (Mclean, 1982; Rhoades, 1982). Calcium carbonate ( $\text{CaCO}_3$ ) was determined by measuring the volume of emitted  $\text{CO}_2$  from carbonates (Nelson, 1982). Soil organic matter (OM) was measured by a wet combustion method proposed by (Smith and Weldon, 1941).

## 2.4. Soil compaction

Depending on Proctor test results (Figure 1 and 2), two levels of compaction were chosen for each type of soil with low and high, (BD), which is for a clay soil  $1.20$  and  $1.35 \text{ g cm}^{-3}$ , and for a sandy loam soil  $1.50$  and  $1.70 \text{ g cm}^{-3}$ . The soil samples were compacted in the core (volume of  $100 \text{ cm}^3$ ) with 5 layers according to the method suggested by (Houskova, 2004).

## 2.5. Statistical evaluation

Statistical fit-measure indices, the coefficient of determination  $R^2$  and the normalized root mean square error (NRMSE), were obtained to assess the goodness of fit between predicted and observed values. The NRMSE can be expressed as absolute by the following:

$$\text{NRMSE} = \frac{100}{\theta_{\max} - \theta_{\min}} \sqrt{\frac{1}{N} \sum_{j=1}^N (\theta_{mj} - \theta_{aj})^2}$$

Where:

$\theta_{mj}$  and  $\theta_{aj}$  are, respectively, predicted and observed volumetric water contents,  
 $\theta_{\max}$  and  $\theta_{\min}$  are maximum and minimum observed volumetric water contents,  
and  $N$  is a number of selected points for soil-water retention.

## 2.6. Modelling of SWCC

A lot of models were investigated for predicting of SWCC by researchers from around the world. The RETC (version 6.02) program was used to determine the parameters of van Genuchten (1980) model,

$$\theta = \theta_r + \frac{(\theta_s - \theta_r)}{[1 + (\alpha h)^n]^m}$$

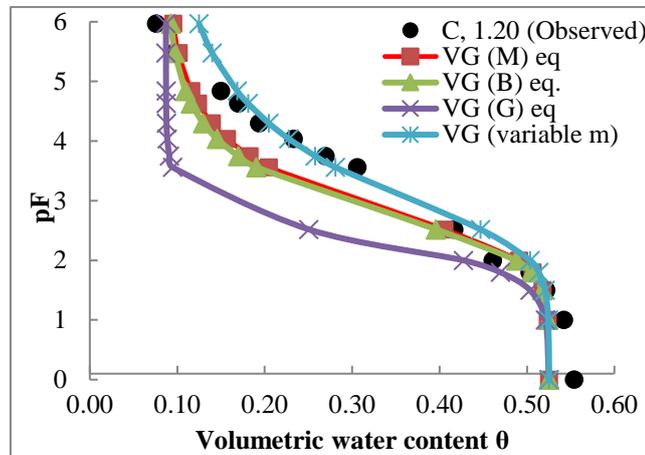
Where:

$\theta(\psi)$  is volumetric water content with respect to suction  $\psi$ ,  $\theta_r$  and  $\theta_s$  are residual and saturated volumetric water contents, respectively, and  $\alpha$ ,  $n$  and  $m$  are the fitting parameters.

Depending by four model classes of ( $m$  parameter) SWCC's were predicted, which is as follows; Mualem,(1976),  $m=1-1/n$ ; Burdine, (1953),  $m=1-2/n$ ; Gardner, (1958),  $m=1$ ; and van Genuchten,(1980),  $m \neq 1$  (variable), In this model, our predicted  $m$  was used in the model of VG depending on the highest  $R^2$  and lowest NRMSE value.

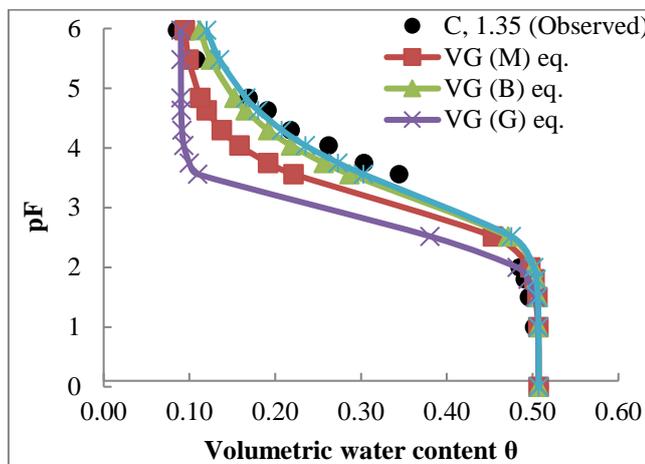
## 2. RESULTS

According to the figure 1 and statistical evaluation, the results showed that model of VG with variable  $m$  ( $m \neq 1$ ) had the best fit with the observed values from  $pF$  0 to 5. Therefore, VG (M) and VG (B) models had the best fit when water suction was more than  $pF5$ .



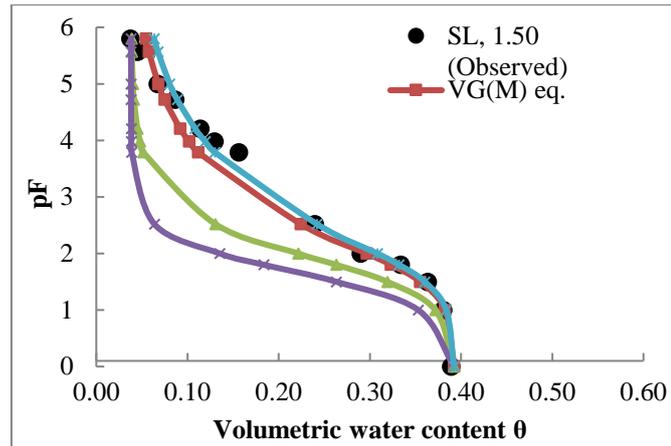
**Figure 1.** Illustration of the observed and predicted values of SWCC for a clay soil with bulk density of  $1.20 \text{ g cm}^{-3}$

From figure 2, and statistical evaluation, the results showed that model of VG with variable  $m$  ( $m \neq 1$ ) and VG (B) had the best fit with the observed values from  $pF$  0 - 5. Therefore, VG (M) and VG (G) models had the best fit when water suction was more than  $pF5$ .



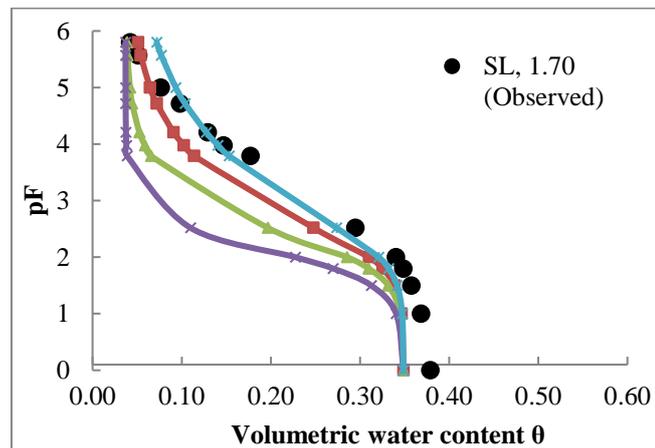
**Figure 2.** Illustration of the observed and predicted values of SWCC for a clay soil with bulk density of  $1.35 \text{ g cm}^{-3}$

Figure 3 showed that the predicting of SWCC with VG (variable  $m$ ) and VG (M) model classes had the best fit with observed values from  $pF$  0 to 5. Therefore VG (B) and VG (G) models had the best fit when water suction was more than  $pF5$ .



**Figure 3.** Illustration of the observed and predicted values of SWCC for a sandy loam soil with bulk density of  $1.50 \text{ g cm}^{-3}$

Figure 4. Show the same trend of all previous graphics, with a clear preference to fitting for VG (variable) model comparing with other model class from pF 0 - 5. However, VG (M) model had the best fit when water suction was more than pF5.



**Figure 4.** Illustration of the observed and predicted values of SWCC for a sandy loam soil with bulk density of  $1.70 \text{ g cm}^{-3}$

### 3. CONCLUSIONS AND DISCUSSION

The following conclusions can be drawn from this study:

- 1- In both soils (clay and sandy loam), compaction increased the volumetric water content at FC, PWP as well as AWC and reduced the water content at saturation.
- 2- The predicting of SWCC in normal clay and sandy loam soils (minimum bulk density) were given as more accuracy to fitting with various model classes than compacted soil (maximum bulk density)
- 3- The predicting of SWCC by the model of van Genuchten with our variable  $m$  that was determined by testing different values of  $m$  ( $m \neq 1$ ), gave us the best graphical fitting, high correlation and less NRMSE with the observed value.

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## **O 48. IMPACT OF COMPOST AND BIOCHAR ON THE MANAGEMENT OF SOIL SUSTAINABILITY**

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**ABSTRACT:** Climate change, soil degradation, erosion, loss of soil organic matter and leaching of nutrients pose a major constraint to growth and yield of crops, as well as environmental quality. Compost and biochar have long been reported to significantly contribute to the betterment of soil quality, crop performance and environmental quality. However, the effectiveness of compost and biochar obtained from identical biomass in soil fertility and environmental improvement is still unknown. In this study, compost and biochar both produced from *Elaeagnus* tree as the soil amendments were individually applied at a rate of 0, 1, 2 and 4 % (wt/wt) to a sandy clay loam soil for determining their effects on soil fertility and environment. Experimental results showed that the improvements were proportional to the applied rates of biochar and compost, and both compost and biochar applications significantly improved soil fertility via increasing macro- and micronutrient of plant. However, biochar decreased micronutrient, indicating its potential in improving environmental quality via remediating heavy metals polluted soil. To conclude, both compost and biochar could be used as a promising avenue for improving soil sustainability via increasing soil fertility, thereby boosting agricultural production. Furthermore, biochar is recommended for being used in removing heavy metals from a polluted soil, and thereby mitigating environmental and soil pollution.

*Keywords: Biochar, compost, maize crop, soil fertility, soil sustainability*

### **1. INTRODUCTION**

Soil salinity is typically found in arid and semiarid regions due to excessive evaporation and low rainfall, which is not enough to leach out soluble salts, and thereby leading to the accumulation of soluble salts at the surface layer. The salts affected soil generally contains soluble salts of chloride, sulfate, carbonate and bicarbonates ions of Ca, Mg, K and Na. Because of these soluble salts greater than 4 dS/m alongside exchangeable sodium percentages less than 15 in saline soil, soil structure of these soils is very weak due to these soluble salts especially Na make soil becomes dispersed and almost impervious to water, which in turn lead soil erosion. Soil disaggregation frequently lead to degraded soil physical properties, such as low aggregate stability, low organic matter, poor water and nutrients holding capacity and low soil porosity, all of which lead to soil erosion. Additionally, saline soil possesses a high soil pH between 7- 8.5 due to mainly limestone parent material from which soils were developed and most plant nutrients are readily available to plant at pH ranging from 6 up to 7.5. Because of this, plant nutrient availability, uptake and use efficiency is constrained due to locking up plant nutrients, salt stress and negative interaction between cations and anions like P fixation by Ca under high pH typified saline soil, and thereby decreasing plant growth and productivity. Additionally, soil microbial and enzymes activities which supply energy to nutrients uptake are reduced by high salts stress. Thus, the aforementioned issues found in saline soil lead to poor soil fertility, and thereby limiting agricultural production and leading to environmental pernicious effect associated with soil erosion and leaching of plant nutrients. Avoidance of soil structure degradation and depletion of soil fertility could potentially be achieved by adding organic matter to soil which make complexes with soluble salts in the soil, and thereby rectifying soil salinity issues which in turn lead to decreased soil erosion via restoring soil structure, improved soil fertility via ameliorating soil physical, chemical, mechanical and biological properties and enhanced plant growth and productivities via increasing nutrient availability, uptake and used efficiency, and consequent improvement of environmental quality.

Therefore, biochar and compost is amongst soil organic amendments endowed with not only organic matter source, but also source of plant nutrients as well as good physical feature and has been previously reported to improve soil fertility, plant growth and productivity, as well as mitigate climate change and

global warming via decreasing greenhouse gases emissions and sequestering atmospheric CO<sub>2</sub> when applied alone or in combination with tree and pasture species. This will not only sustainably increase food production, but also preserve the environment (Barrow, 2012). Agegnehu et al. (2017) reported that the application of compost and biochar either singly or in combination significantly improved soil organic carbon, nutrients status, water holding capacity and crop growth and yield, as well as decreased greenhouse gases emissions in the studies soil. Previous research evidenced that biochar application decreased emissions of greenhouse gases (Cayuela et al., 2014; Shackley et al., 2010), improved soil fertility and sequestered atmospheric CO<sub>2</sub> (Agegnehu et al., 2017). Yoon et al. (2017) reported that the application of biochar permeable reactive barrier in combination with fast growth tree rectified soil quality. Previous results also revealed that the infusion of biochar into a soil increased soil water holding capacity (Ouyang et al., 2013), increased total porosity (Omondi et al., 2016) and the perks of biochar in improving soil structure, soil fertility, soil physical, chemical, mechanical and biological properties were also reviewed by Manirakiza and Şeker (2018).

Therefore, the aim of this project was to reverse degraded soil fertility of a sandy clay loam soil exposed to wind erosion via applying compost and biochar as soil ameliorant both obtained from identical products.

## **2. METHODOLOGY**

### **2.1. Field site and experimental design**

The study was a pot experiment conducted in the laboratory, and employed materials were: a) calcareous and alkaline sandy clay loam textured (60.48% sand, 13.33% silt and 26.19 % clay) collected from Karapinar region subjected to wind erosion (37.72° N latitude and 33.55 °E longitude, 0-20 cm depth) located in Konya, Turkey; b) compost as soil amendment was produced from pruning residues of *Elaeagnus* tree through windrow composting process as detailed by Mücehver et al. (2018); c) Biochar as soil amendments was produced from *Elaeagnus* tree through pyrolysis process at 450 °C as elucidated in detail by Mücehver et al. (2018). A completely randomized plot design with four replicates was employed in this study. The applied rates were: 1, 2 and 4 % (wt/wt) of the both compost and biochar, which were thoroughly mixed with 3 kg of air-dried soil sieved through 2-mm sieve, subsequently potted in plastic pot, all pots including the control were moistened to exactly field capacity, then incubated for 62 days.

### **2.2. Soil sampling and analysis**

Soil samples were collected from every pot for determining selected soil chemical properties, such as extractable cations (Ca, Mg and K) were determined through 1 N ammonium acetate extraction method buffered at pH 7 (Thomas, 1982). Available micronutrients (Fe, Cu, Mn and Zn) were determined using DTPA extraction method (Lindsay and Norvell, 1978). Available phosphorous was determined using sodium bicarbonate method (Nelson and Sommers, 1982).

### **2.3. Statistical analysis**

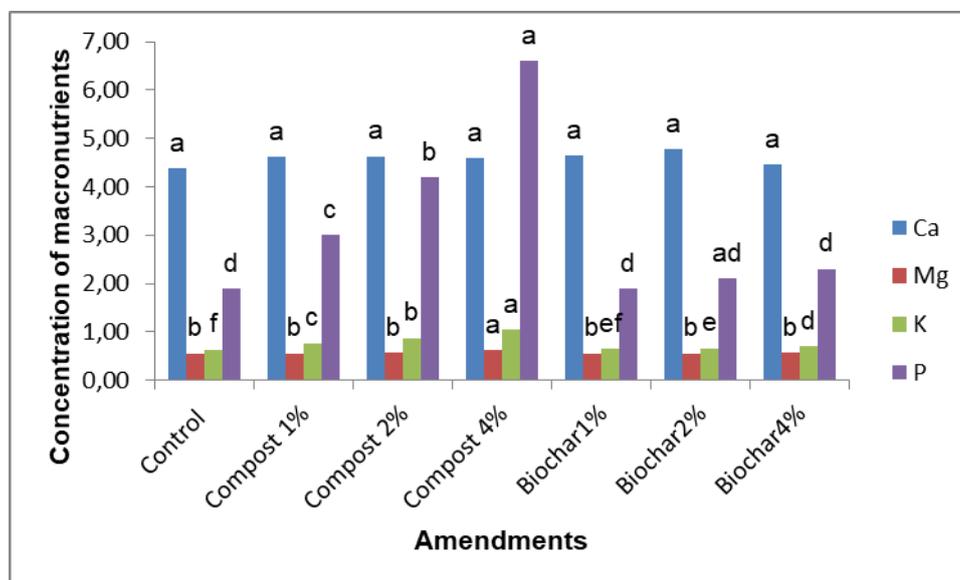
The responses of soil chemical properties to the application of compost and biochar were quantified and then statistically subjected to one-way ANOVA using Minitab 16 software and differences between amendment means were considered statistically to be significant at  $P < 0.05$  through Tukey's test.

## **3. RESULTS AND DISCUSSIONS**

### **3.1. Effect of compost and biochar on plant macronutrients**

Soil fertility is a leading factor affecting plant growth and development. Experimental findings showed that both applied forms of *Elaeagnus* tree (compost and biochar) significantly increased soil nutrients status (P, K, Ca and Mg) (Figure 1), indicating the positive impact in improving soil fertility, and thereby leading to increased crop growth and yield. However, it is obvious that the effect of compost exceeded that of biochar despite the fact that insignificant differences among some doses statistically were observed. Increased in soil nutrients status was due to the presence of P, K, Ca and Mg in both compost and biochar per se. additionally, increased organic matter and microbial activities could be also another

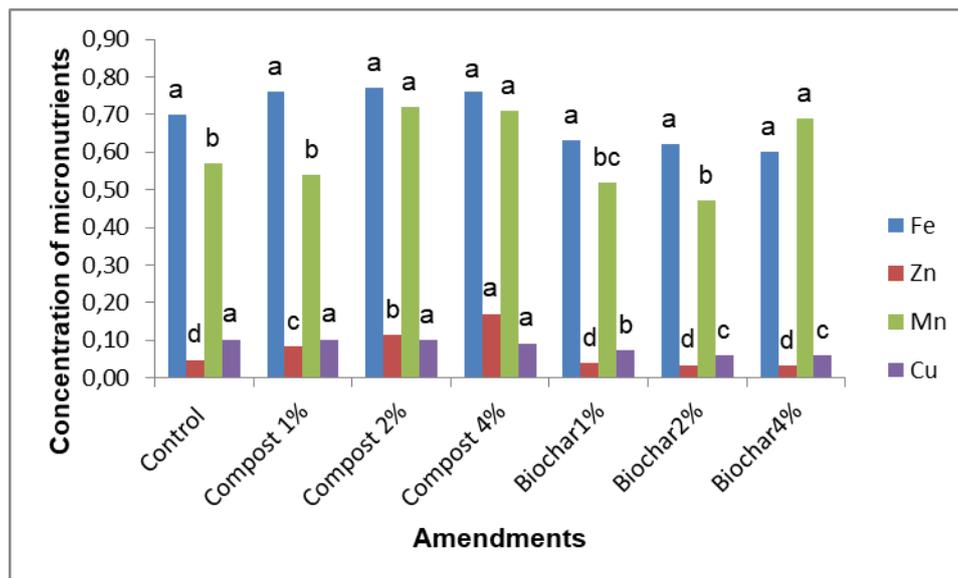
reason of increasing soil fertility. The improvements were linear to applied doses for both amendments. Our results are also in line with other previous study. Mensah and Frimpong (2018) reported that compost increased  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$  and  $\text{K}^+$  and also Pandit et al. (2018) indicated that biochar increased  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$  and  $\text{K}^+$ . Similarly, Agegnehu et al. (2015a) found that compost increased exchangeable cations (Ca, Mg and K). Agegnehu et al. (2016) stated that compost and biochar additions increased available phosphorous.



**Figure 1.** Responses of plant macromutrient nutrients to the applied compost and biochar; Ca, Mg and K are expressed in  $\text{g kg}^{-1}$ ; P in  $\text{cg kg}^{-1}$ ; Within each column, means with different letters are significantly different at  $P < 0.05$ , while means with similar letters are insignificant at  $P < 0.05$ .

### 3.2. Effect of compost and biochar on plant micronutrients

The results of the study indicated that compost application increased micronutrients (Cu, Zn, Mn and Fe), while biochar addition decreased micronutrients (Cu, Zn, Mn and Fe) (Figure 2). An upward trend in micronutrients due to compost was due to the fact that compost is endowed with a sizeable amount of Cu, Zn, Mn and Fe. On the other hand, a downward trend in Cu, Zn, Mn and Fe was due to sorption effect (Atkinson et al., 2010). In addition, biochar had the potential of decreasing solubility of heavy metals (Méndez et al., 2009). Increment in micronutrients was proportional to applied rate of compost, whereas abatement in micronutrients due to biochar was linear to applied dose of biochar. Increase in micronutrients due to compost is a good indicator of improving soil fertility while decreasing in micronutrients due to biochar is a leading indication that biochar can be used as a promising materials in removing heaving metals from a soil, and thereby mitigating environmental quality degradation. Our findings are in agreement with other previous conducted research. Cox et al. (2001) reported that compost had a significant effect on increasing manutrients.



**Figure 2. Responses of plant micronutrients to the applied compost and biochar;** Fe, Zn, Cu and Mn are expressed in  $\text{cg kg}^{-1}$ ; within each column, means with different letters are significantly different at  $P < 0.05$ , while means with similar letters are insignificant at  $P < 0.05$ .

#### 4. CONCLUSION

Based on the findings of this study, *Elaeagnus* tree which is grown in the study area can be used to improve soil fertility of a sandy clay loam soil via increasing plant available nutrients after being converted into either compost or biochar. The effect of compost exceeded that of biochar in terms of increasing macronutrient and thus is highly suggested. However, biochar has been evidenced for adsorbing heavy metals and thus is recommended in remediating heavy metals polluted soils.

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**O 49. PRODUCING ENERGY FROM MAGNETIC FIELD WITH WAVE ENERGY**

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**ABSTRACT:** As a result of the increase in the world population and the continuous growth of the industry, it has been seen that the energy demand will increase in the coming years. Due to the cost of standard energy production methods and environmental pollution, many countries tend clean and renewable energy sources. Therefore, the energy sector is looking for alternative energy production methods for clean and renewable energy. In the historical development process related to renewable energy, different renewable resources in energy production, and energy production technologies derived from these sources have been developed. In this study, the properties of the wave energy which is a renewable source, the principles of transformation were investigated, and a system has designed to generate electricity energy by using the potential energy of the wave power. In this design, buoys on the water surface oscillates up and down due to the potential energy of the wave energy. The potential energy of the wave power has converted into kinetic energy by means of buoys. The kinetic energy gained by the buoys influenced the coil system and the magnetic field has formed and the energy produced in the magnetic field converted into electrical energy.

*Keywords: Renewable Energy, Wave Energy, Electricity Production, Magnetic Field*

## **O 50. INDOOR AMBIENT PARTICLE MEASUREMENT OF SOME CAFES IN BOSNA-HESEK DISTRICT OF KONYA CITY, TURKEY**

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**ABSTRACT:** Recently, increasing social activities the welfare levels and people spend a large part of their time outside of places such as cafes, restaurants and tea gardens. Nowadays, these places like have increased around university regions. People who visit such places are increasing day by day. This has brought some environmental problems with them. The weather is also a very pollutant affecting environmental conditions. These pollutants have negative effect on human health especially respiratory system. In this study, internal ambient particulate matter levels were measured at different point places and at different time periods in some cafe around the Selcuk University Campus. Internal air quality is evaluated and its effects on human health are examined.

*Keywords: Cafe, indoor air quality, particle measurement, air pollution, ambient air*

### **1. INTRODUCTION**

Air pollution is a very important environmental health problem and has affected all countries of the world. Millions of people died every year due to air pollution problem. Air pollution can be defined as the rise of pollutants in the atmosphere in the form of dust, gas, smoke, odour, water vapour to harmful amounts to human beings and other living things. In addition to this, weather conditions that endanger the human health and life of living organisms as a result of the intense amounts of gaseous or particulate substances, especially fuel residues that arise from various chemical processes are also included in this definition [1-4]. One of the most important causes of air pollution has been the increase in the use of fossil fuels as a result of the rapidly increasing world population, industrialization, urbanization and consequently increasing energy demand. The increase in the use of fossil fuels also leads to ever-increasing changes in atmospheric composition. People breathe the air around them without a choice. If the air is polluted, particles and contaminants in the air are also inhaled. These pollutants damage people's lungs, heart and other organs. In the past, deaths have occurred in many countries due to air pollution. For example, 63 people died in Belgium in 1930, 20 people in Pennsylvania in 1948 and more than 4,000 people in London in 1952 due to air pollution. Long-term inhalation of low-concentration air pollutants is also considered dangerous to human health [4-6]. Children are more active: the liver, lungs and other organs are at the stage of development and are at greater risk. Air pollutants, for example carbon monoxide (CO), Sulphur dioxide (SO<sub>2</sub>), nitrogen oxides (NO<sub>x</sub>), volatile organic carbon (VOC), ozone (O<sub>3</sub>), heavy metals, respirable particulate matter chemical composition, reaction properties, diffusion properties of short and long range are different. Although many natural physical activities (volcanoes, fires) emit different pollutants into the atmosphere, anthropogenic activities (human activities) have been identified as the main cause of environmental air pollution [7-9].

#### **1.1. Ambient Air Pollution**

Indoor air; housing, office, shopping and living centres, interiors of transportation vehicles (buses, trains, airplanes, ships, *etc.*) and buildings, in buildings such as schools. Indoor air pollution is the appearance of respirable substances harmful to health in these environments. Breathable substances can be observed in the form of dust, gas, steam. The concentration and diversity of these substances vary according to the characteristics of the environment, building construction and indoor materials, the behaviour of individuals living, and many environmental factors [10-14].

For example, in an elementary school, due to the active activities of the students, particulate matter ratios will be observed in classrooms and corridors, while the release of some volatile organic compounds from equipment such as copiers and printing machines used in a stationery environment can

be observed. The energy saving policies in the countries and consequently the indoor air circulation to the minimum level, insufficient ventilation, insulated windows with non-opening windows and air conditioners are used have created important problems in indoor air quality. The effect of indoor air quality on human performance is a known fact. For human comfort and productivity, the breathing air must contain 30-50% relative humidity and the working environment should be at 19-20 ° C. The quality of the indoor environment, physical particulate matter, carbon monoxide (CO), carbon dioxide (CO<sub>2</sub>), temperature, nitrogen oxides (NO<sub>x</sub>), oxygen (O<sub>2</sub>) content, Sulphur oxides (SO<sub>x</sub>), volatile organic compounds (VOCs), various microorganisms and allergens such as physical and the presence of biological agents. The incidence of these pollutants and the exposure to various pollutants increase the incidence of various diseases by breathing this air for a long time. Said pollutants may be released from internal sources or may be characterized as secondary pollutants produced by external penetrations or photochemical reactions in the internal environment [15-18].

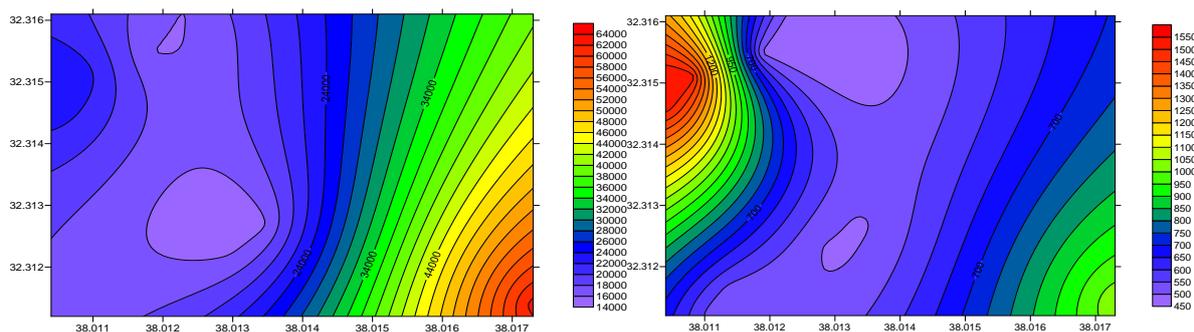
## **2. MATERIALS AND METHODS**

The measurements were performed at nine different points of each café in the vicinity of Studio Selcuk, at five different time periods of the day. Internal particulate matter measurements were made at the centre of the cafes. PCE - PC01 Particle Counter was used for particulate matter measurements. The device is capable of measuring and recording solid and liquid substances suspended in air in atmospheric environment and breathable by human. The device can measure existing particles directly in the air without the need for an air pump. The device could save the data obtained from the measurement points to its own memory. It also has video and photo capture capabilities. The device can store up to 5000 data. It gives the measurement results in ppm. The instrument has a green, yellow, red colour scale and can give a warning when it reaches high concentrations.

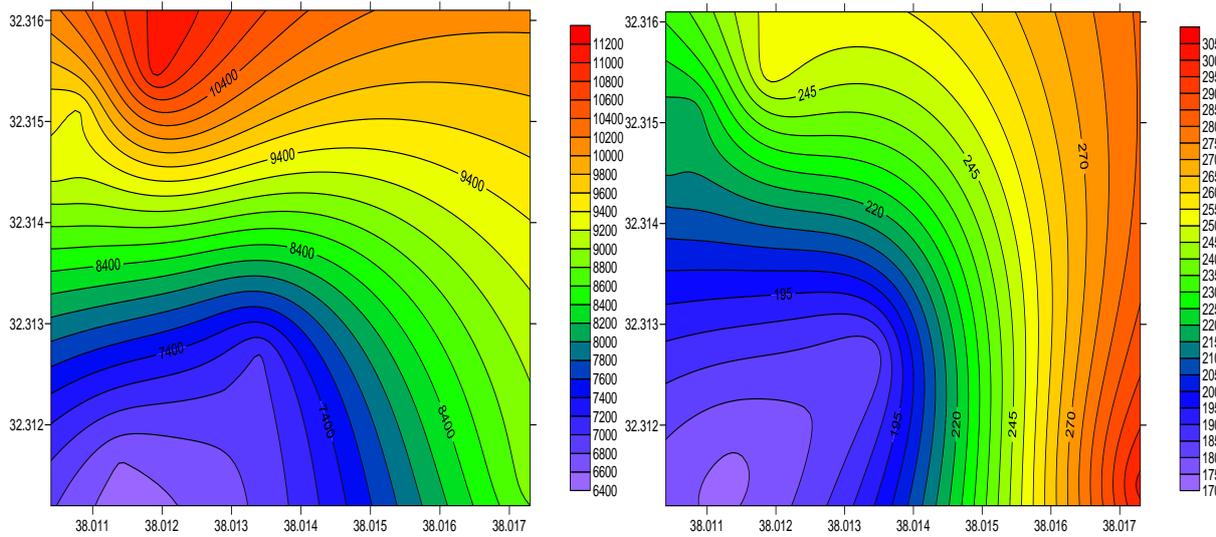
## **3. RESULTS**

This research was conducted in 5 different cafes operating in Bosna-Hesek district of Konya city centre, Turkey. Particle matter measurements were done at nine different points of each café. Measurements were performed at 5 different time period which are 08:00, 12:00, 16:00, 19:00 and 23:00. Particle matter of 2.5µm and 10µm were measured and distribution maps were prepared by Surfer-08 packet program. Each café is namely numbered **1, 2, 3, 4, 5**.

Café-1: In all measurements in this study, the lowest value for 2.5µ was 6579 mg / m<sup>3</sup> at 16:00 and the highest value was 62811 mg / m<sup>3</sup> at 19:00 and the lowest value was measured at 16:00 for 10µ. 184 mg / m<sup>3</sup>, and the highest value were measured as 1527 mg / m<sup>3</sup> at 19:00.

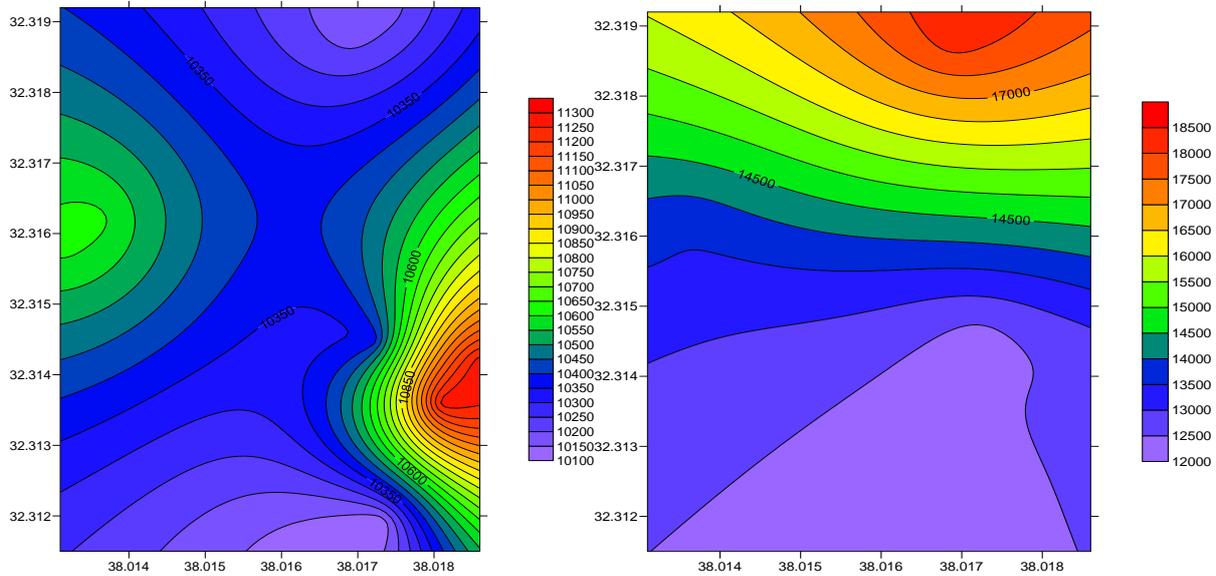


**Figure 1.** Distribution maps for 2.5µ and 10µ particulate matter of measurement on 01.04.2019 at 19:00 in Café-1

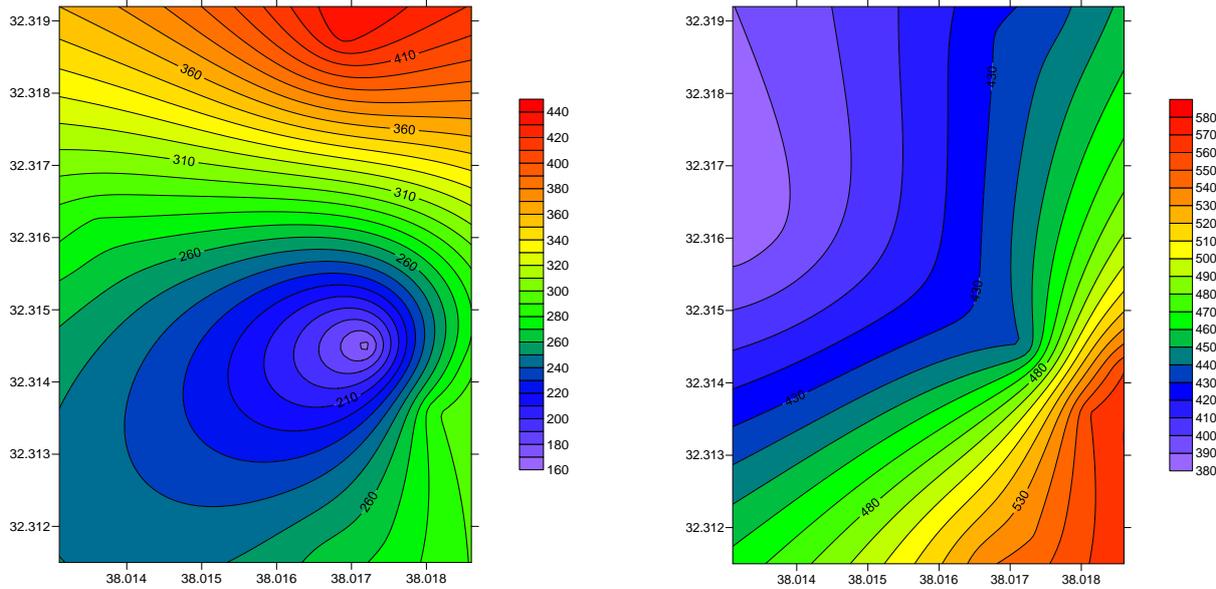


**Figure 2.** Distribution maps for 2.5µm and 10µm particulate matter of measurements on 01.04.2019 at 16:00

Café 2: In all measurements in this study, the lowest value for 2.5µ is 10108 mg / m<sup>3</sup> at 12:00 and the highest value is 18282 mg / m<sup>3</sup> at 16:00, the lowest value is measured at 23:00 for 10µ. 166 mg / m<sup>3</sup>, the highest value was measured at 19:00 was 559 mg / m<sup>3</sup>.

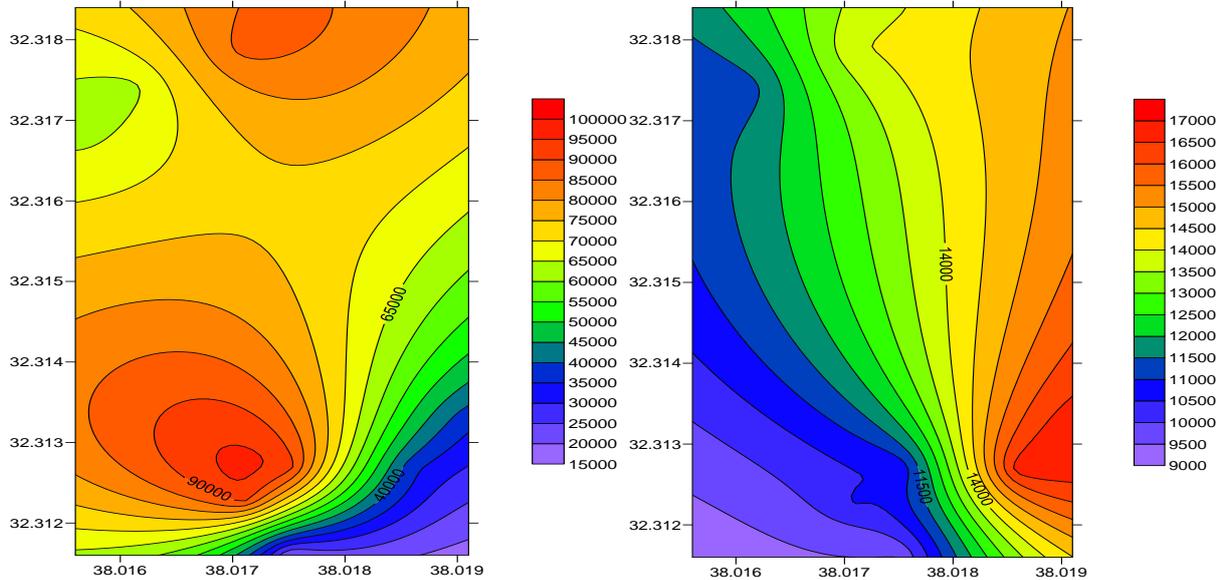


**Figure 3.** Distribution maps for 2.5µm particulate matter of measurements on 01.04.2019 at 12:00 and 16:00

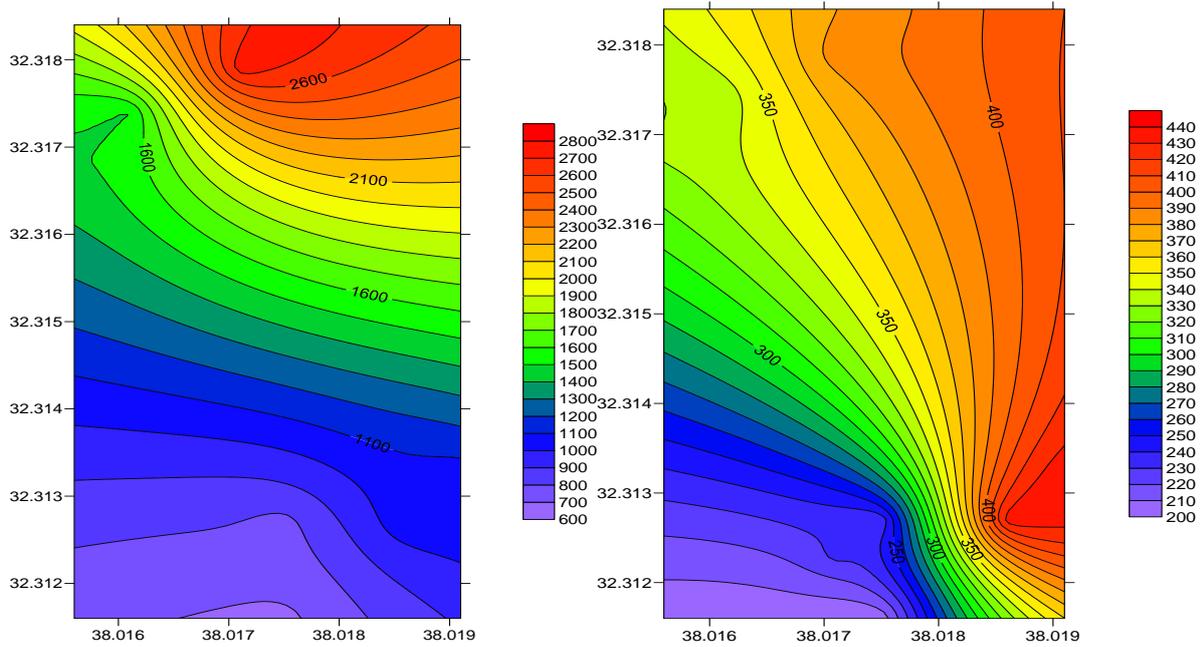


**Figure 4.** Distribution maps for 10µm particulate matter of measurements on 01.04.2019 at 19:00 and 23:00

Café 3: In all measurements in this study,, the lowest value for 2.5µ is 9493 mg / m<sup>3</sup> at 23:00 and the highest value is 1919 at 92194 mg / m<sup>3</sup>, the lowest value for 10µ is at 23:00. 233 mg / m<sup>3</sup>, the highest value was measured at 19:00 was 2744 mg / m<sup>3</sup>.

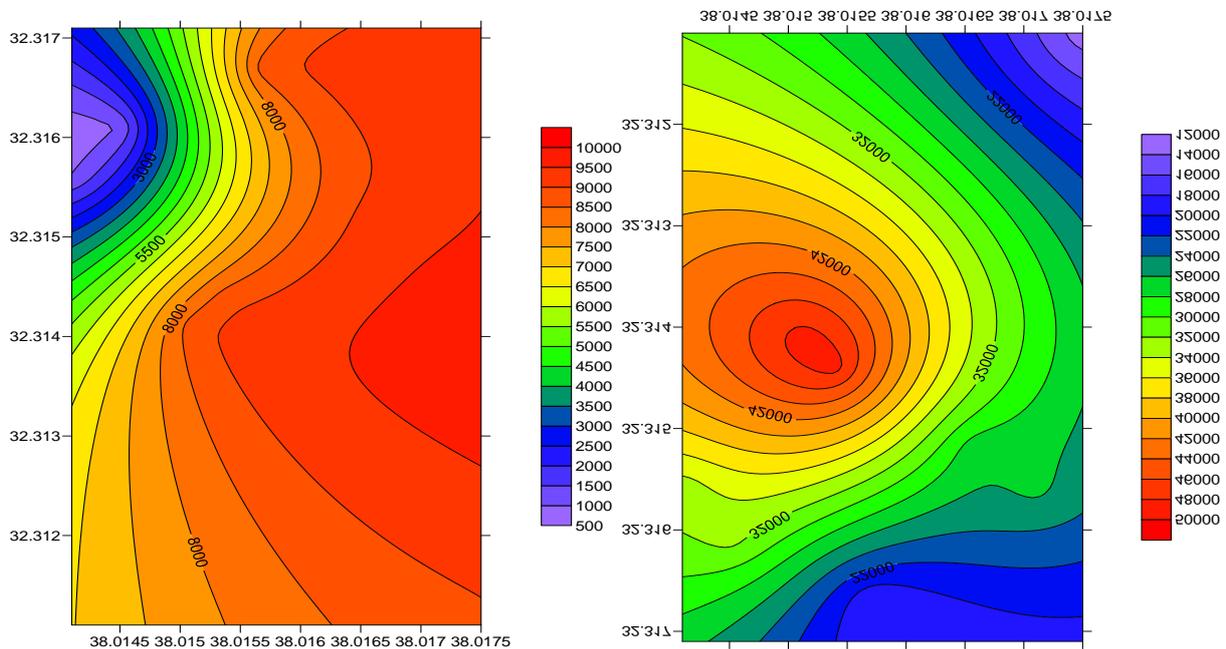


**Figure 5.** Distribution maps for 2.5µm particulate matter of measurements on 01.04.2019 at 19:00 and 23:00

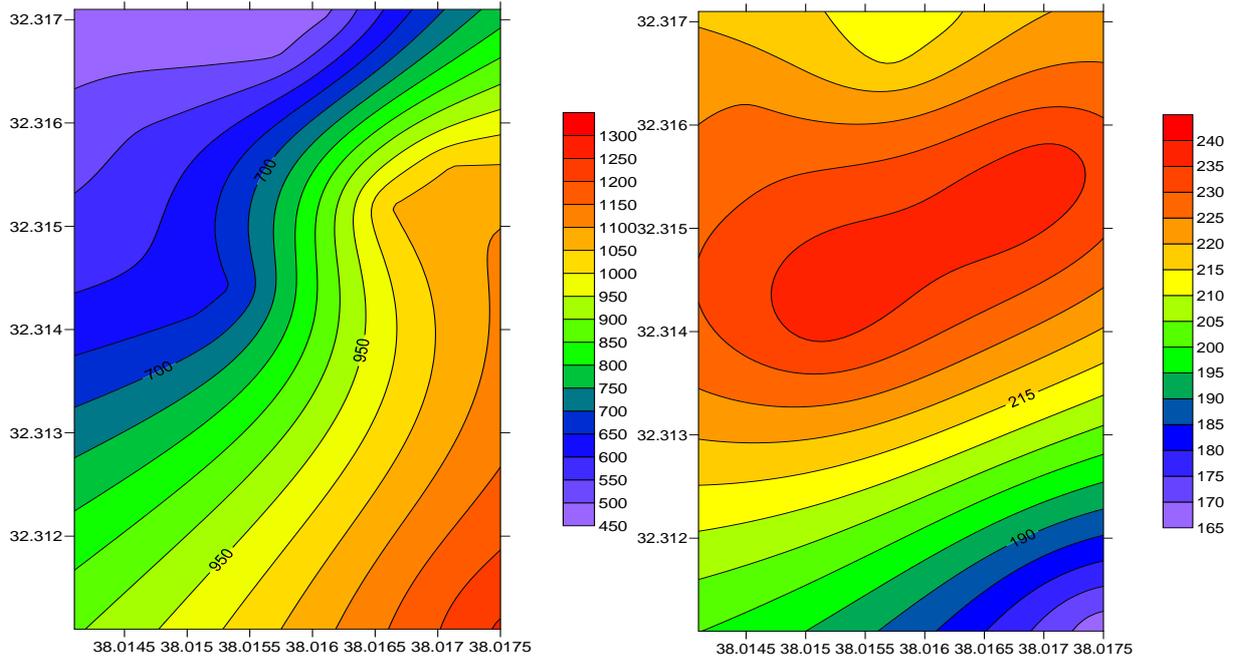


**Figure 6.** Distribution maps for 10 µm particulate matter of measurements on 01.04.2019 at 19:00 and 23:00

Café 4: In all studies, the lowest value for 2.5µ was 1034 mg / m<sup>3</sup> at 08:00 and the highest value was 48752 mg / m<sup>3</sup> at 19:00 and the lowest value was measured at 23:00 for 10µ. 166 mg / m<sup>3</sup>, the highest value was measured at 19:00 was 1047 mg / m<sup>3</sup>.

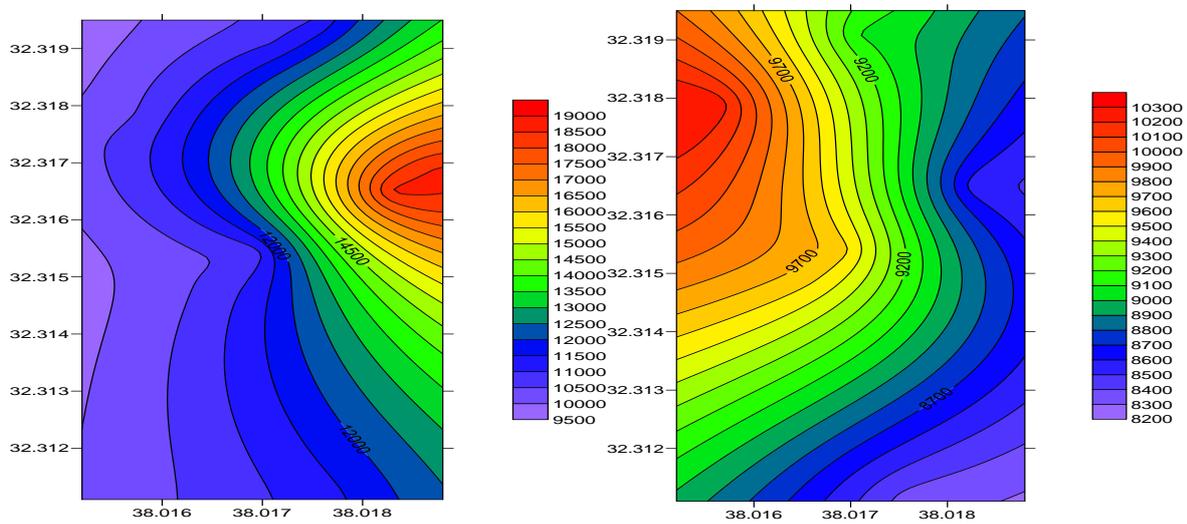


**Figure 7.** Distribution maps for 2.5µm particulate matter of measurements on 01.04.2019 at 08:00 and 19:00

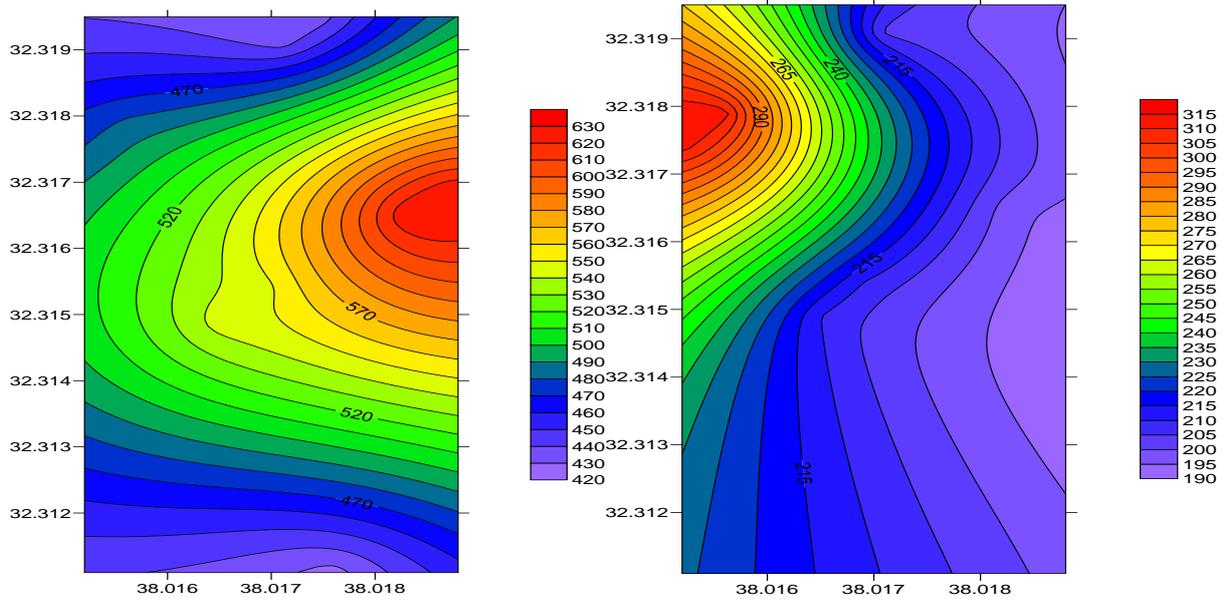


**Figure 8.** Distribution maps for 2.5 µm particulate matter of measurements on 01.04.2019 at 19:00 and 23:00

Café 5: In all studies, the lowest value for 2.5µ was measured at 23:00 and 8347 mg / m<sup>3</sup>, and the highest value was measured at 16:00 for 18564 mg / m<sup>3</sup>. 197 mg / m<sup>3</sup>, the highest value was measured at 19:00 was 628 mg / m<sup>3</sup>.



**Figure 9.** Distribution maps for 2.5µm particulate matter of measurements on 01.04.2019 at 16:00 and 23:00



**Figure 10.** Distribution maps for 10 µm particulate matter of measurements on 01.04.2019 at 19:00 and 23:00

#### 4. RESULTS AND DISCUSSION

Cafes hookahs cigarettes and dusting is a sector seen due to the crowd. The resulting dust adversely affects the health of workers and cafe residents. In the Regulation No. 20635 on Dust Control published in the Official Gazette on September 14, 1990, the required limit value for silica powder PM is 10 mg / m<sup>3</sup>. Respirable dust amount should not exceed 5 mg/m<sup>3</sup>. According to American OSHA Standards-29 CFR, total dust amount should not exceed 15 mg / m<sup>3</sup>. As a result of our measurements, it was observed that the values found were above these limit values. In the measured region, the highest values were observed in the most crowded hours and the lowest values were in the calmest hours. As a solution, the vents can be increased a little. This situation may not cause problems in the short term, but it may cause health problems in the long term. It may be responsible for respiratory infections such as acute and diseases like cancer.

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## **O 51. OCCUPATIONAL WORK AND WORKPLACE SAFETY PARAMETERS AT QUARRIES**

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**ABSTRACT:** Workplaces have been locations where people work for their earnings as employees. Occupational safety rules applied for work and workplaces have gradually regulated jobs to supply healthy working conditions. Mining law and related legislations applied for occupational safety of mines have also synchronized working conditions. Rules functional for safety precautions at mining workplaces have also arranged official relationships between employers and employees. Precautions listed for occupational work & workplace safety have activated engineers to focus on the risks of accidents. In this study occupational safety conditions for quarries have been studied to understand possible risks to decide about their preventions. In order to comprehend risks appeared at quarries, whole quarry operations had been analyzed for a selected quarry near Kayseri-Turkey. Results of risk analyses are supplied here to present the importance of safety understandings and safety cultures in mine related societies.

*Keywords: Mine safety, Safety in quarries, Workplace safety parameters, Safety precautions for quarries*

### **1. INTRODUCTION**

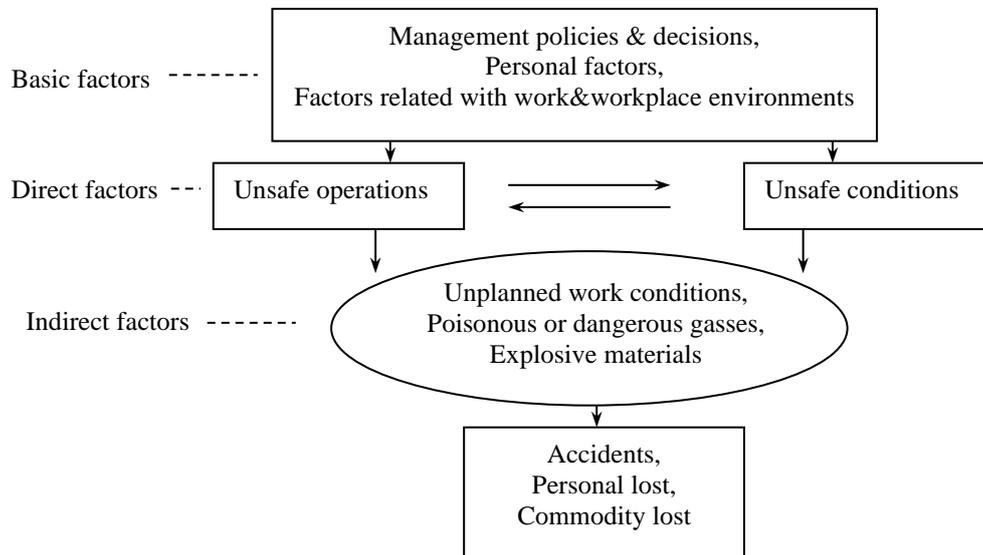
Work and workplace health and safety rules have strictly been implemented in all sectors including mining industry for 50 years. Mining workplaces include underground mines, open pits and ore dressing facilities had been known as dangerous and workers in these workplaces were accepted as honoured members of societies but they certainly had short periods of life. Before World War I, industries in countries had been forced to produce their raw materials, semi and final products without thinking too much about the workplace health and safety conditions deeply. Statistics demonstrates fatal accidents occurred in different branches of works were clearly too many for those earlier years. For example, average numbers of men killed in quarries were 182, 146 and 136 in every 5 years time periods of 1911-1915, 1916-1920 and 1921-1925 respectively. In those years average numbers of men who had worked in quarries were 103740, 80682 and 91872 for the same time intervals respectively (Adams, 1929). These numbers present the importance of safety rules forced by current governments in the world.

Work & workplace health and safety rules have been accepted as general human right subject and related legislations and rules are influenced companies' productions positively in all working sides. Health is expensive assets in modern world even with supplying related compulsory insurances. Therefore, modern societies are asked safety culture from their members in all circumstances of their life. Thus, work & workplace safety conditions for quarry operations were selected to analyze in this study to compensate mentioned safety culture especially in quarry sectors in Turkey. Quarries are essential part of raw material supply chains of construction industry. Different sizes of broken rocks, usually limestone in Turkey, have been used mainly as an aggregated material in concrete mixtures. Some parts of them have also been used as roads' foundation and asphalt road cover raw materials. These coverage presents aggregated rocks wide spread usage in Turkey. Thus there are always quarries around new road construction sides and cities. Some of the quarries have been worked for a long time but, some of them are new in business. All the men related with quarries should be in a self-control state that, they must not accepted quarries as common workplaces where you can use loaders, mine trucks and rock crushers. Quarries which have men as a patrons, engineers, foremen and workers should be ready for all types of accidents. In addition, these people are required to equip themselves in a state of safety culture in their daily life as well. Quarries in fact, have big scale excavation, hauling and crushing machines which have usually been operated with harsh conditions. Thus mining men there must obey strictly law-enforced

rules. Engineering decision parameters observed in quarries which influence the work & workplace safety have been analyzed here to show accident risks. Putting extra efforts to eliminate risky factors in quarries have definitely decreased workplace accidents. Then what can be the factors which raise dangerous working conditions were researched here to perform supplied risk evaluation method.

## **2.ACCIDENT STATISTICS**

In general, analyses performed in most of the industry demonstrate that 95 % of accidents are originated through working men. In reality, workplaces are necessary locations to produce targeted products but, commodities should be supplied into markets without any accidents. These can be handled by engineered work-plans and organisations. Main motivations of accidents are given in Figure 1. There are three types of grounds in accidents, and they are basic, direct and indirect factors. Attitudes of managers, their professional behaviours, engineers in quarries and work & workplace conditions can be considered as basic influencing factors on accidents. Supervisions on works are mostly necessary in open pit mines. Close control of pits by engineers have usually decreased the number of quarry accidents in Turkey. Accidents have occurred through serious circumstances of small scale facts. Therefore, if one of these facts has been recognised in mine, then precautions must be handled to eliminate recognised ongoing accident factors.



**Figure 1.** Main reasons of workplace accidents (Altay, 2015)

Physical, chemical, mechanical, dynamical etc. aspects influence quarry working conditions and sometimes create good, favourable, conditions for mine related accidents. In order to evaluate accidents, it is not enough to report the total number of accidents (accident statistics) at certain types of industry. That values can be used to understand level of accident occurrences, but number of working men in the selected industries are also considered to realize their impacts. Table 1 includes numbers of occupational accidents in mining, metal and construction industries together with the numbers of working men in these sectors. This table shows that, number of occupational accidents in mining sector was smallest (10336 accidents) among these 3 sectors (for 2015) but, when accident numbers were compared with the numbers of sectors' working men, related ratio for mining industry was found highest.

**Table 1.** Accident statistics of Turkey including three different industry sectors for year 2015, (Bayraktar et al., 2018)

Industry sectors	Occupational accidents	Number of working men	Accident ratio (for every 100 men)
Mining	10336	128741	8.05
Metal	51327	1070162	4.80
Construction	33361	1980630	1.68

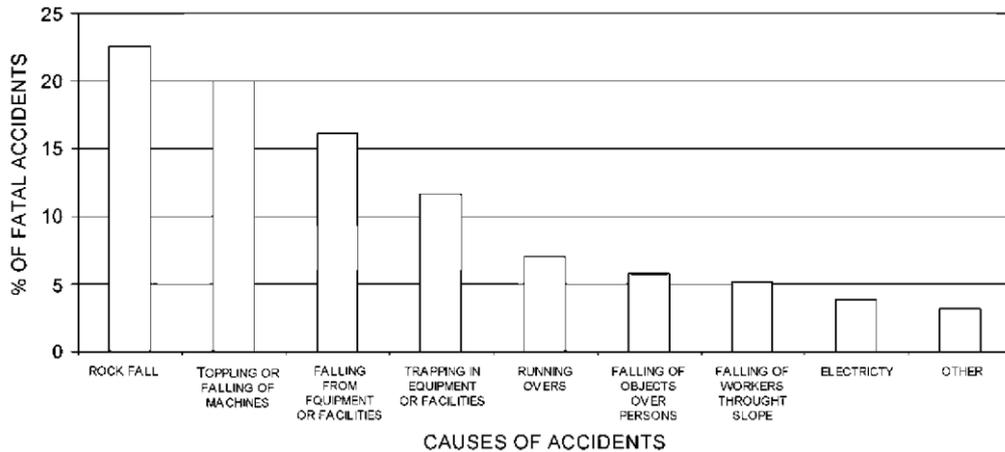
Sometimes researchers have supplied accident evaluations with respect to the size of the companies, (Table 2). In general size of the organisation is related with their professionalism. Big mining companies in Turkey for example are governed by state owned organisations and big private cooperations (holdings). They have numerous employees, specialists and expert mine engineers together with shift mining engineers to produce their ore. Soma mine accident (Soma disaster) in Turkey (2014) showed that, scale of companies and number of foremen and engineers sometimes are not enough to prevent accidents if organisations and related controlling mechanisms are not pay their full attentions including all scientific and engineering rules.

**Table 2.** Company sizes in mining industry of Turkey in 2015, (Bayraktar et al., 2018)

Size of workplaces, companies	Share in all industry sectors, (%)	Share in mining sector, (%)
Big-scale	0.27	0.88
Middle-scale	1.80	5.25
Small-scale	12.52	31.03
Micro-scale	85.41	62.84

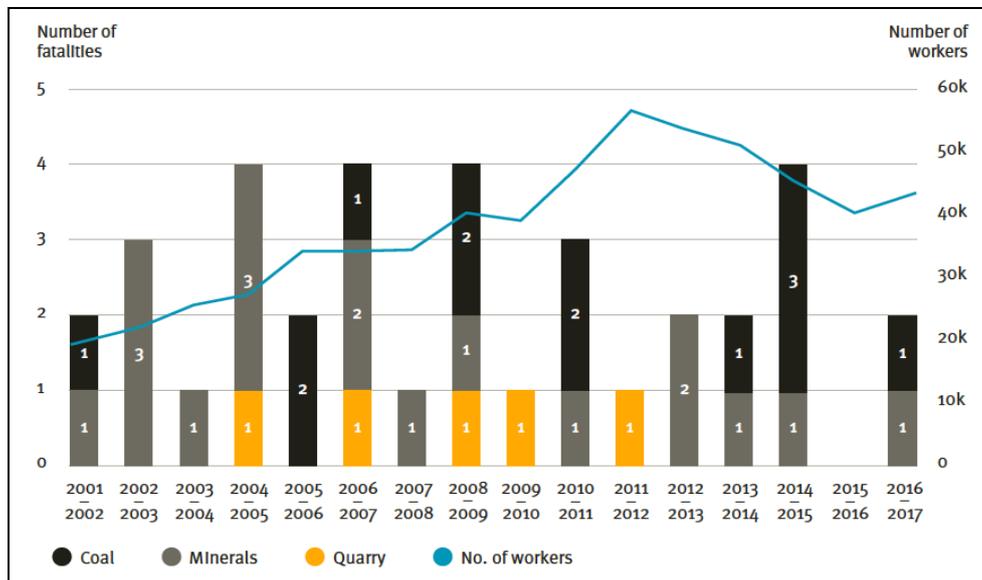
Arslanhan & Cunedioğlu (2010) wrote that due to several influencing parameters (paying less attentions on work & workplace health and safety details, cost of experts in mining, cost of experienced workers etc.), mining sector has become more dangerous sectors. Table 2 presented that micro-scale mining companies (workplaces) are widespread and they constitute more than half of the sector (62.84 %). When we think micro-scale and small-scale companies in mining sectors they form 93.87 % of workplaces together in Turkey. This value is very important during mine accident evaluations. Mining engineers who work for micro or small scale companies should then be more careful on causes of accidents and they have to decide carefully about their precautional works. Quarries in general mining operations can be considered as micro or small scale mining workplaces according to the size of the quarry operations. One of the researchers who evaluated quarry operations and related accidents was from Kenya. Wanjiku (2015) worked on occupational health and safety hazards associated with quarrying activities at a quarry in Kenya. Wanjiku reported that; the European Agency for Safety and Health at Work (EASHW, 2008) had stated; “*the quarry workers are twice as likely to be killed in an accident at work as construction workers, and 13 times more likely to die at work as those in manufacturing industries*”. Wanjiku noted also; “*In France about 44% of all fatal accidents in 2002 were related to quarrying while in Germany, between 1999 and 2003, 48% of all accidents reported were from the quarrying sector, (ILO, 2005)*”.

What can be the causes of accidents in quarries. These parameters are main research considerations in related studies. Alejano et al. (2008) supplied their reasonings for fatal accidents occurred for open pit aggregate mining in Spain (Fig.2). According to their paper, ANEFA (Spanish Association of Aggregate Producers) supplied data that they pointed 9 main accident causes for Spanish quarries. These data presented that most effective causes in fatal quarry accidents in Spain (for 1987-1995 time period) were; “rock fall”, “toppling or falling of machines”, and “falling from equipment or facilities”. The other causes were; “trapping in equipment or facilities”, “running overs”, “falling of objects over persons”, “falling of workers through slopes”, “electricity” and “others”.

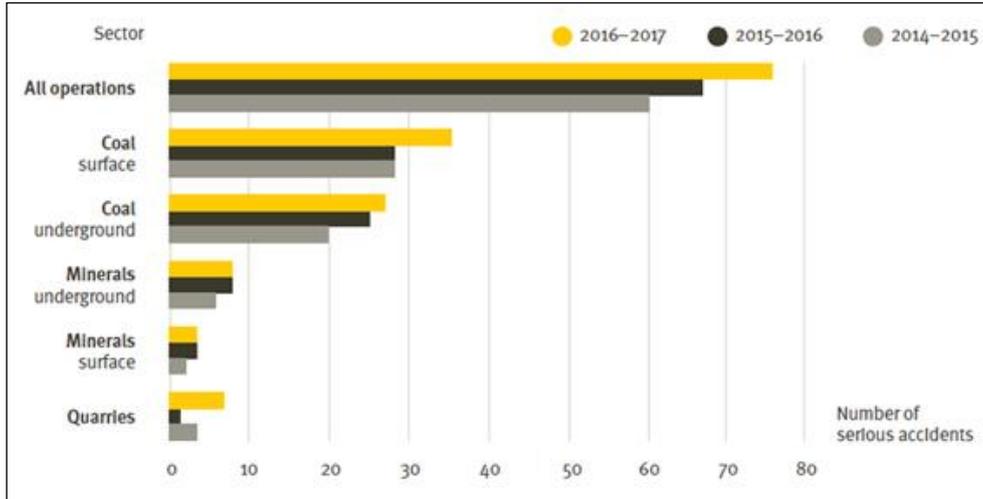


**Figure 2.** Causes of fatal accidents in open pit aggregate mining in Spain (for 1987-1995 time periods, data reported by Spanish Association of Aggregate Producers), (Alejano et al., 2008)

In order to understand work & workplace accidents, comparisons among quarries and other industry sectors, report supplied by Queensland (Australia) Government might also be helpful. Mining sector influence (as a production capacity and number of men worked in the sector) has gradually decreased in European countries for 40 years. Therefore, data from Australia, China and US have more recent working conditions for mines. Figure 3 showed that there is no distinct relation between size of the industry and the frequency rate of fatalities (in accidents). According to QMQSP, (2017), “increases in fatalities have occurred during periods of industry growth, as well as construction”. Queensland Government (Australia) supplied numbers of accidents (Fig. 4) in mining sector for 2014-2017 time period.

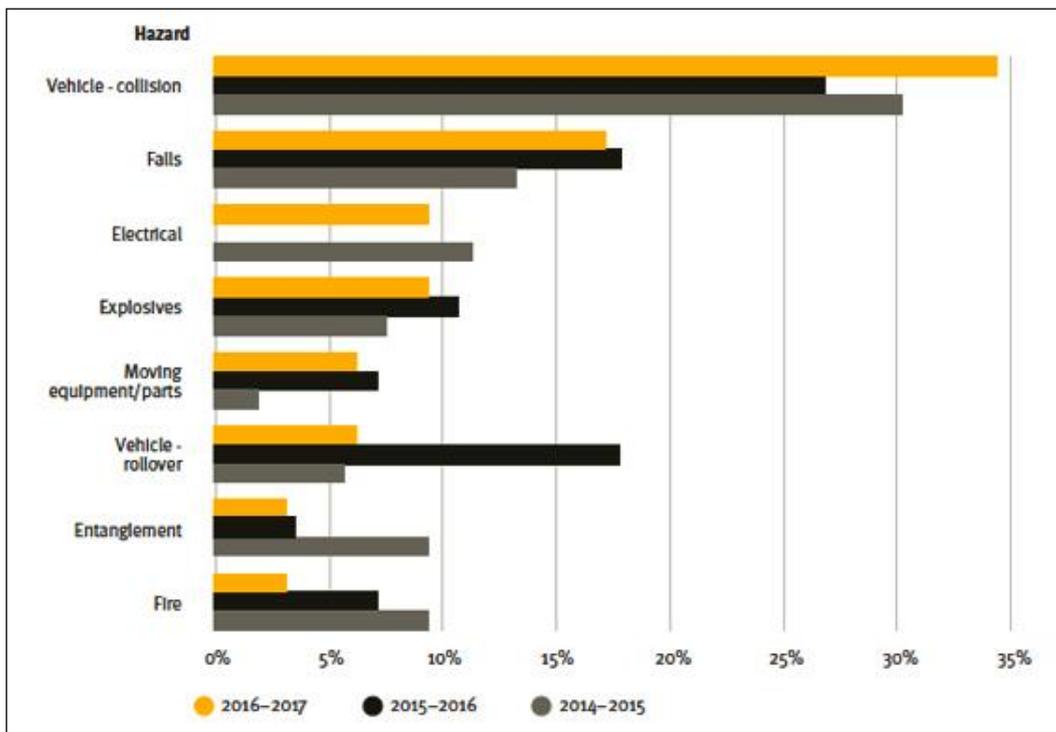


**Figure 3.** Numbers of fatalities in mining sector together with numbers of workers in Queensland (Australia) for 2001-2017 time periods, (QMQSP, 2017)



**Figure 4.** Numbers of “serious mine accidents” (in different operations) in Queensland (Australia) for 2014-2017 time period, (QMOSP, 2017)

According to their classification “serious accident” refers incidents where working men who involved in accidents are “requiring admission to hospital as an patient and exclude fatalities”, (QMOSP, 2017). This figure (Fig. 4) illustrated that number of serious accidents in quarries of Queensland were higher than mineral ore open pit mining operations for 2016-2017 time period. In Queensland (Australia), there were; 1464 workers, 992 employees, 472 contractors, 216 quarries in production, 43 quarries in care & maintenance, 49 quarries in infrequent operations. These quarries have no fatal accident in 2016-2017 time period but, 6 “serious accidents” and 64 “high potential incidents” were occurred. Figure 5 summarized “high potential incidence” according to hazard types. Due to vehicle, excavator and mine truck usage for overburden and rock mass moving in quarries, their collision incidents were in high level with respect to other accident types.



**Figure 5.** High potential incidents by hazard type in quarries in between 2014-2017. In these graph only the top 8 occurring categories have been included by (QMOSP, 2017)

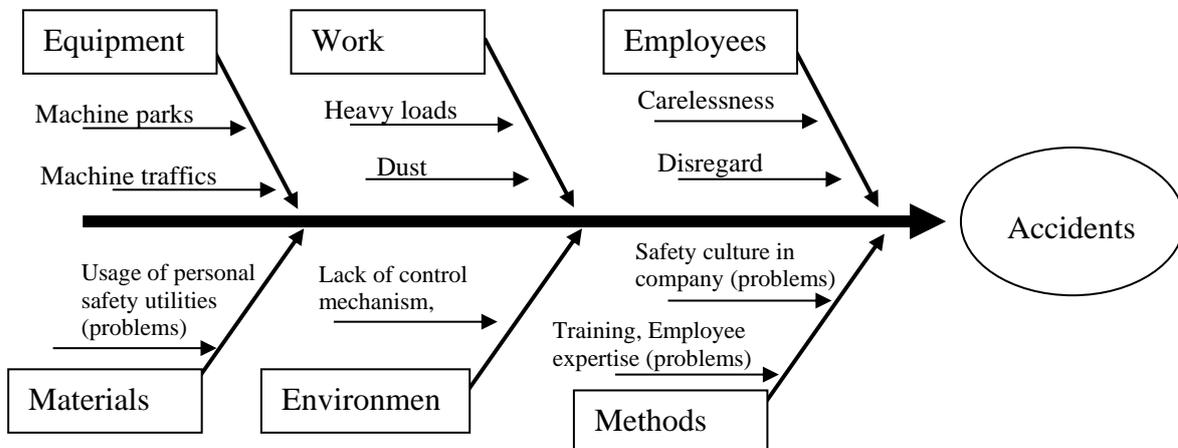
High level of work&workplace alerts in government offices, general cultural background for workplace safety, health insurance costs in Queensland may force companies to record almost all minor & major incidents occurred in quarries. Actually, statistics supplied through different government offices have some degree of biases about workplace accidents. Countries which have separated private companies for; workplace safety controls; workplace preliminary inspections; workplace insurances; workplace health caring services etc. might be more effective about work&workplace accident recordings. Employees usually are members of labour sendicates and these sendicates record carefully all incidents and accidents for the behalf of their members. Fatal accident statistics supplied for 3 different industry sectors of Turkey (for 2015) is given in Table 3. It shows fatality ratios for every 100000 working men in each sector. These industry sectors in Turkey have been selected due to their high fatal accidents and high fatality ratios. According to supplied data; highest number of fatality ratio was determined for mining sectors and it was 61.4 accidents/(100000 working men). This value was 23.9 for construction industry and 8.8 for metal industry in Turkey.

**Table 3.** Fatal accident ratio per 100000 working men in three main industry sectors of Turkey (for a calendar year; 2015), (Bayraktar et al., 2018)

Industry sectors	Occupational accidents	Number of working men	Accident ratio (for every 100000 men)
Mining	79	128741	61.4
Construction	473	1980630	23.9
Metal	94	1070162	8.8

**3. MATERIALS AND METHODS**

Accident risk factors evaluated in literatures have been analyzed in this study to rate quarries in Turkey. At the beginning of such a work, responsibilities of all employees are analyzed by considering applicable current legislative rules in Turkey. As a researcher, factors influencing the quarry products (aggregated and sized rock materials) have been observed in a test quarry to understand actual conditions. In addition, critical approach for every operation in selected quarry resulted in decision parameters qualifications. Creative thinking about quarry operations results in different possibilities of accidental cases. According to these cases, quarry administration & engineers can develop their own accident precautions. Factors that may influence the “causes of expected (but unwanted) accidents” should be established for more detail analyses of their appearances. Are they human depended factors? Do they include any machine or procedural features? These and similar questions should be considered to catch “the causes of expected accidents in quarries”. These parameters can also be analysed by using fish-skeleton type (Fig. 6) presentation charts. This chart helps engineers to think deeply about the accident cases together with their causes and related decision parameters.



**Figure 6.** Fish-skeleton type reasoning for expected (synthetic) quarry accidents

In order to evaluate causes of expected quarry accidents, selected quarry's 3D location plan were checked and struggle points in terms of; *elevations, vehicle-vehicle cross-passages, vehicle-pedestrian cross-passages, rock slopes, types of rock failures concluded according to rock discontinuities, dangerous locations where the slope failure are expected etc.* should be determined. In order to rate safety considerations that may arise in selected quarry, "L-type risk evaluation and decision matrix" was used in this study, (Table 4). For the selected test quarry, (basalt quarry near Kayseri-Turkey); machines, vehicles, offices, natural plants&creatures, water bodies, environmental facts, related legislations etc. have been evaluated for the quarry's safety conditions. Table 5 illustrates accident probability cases and their classifications in terms of probabilistic level of occurrences. These classes are usually decided by expert engineers who have enough information and knowledge about quarries working conditions. After analysing all presumptional cases including accident precautions and actual facts related with works&working conditions of analysed quarry; If the conclusion points inevitable "accident"; what will be the results then.

**Table 4.** L-type risk evaluation matrix, (Ceylan & Bashelvaci, 2011).

Level of harmness Probability of occurrence	→Very low (1)	Low (2)	Middle (3)	High (4)	Very high (5)
Very low (1)	Too low, Tolerable (1)	Too low, Tolerable (2)	Low (3)	Low (4)	Low (5)
Low (2)	Too low, Tolerable (2)	Low (4)	Low (6)	Middle (8)	Middle (10)
Middle (3)	Low (3)	Low (6)	Middle (9)	Middle (12)	High (15)
High (4)	Low (4)	Middle (8)	Middle (12)	High (16)	High (20)
Very high (5)	Low (5)	Middle (10)	High (15)	High (20)	<b>Very high Untolerable (25)</b>

**Table 5.**Probability designation for expected accidents. If accident is inevitable, the resultant facts can be classified in 5 categories (Ceylan & Bashelvaci, 2011)

Probability	Accident probability	Results	Classification
Very low (1)	Never	Very low (1)	No lost of working days; Emergency health care
Low (2)	Very a few (once a year) abnormal case	Low (2)	No lost of working days; No permanent effects; Care without hospitalization
Middle (3)	Low (a few cases per year)	Middle (3)	Minor wounding; Hospitalization necessary
High (4)	Frequently (once a month)	High (4)	Serious wounding; Hospitalization; Long-term treatment
Very high (5)	Very frequently (once a week, in every day, in normal working days)	Very high (5)	Fatal accident; or workers permanently out of jobs

Table 5 shows "result classifications" for expected accidents. These results should be predicted early enough to handle required precautions. The results presented in Table 5 (*which no one would like to experience*) are in fact, the reality of the accidents and their results on employees. For the case of selected

quarry, expected accident cases have been evaluated to understand risky parameters for the tested basalt quarry. The evaluations are as follows;

- i.** In this quarry, different machines, vehicles and employees (pedestrians) move in the same pit for different purposes. Machines for this quarry were planned and handled for heavy excavation, loading and hauling steps. Therefore size of the rock blocks, rubbles, sometimes can be big enough to harm employees. Rolling over might be one important accident cause. [Probability of accident occurrence: Low (2), Expected results: High (4) or Very high (5)].
- ii.** Personal safety utilities which employees have to use at workplaces of quarry should be reinforced. For example any men in the pit should wear helmet other than the office rooms. Helmets protect employees from any falling and flying (small) rock pieces or materials. [Probability of accident occurrence: Low (2), Expected results: High (4)].
- iii.** Dusts originated due to quarry excavations and truck movements (on pit roads) may create hazardous circumstances for employees' health. Dusts sometimes eliminate clear view which is important for drivers and excavator operators. Water spraying is one practical solution for dusts. [Probability of illness and accident occurrence: Low (2), Expected results: Low (2)].
- iv.** If there is any accident case in this quarry, quick responded rescue team should always be ready to handle the situation. This team includes first-aid health service should be trained regularly to update their knowledge and readiness. [Probability of accident occurrence: Low (2), Rescue team readiness: Ready].
- v.** Experts should controls all facilities in quarry "service-sides" including all the machines and vehicles park sides, offices, stores, for fire control facilities, electrical water appliances. They should not create any causes for accidents. These control actions should be organised and performed in regular bases. [Probability of accident occurrence: Low (2), Expected results: High (4)].
- vi.** Quarry slopes should be controlled daily bases for their stabilities. In any case of instability, dangerous locations, preliminary support or controlled excavation procedures should be applied to eliminate danger of rock falls or slope failure cases. [Probability of accident occurrence: Low (2), Expected results: High (4)].
- vii.** In quarries, excavation machines are big machines so their park areas and small control vehicles' park sides should be different. At excavation sides in the quarry, any service vehicle should definitely be parked away from those machines. [Probability of accident occurrence: Low (2), Expected results: High (4)].
- viii.** Safety related announcements, signboards and banners should be big enough and firmly attached to their locations. They should be clearly seen. Safety signboards should be written in basic-understandable language. Employees have to be trained for the seriousness of these signs. [Probability of accident occurrence: Low (2), Expected results: Middle (3)].

#### **4. CONCLUSIONS**

Quarries are operated to supply aggregated material for construction industry. Therefore, aggregated materials should be economical enough to be used in concrete mixtures for instance. Some aggregates are used as railroad ballast and some of them used for road foundations. Most of the quarries are open pit mines and they are not so deep, that means they have limited slope benches. When the depth of quarry pits is getting deeper, the costs of operations are getting higher as well. So companies have surely checked other rock mass reserves for suitable and economical new quarry locations. In general accidents in quarry operations are originated due to machine usage, rock falls and falling from slopes. Commonly they are caused due to lack of attentions. Vehicles, mine trucks and excavators used in quarry operations are technologically high in standard. If their maintenances and services are also made in required time

periods, they produce very limited opportunities which cause inevitable accidents. Most of the accidents in quarries which include humans, machines, excavators and vehicles interactions are related with human factors. Therefore employees in quarries should be trained in a way that they must measure their attitudes and attentions during workdays. They should be in level of professionalism that, they may decide themselves to stop working immediately in case of any lost of carefulness. It was also revealed that training of the employees for their safety is not enough to protect them from accidents. They should have eager to obey safety rules. Employees and any other men who do not carry personal safety utilities should not be allowed to enter quarry operation sides. Employers, employees and even daily-visitors of a quarry companies should understand importance of the safety rules. Basic health and safety requirements which companies have to implement at their quarry operations need extra spending of money, (increase the cost). Thus, costs of quarry operations may increase due to engineered operations and actions (*including: water spraying at rock crushers, water spraying of pit roads, slope stability precautions, efficient blast requirements, personal safety utilities, training for first-aids, training for rescue operations, traffic control in pits, putting signboards and banners in necessary locations, safe electric and water appliances, safe office buildings at safe locations, training of engineers and foremen, asking safety or stability reports from referenced professionals etc.*). However, in long time periods, these actions have positively influenced the safety of the quarries.

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## O 52. NATURAL STONE CUTTING PLANTS AND AMOUNT OF WASTE PRODUCED

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**ABSTRACT:** Marbles, travertines and andesite rocks have been common natural stones types economically mined in Turkey. When the waste, (unusable stone fragments, leftovers, micronized rock dust, slurry etc.) in consideration; wastes can be occurred in natural stone mines and additionally they can be produced in Natural Stone Dimensioning (NSD) plants. Wastes generated at a NSD plant near Elazığ city (Turkey) have been perceived here to evaluate waste occurrence cases. When two typical equal sized natural stone blocks from the same stone mines are started to be dimensioned in a NSD plant (by using the same cutting and dimensioning machines), total saleable natural stone plates' surface areas (for the similar plates) obtained at the end of the operation might be different. It was aimed in this study to observe and understand governing (influencing) parameters of these differences. Actually, factors influencing waste amounts in NSD plants can be related with: cutting machine and its disk & blade performances; different plate dimensions (thickness, length, width); discontinuity contents; irregularities in natural stone blocks, problems related with block and plate handlings, mechanical property differences in stones blocks, natural stone dimensioning machine types and their properties etc. Detail evaluations of these parameters have been performed and amount of waste volumes and percentages were calculated here to compare main influencing parameters.

*Keywords: Natural stone, Marble, Natural stone cutting, Waste in Natural stone cutting.*

### 1. INTRODUCTION

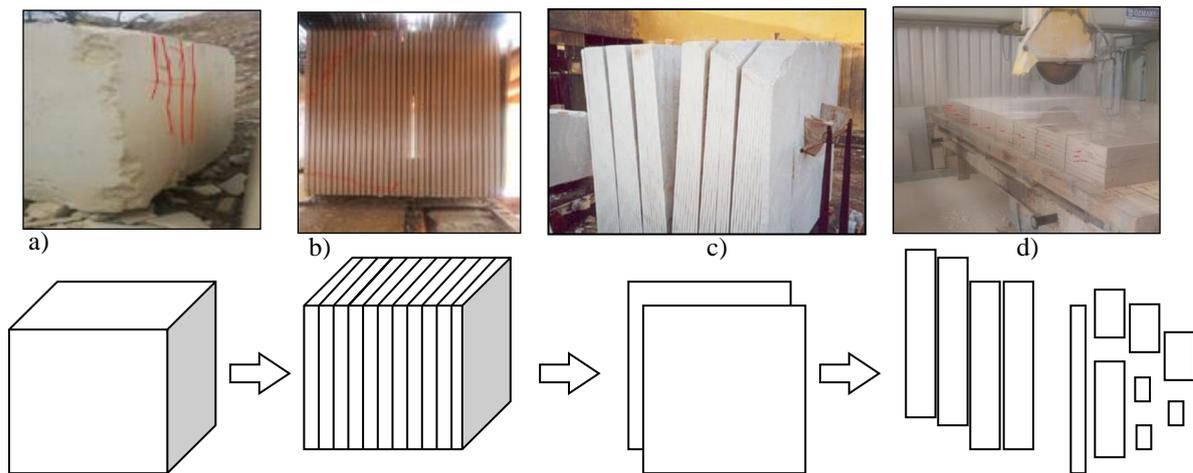
Waste amounts related with Natural Stone Dimensioning (NSD) plants can be reached considerably high levels in certain mining regions. Afyon city in Turkey for example has special waste disposal area for NSD plants located near this city limits (Celik&Tur, 2012). Natural stones excavated from nature for their aesthetic appearances and some other physical and strength related properties. Marbles, travertine, andesite and granite rocks are famous natural stones in Turkey and there are always customers for them mainly from construction industry. In civil buildings, floor and wall covering layers, material, have been differentiated according to construction designs, aims. These covers can be different for museums, domestic houses & apartments, shopping centres etc. Natural stone plates prepared for surface covers are then good alternatives to catch customer's attentions during liquefactions of these assets in construction markets.

Natural stone mines have mostly operated by open pit operations. One of the main differences of natural stone pits from other open pit mines is the product of the natural stone pit. Mining operations in this case are arranged to handle, cut out, dimensioned rock blocks from the main rock masses. Therefore blasting operations and any other excavation methods which create abnormal vibrations are discarded. Natural rock masses have been cut into big in-situ blocks at benches by using powerful wire-cutters. These blocks are usually very big in dimensions (around 2x7x7 m). After smooth detaching operations, in-situ blocks have been cut into smaller block sizes (around 1.7x1.8x3.0 m) by bench-top wire-cutters. These small size blocks are then moved to mine stock sides for sales. Wastes occur during these mining operations are inevitable. Waste volumes in natural stone mining conditions are considerably high due to rock mass discontinuities. Yavuz (2001) worked on discontinuities in natural stone pits and their influence on block production. Ersoy et al., (2012) compared plate production efficiencies of small sized natural stone blocks (rubbles, broken leftover small blocks) with respect to normal sized natural stone blocks. These and similar works performed before had focussed on the wastes occurred in natural stone mines. In natural stone business, natural stone blocks can be cut into laminated plates to increase companies' market places and profits. Therefore, natural stone miners have also NSD plants. This study therefore concentrated mainly on stone wastes occurred at these NSD plants. It was aimed in this study

to understand what could be the percentage of total waste volume occurred during cutting of a natural stone block. It was also aimed to analyze factors influencing the resultant wastes.

## 2. MATERIALS AND METHODS

Waste produced due to NSD plant operations have been analysed during this study. It was aimed to observe natural stone cutting operations step by step to determine the main reasons of waste occurrences. Figure 1 presents main steps in NSD plants to obtain natural stone plates for sale. Natural stone blocks obtained from natural stone pits are first cut into big-scale plates by gang-saw machines. Then these big-plates are cut into dimensioned small plates (s-plates), which look like rectangular, laminated, prism, (plates with 2-3 cm thickness). After that; s-plates' faulty parts are cut out to obtain saleable products. Final dimensioned stone products are then presented at company showrooms or internet web pages for related markets.



**Figure 1.** Natural stone block cutting steps to obtain dimensioned small plates

Like timber logging machines, natural stone cutting machines have special cutting saws. Unlike timber logging machine saws, natural stone cutters have extra hard and abrasive sockets (segments) attached to disk shaped saws or steel-rod shaped blade saws. In general, these segments put extra 0.3-0.8 cm thickness to saws's main metal (load carrying) structures. These segments cut stones by chipping actions by facilitating especially designed cutting machines. In order to continue the cutting actions, the segments cut out enough apertures in the stone (Fig.1b) which saw disks or blades move freely in. Natural stone cutting machines and their spare parts are produced by particular machine manufacturing industry which several companies in the world have competed. They have tried to produce more efficient and safer cutting machine models in each year. Therefore, NSD engineers can find (or they can order to manufacture) different saws for their natural stone cutting operations. These machines can be different in models and they might be equipped with different cutting disks or blades (with different cutting thickness). Assume that 2x2x2 m block is planned to divide into 2 cm thick big-plates like in Figure 1. In theory, this block has 100 big-plates capacity which have 2 cm thickness and 2x2m surface dimensions. In reality, natural stone cutting machines have blades which have 0.3-0.8cm thicknesses to cut the blocks. Therefore gang saw blade thicknesses (blade steel rod+segment thicknesses) should also be considered. This thickness was 0.5cm for Elazig-cream marble cutting and 0.4cm for onix cutting operations. In order to obtain 2cm thick Elazig-cream big-plates, 0.5cm aperture should be cut out among the plates by gang saw blades. This is the cause of waste occurred at gang saw machine operation and it is inevitable with this type of cutting technology. Then, for the given block example above;  $(200\text{cm}/2.5\text{cm}) = 80$  big-plates can actually be obtained instead of theoretical 100 big-plates. Actual obtained big-plate numbers are then different for 0.4cm blade thickness (blade steel rod+segment thickness) as well. For this case;  $(200\text{cm}/2.4\text{cm}) = 83.33$  big-plates can be obtained (*in this case; 83 big-plates can be obtained with 2cm thickness and in addition 1 more big-plate can also be obtained but its thickness is less than 1cm*). This operation cause lost of natural stone mass inevitably. Waste percentage calculated through numbers of big-plates (for the example assumed above) are;

- i) Theoretical division without producing any slot aperture for blades= 100 imaginary big-plates
- ii) Case 1: Actual 0.5cm slot aperture (for blades+cutting sockets)=80 big-plates (%20 lost)
- iii) Case 2: Actual 0.4cm slot aperture (for blades+cutting sockets)=83.33 big-plates (%16.67 lost)

In this work of study, waste produced during dimensioned natural stone plate cuttings operations are researched through actual plant cases in Elazig city in Turkey. It is required to be point that, cutting the natural stone plates into smaller sized, s-plates, produces more wastes due to further cutting operations. To present this fact, one NSD plant cutting Elazig-cream blocks and another NSD plant cutting onix blocks were observed for their s-plate and big-plate productions respectively. In Turkey, s-plates cut from natural stones (usually; marble, travertine, andesite and granite) have 2cm in thickness. The other dimensions of these s-plates are listed below according to their usages (categories) described;

- i) Plates for staircases, ladders; (2x30x60) cm,
- ii) Plates for window sills; (2x14.5x free length) cm,
- iii) Plates for (rooms, saloons, corridors etc.) floor cover; (2x40x40) cm,
- iv) Plates for (rooms, saloons, corridors etc.) floor cover; (2x60x60) cm.

Observation method was used in this study. Waste and saleable products were closely observed for selected rock blocks. Due to natural characteristics, natural blocks transported to NSD plants had not similar in dimensions and discontinuity properties. Therefore, Elazig-cream and onix blocks were randomly selected at NSD plants' stock areas for their cutting procedures. Waste volumes produced during s-plate and big-plate cutting operations were then analysed step by step to evaluate the causes of the natural stone wastes in NSD plants. There are common acceptations on the basis of experiences about NSD plant wastes. This study on the other hand supplied actual NSD plants' data observed. Therefore it is more valuable (contains no bias) to evaluate natural stone block cutting operations and their wastes.

### **3. FACTORS INFLUENCING WASTE VOLUME IN NSD-PLANTS**

When natural stone blocks are supplied to NSD plants, they are stocked at open areas which have suitable crane facilities for block handling. These blocks have gradually cut into big-plates or s-plates in NSD plants according to customer requirements. After analysing the cutting procedures in several NSD plants and observing closely the actual operations, it can be concluded that following factors are the main reasons of wastes in these cutting operations;

- i) Slurry wastes due to saw machines;  
It is slurry, muddy form of natural stone material. Saw machines cut the natural stone by opening aperture for their disks or blades. Thickness of cutting segments attached to disks and blades control the width of the apertures. These apertures are 0.4cm and 0.5cm for the observed NSD plants in this study. Natural stone materials in these apertures have been chipped away to separate stone plates. These chipping or powdering actions of saws create stone-slurry due to applied water spraying (dust control sprays).
- ii) Wastes due to handling operations,  
Organising works and duties in NSD plants require concentrated efforts. Sometimes workers have not careful enough to arrange natural blocks alignments in gang-saw machines. These faulty set-ups may cause extra leftovers, wastes. In addition, handling the stone plates in NSD plants needs full attentions. Plates fell from even small elevations cause extra breakages which increase the leftovers, wastes.
- iii) Waste due to plate dimensioning;  
Block cutting operation at gang saw machines produce big-plates. Due to unevenness of blocks' sides there are always small amount of leftovers at the left and right side of the natural stone blocks during gang saw cutting operations. Additionally, natural stone usage in construction industry is basically for aesthetic purposes. Therefore customers might require s-plates in different dimensions. When NSD plants have big-plates from blocks, next step is dividing big-plates to obtain s-plates. This cutting operation on big-plates creates leftovers (wastes) according to supplied s-plate sizes.

iv) Waste due to discontinuities;

Natural rock masses have discontinuities. Normal distribution peak value for rock masses presented that one can observe 1 joint every 1.5m of rock mass extensions. Natural stone reserves have discontinuities similarly. Some of these fractures are tightly cemented by natural rock minerals, so they will not create problems in cutting operations at NSD plants. But some of them cause extra breakages during cutting operations. When the number of cutting operations for the required s-plates is increased, waste due to breakages might be increased as well. Companies operated NSD plants have sometimes used epoxy polymers to cement fractures in natural stone blocks. These increase cost of big-plates and s-plates produced at NSD plants, but decrease dramatically waste amounts caused by discontinuities. NSD plants cutting onixes or similar valuable natural stones have preferred to apply different chemicals to decrease their waste originated due to discontinuities. Oztekin (2007) studied on epoxy-polyester chemical application on fractured marble blocks to present the effects of the applications and advantages supplied through.

v) Waste due to polishing;

After obtaining big-plates or s-plates, one face of each plate are selected for polishing operation. Originally, surfaces of these plates have traces of saws and blades's cutting segments. These marks or traces are firstly levelled by abrasives and then polished by brushes. These actions cause thinning of the plates. Stone slurry created in these operations are considered as waste.

vi) Waste due to sale conformity;

This is not the wastes occurred in NSD plants. It is related with marketing steps of big-plates of natural stones. It is an assumption. It is a stone volume, assumed as a "waste" volume due to marketing agreements between NSD plants and their customers. Big-plate customers in natural stone sector assume that; big-plates they are going to buy might have micro fractures at their outer skirts (other sides & edges) due to handling operations. Therefore, they would like to decrease actual surface areas of big-plates (a few centimetres from actual dimensions) to pay. It is assumed in this type of agreements that; outer skirts of big-plates are cut out to obtain actual payable, usable, plate areas. Thus, this waste is hypothetical and it does not increase waste volumes in NSD plant waste areas.

These factors are the main ones which create opportunity to waste natural stone block materials. It is important to mention that, natural blocks arrived to NSD plants are valuable assets when the whole mining procedures are considered. The costs of these blocks are high enough, so maximum natural saleable plates should be produced by controlled cutting operations. Table 1 and 2 present waste volumes and percentages occurred due to the factors described above. These values were obtained through NSD plants by close observations.

**Table 1.** Waste volumes turned out during natural stone cutting operations for s-plates and their percentages with respect to initial block volume

Block	Block volume, m <sup>3</sup>	Slurry waste m <sup>3</sup> , (%)	Waste due to handling m <sup>3</sup> , (%)	Waste due to dimensioning m <sup>3</sup> , (%)	Waste due to discontinuities, m <sup>3</sup> , (%)	Waste due to polishing m <sup>3</sup> , (%)	Total waste volume, m <sup>3</sup> , (%)
Elazig cream-n1	1.5136	0.3027 (% 20.00)	0.0704 (% 5.81)	0.0496 (% 4.36)	0.1144 (% 10.48)	0.0521 (% 5.30)	0.5892 (% 38.92)
Elazig cream-n2	5.4600	1.0920 (% 20.00)	0.1040 (% 2.38)	0.2713 (% 6.46)	0.8248 (% 20.66)	0.1759 (% 5.59)	2.4682 (% 45.20)

**Table 2.** Waste volumes turned out during natural stone cutting operations for big-plates and their percentages with respect to initial block volume

Block	Block volume, m <sup>3</sup>	Slurry waste m <sup>3</sup> , (%)	Waste due to gang-saw dimensioning m <sup>3</sup> , (%)	Waste due to sale conformity m <sup>3</sup> , (%)	Waste due to polishing m <sup>3</sup> , (%)	Total waste volume, m <sup>3</sup> , (%)
Onix-n1	1.9260	0.3211 (% 16.67)	0.0430 (% 2,67)	0.0718 (% 4.74)	0.0468 (% 3.00)	0.4825 (% 25.01)
Onix-n2	6.9552	1.1594 (% 16.67)	0.1370 (% 2.37)	0.1901 (% 3.44)	0.1368 (% 2.42)	1.6236 (% 23,34)

#### 4. CONCLUSIONS

Natural stone plates have different aesthetic beauty therefore customers' preferences are important factors on their marketing conditions. Discontinuities and weakness zones in natural stone reserves are main decision parameters on their mining conditions. Modified open pit mining methods are applied in Turkey to cut and handle big stone blocks from their rock masses. There are waste and leftovers in natural stone mining conditions. However, this study have concentrated on waste occurred at NSD plants. After selection, natural stone blocks were transported to NSD plants, and waste occurred in these plants were researched to understand the levels according to cutting operations realized in the plants. Natural stones can be found in stone markets in 3 different categories, these are, block, big-plate and s-plate categories. According to natural stone types and companies' preferences, natural stones are supplied to market to maximise related companies' profits. Total waste volume occurred during cutting operations of these 3 types of saleable natural stone items are different also. In general, when stone blocks are cut into further small plate sizes, waste amounts are also increased. Waste volume occurred in NSD plants producing big-plates of onixes and s-plates of Elazig cream marbles were observed to evaluate the scale of wastes. Total waste percentages for big onix plates production and Elazig cream marble s-plates production were obtained approximately % 25 and % 41 respectively. Observation presented that epoxy polymers coverage of stone blocks have almost eliminated waste occurred due to discontinuities. It is also important to point that, main part of total waste amounts is produced in cutting operations at gang saw machines. Cutting blade-segment thickness is main influencing factor on these machines' waste production. These thicknesses were 0.5cm and 0.4cm in this study and the resultant waste percentages were around % 20 and % 16.67 respectively. Consequently, cutting technologies applied in NSD plants' cutting machines (*covering: thinner blade-disk cutting segment usage; decreasing machine vibrations; stable plate holding apparatuses; robotic arms for plate transfer between cutting machines etc.*) are one of the main influencing factors in NSD plant waste production. Another factor is stones' discontinuity content. Some part of waste occurred due to handling at NSD plants can also be related with discontinuities. Thus, fractures can cause extra breakages during s-plate handling among cutting machines. Experiences have demonstrated that; epoxy polymer applications on fractured natural stone blocks have generally stabilized the discontinuities before cutting operations. Therefore, epoxy polymer applications can be accepted as governing influencing factor on NSD plants' waste volumes.

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**O 53. URBAN DRAINAGE DESIGN ACCORDING TO TURKISH RAINWATER  
HARVESTING AND DISPOSAL GUIDELINE**

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**ABSTRACT:** The natural cover of land has been changed to impermeable layers in most of the cities with rapid urbanization. The impermeable layers are the drivers of urban floods. Urban areas are becoming prone to flood disasters. The rate of infiltration is higher in natural land cover and lower in impervious surfaces. In impervious surfaces, the high rates of runoff are responsible for urban flood disaster. Runoff in urban areas might be one of the restrictions for drainage during the intense rainfall events. Hence, for accurate drainage design, factors which affect the drainage should be taken into consideration. In urban areas integrated green infrastructure design is one of the most effective tools for stormwater management and runoff reduction. There is a need for water sensitive urban designs for flood risks mitigation. Identification of flood-prone regions is crucial for flood mitigation. Improving permeable paving and sustainable drainage system can reduce floods in urban areas. In this study, Barış Street in Selçuklu district of Konya province is selected for rainwater drainage design using rational method according to the rainwater collection, storage and discharge systems regulation which published in 2017. The study area covers 11.04 ha. The study area has many grey infrastructures and there is no green infrastructure existed. Hence, it is prone to urban flood. Intensity-Duration-Frequency (IDF) rainfall curves were used for the intensity and frequency determination. Seven different periods, namely 2, 5, 10, 25, 50, 100 and 200 years were selected for rainfall drainage design. Rainfall intensity determination was based on 15 minutes of rainfall. Rain yield was calculated for each period. The required diameters of pipes for drainage are calculated for the selected periods according to 60% full rates. As a result, 400 mm diameter for 2 years, 500 mm diameter for 5, 10, 25 years and 600 mm diameter for 50, 100, 200 years periods have been found as appropriate.

*Keywords: Rainfall intensity, Rainwater, Runoff, Urban flood, Urban flood control*

**O 54. APPLICATION OF HOLMIUM (Ho<sup>+3</sup>) DOPED TiO<sub>2</sub> PHOTOANODES TO IMPROVE PHOTOVOLTAIC PERFORMANCE OF DYE SENSITIZED SOLAR CELLS**

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**ABSTRACT:** In this work, pure and Holmium (Ho<sup>+3</sup>) doped TiO<sub>2</sub> pastes were employed to produce dye sensitized solar cells (DSSCs). The influence of using Ho<sup>+3</sup> doped TiO<sub>2</sub> photoanodes on the photovoltaic performance of DSSCs was investigated. For this purpose, firstly, pure and doped TiO<sub>2</sub> solutions were prepared by sol-gel method and mixed with TiO<sub>2</sub> nanopowder to produce TiO<sub>2</sub> pastes. Then these pastes were applied on FTO substrates by doctor blade technique. The prepared films were used as photoanodes in DSSCs. Some morphological, structural and optical characterization parameters of the photoanodes were determined by SEM (Scanning Electron Microscope), XRD (X-Ray Diffraction) and UV-Vis spectroscopy analyses. The performance of the fabricated cells were determined by Current (I)-Voltage (V) analysis. The impact of doping on the physical properties (characterization) of the photoanodes and thereby the efficiency of the DSSCs was analyzed. It was concluded that the modifications of TiO<sub>2</sub> photoanodes with Holmium (Ho<sup>+3</sup>) doping enhanced the performance of the cells.

*Keywords: Dye sensitized solar cell, Holmium, photoanode*

**O 55. GEOCHEMICAL PROPERTIES AND GEOLOGICAL SIGNIFICANCE OF KARASU  
SPRING WATER AND YERKÖPRÜ TUFAS (HADIM-YERKÖPRÜ KONYA)**

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**ABSTRACT:** Karasu spring water is located in Yerköprü region, which is 100 km away from Konya. The Karasu spring coming out from a fault and water output from karstic network into the valley. The Karasu spring which is enriched in carbonate discharges into valley as surface water, while the other spring discharges into the Göksu valley from a karstic void close to the Yerköprü waterfall. Water from both springs mixes at the waterfall and flow through Göksu valley.

Bicarbonate ions in Karasu spring water are deposited as tufa (terrestrial carbonate) in Yerköprü waterfall region.

In the past, Karasu spring water with bicarbonate has been used in water mills. Therefore, tufa deposition occurred in different areas. Changing the bed of the Karasu Spring causes the current precipitation to stop. This situation caused the pollution of the white tufas. Deposited tufas due to the change of the bed of the Karasu source on different parts of the waterfall cause slope collapse. The region, which is an important geosite area for Geotruzm, so, the Karasu source and the fascinating tufa structures should be protected. Thus, both the geological structures will be protected and the environmental pollution will be prevented.

*Keywords: Karasu, Yerköprü, Tufa, Karstic spring water*

### **1. INTRODUCTION**

Tufa is common continental carbonate deposits in a wide range of environmental depositional, climatic, and tectonic settings throughout the World (Ford and Pedley, 1996; Guo and Riding, 1998; Hancock et al., 1999; Arenas et al., 2000; Glover and Robertson, 2003; Martín-Algarra et al., 2003; Andrews 2006).

The purpose of this paper is to describe and interpret geochemical characteristics of tufa facies in an active tufa deposition site in the Yerköprü area (South of Konya, Turkey) and Karasu spring Water.

### **2. MATERIAL AND METHOD**

Samples were collected systematically in places where the tufa sequence is thick. Also, random sampling was realized from different lithologies. 15 water samples were collected in spring months. First the thin sections and acetate peels from samples were prepared for determining the petrographic and sedimentological characteristics of different facies. The mineralogical composition of the samples was determined by X-ray diffraction (XRD) and SEM method at ILTEK laboratory in Selçuk University.

### **3. GEOLOGICAL SETTING**

The recent Yerköprü tufa sediment were deposited with angular unconformity on the Aladağ terrace tufa (~90-350 ka, Delikan et al., 2017; Fig. 1 and 2), the Permian carbonate rocks (Taşkent formation) and Triassic meta-olistostrome (Zindancık metaolistostrome).

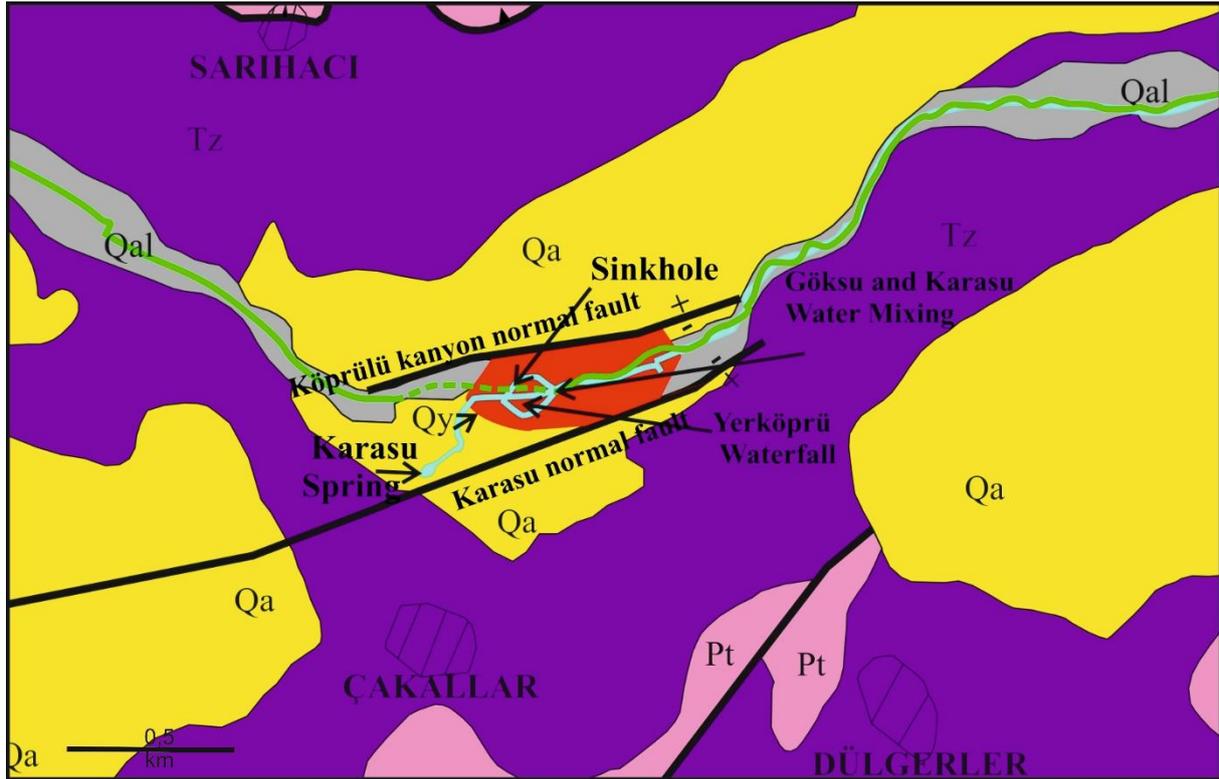


Figure 1. Geological map of the study area (Mert and Delikan, 2014)

## 4. RESULT

### 4.1. Lithologic classification

In the study area, four different tufa facies have been differentiated using the classification of Pedley (1990)

#### Autochthonous facies

- Phytoherm framestone facies
- Phytoherm boundstone facies

#### Allochthonous Facies

- Brecciated Tufas facies
- Micritic tufa facies

### 4.2. Karasu Spring

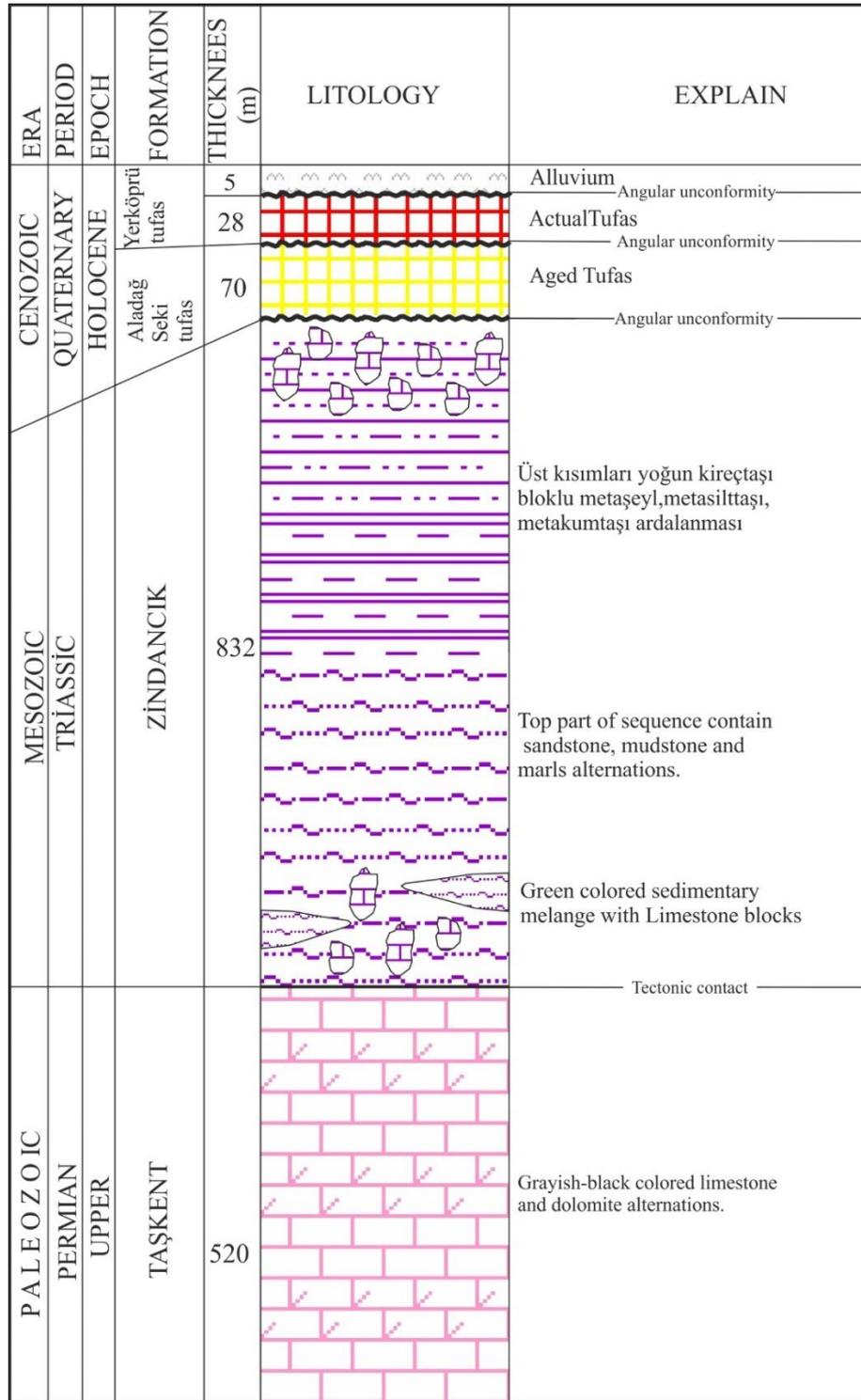
The field observation and chemical analysis of waters from Karasu spring and Göksu river showed clearly that the tufa deposition is resulted only from the carbonate rich water of the Karasu spring (Table 1). The water from Karasu spring flow on the natural bridge where the Göksu river flow beneath. The distance from the source of Karasu spring and the waterfall is 700 meters, but the tufa formation took place only on and around the waterfall where the water flow fast and turbulent (Jet flow) causing aeration and low pressure on the carbonate rich Karasu water. This increases the rate of degassing of CO<sub>2</sub> (Figure 3 and 4). Tufa deposition in the waterfall area is resulted from degassing of CO<sub>2</sub> due to sudden hydrological changes rather than due to the effects of organisms, evaporation and sediment water interaction. This cause the water reach to the oversaturation and accelerate the tufa deposition. This fast deposition of tufa on the water fall is known as waterfall effect (aeration effect, low pressure effect and jet-flow effect; Figure 5) (Zhang et al., 2001; Cheng, 2004).

## 5. CONCLUSIONS AND DISCUSSION

1. All tufa in the study area were deposited in Fluvial environment.
2. Water chemistry points that tufa formation was mainly deposited in relation to the Karasu spring in the area . Field Observation also support this.

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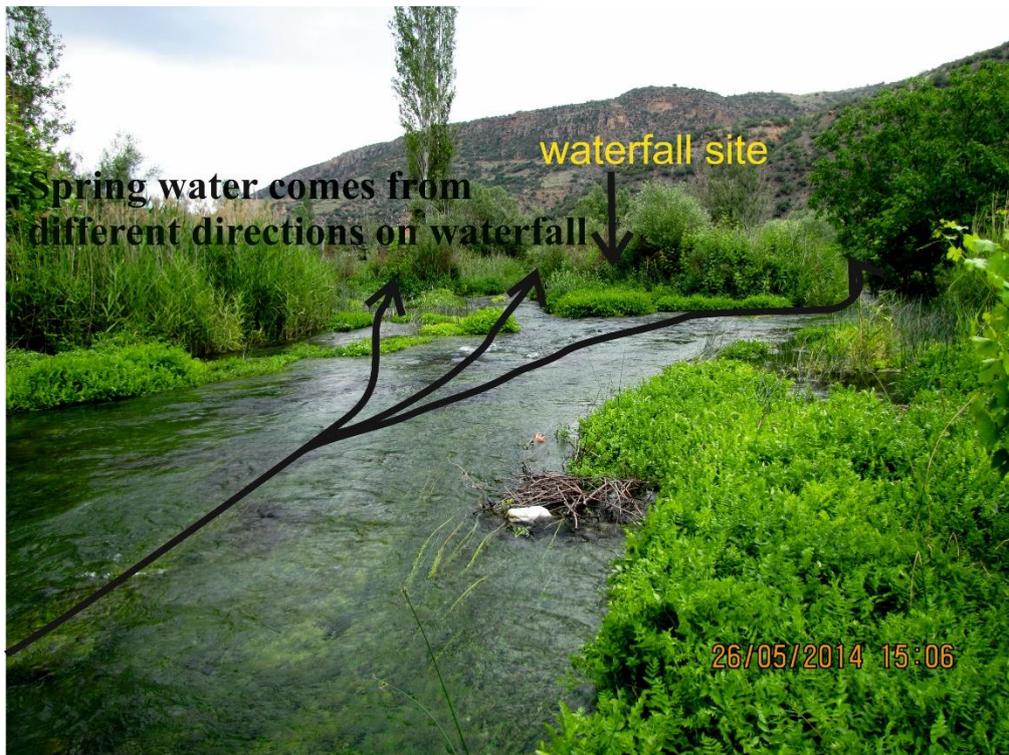
3. The deposition rate of tufa is very low in places where Karasu flow laminarly, but is high in places where the water flow turbulently such as at waterfall.
4. In the study area, the deposition site of the facies was mainly controlled by faults and recently by human who cahanges the water ways for different purposes.
5. The Yerköprü tufa deposits, which at an altitude above 800 m., correspond to ‘the high mountain tufa’ on the Andrew’s (2006) classification
6. The study area is a candidate for being a geosite because of actual tufa formation and magnificiant waterfall.



**Figure 2.** generalized column section of the study area (Mert and Delikan, 2014; unscaled)



**Figure 3.** Karasu spring water and carbon dioxide gas discharge outlet



**Figure 4.** After flowed a few hundred meters of Karasu spring water reaches to Waterfall

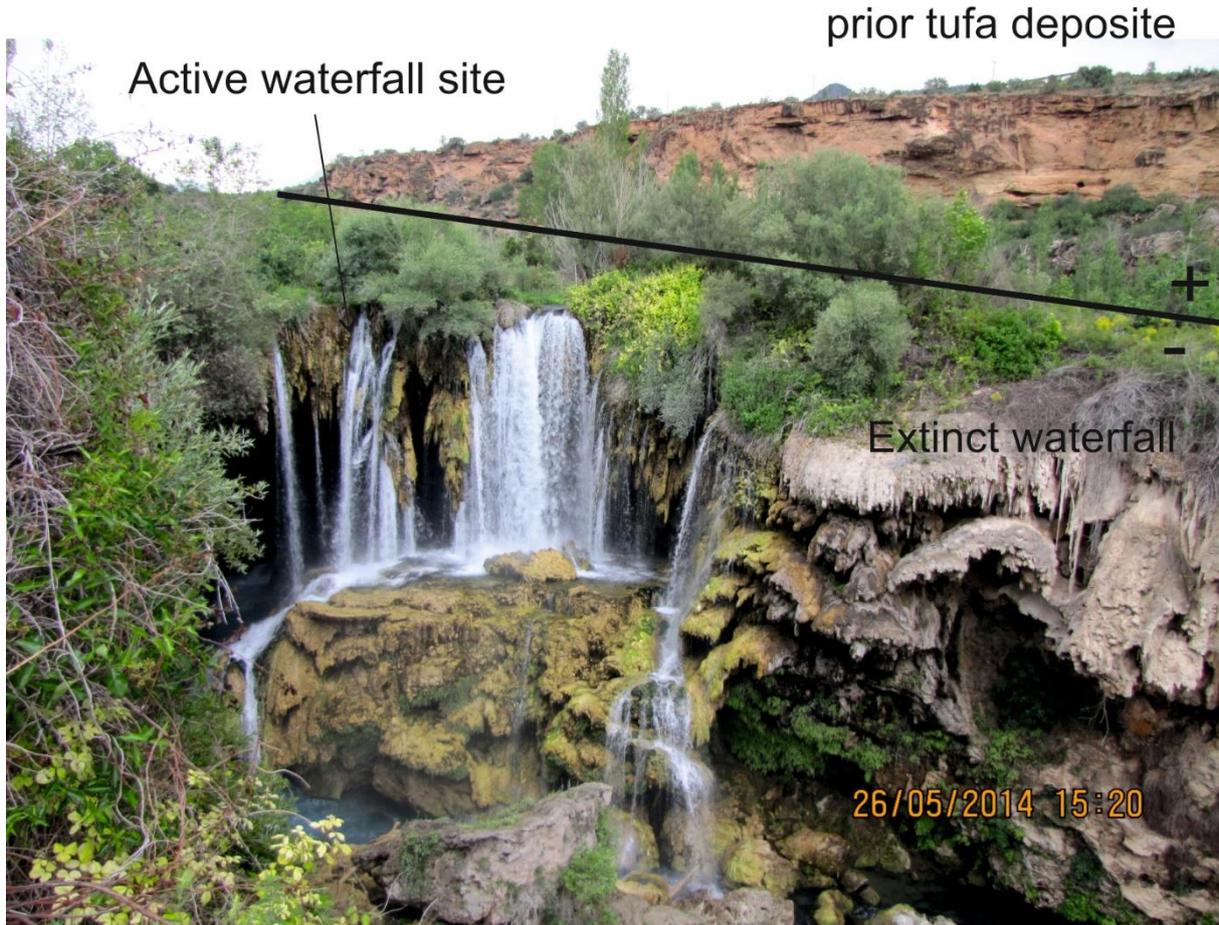


Figure 5 . Yerköprü waterfall and active tufa deposition

Table 1. The results of the chemical analysis of the Karasu spring water (spring and summer months)

	Sampling Seasons							
	Spring				Summer			
	Karsu spring	Waterfall top	Waterfall bottom	Waterfall downstream	Karsu spring	Waterfall top	Waterfall bottom	Waterfall downstream
Measurement Temperature °C	16,5	16,2	17,3	16,8	25,4	25,4	25,3	25,3
pH	6,98	7,38	7,67	7,79	7,15	7,46	7,19	7,45
Bicarbonate mg/lt	506,3	549	231,8	244	555,1	555,1	512,4	518,5
Calcium mg/lt	142,6	138,4	69	69,8	144	144	135	130
Total Alcalinite (CaCO <sub>3</sub> ) mg/lt	415	450	90	200	455	455	420	425

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## **O 56. GEOLOGICAL APPROACH TO KAVAKLI NATURAL PROTECTION AREA**

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**ABSTRACT:** The Kavaklı Natural Protection Area (KNPA) is located just south of the Yenice-Karabük region. This region has one of Turkey's richest forest texture areas and oxygen content. The kavaklı area is also located in the wildlife protection areas.

KNPA consists of one polygon and two different types of rock community. Nature Protection area includes Early-Late Cretaceous Ulus formation. Ulus formation consists of Early-Late Cretaceous clastic sedimentary rocks. As a member of the Ulus formation, Sunduk member covers carbonate rocks. KNPA a consists mostly of carbonated rocks. Detrital sedimentary rocks are only exposed in a small area to the east of the polygon.

The region is very close to the North Anatolian Fault Zone (NAFZ). Therefore, the region is frequently influenced by active seismic movements. KNPA consists mostly of carbonaceous rocks, thus creating more stable areas against earthquakes and less danger for natural life and besides, there are many small and large caves in carbonate rocks. These karstic structures constitute important shelters and feeding areas for natural wildlife. In addition, the infrequent forest texture in carbonated rocks create the breathing areas in the forests. Limestone and clastic rocks between contacts are exposed to spring water. Spring water are important for natural life.

*Keywords: Kavaklı, Karabük, Natural Protection area, Geological approach*

### **1. INTRODUCTION**

Kavaklı Nature Protection Area (CNPA) is located in the southwest of Karabük province. Accumulation of main Tecronic of Turkey in the Pontian in the western part of the main tectonic Association (West-Pontides) is located in the Istanbul zone (Figure 1).

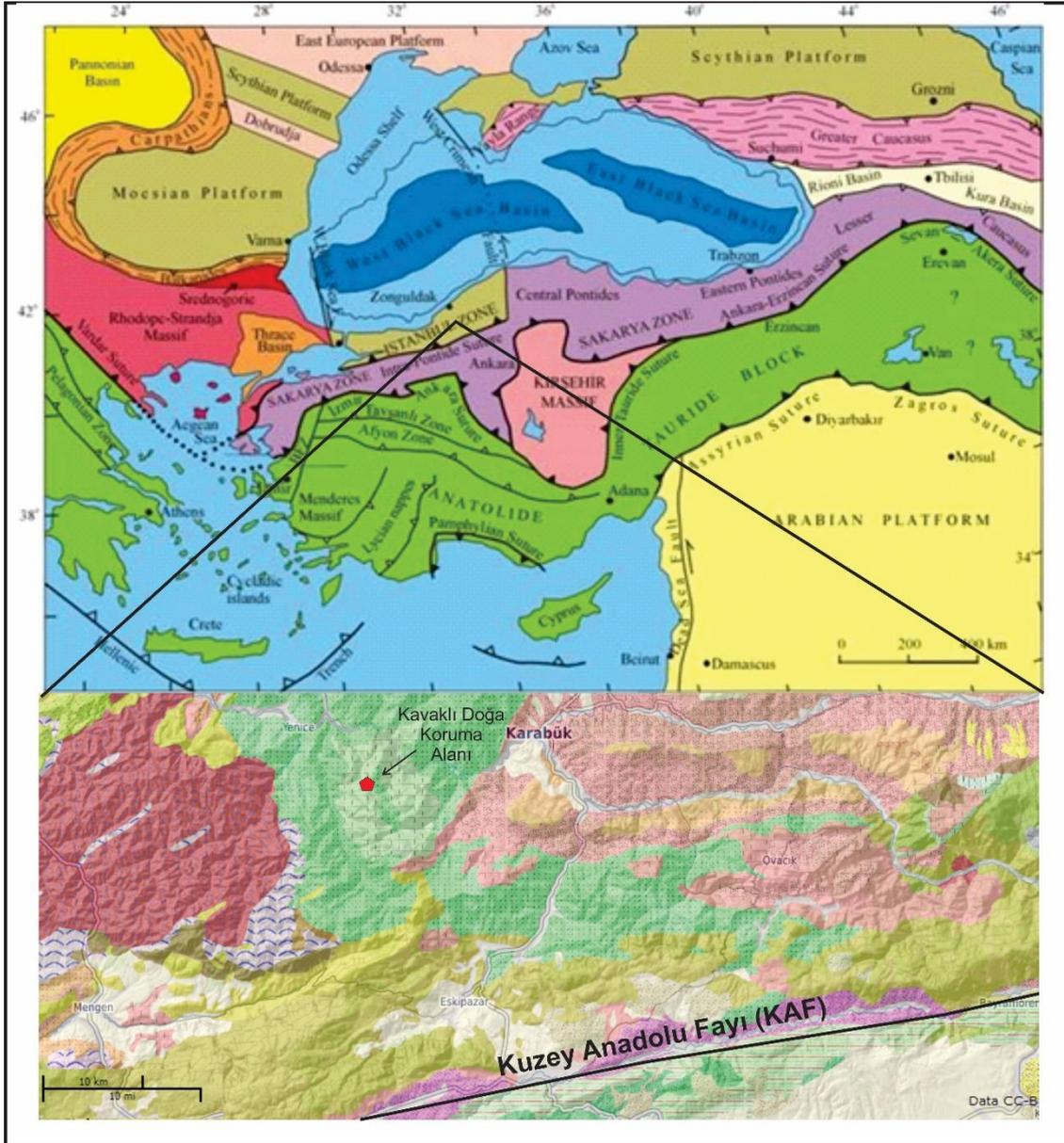
Çitdere Nature Protection Area is located in a dense forest texture as well as a very steep topography. The rock assemblages in the region are located to the north of the North Anatolian Fault (NAF) line and have a very folded and fractured internal structure (Figure 1).

### **2. MATERIAL AND METHOD**

Geological map of the study area was made. Samples were collected systematically in places where the sequence is thick. Also, random sampling was realized from different lithologies. The thin sections and acetate peels from samples were prepared for determining the petrographic and sedimentological characteristics of different facies.

### **3. GEOLOGICAL SETTING**

The Ulus formation, which is widespread in the region, contains Early and Late Cretaceous sandstone, shale, conglomerate, limestone and various types of blocks. There is a Late Cretaceous Sunduk member in the Ulus formation. The Sunduk member generally consists of late Cretaceous aged carbonated rocks.



**Figure 1.** Geo-tectonic location of Kavaklı Nature Protection Area and its surroundings (Alan and Aksay, 2002)

#### 4. RESULT

##### 4.1. Ulus Formation (Upper Cretaceous)

Kavaklı Nature Protection Area consists of a polygon. Kavaklı Nature Protection Area consists of a member of Sunduk, which is generally composed of carbonated rocks within the Ulus formation.

Early-Late Cretaceous aged sandstone-mudstone-marl and occasionally limestone intercalated sedimentary rocks. There are marble blocks at the base of the unit, which is composed of phylloid type rocks (Figure 4). Marble blocks consist of crystalline limestones (Folk 1962). There are clastic facies consisting of mudstones and sandstones on the blocky series. It consists of thick bedded sandstones and thin-medium bedded and occasionally laminated mudstones. Despite the predominance of green color, there are colored laminae in the mudstones (Figure 5). Sandstones are yellow-green colored, medium-bedded and sometimes laminated. Sandstones with quartz arenite (and greywacke composition are mostly fine grained (Dott, 1964).

Carbonated rocks in the Ulus formation should be located at the base of the block or Ulus formation since they generally reflect shallow environmental conditions.

The fossil content (Radiolari sp.) Within the Ulus formation and lithological features and its place in the literature is a sequence of flysch character (Figure 4, immediately south of the polygon). The blocky series of wild flysch character, alternation of fine clastic levels and presence of micritic limestones (deep marine) reflect a deep marine environment.

Ulus formation has a very curved and fractured appearance (Figure 5). Therefore, it presents quite thick stacking structures.

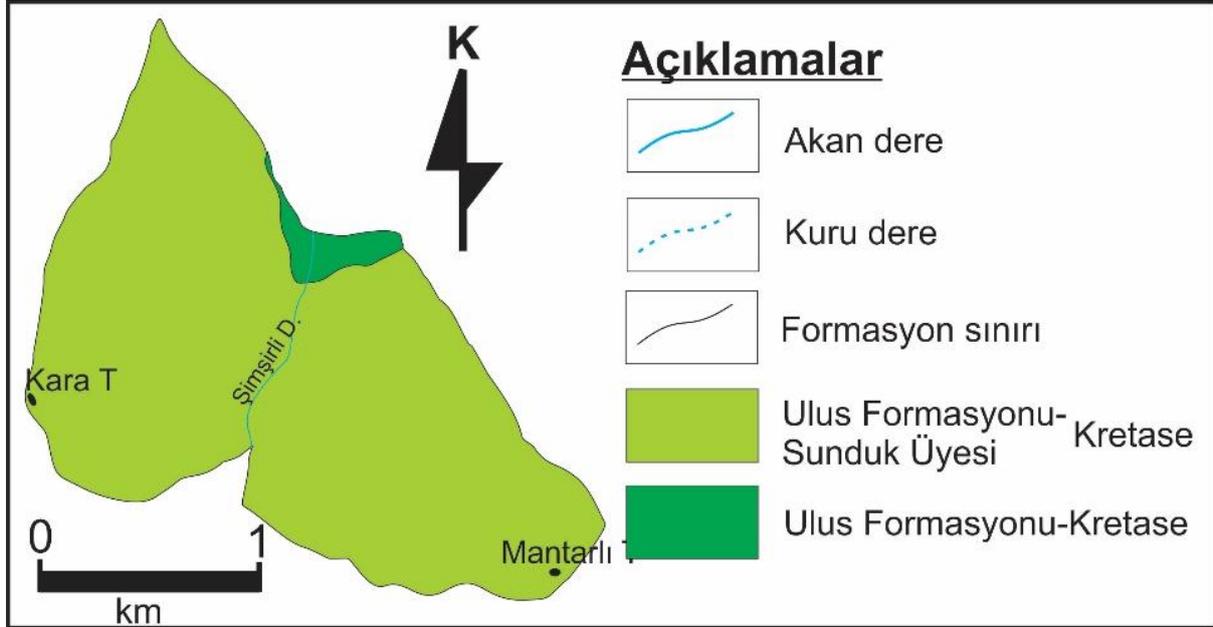


Figure 2. Geological map of Kavaklı Nature Protection Area

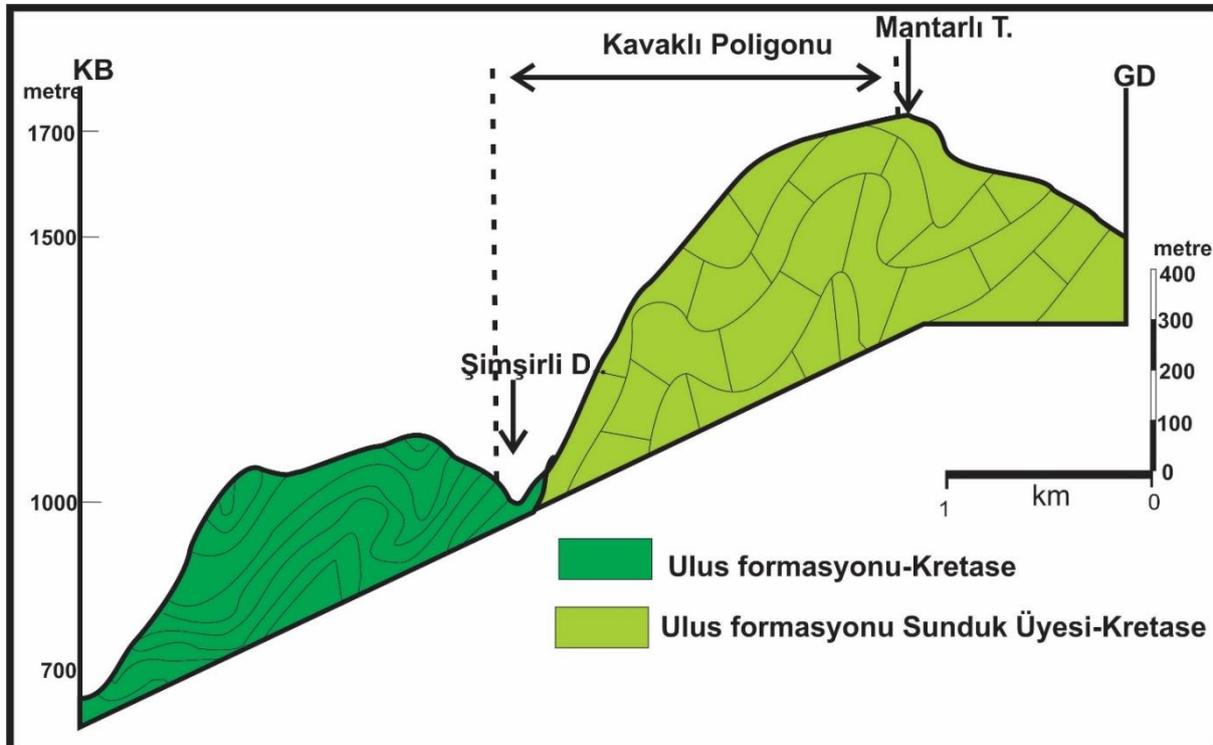


Figure 3 Geolpical cross section of Kavaklı Nature Protection Area

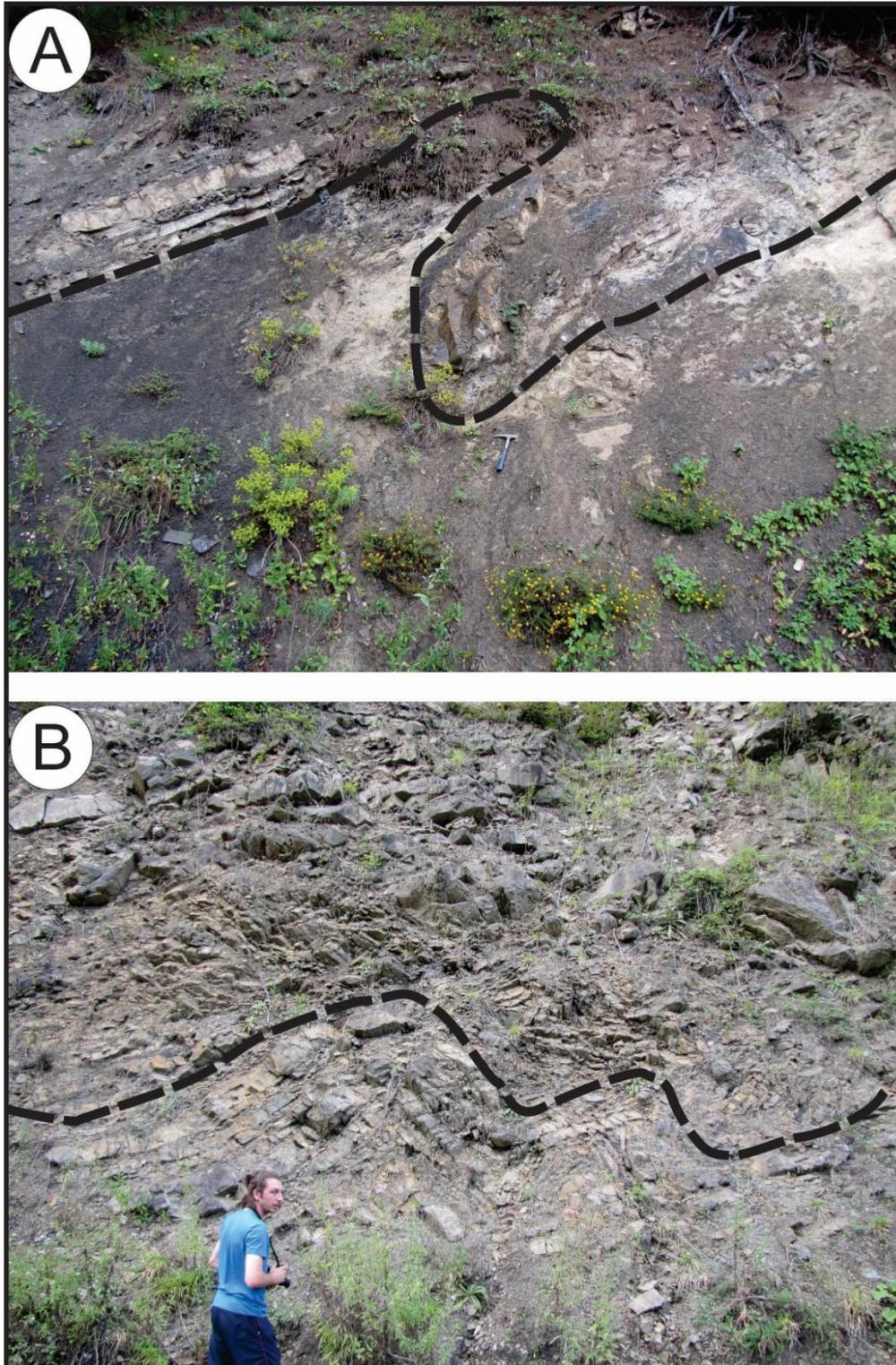


**Figure 4.** Mudstone and thick bedded sandstone alternation in the Ulus formation in Kavaklı region

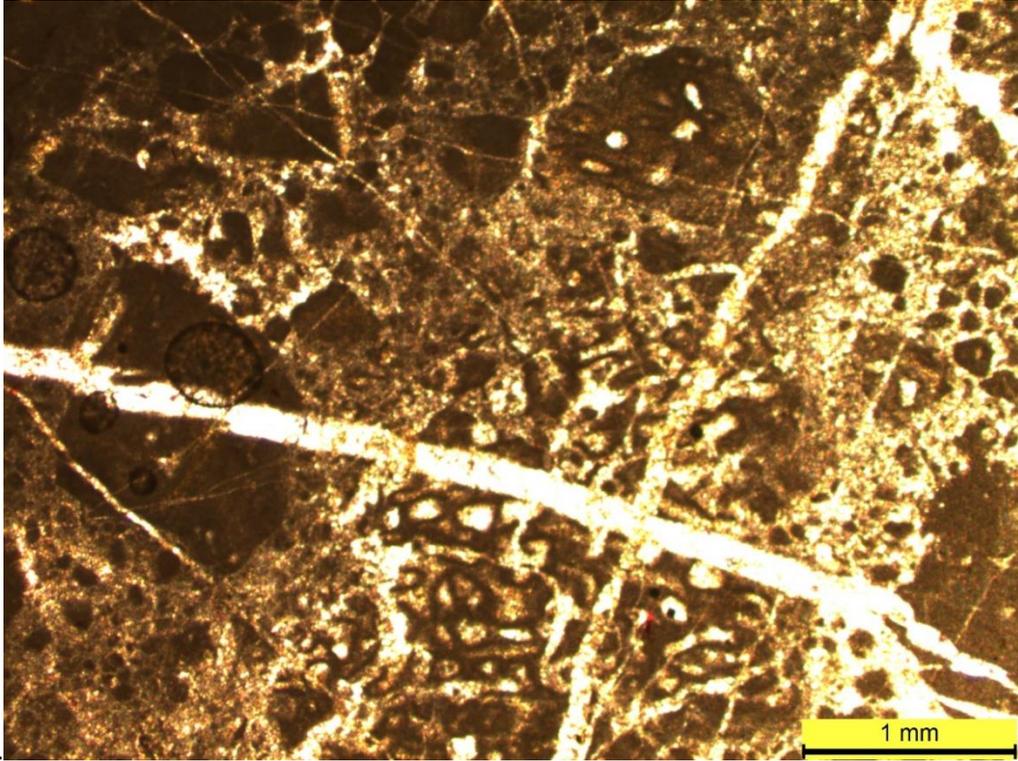
#### **4.1.1. Sunduk Meber (Upper Cretaceous)**

unduk member is composed of platform type carbonated rocks such as beige colored medium-thick bedded biomicrite, oopelintra sparit, (Folk 1962) and fresh gray surface. Although the boundary relationship between the Ulus formation and the Sunduk member seems to be compatible in the study area, it is suggested by some researchers that there is a block (Figure 8). In the Sunduklu member KTKA region, almost all of them are composed of Sunduk member carbonated rocks (Figures 3 and 4).

Carbonates in the region are gray-beige medium thick bedded highly resistant carbonates which are biomic and begin with very shallow platform type carbonates such as micrite (Figures 6). In the upper parts, deeper inner shelf type continues with abundant fossiliferous red algae carbonates (Figure 6).



**Figure 5 .** Deformational tectonic structures due to compression in Ulus formation, A. isoclinal fold structure, B. Similar fold structure



**Figure 6.** Bio-micrite, observed in Sunduk member, red algae carbonates deposited in deep shelf environment

## 5. CONCLUSIONS AND DISCUSSION

1. As it is known, the region is an important conservation area in terms of wildlife. The fact that the forest is very frequent, the topography is highly variable, the rock characteristics in the region and the climate are among the main factors in terms of wildlife
2. Geological features of rocks are important in terms of maintaining the lives of wild animals of animals. The area is almost entirely composed of carbonated rocks, which can dissolve with groundwater and surface water to form caves.
3. In addition, the gaps between the layers of carbonate rocks are important for the housing and feeding of many small size animals. It is very important for the continuity of wildlife in the caves in the region.
4. While carbonate rocks are more resistant to erosion, clastic rocks of Ulus formation may be less resistant. In addition, since the region is seismically mobile, wild animals nesting in carbonated rocks will be safer.
5. In addition, clastic rocks in the region appear to be very fragmented due to deformation and faulting. On steep slopes, such features can cause stone fall and collapse. It is also possible in landscapes rich with mudstones
6. The fact that Kavaklı Nature Conservation Area has a rugged topographic structure allows different views and species that need different climatic conditions at close distances. Due to the fact that there are deep valleys and steep slopes make it difficult to access the area, there are many trees in the region that can carry the characteristics of monumental trees.

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## **O 57. GEOLOGICAL APPROACH TO ÇİTDERE NATURAL PROTECTION AREA**

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**ABSTRACT:** Karabük region has a dense forest area. The forest area is one of most important location for Oxygen content in Turkey. There are many nature and wildlife protection areas in the Karabük region.

Çitdere region is a Nature Protection Area (NPA) in Karabük province. The Çitdere Nature Protection Area (ÇNPA) consists of two polygon and different types of rock community. ÇNAP covers of Early-Late Cretaceous Ulus formation. Ulus formation consists of Early-Late Cretaceous clastic sedimentary rocks (conglomerate-sandstone-mudstone and marl alternation). The Sunduk member (as a member of the Ulus formation) include carbonate rocks. The southern polygon of the ÇNAP consists of clastic rocks and the northern polygon consists of carbonate rocks.

The ÇNAP is very close to the North Anatolian Fault Zone (NAFZ). Therefore, the region is frequently influenced by active seismic movement. Seismic movements affect very loosely packed sedimentary rocks more than carbonated rocks. So, the karstic limestones (Late Cretaceous Ulus formation-Sunduk member) in the northern polygonal contain safer areas for natural wildlife. This situation shows that the areas of the Çitdere Nature Conservation consisting of carbonates rocks resistance to landslides and earthquakes. Furthermore, the area including of karstic carbonate rocks covers natural shelters and feeding areas to natural wildlife.

*Keywords: Çitdere, Karabük, Natural Protection area, Geological approach*

### **1. INTRODUCTION**

Çitdere Nature Protection Area (CNPA) is located in the southwest of Karabük province. Accumulation of main Tecronic of Turkey in the Pontian in the western part of the main tectonic Association (West-Pontides) is located in the Istanbul zone (Figure 1).

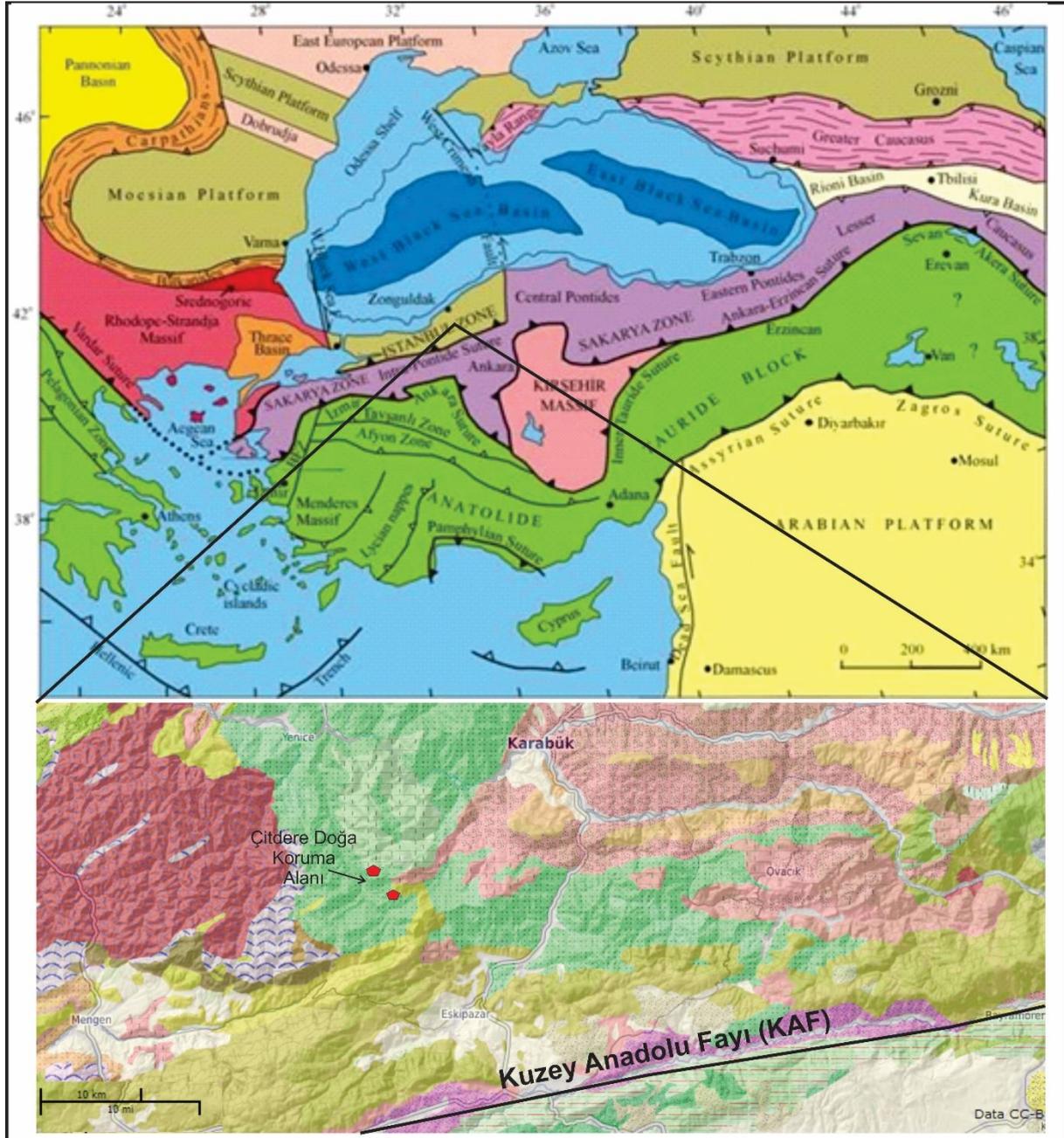
Çitdere Nature Protection Area is located in a dense forest texture as well as a very steep topography. The rock assemblages in the region are located to the north of the North Anatolian Fault (NAF) line and have a very folded and fractured internal structure (Figure 1).

### **2. MATERIAL AND METHOD**

Geological map of the study area was made. Samples were collected systematically in places where the sequence is thick. Also, random sampling was realized from different lithologies. The thin sections and acetate peels from samples were prepared for determining the petrographic and sedimentological characteristics of different facies.

### **3. GEOLOGICAL SETTING**

The Ulus formation, which is widespread in the region, contains Early and Late Cretaceous sandstone, shale, conglomerate, limestone and various types of blocks. There is a Late Cretaceous Sunduk member in the Ulus formation. The Sunduk member generally consists of late Cretaceous aged carbonated rocks.



**Figure 1.** Geo-tectonic location of Çitdere Nature Protection Area and its surroundings (Alan and Aksay, 2002)

#### 4. RESULT

##### 4.1. Ulus Formation (Upper Cretaceous)

ÇTKA consists of two separate polygons. The southern polygon consists entirely of the Ulus formation (Figures 3 and 4). The northern polygon consists of a member of Sunduk, which is generally composed of carbonated rocks within the Ulus formation.

Early-Late Cretaceous aged sandstone-mudstone-marl and occasionally limestone intercalated sedimentary rocks. There are marble blocks at the base of the unit, which is composed of phylloid type rocks (Figure 4). Marble blocks consist of crystalline limestones (Folk 1962). There are clastic facies consisting of mudstones and sandstones on the blocky series. It consists of thick bedded sandstones and thin-medium bedded and occasionally laminated mudstones. Despite the predominance of green color, there are colored laminae in the mudstones (Figure 5). Sandstones are yellow-green colored, medium-

bedded and sometimes laminated. Sandstones with quartz arenite (and greywacke composition are mostly fine grained (Dott, 1964).

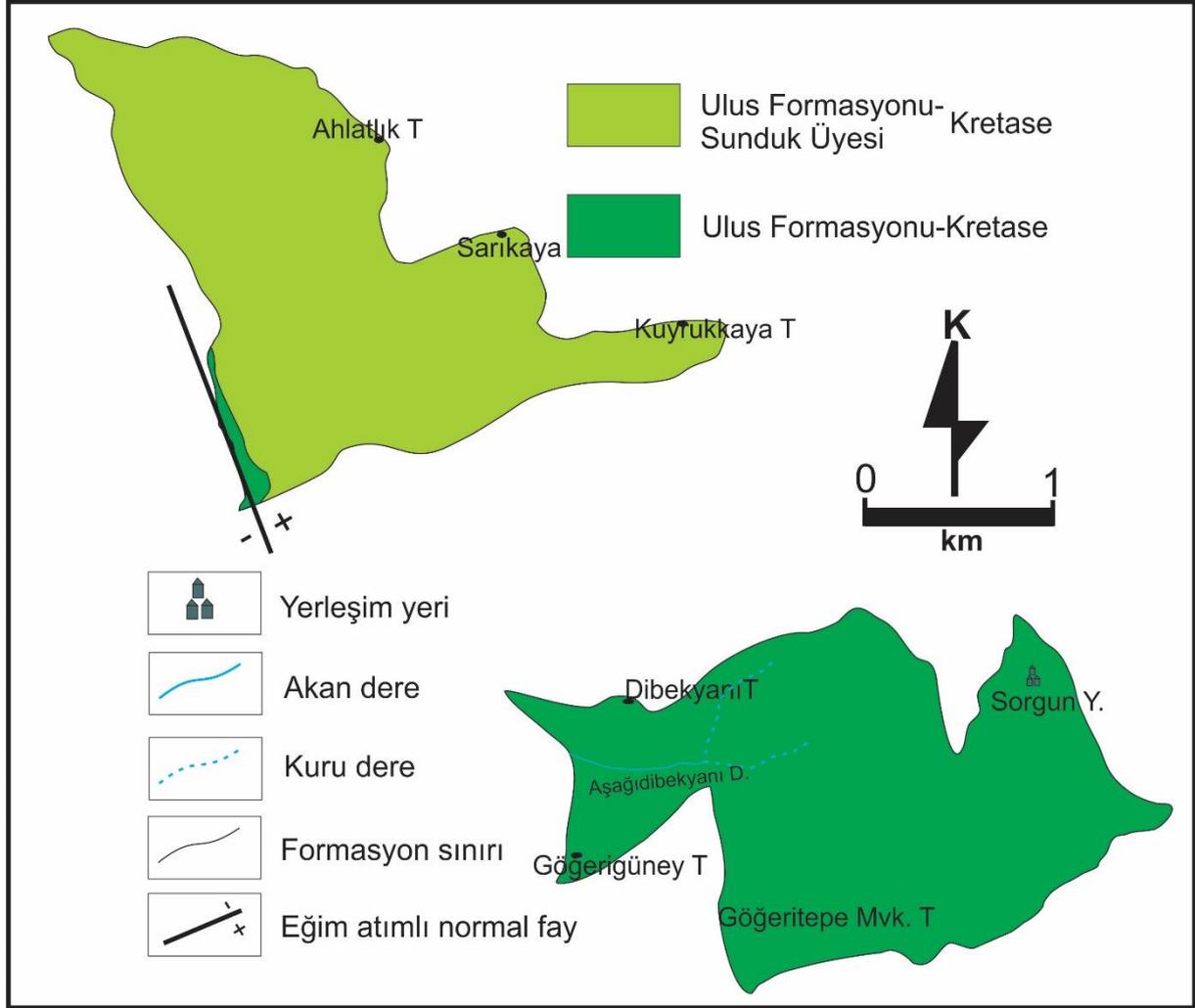


Figure 2. Geological map of Çitdere Nature Protection Area

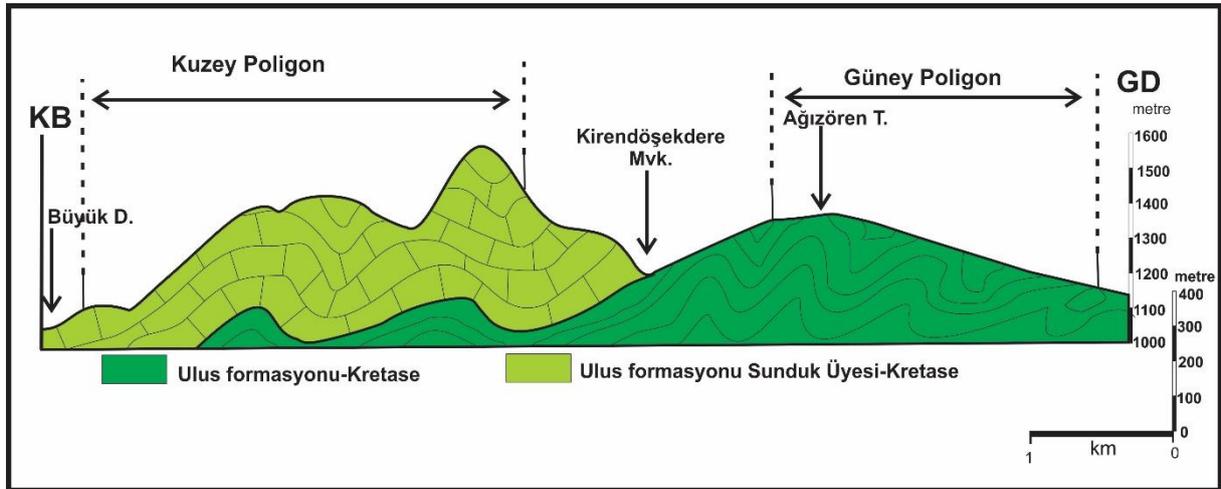


Figure 3 Geolological cross section of Çitdere Nature Protection Area



**Figure 4.** Marble blocks in Ulus formation at southern polygon of Çitdere Nature Protection Area



**Figure 5 .** Laminated mudstone-mudstone and sandstone alternation in Ulus formation

#### 4.1.1. Sunduk Meber (Upper Cretaceous)

Sunduk member consists of platform type carbonated rocks such as beige colored medium-thick bedded biomicrite, oopelintra sparit, (Folk 1962). Although the boundary relationship between Ulus formation and Sunduk member seems to be compatible in the study area, it is suggested by some researchers that there is a block. In the Sunduklu member ETCA region, almost all of the northern polygon is composed of Sunduk member carbonated rocks (Figures 3 and 4). The carbonates in the region are gray-beige medium thick bedded highly resistant carbonates biomic, starting with a very shallow platform type carbonate such as micrite, oo-pel intra-sparit (Figure 12). In the upper parts, deeper inner shelf type continues with abundant fossiliferous red algae carbonates (Figure 13). Typical fossils of the Late Cretaceous were identified at this level; Orbitoides sp and Siderolites sp. (Figure 6).

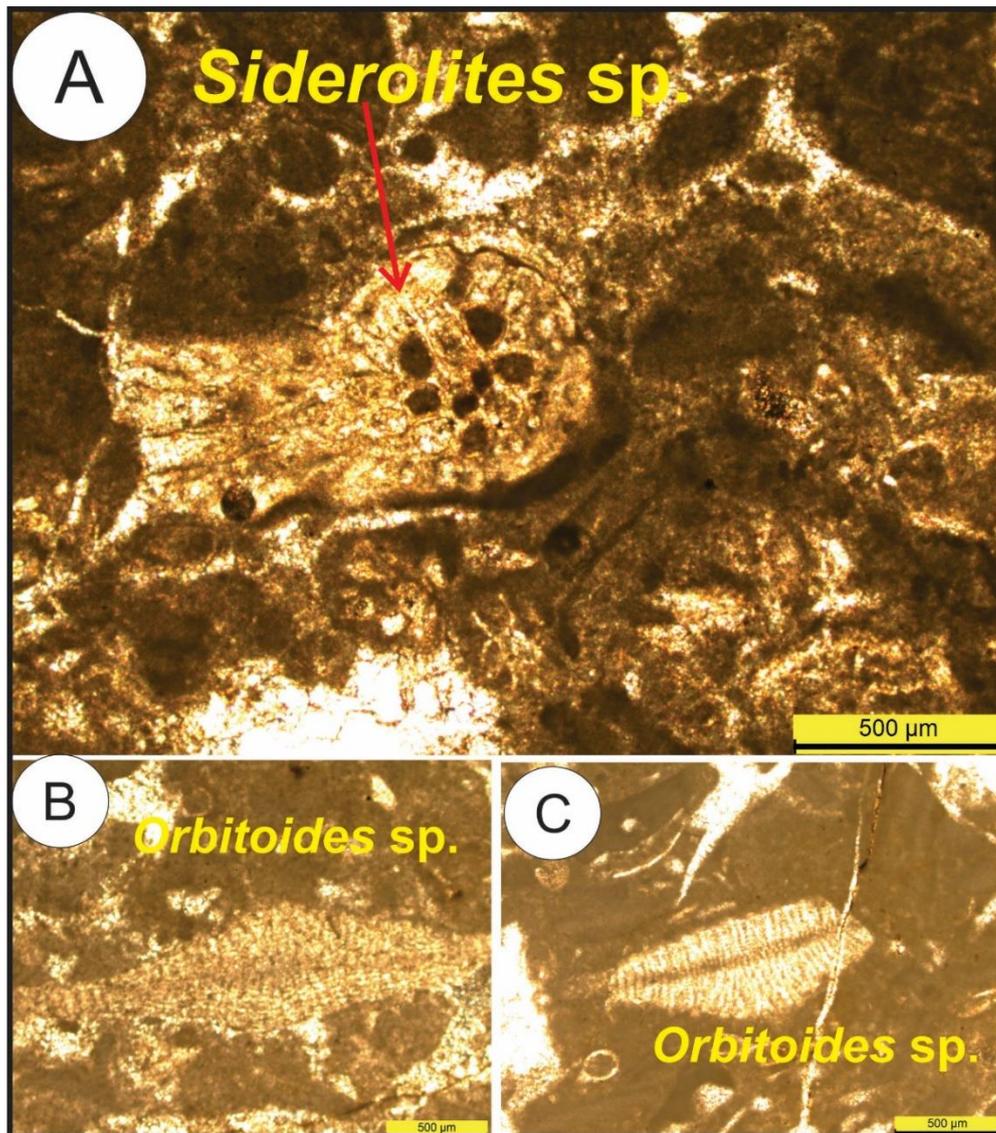


Figure 6. A. Biomicrite with Siderolites sp., B and C Orbitoides sp.

## 5. CONCLUSIONS AND DISCUSSION

1. As it is known, the region is an important conservation area in terms of wildlife. The fact that the forest is very frequent, the topography is highly variable, the rock characteristics in the region and the climate are among the main factors in terms of wildlife

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2. Geological features of rocks are important in terms of maintaining the lives of wild animals of animals. In particular, it consists of northern polygonal carbonate rocks, which can dissolve with groundwater and surface waters to form caves.
3. In addition, the gaps between the layers of carbonate rocks are important for the housing and feeding of many small size animals. It is very important for the continuity of wildlife in the caves in the region.
4. In the southern polygon, there are clastic rocks of the Ulus formation. Since clastic levels have low strength and easily disintegrate, it is more difficult to form and protect resistant cavities and caves than carbonates. But in these areas, frequent weaving is stronger.
5. While carbonate rocks are more resistant to erosion, clastic rocks of Ulus formation may be less resistant. In addition, since the region is seismically mobile, wild animals nesting in carbonated rocks will be safer.
6. In addition, clastic rocks in the region appear to be very fragmented due to deformation and faulting. On steep slopes, such features can cause stone fall and collapse. It is also possible in landscapes rich with mudstones

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**O 58. TREATMENT OF METAL PLATING WASTEWATER BY ELECTROCOAGULATION  
PROCESS**

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**ABSTRACT:** Metal plating industry has an important place among the rapidly developing industries. In these facilities, heavy metal rich wastewaters are generated from the facilities which have galvanized process. Heavy metals have a significant impact on environmental pollution. In this study, it was investigated that the heavy metals in wastewaters due to metal coating industry rinsing bath waters can be treated by electrocoagulation method. In this study, it was investigated that heavy metals ( $\text{Cr}^{+3}$  ve  $\text{Zn}^{+2}$  ) in metal plating industry wastewater can be treated by electrocoagulation method. The experiments were carried out at room temperature in 1 L glass reactors. Two different electrodes, iron-iron and iron-copper, were used and experiments were performed at different pH values (pH 5-pH 12). Heavy metal analyzes were performed with ICP-MS. 99.9%  $\text{Cr}^{+3}$  removal was obtained in iron-copper electrode at the original ph value in 10 minutes and 99.9 %  $\text{Zn}^{+2}$  removal was obtained in iron-copper electrode at the pH value 9 in 30 minutes.

*Key words: Chromium, Electrocoagulation, Treatment, Wastewater, Zinc.*

**O 59. PLANING THE BICYCLE ROADS IN THE CITIES; EXAMPLES IN THE WORLD AND  
IN TURKEY**

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**ABSTRACT:** Increasing population, increasing usage of motor vehicle due to the unplanned city construction brought problems related transportation, this situation has affected human health and also the quality of city life. Bicycle is not also healthy, eco friendly, trustworthy and enjoyable also it is accepted as a way of transportation especially in these years, usage of bicycle has increased. The most important factor to support usage of bicycle is to obtain the road security. In this study, the historical development of bicycle roads ,samples of bicycle roads and the importance of the criteria's of planning have been mentioned and talked about the samples around the world and in Turkey. As a result, opinions about this issue.

*Keywords: Bicycle road, Planning, Criteria*

**O 60. EVALUATION OF THE POTENTIAL OF DISABLED EXAMPLES IN THE WORLD AND  
IN OUR COUNTRY**

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**ABSTRACT:** Tourism is a cultural and economic activities, that people conduct to rest, to joy, to explore, to have more information during their temporary stay. According to World Health Organization's data more than one billion people on Earth have disability among seven million people in our country, ten million people out of 80 million have disabilities. In modern communities all individuals have the canal rights to join this kind of activities. Disable tourism, which is a global sector within tourism, needs to be developed in order to have economic growth. In this study, classification of disabilities, measurements of disability tourism, the situation in the word and in our country is analyzed and brought same solutions.

*Keywords: Disabled tourism, Disability, Tourism contributions*

**O 61. EXAMINATION OF THE ACCESSIBILITY PROBLEM FOR THE DISABLED IN  
URBAN LANDSCAPE: A STUDY ON İZMİR-KONAK İNÖNÜ STREET**

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**ABSTRACT:** According to the principle of equality between individuals on the basis of modernity, public administrations must offer citizens the opportunity to live in without any discrimination. For this reason, the problems of the disabled people, who are an integral part of social life, need to be solved and integrated into the society. There are many problems in the integration of disabilities into the social life. Foremost among these are, lack of disability-oriented solutions in the design of the physical environment or the implementation mistakes. In this study; Inonu Street, one of the busiest streets in the city, located in İzmir-Konak province was examined. Data were obtained by taking into consideration the access problems of the disabled, weekday photo shoots and observations were performed, in which the traffic of people and vehicles is intense. The obtained data were evaluated in terms of appropriate and faulty applications for disabled people and solutions were proposed according the subject.

*Keywords: Urban landscape, Universal design, Disability, Accessibility, İzmir*

**O 62. THE EVALUATION OF THE DISABLED STANDARDS IN BUYUK PARK IZMIR /  
BORNOVA IN TERMS OF URBAN LANDSCAPE**

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**ABSTRACT:** According to the Law Number 5378 of 2005 on Disability people in Turkey; they are defined as disabled who are affected by the attitudes and environmental conditions and physical and mental, mental and sensory abilities of individuals due to various levels of loss the full and effective participation of the society with other individuals. According to research, 15% of the world's population or 1 billion people have any obstacles. In this study, it was determined that the reinforcement elements of the park located were compatible with the disability standards in Bornova /İzmir. In the observations obtained, Büyük Park had not disability standards because of garbage can incompatibility, lack of railings on ramps, the fountain on the sidewalk, the pedestrian road does not comply with the disability standard, tree in the middle of the pedestrian path, the slope of the ramp does not comply with the disability standard, end of the road with pavement, the lighting element is in the wrong place, and wrong application of the stairs.

*Keywords: Reinforcement elements, Park, Accessibility, Izmir*

## **O 63. THE IMPORTANCE OF OPEN AIR HOMES IN LANDSCAPE ARCHITECTURE**

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**ABSTRACT:** Today's people are becoming increasingly inefficient and unhealthy due to their dense, monotonous, boring life and full of problems in urban areas. For this reason, people need green tissue to relax and relax themselves in their work and living spaces. Therefore, building gardens or open-air homes show its importance for urban life. Open air homes allow people to reach recreation in a short time. The use of the spaces in the buildings while maintaining the functionality of the buildings constitutes the phenomenon of open-air rooms. The aim of this study was to associate; open-air homes; to design open air rooms, to examine sub-places and materials and to be used in open-air rooms with the landscape architecture profession discipline.

*Keywords: Urban landscape, Open air home, Urban life*

### **1. INTRODUCTION**

Today's people are becoming increasingly inefficient and unhealthy due to their dense, uniform and boring lives in urban areas full of problems (Özkan, 2001; Yazici and Gülgün, 2017; Aşur and Alphan, 2017; Aşur, 2019; Akça and Yazici, 2017). Therefore, people need green tissue to relax and relax in their working and living spaces (Durmuş, 2006; Gülgün et al., 2014; Çetin et al., 2018). Building gardens come into play with these aims. Building gardens allow people to reach recreation in a short time. The use of the spaces in the gardens while preserving the functionality of the building constitutes the phenomenon of open- air rooms.

The aim of this study; design of open -air homes examination of sub-spaces and materials were examined. The aim of the study was to establish the relationship between landscape architecture and professional discipline.

#### **1.1. Open-air homes concept**

According to Eckbo, the open -air homes are a space for human life and activities, volume, back space and shelter. The open-air homes are similar to another room in the house, with a garden, bounding walls, cushioned seats and plenty of sunlight (Stewart and Strathern, 2003). Therefore, the reason for the existence of the gardens which we call open-air homes both inside and outside the house is to be a little closer to nature and to live in the comfort of the house in the garden (Stewart and Strathern, 2003).

#### **1.2. Design and application of open air homes**

How many rooms are needed in open air rooms? How much space is needed to walk? the sunshade according to the hours of the space used, the presence of sockets for electronic devices should be known. All possibilities must be considered when constructing the function.

How to use this area when creating an open- air room, the design requirements for the function in this area, how big the open air room should be, how much is needed for shading, watering, sun, lighting and privacy, what kind of a habitat is required or the contrast of which is preferred, which features of the plant, such as fragrant or odorless properties are desired, in short, the space is both aesthetic and practical needs to be considered to meet the needs of the user.

High ceilings, spacious spaces may be more attractive to users. Patio ceilings and gazebos have this opening and also have ceilings to protect the user against adverse weather conditions. As in the interior, some of these spaces may be warm and cozy, while others may be open and spacious.

Corridors are used to connect open air rooms and to establish their relations with each other. In these corridors, corridor elements such as simple roads and step stones are used.

Classical geometry in garden design is traditional and easy to use. Simple geometry forms strong axial lines that focus to water. Specific palettes can be used to integrate the design. Pastel Palette; blue, purple, lavender, soft pink, white Hot Pallet; orange, yellow, red, purple, white Monochromatic; white, red, yellow, purple-blue.

## **2. EXTRA SPACES IN OPEN –AIR HOMES**

The pergolas that adorn the gardens always attract attention and are used for many activities. Intertwined and successive, fragrant jasmine and purple clusters, colorful bougainvillea and honeysuckle plants, such as a kind of second garden pergolas, paths and terraces shade. An example is given in Figure 1.



**Figure 3.** Use of pergola in open-air homes (URL-1)

Showers in open-air rooms are a luxury element for some areas, which is necessary for some areas, allowing a smooth transition to a comfortable evening after day's activities. Outdoor showers help keep homes cleaner; because dirt, sand, grass and other debris are kept outside the indoor shower tubs (Figure 2).



**Figure 2.** Use of bath in open air homes (URL-2)

The barbecue has come a long way since charcoal grills and small barbecues used in postwar patio culture. Outdoor kitchens now have devices and more sophisticated components that incorporate advanced technologies that help create convenience and a potentially luxurious outdoor lifestyle (Figure 3).



**Figure 3.** Use of kitchen in open-air homes (URL-3; URL-4)

The deck can be connected to a house or be independent of any place. Flooring materials can use softwoods, tropical hardwoods, synthetic trees and pressurized timber. The desired type of deck (such as winding, pool deck, etc.) can then be applied together with the shape, size and layout of the wood (Figure 4).



**Figure 4.** Use of deck in open-air homes (URL-5)

When planning a deck, one of the most important aspects is to place the deck in a location that offers a wonderful view. This creates a great emphasis. There is also a need for glass partitioned railings that do not obstruct visibility when placing a deck too high (Figure 5).



**Figure 5.** Use of landscape in open-air homes (URL-6)

The connection of the deck to the enclosed space must be strong. The hot tub and pool should be easily accessible from the various rooms of the indoor area. When using the deck with the hot pool and bathtubs, the hot tub must be submerged for a tidy look. In addition, the shape of the deck and the steps should be appropriate to the architecture of the indoor space (Figure 6).



**Figure 6.** Use of hot rub in open-air homes (URL-7)

The areas where the deck and patio are used together are small and very handy outdoor spaces for dining and relaxation. In addition, elevated verandas can often be surrounded by plants such as small trees, grapes and shrubs, various plant pots, or vice versa, with decks raised and lowered to verandas. Parquet types made of hard wood such as teak and iroko are as good as decking. They are resistant to most insects and weather conditions and they can remain undamaged for 10 years. When building decks on roofs, it is necessary to use parquet made of such durable trees (Figure 7). A swimming pool becomes a warm and inviting outdoor area with a rich wooden deck frame. Real or artificial rocks used in the area provide the pool area with walls for privacy as well as a rustic, natural look (Figure 8).



**Figure 7.** Use of deck material in open – air homes (URL-8)



**Figure 8.** Use of pool in open- air homes (URL-9)

Use of the deck in the courtyard; the sides are often used as walkways to walk from the front to the backyard, or vice versa. A side garden becomes a destination when wood decking is added. Various plants can be planted for privacy and the area becomes a secluded place to relax, read, eat and sunbathe (Figure 9).



**Figure 9.** Use of courtyard in open-air homes deck (URL-10)

### **3. USE OF MATERIALS IN OPEN AIR**

*Wood* is a renewable building material found almost everywhere. It can be used in different ways, but the cost is high (Figure 10).

**Wood Properties:** Wood is a natural, versatile building material, easy to process; high tensile and compressive strength in fiber direction; moisture-dependent expansion; low weight and thermal conductivity (Hegger et al., 2012).

**Wood Usage Areas:** The directional structure of the wood is also suitable for the carrier system and layers providing thermal insulation. Facade coverings by overlapping panels and washers; used in high quality furniture and handles.

*Natural stone* symbolizes permanence, authority and tradition. Its gross density, strength, surface hardness and thermal conductivity are high.

**Properties of Natural Stones;** Natural, inorganic, layered or homogeneous building material depending on the source; high density, hardness, compressive strength, thermal conductivity and heat storage ability abrasion resistance; To create a special visual effect are the main features of natural stones.





**Figure 10.** Use of materials in open-air homes

Usage Areas of Natural Stones; Due to its compressive strength, it is used in carrier walls. In addition, since the plates have all technical properties, they are used as façade or floor covering on a supporting sub-construction (Url 1; Url7).

*Concrete* is the most common building material to be used today. It is also accepted as an artificial stone due to its robustness. It has no specific shape: It is molded into a mold.

Concrete Characteristics: As a liquid stone, concrete has similar properties to natural stone. Properties can be changed with additives. It loses volume when applied and requires a second carrier system (mold).

Usage of Concrete: Used in pressure loaded shell carrier systems. Pulling forces only steel and so on. materials.

*Mineral Connector Wall Blocks*; Concrete blocks made of calcium silicate bricks and cement are wall blocks with mineral binders. These materials are lightweight because they are hollow; surfaces can be shaped with reliefs (Url 5; Url 10).

Features Of Wall Blocks With Mineral Connectors: It has similar features with natural stone. Gross density and thermal conductivity are lower. It has high dimensional accuracy resulting from small shrinkage in production.

Wall Blocks With Mineral Connectors: It is used to form low-joint, monolithic walls. Due to its low thermal conductivity, it can be applied as a single-walled wall. In addition, it can be used in sheet form as a floor covering.

*Ceramics And Brick*; Today, ceramic materials of different thickness are produced by extrusion presses. The ceramic which is drawn into strips from the mold is cut to different sizes.

Properties of Ceramics and Bricks: It is an inorganic material with high strength, hardness and thermal conductivity. The capillary ratio depends on whether the surface is glazed or unglazed (Url 9; Url 12).

Application Areas of Ceramics and Bricks: Bricks are used in walls based on metric system. Can be used as facade and floor covering.

*Metals*; Metals constitute the largest group of chemical elements. It is divided into heavy and light metals.

Properties of Metals: Dense, bright elastic material with high compressive and tensile strength; high thermal and electrical conductivity; corrosion forming a continuous protective layer (coating) on the surfaces of certain metals; A wide range of cross-section / shape options are available.

Areas of use of Metals: Statically developed metal profiles in carrier systems or as concrete reinforcement; sheet metal plates, especially as exterior cladding; prefabricated products are handrails, door handles, pipes and so on. as used (Url 5; Url8).

*Glass* is a transparent building material. It shows the physical structure of buildings with its transparency. It provides natural light, one of the basic human needs.

Glass Properties: Unshaped and transparent material with high density, tensile strength and hardness; The bearing capacity proportional to the surface stresses has moderate heat conductivity which can be reduced by the coatings applied to the surface.

Application areas: It is used in transparent facades and windows. In addition to a wide variety of surface coatings that can be used to reduce light transmission, a reflective layer can be applied to the glass to receive light from only one surface.

*Plastic*; Low thermal conductivity and gross density, usually translucent, compact, organic material; It is a component that can be used in all kinds of production with high elasticity, tensile strength and thermal expansion capability (Url, 5; Url 9)

Properties of Plastics: Compact, organic material with low thermal conductivity and gross density, usually translucent; It is a component that can be used in all kinds of production with high elasticity, tensile strength and thermal expansion capability.

Applications of plastics: It is a widely used material ranging from high-strength, fibrous composite sections to interior coatings, facade panels, functional products such as paint and glue.

*Textiles and Membranes*: The Latin word 'textile' means woven or knitted and is the general name for all types of woven material.

Properties of Textiles and Membranes: Soft materials with low thermal conductivity. If two-dimensional felt layer is added in its structure, it is three-dimensional. Waterproofing by coating.

Usage of Textiles and Membranes: It can be used as a cover resistant to external weather conditions by stretching. It is also used as flooring and wall covering, movable partition, upholstery fabric and acoustic insulation material (Url 2; Url4)

#### **4. ROOMS OPEN AIR ROOMS AND LANDSCAPE ARCHITECTURE**

Landscape Architecture examines the concepts of nature, planning and design in a systematic structure; It is a professional discipline that combines art, science, engineering and technology, and makes use of the natural and cultural resources in the right way for the usage decisions of the area, planning ecology-economic-functional and thus sustainable, and dealing with the management and field design (Atıl et al., 2005).

The Role of Landscape Architects In designs of Open-Air homes ; open-air rooms are the integration of residential spaces into gardens with building materials of design green scale. These open spaces are created in accordance with the design principles. Open air chambers created in line with these principles are directly related to the discipline of landscape architecture.

Landscape architects; By combining the concepts of space usage, functionality, green texture and aesthetic concern, landscape architects create open-air rooms. design, planning, repair, management, and protection of existing or open air rooms. The technical education and environmental awareness of a landscape architect is of great importance during these studies. However, there are problems in reaching the targets and criteria to be achieved due to the fact that the interdisciplinary boundaries are not completely drawn and the sharing of authority among the professional groups cannot be made fully.

#### **5. CONCLUSIONS AND RECOMMENDATIONS**

Open-air rooms, which have been used more frequently after World War II, have become more modern and functional and can be more aesthetic and functional than other areas. In addition, a remote room can be an attractive place to visit. Nowadays, the best way to get away from the dense urbanization and its stressful environment is open air rooms. This study emphasizes the importance of open air rooms in landscape architecture. In future studies, design of open air rooms with global warming can be discussed.

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**O 64. DEVELOPMENT OF A WATER MANAGEMENT FOR AN AUTOMOTIVE PEM FUEL CELL SYSTEM**

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**ABSTRACT:** There are several factors, such as lack of fossil fuel reservoir and global warming phenomena which lead to the search alternative ways to replacement the internal combustion engine (ICE) for vehicles. PEM Fuel cells are one of the most promising technologies for automotive applications because they operate at low temperature, environmentally friendly, have a high-power density, and can be fueled by the hydrogen fuel which produces from different renewable sources. Consequently, investigation on a proper an automotive PEM fuel cell system design is necessary in order to perfect vehicle performance, increase efficiency, and reduce costs. Water management is one of the most important problems in PEM fuel cell, and this study makes a contribution to the improvement of the performance of an automotive fuel cell system. The effect of some operation parameters such as vehicle speed, air stoichiometry, and operation pressure on the water management issue, and the performance of an automotive fuel cell system was studied. The results showed that the operating pressure and the air stoichiometry ratio are two significant criteria in the water management of PEM fuel cell. System pressure has an important effect on water management and the performance of the PEM fuel cell. The decrease of air stoichiometry at high operation pressure enhances the water management of the system.

*Keywords: PEM fuel cell, operating pressure, air stoichiometry*

## O 65. HYDROGEN PEROXIDE FUEL CELL USING CORE-SHELL CATALYSTS

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**ABSTRACT:** As a result of the on-going global energy crisis and climate change concerns, significant research efforts have been devoted to the development of sustainable and clean energy devices. Nowadays, fuel cells have been approved as a novel energy production technology, which is efficient, economic and environmentally compatible. The fuel cell is a power device which converts the chemical energy into usable electrical and heat energy without burning and using any intermediate unit (Li, et al., 2015). H<sub>2</sub>O<sub>2</sub> is one of the liquid base fuels which is used in fuel cells due to the advantages of having high power density and theoretical potential, low activation energy (Song, et al., 2017). Many studies have reported the catalysts for H<sub>2</sub>O<sub>2</sub> reduction. At present, noble metal catalysts, such as Pt, Pd, Au, Ag or a combination of these metals, exhibit the highest catalytic performance towards H<sub>2</sub>O<sub>2</sub> reduction. In this study, highly active carbon nanotube supported bimetallic catalysts have been synthesized for H<sub>2</sub>O<sub>2</sub> fuel cells. Pd-M (M: Ni, Ag, Co, Mn, V, Zn) bimetallic alloy and core shell catalysts have been prepared via NaBH<sub>4</sub> reduction and dendrimer template methods. After the preparation of electrodes; amperometric, voltametric and impedance measurements will be performed by potentiostat device.

*Keywords: Energy, hydrogen, fuel cell, hydrogen peroxide, bimetallic catalyst, palladium*

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**O 66. SYTHESIS AND CHRACTERISATION OF Pd BASED CATALYSTS FOR SENSOR APPLICATION**

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**ABSTRACT:** Hydrogen peroxide(H<sub>2</sub>O<sub>2</sub>) is one of the most appreciated analytes that is used in various areas such as food processes, bleaching of textiles and paper, pharmaceutical research, clinical laboratory, medical diagnostics, removal of inorganic and organic pollutants from wastewater, antiseptic and cleaning product, minerals processes and biochemistry (Ramazeni et. all, 2017). On account of their tremendous catalytic activity to H<sub>2</sub>O<sub>2</sub> and high electrical conductivity in comparison with many other bulk metals, bimetallic catalysts were commonly used for constructing nonenzymatic H<sub>2</sub>O<sub>2</sub> sensors. Different techniques have been employed for the determination of H<sub>2</sub>O<sub>2</sub>. Among them, electrochemical methods have attracted considerable interest due to their high sensitivity, fast response, low-cost and convenient operation (Davila et. all, 2016). In this study, highly active carbon nanotube supported bimetallic Pd based bimetallic catalysts have been synthesized for H<sub>2</sub>O<sub>2</sub> sensors. After the preparation of electrodes; amperometric, voltametric and impedance measurements were performed by potentiostat device.

*Keywords: Energy, hydrogen, sensor, hydrogen peroxide, bimetallic, catalyst*

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Ramazeni, H., Azizi, S. N., & Hosseini, S. R. (2017). NaY zeolite as a platform for preparation of Ag nanoparticles arrays in order to construction of H<sub>2</sub>O<sub>2</sub> sensor. *Sensors and Actuators B: Chemical*, 571-579.

**O 67. ELECTROCHEMICAL DETERMINATION OF CADMIUM AND LEAD ON  
ZnFe<sub>2</sub>O<sub>4</sub>/rGO/GCE**

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**ABSTRACT:** Contamination of heavy metals (lead, cadmium, mercury, chromium, copper, nickel and zinc etc. possess serious problems to the environment and public health. Heavy metal ions are the main pollutant one of aqueous systems due to their solubility in water and non-biodegradable properties. Heavy metals taken in low concentrations can cause health problems. Serious and chronic illnesses are the worse effects associated with heavy metal ions poisoning even at low level exposure. (Kitt, et al., 2019). Stripping voltammetric methods are the most efficient electrochemical techniques for trace analysis due to their short response time, low cost, high sensitivity and selectivity for the detection of heavy metal ions in environmental samples. The performance of voltammetry is strongly influenced by the working electrode material. (Serran, et al., 2015). In this study, ZnFe<sub>2</sub>O<sub>4</sub>-rGO modified glassy carbon electrode has been used to detect lead (Pb (II)) and cadmium (Cd (II)) in industrial wastewaters. In addition operational parameters including pH, deposition potential and time has been optimized.

*Keywords: Electrochemical detection, Heavy metal ions, Modified electrode, Stripping voltammetry.*

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Zhu, X. et al., 2017. Alkaline intercalation of Ti<sub>3</sub>C<sub>2</sub> MXene for simultaneous electrochemical detection of Cd(II), Pb(II), Cu(II) and Hg(II). *Electrochimical Acta* 248, pp. 46-57.

## O 68. SYNTHESIS OF IN-SITU S DOPED FEW LAYER GRAPHENE BY CHEMICAL VAPOR DEPOSITION TECHNIQUE AND THEIR SUPERIOR GLUCOSE ELECTROOXIDATION ACTIVITY

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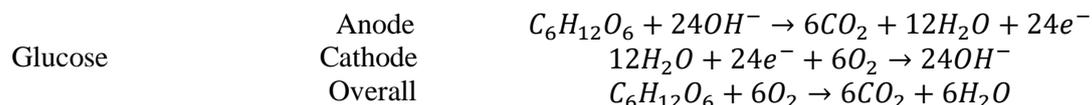
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**ABSTRACT:** In this study, sulfur (S)-doped graphene and insitu S-doped graphene are deposited on copper (Cu) foil by chemical vapor deposition (CVD) method. Then, S-doped graphene and insitu S-doped few-layer graphene on the Cu foils were coated onto few-layer the indium tin oxide (ITO) electrode for glucose electrooxidation. These electrodes are characterized by Scanning Electron Microscopy-Energy Dispersive X-Ray Analysis (SEM-EDX) and Raman Spectroscopy. In addition, glucose electrooxidation was investigated with cyclic voltammetry (CV) and chronoamperometry (CA).

*Keywords:* Chemical Vapor Deposition, Few-Layer Graphene, Glucose Electrooxidation.

### 1. INTRODUCTION

Fuel cells have gained a great deal of importance due to increasing energy needs related population and growing industry (Ulas, Caglar et al. 2018). Besides, fuel cells are clean, efficient, and promising for the future (Çağlar, Aldemir et al. 2018). Direct glucose fuel cell (DGFC) is an energy device converting chemical energy into electrical energy. Glucose is alluring due to its strong demand in research subject as fuel for DGFCs (Chai, Zhang et al. 2018). The glucose is the richest carbohydrate in nature and could be readily extracted from biomass. When glucose is fed directly to the anode of a DGFC, it could produce 24 electrons by full electrooxidation to CO<sub>2</sub> given as follows (Brouzgou, Song et al. 2014):



Glucose can be employed as a fuel in fuel cells when it can be directly oxidized to produce electricity such as ethanol and methanol fuel cells (Brouzgou, Yan et al. 2014). Chai et al. (Chai, Zhang et al. 2018) reported that Pd<sub>3</sub>Cu-B/C catalyst synthesized by a simple aqueous phase approach and examined glucose electrooxidation. Yan et al. (Yan, Brouzgou et al. 2014) ] studied the activities of Pd<sub>x</sub>Au<sub>y</sub>/C binary electrocatalysts for glucose electrooxidation.

Herein, the S-doped graphene and insitu S-doped graphene were coated on Cu foil by the CVD method. The S-doped graphene and insitu S-doped graphene on the Cu foil were then coated onto few-layer the ITO electrode. ITO electrodes were employed as working electrode for electrochemical measurements in three electrode system. The S-doped G/ITO and insitu S-doped G/ITO electrodes were characterized by SEM-EDX and Raman Spectroscopy measurements. To investigate their glucose electrooxidation activities, CV and CA electrochemical measurements were used.

### 2. MATERIAL AND METHOD

#### 2.1. The S-doped graphene and insitu S-doped graphene Synthesis

The reactor medium was fixed to 5 sccm hexane and 50 sccm hydrogen gas for 20 min. The reactor temperature was increased to 950 °C. Then, quartz boat containing 1 mg of sulfur powder was brought closer to the reactor. After 10 min, the oven was shut down and allowed to cool. Cu foil was first pre-cleaned for insitu S doped graphene. The quartz bot containing 1 mg sulfur with Cu foil were placed

into CVD. The reactor medium was fixed to 5 sccm hexane and 50 sccm hydrogen gas for 20 min. The reactor temperature was increased to 950 °C. After 20 min, the oven was turned off and allowed to cool.

## **2.2. Transfer of S-doped graphene and insitu S-doped graphene on ITO electrode**

The protective polymer layer polymethylmethacrylate (PMMA) was utilized for transfer graphene to ITO surface. PMMA was covered on the graphene surface. Firstly, the amount of PMMA in powder structure was weighed and suffixed to glass bottle including chloroform. Then, the graphene-coated Cu foil was placed on the rotating table. PMMA solution was added onto the graphene and the coating was initiated. After this process, the sample was get onto a plate and it was completely dried graphene surface at 90 °C for 2 min.

## **2.3. Physical Characterization**

The S-doped G/ITO and insitu S-doped G/ITO electrodes were characterized by SEM-EDX and Raman Spectroscopy. SEM-EDX measurement was obtained utilizing the zeiss sigma 300 to scan the surface of S-doped G/ITO and insitu S-doped G/ITO. Raman spectroscopy of S-doped G/ITO and insitu S-doped G/ITO was analyzed by using Raman Scope II to determine intermolecular vibration energy.

## **2.4. Electrochemical Measurements**

The glucose electrooxidation activity of ITO, G/ITO, S-doped G/ITO, and insitu S-doped G/ITO electrodes was investigated by CV and CA in 1.0 M KOH + 0.5 M glucose solution. These measurements were investigated employing the CHI 660E potentiostat with three electrode systems. CV measurements were taken at a scan rate of 50 mV/s at -0.6–0.4 potential range in 1.0 M KOH + 0.5 M glucose solution. In order to measure the stability of the ITO, G/ITO, S-doped G/ITO, and insitu S-doped G/ITO electrodes, 1000 s and -0.5 V were examined in the CA.

# **3. RESEARCH FINDINGS**

## **3.1. Characterization**

The S-doped graphene and in situ S-doped graphene were characterized by SEM-EDX and mapping images. SEM and mapping images are shown in Figures 1 and 2. Carbon and sulfur are homogeneously dispersed on Cu foil. The S-doped graphene and in situ S-doped graphene, the atomic element compounds were obtained as 8.1 % C, 0.39 % S, 82.79 % Cu and 9.4 % C, 17.95 % S, 82.51% Cu, respectively.

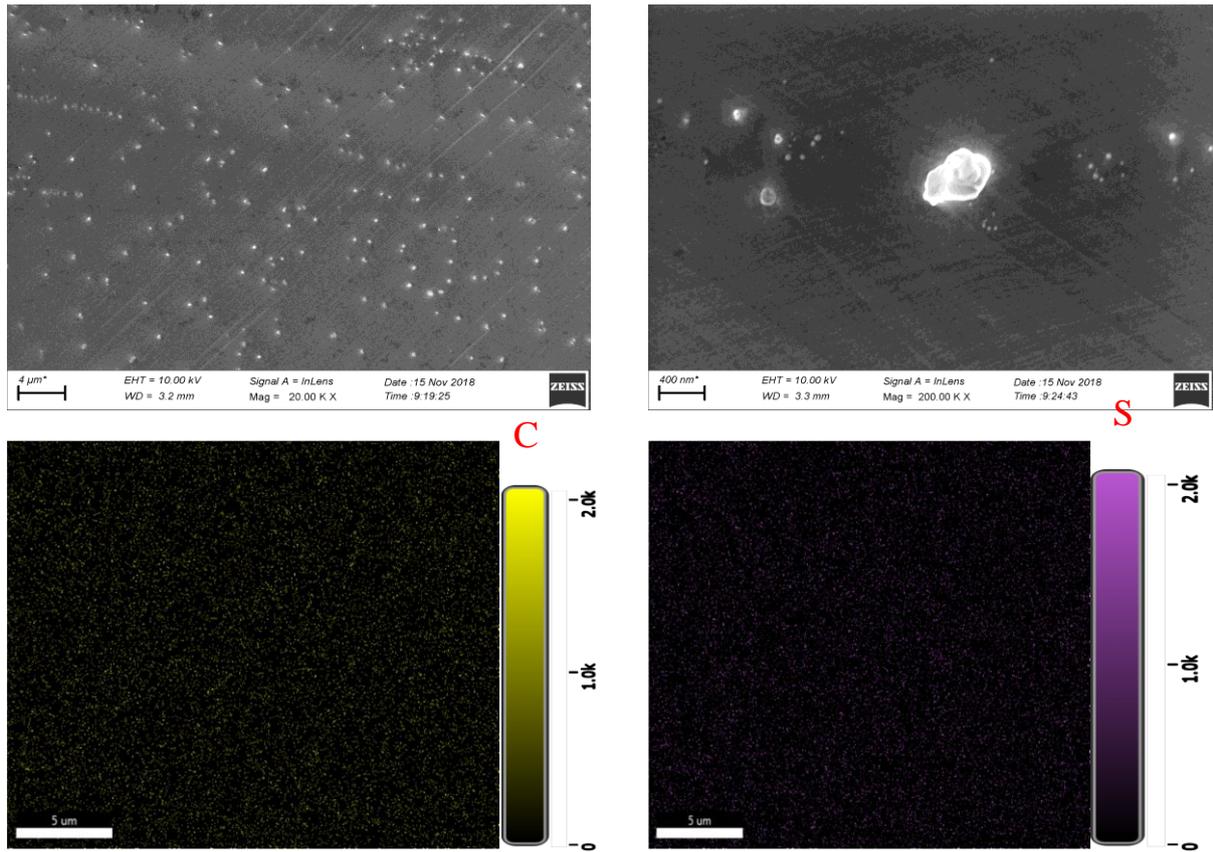


Figure 1. SEM and mapping images of S-doped G/ITO

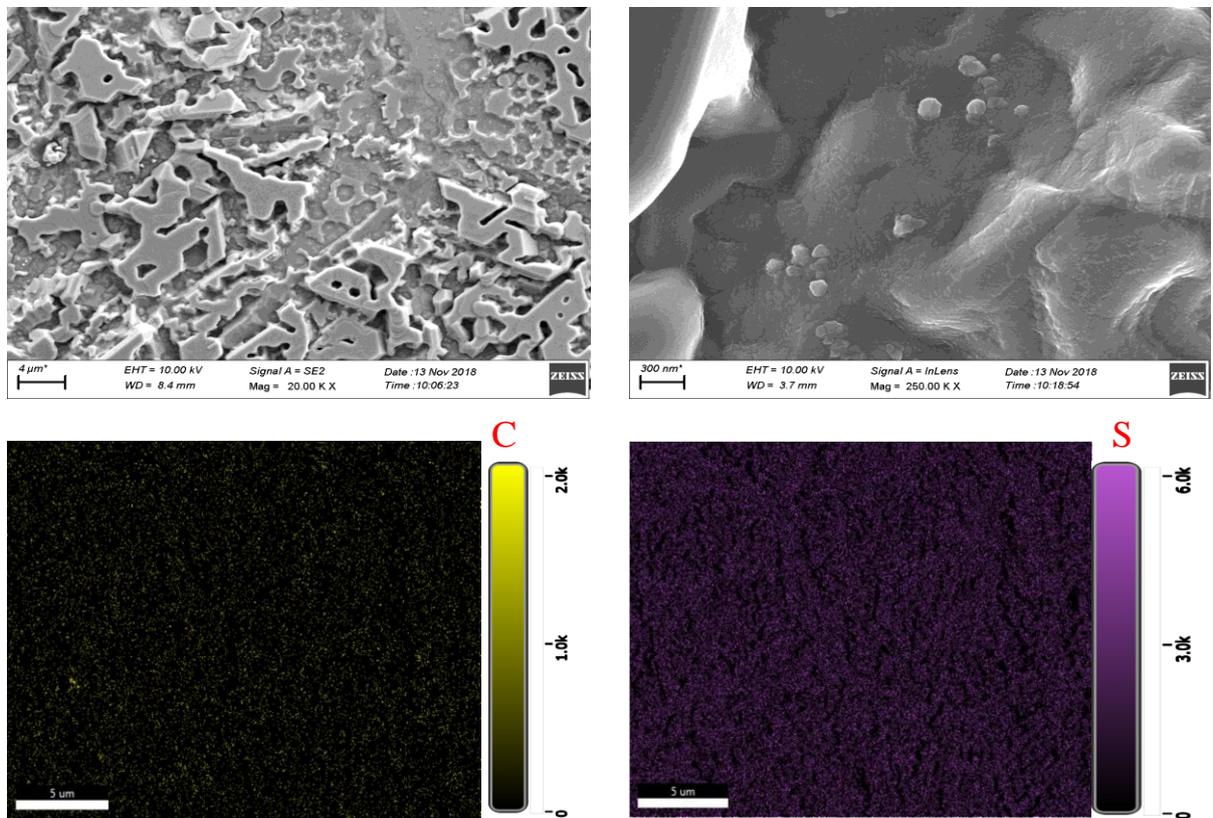


Figure 2. SEM and mapping images of insitu S-doped G/ITO

Figure 3(a,b) displays the Raman spectra of S-doped G/ITO and insitu S-doped G/ITO electrodes. The insitu S-doped G/ITO possessed higher D/G ratio than ITO/graphene ( $0.190 > 0.138$ ) showing that doping the S on ITO/graphene increased the number defective sites. The crystallinity of graphene was significantly degraded by S doping on G/ITO surface. For raman spectroscopy of S-doped G/ITO electrode, the peak at 283, 330 and 615  $\text{cm}^{-1}$  belongs to the characteristic peaks of copper and copper oxide.

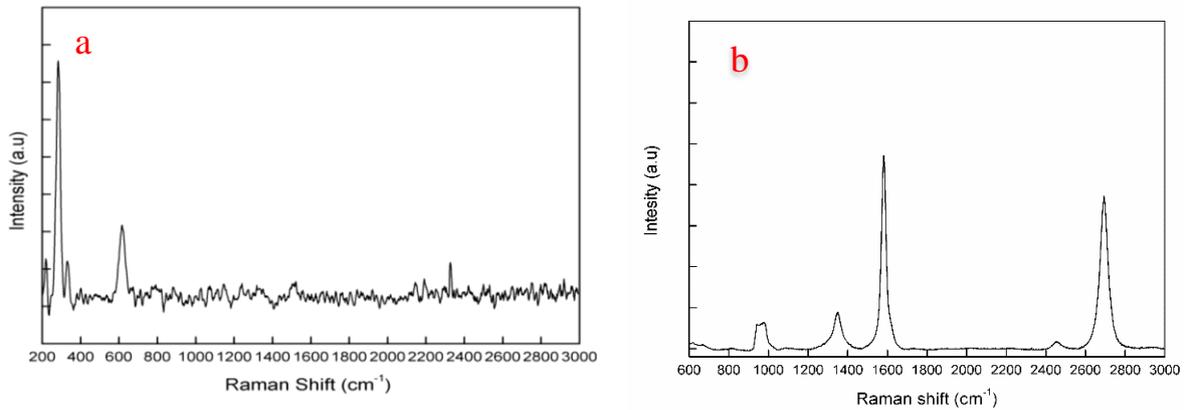


Figure 3. Raman spectra of a) S-doped G/ITO b) insitu S-doped G/ITO.

### 3.2. Electrochemical Measurements of ITO, Graphene/ITO, S-doped graphene/ITO, and insitu S-doped graphene/ITO Electrodes

Electrochemical measurements of obtained ITO, graphene/ITO, S-doped graphene/ITO, and insitu S-doped graphene/ITO were investigated via CV in 1.0 M KOH + 0.5 M glucose solution. CVs were taken at -0.6 V–0.4 V potential range at 50 mV/s scan rate. Figure 4 indicates CV behavior of ITO, graphene/ITO, S-doped graphene/ITO, and insitu S-doped graphene/ITO electrodes in 1.0 M KOH + 0.5 M glucose solution. The specific activity value of the insitu S-doped graphene/ITO electrode was obtained as  $7.86 \text{ mA cm}^{-2}$ . The insitu S-doped graphene/ITO electrode exhibited about 1.27, 1.2, and 4.2 times higher activity than S-doped graphene/ITO, graphene/ITO, and ITO electrodes, respectively.

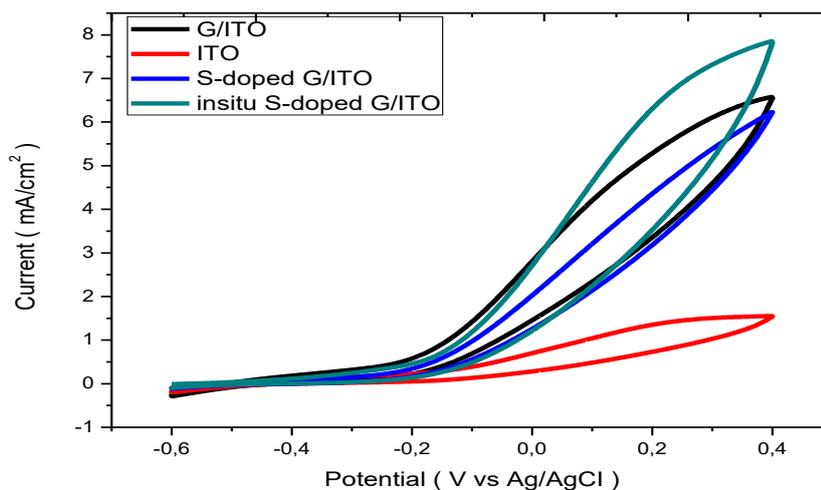
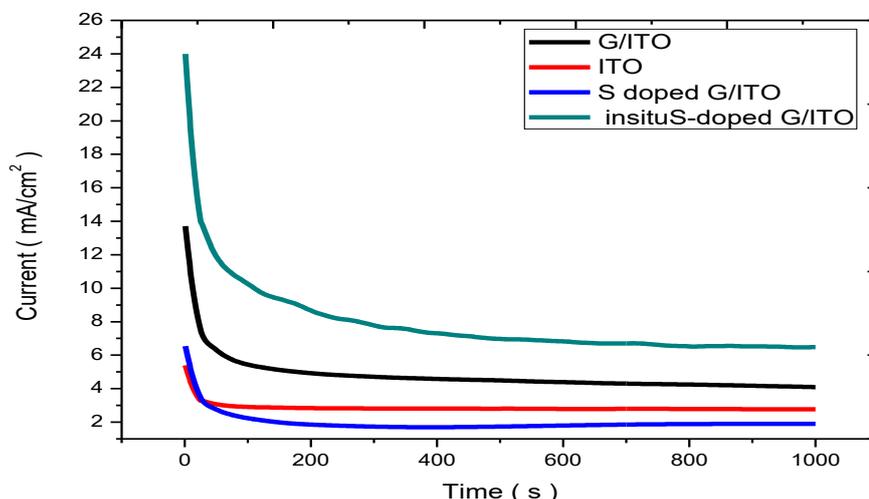


Figure 4. Cyclic voltammety obtained in ITO, G/ITO, S-doped G/ITO, and insitu S-doped G/ITO electrodes in 1.0 M KOH + 0.5 M glucose solution; scan rate:  $50 \text{ mV s}^{-1}$ .

The stability of ITO, graphene/ITO, S-doped graphene/ITO, and insitu S-doped graphene/ITO electrodes were obtained with CA at -0.15 V and 1000 s in 1.0 M KOH + 0.5 M glucose solution. The CA curves of these electrodes are illustrated in Figure 5. The insitu S-doped graphene/ITO electrode was realized higher activity and stability than ITO, graphene/ITO, and S-doped graphene/ITO electrodes.



**Figure 5.** Chronoamperometry curves of ITO, G/ITO, S-doped G/ITO, and insitu S-doped G/ITO electrodes obtained at -0.15 V and 1000 s.

#### 4. CONCLUSIONS AND DISCUSSION

At present, S-doped graphene and insitu S-doped graphene were coated on Cu foil by CVD method. Then, the S-doped graphene and insitu S-doped graphene on the Cu foil was coated few-layer on the ITO electrode. The graphene and sulfur structures were clearly visible from SEM images. The S-doped graphene and insitu S-doped graphene structures were confirmed by Raman analysis. The insitu S-doped graphene electrode has exhibited the highest electrochemical activity and stability toward the oxidation of glucose compared ITO, graphene/ITO, and S-doped graphene/ITO electrodes.

#### ACKNOWLEDGEMENTS

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## O 69. DEVELOPMENT OF THE DIRECT BOROHYDRIDE FUEL CELL CATALYSTS

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**ABSTRACT:** The decreasing natural gas, coal and petroleum reserves, and increasing consumption rate of these resources shows the importance of renewable energy. Although the consumption of fossil fuels is restricted because of their high carbon/sulfur contents, these restrictions are not always effective. Thus, environmental problems, such as acid rain, ozone depletion and climate change, arise from the presence of CO<sub>2</sub>, SO<sub>x</sub> and NO<sub>x</sub> in the emission gases. Most of these problems can be improved by using clean and renewable energy sources. For this purpose, hydrogen seems to be the most appropriate energy source. Fuel cells using borohydride as the fuel have received much attention because of the high potential and power density. A direct borohydride fuel cell (DBFC) is a device that converts chemical energy stored in borohydride ion (BH<sub>4</sub><sup>-</sup>) and an oxidant directly into electricity by redox processes. Usually, a DBFC employs an alkaline solution of sodium borohydride (NaBH<sub>4</sub>) as fuel and oxygen or hydrogen peroxide as oxidant (Muir and Yao, 2011). NaBH<sub>4</sub>, a safe and high energy density source of H<sub>2</sub> for fuel cells, requires a catalyst for reliable hydrogen production (Genga et. all, 2010). In this study, it is aimed to synthesize highly active carbon nanotube supported bimetallic catalysts (Pt-M (M: Au, Ir, Cu) for NaBH<sub>4</sub> fuel cells. The catalytic activity of these catalysts was investigated by cyclic voltammetry, chronoamperometry, and impedance measurements.

*Keywords: Fuel cells, Sodium borohydride, Bimetallic nanocatalyst, Catalytic activity.*

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**O 70. FEW-LAYER GRAPHENE COATED ON INDIUM TIN OXIDE ELECTRODE  
PREPARED BY CHEMICAL VAPOR DEPOSITION AND THEIR ENHANCED  
GLUCOSE ELECTROOXIDATION ACTIVITY**

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**ABSTRACT:** At present, few-layer graphene is deposited on copper (Cu) foil by chemical vapor deposition (CVD) method. The methane flow rate, hydrogen flow rate, and deposition time parameters with CVD method are transferred on Cu foil. Then, the graphene on the Cu foil is coated onto few-layer the indium tin oxide (ITO) electrode for glucose electrooxidation. These electrode is characterized by Scanning Electron Microscopy-Energy Dispersive X-Ray Analysis (SEM-EDX) and Raman Spectroscopy. Furthermore, glucose electrooxidation is examined with cyclic voltammetry (CV) and chronoamperometry (CA).

**Keywords:** Fuel cells, Glucose Electrooxidation, Chemical Vapor Deposition.

## **1. INTRODUCTION**

Energy needs have increased due to raising population and growing industry in the world. Hence, alternative energy sources are examined to satisfy the energy needs (Çağlar, Aldemir et al. 2018, Ulas, Caglar et al. 2018). Fuel cells are renewable energy sources that is clean, efficient, and promising for the future (Caglar, Sahan et al. 2018). Different types of fuel cells are presented such as direct formic acid fuel cells (DFAFCs) (Ulas, Caglar et al. 2018), direct ethanol fuel cells (DEFCs) (Sahin, Duzenli et al. 2016), direct methanol fuel cells (DMFCs) (Kivrak, Can et al. 2014), and direct glucose fuel cells (DGFCs) (Zhiani, Abedini et al. 2018). Glucose (C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>) is the most abundant monosaccharide in nature (Basu and Basu 2011). When the glucose is fed with an alkali membrane, it could produce 24 electrons for the complete oxidation of CO<sub>2</sub> (Li, Scott et al. 2013). In addition, literature studies with PdSn (Brouzgou, Song et al. 2014), PdRh (Brouzgou, Yan et al. 2014), PdAu (Yan, Brouzgou et al. 2014), NiCo (Gao, Liu et al. 2018), and PtPdAu (Basu and Basu 2012) catalysts were developed for the glucose electrooxidation.

Graphene has a hexagonal, single-atom, and two-dimensional (2D) sp<sup>2</sup>-hybrid carbon atom layer separated from 3D structured graphite (Bollella, Fusco et al. 2017). Graphene production techniques have been known such as Hummers method, sublimation of 4H-SiC, electrochemical reduction, and chemical vapor deposition (CVD). Among these methods, CVD layer system formed on the surface of a solid material is a short-time and simple method (Tan, Jayawardena et al. 2012). Vapor carrier gas exposes to the surface of a material via heating in a closed container, mostly used in graphene synthesis. At present, the few-layer graphene was coated on Cu foil by the CVD method. The few-layer graphene were transferred on Cu foil with 5 sccm hexan flow rate, 20 sccm hydrogen flow rate, and 20 min deposition time parameters via CVD method. The few-layer graphene on the Cu foil was then coated onto few-layer the ITO electrode. ITO electrode was used as working electrode for electrochemical measurements in three electrode system. The few-layer graphene/ITO electrode was characterized by SEM-EDX and Raman Spectroscopy measurements. To investigate their glucose electrooxidation activities, CV and CA electrochemical measurements were used.

## 2. MATERIAL AND METHOD

### 2.1. The Few Layer Graphene Synthesis

The few layer graphene was coated on Cu foil with the CVD method. Firstly, Cu foil was cleaned with acetone and isopropyl alcohol. Then, Cu film was annealed at temperatures of 900-1000 °C to raise grain size under an atmosphere of Ar/H<sub>2</sub>. After Cu foil was annealed, hydrogen gas was fed into the reactor medium for time. The reactor temperature was set to 950 °C. After the temperature reached the desired value, it was exposed to reactor medium 50 sccm hydrogen gas. Then, the reactor medium was fixed to 5 sccm hexane for 20 min. Finally, the reactor was brought to room temperature.

### 2.2. Transfer of Few-Layer Graphene/ITO Electrode

The protective polymer layer polymethylmethacrylate (PMMA) was utilized for transfer graphene to ITO surface. PMMA was covered on the graphene surface. Firstly, the amount of PMMA in powder structure was weighed and suffixed to glass bottle including chloroform. Then, the graphene-coated Cu foil was placed on the rotating table. PMMA solution was added onto the graphene and the coating was initiated. After this process, the sample was get onto a plate and it was completely dried graphene surface at 90 °C for 2 min.

### 2.3. Physical Characterization

Few-layer graphene/ITO electrode was characterized by SEM-EDX and Raman Spectroscopy. SEM-EDX measurement was obtained utilizing the zeiss sigma 300 to scan the surface of few-layer graphene. Raman spectroscopy of few-layer graphene/ITO electrode was analyzed by using Raman Scope II to determine intermolecular vibration energy.

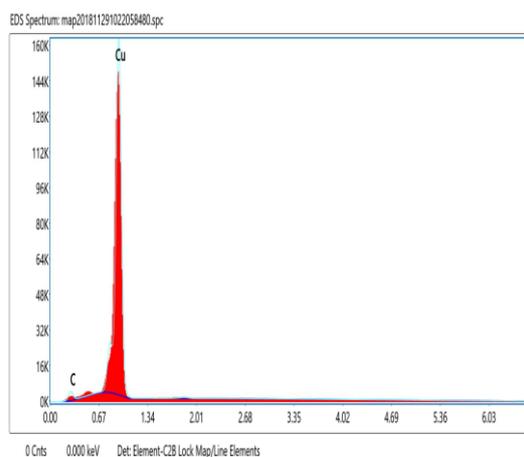
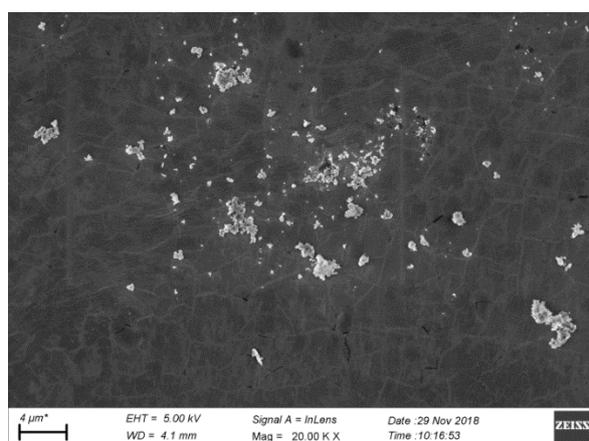
### 2.4. Electrochemical Measurements

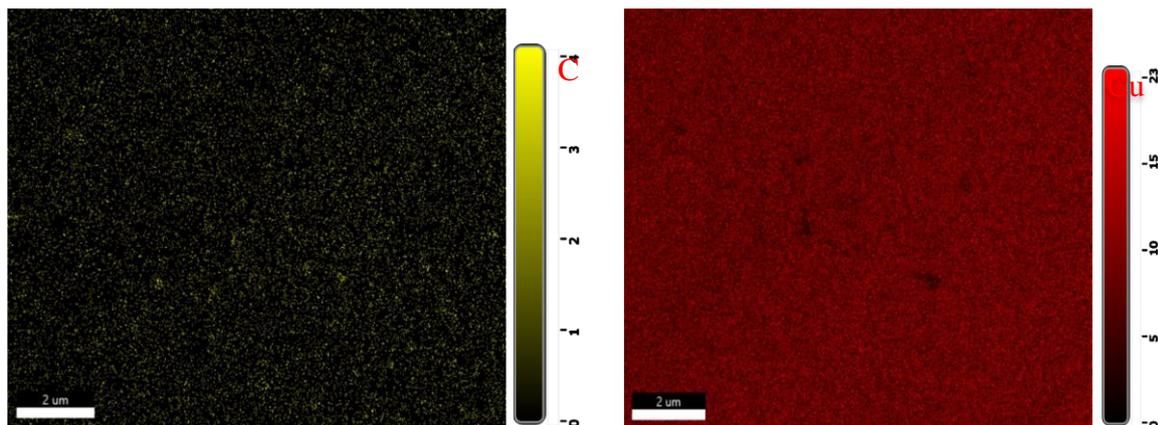
The glucose electrooxidation activity of few-layer graphene/ITO electrode was examined by CV and CA in 1 M KOH + 0.5 M C<sub>6</sub>H<sub>12</sub>O<sub>6</sub> solution. These measurements were performed in a standard three-electrode cell using a CHI 660E Electrochemical Analyzer. CV measurements were recorded potential range in 1 M KOH + 0.5 M C<sub>6</sub>H<sub>12</sub>O<sub>6</sub> solution at a scan rate of 50 mV/s 0.6–0.4 V. In order to measure the stability of the few-layer graphene/ITO electrode, 1000 s and -0.5 V were examined in the CA.

## 3. RESEARCH FINDINGS

### 3.1. Characterization

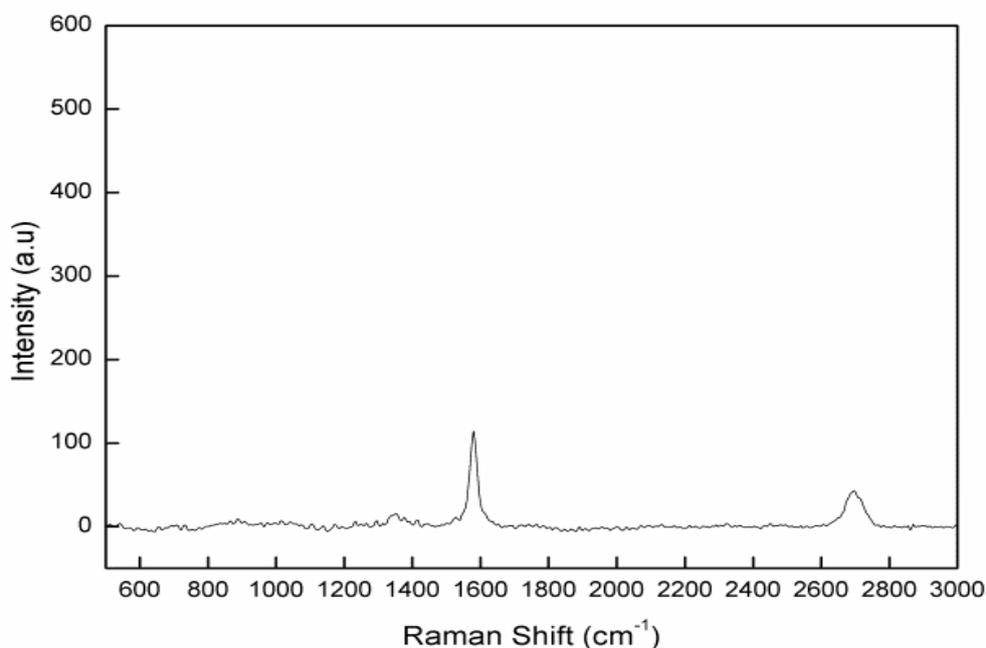
SEM analysis was performed to determine the surface properties of graphene. It is seen that few-layer graphene is distributed on Cu foil. The few-layer graphene contain 13.4% carbon and 86.59% Cu foil





**Figure 1.** SEM-EDX and mapping images of few-layer graphene.

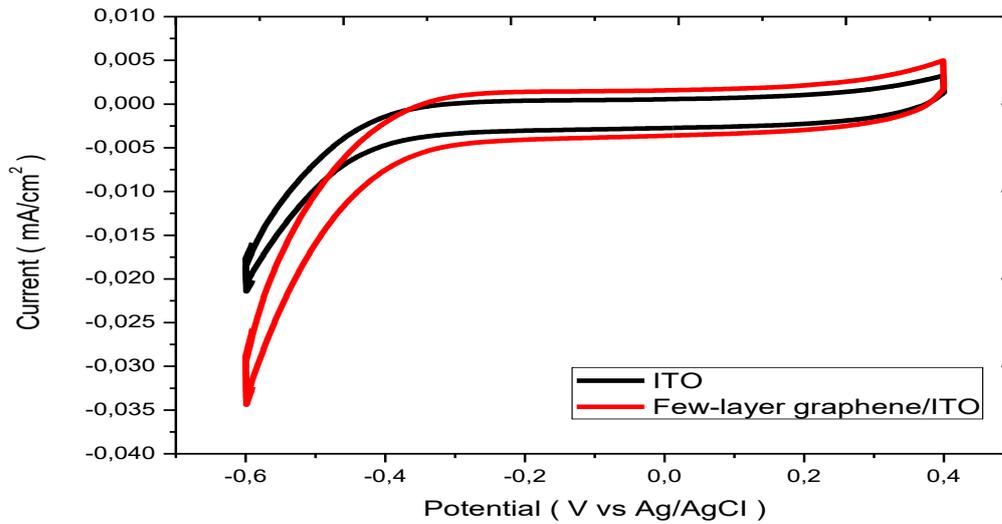
The chemical structure of few-layer graphene was revealed by Raman analysis technique. In the Raman spectroscopy characterization of few-layer graphene, the increase in 2D/G ratio shows that the number of layers decreases and the increase in D/G ratio increases the structural defects on the surface. The D/G and 2D/G ratio were found to be 0.135 and 1.35, respectively.



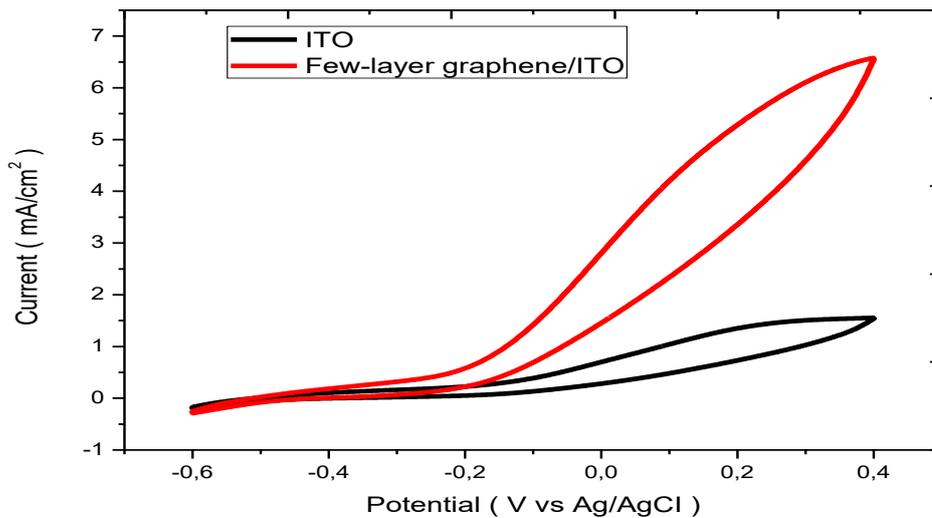
**Figure 2.** Raman spectra of the few-layer graphene.

### **3.2. Electrochemical measurements of ITO and Few-layer Graphene/ITO Electrodes**

Electrochemical measurement of obtained few-layer graphene/ITO electrode was examined by CV in 1 M KOH and 1 M KOH + 0.5 M C<sub>6</sub>H<sub>12</sub>O<sub>6</sub> solution. CVs were recorded at -0.6–0.4 V potential range at 50 mV/s scan rate. Figure 3 shows CV behavior of ITO and few-layer graphene/ITO electrodes in 1 M KOH solution. Current values of H<sub>2</sub> adsorption-desorption peaks were obtained in the order of few-layer graphene/ITO>ITO electrodes. The glucose electrooxidation of ITO and few-layer graphene/ITO electrodes was illustrated in Figure 4. The few-layer graphene/ITO electrode exhibited about 4.2 times better activity than ITO electrode.

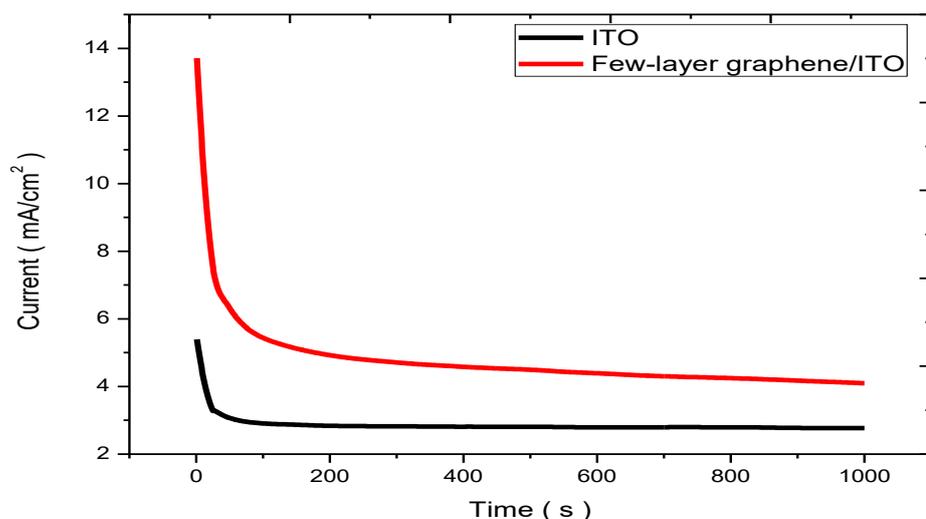


**Figure 3.** Cyclic voltammetry obtained in Few-layer garphene/ITO and ITO electrodes in 1 M KOH solution; scan rate:  $50 \text{ mV s}^{-1}$ .



**Figure 4.** Cyclic voltammetry obtained in Few-layer graphene/ITO, and ITO electrodes in 1 M KOH + 0.5 M  $\text{C}_6\text{H}_{12}\text{O}_6$  solution; scan rate:  $50 \text{ mV s}^{-1}$ .

The stability and response of ITO and few-layer graphene/ITO electrodes were obtained with CA at -0.15 V and 1000 s in 1 M KOH and 0.5 M  $\text{C}_6\text{H}_{12}\text{O}_6$  solution. Figure 5 indicates the CA curves of these electrodes. The few-layer graphene/ITO electrode was carried out better activity and stability than ITO electrode. Furthermore, the few-layer graphene/ITO electrode was realized high activity in CA results as with CV results.



**Figure 5.** CA curves of ITO and Few-layer graphene/ITO electrodes obtained at -0.15 V and 1000 s.

#### 4. CONCLUSIONS AND DISCUSSION

Herein, few-layer graphene was coated on Cu foil by CVD method. The few-layer graphene were transferred on Cu foil with 5 sccm hexan flow rate, 20 sccm hydrogen flow rate, and 20 min deposition time parameters via CVD method. Then, the graphene on the Cu foil was coated onto the few-layer ITO electrode. The graphene structure was clearly visible from SEM images. The few-layer graphene structure was confirmed by Raman analysis. The few-layer graphene/ITO electrode was exhibited higher electrochemical activity and stability than ITO electrode for the oxidation of glucose.

#### ACKNOWLEDGEMENTS

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**O 71. DETERMINATION OF ZINC AND COBALT BY VOLTAMMETRIC METHOD**

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**ABSTRACT:** Metal ions are biological toxicity to living organisms and accumulate in the food chain, which causes several health problems such as kidney deficiency, lung problems, hypertension and nervous system failure (Azmi et. all, 2017). Zinc (Zn) and cobalt (Co) are the metals that appear together in many real samples. These metals are among toxic metals of importance for environmental observation, food control and toxicology. Rapid, accurate and reliable techniques are required for the detection of these metals. Various methods can be used to detect heavy metals, including inductively coupled plasma-mass spectrometry (ICP-MS), inductively bound plasma atomic emission spectrometry (ICP AES) and atomic absorption spectrometry (AAS), and electrochemical methods. Among all commonly used techniques for the detection of heavy metals, electrochemical methods have advantages over spectrometric techniques. Electrochemical methods are cheap, highly accurate, easy to use, fast, portable and can be applied for field monitoring of environmental samples. Especially, the differential pulse anodic stripping voltammetry (DPASV) is a powerful and precise technique for the detection of heavy metals (Susom Dutta et. all, 2018). In this study, the CuFe<sub>2</sub>O<sub>4</sub>-rGO composite was synthesized and the glassy carbon electrode surface has been modified. The detection of Zn and Co were conducted by stripping voltammetry.

*Keywords: Electrochemical detection, cobalt, zinc, voltammetry.*

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**O 72. SYNTHESIS OF B DOPED AND IN-SITU B DOPED FEW LAYER GRAPHENE BY CHEMICAL VAPOR DEPOSITION TECHNIQUE FOR HYDROGEN PEROXIDE DETECTION**

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**ABSTRACT:** In this study, boron (B)-doped graphene and insitu B-doped few-layer graphene are deposited on copper (Cu) foil by chemical vapor deposition (CVD) method. Then, B-doped graphene and insitu B-doped few-layer graphene on the Cu foils were coated onto few-layer the indium tin oxide (ITO) electrode for hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) sensor. These electrodes are characterized by Scanning Electron Microscopy-Energy Dispersive X-Ray Analysis (SEM-EDX) and Raman Spectroscopy. In addition, H<sub>2</sub>O<sub>2</sub> sensor is investigated with cyclic voltammetry (CV) and chronoamperometry (CA).

*Keywords: Chemical Vapor Deposition, Indium Tin Oxide, Hydrogen Peroxide.*

## **1. INTRODUCTION**

H<sub>2</sub>O<sub>2</sub> has a significant role in many fields processes such as food, pharmaceutical, disinfection and cleaning due to its strong oxidizing and reducing ability (Alal, Caglar et al. , Kazici, Salman et al. 2018). Therefore, fast and right determination of H<sub>2</sub>O<sub>2</sub> is very important. Different analytical techniques have been realized to detect H<sub>2</sub>O<sub>2</sub>, such as chemiluminescence (Xu and Dong 1999), spectrophotometry (Luo, Abbas et al. 2008), fluorescence (Cathcart, Schwiers et al. 1983), and electrochemical methods (Düzenli, Sahin et al. 2018). Among these methods, electrochemical sensors are especially important for high sensitivity, selectivity, and simplicity for real-time sensing (Miao, Yuan et al. 2008).

Graphene has attracted strong scientific and technological interest with a hexagonal, single-atom, and two-dimensional (2D) sp<sup>2</sup>-hybrid carbon atom layer separated from 3D structured graphite in recent years. Graphene synthesis methods have been known such as thermal decomposition, chemical vapour deposition (CVD), and Hummers method (Bollella, Fusco et al. 2017). Shao et al. reported the selective development of electrochemical sensors and biosensors of graphene-based electrodes (Shao, Wang et al. 2010).

At present, the B-doped graphene and insitu B-doped graphene were coated on Cu foil by the CVD method. The B-doped graphene and insitu B-doped graphene on the Cu foil were then coated onto few-layer the ITO electrode. ITO electrodes were employed as working electrode for electrochemical measurements in three electrode system. The B-doped G/ITO and insitu B-doped G/ITO electrodes were characterized by SEM-EDX and Raman Spectroscopy measurements. To investigate their H<sub>2</sub>O<sub>2</sub> sensor activities, CV and CA electrochemical measurements were used.

## **2. MATERIAL AND METHOD**

### **2.1. The B-doped graphene and insitu B-doped graphene Synthesis**

Cu foil was first pre-cleaned for B doped graphene. The reactor medium was fixed to 5 sccm hexane and 50 sccm hydrogen gas for 20 min. The reactor temperature was increased to 950 °C. Then, quartz boat containing 1 mg of boric acid powder was brought closer to the reactor. After 10 min, the oven was shut down and allowed to cool.

Cu foil was first pre-cleaned for insitu B doped graphene. The quartz bot containing 1 mg boric acid with Cu foil were placed into CVD. The reactor medium was fixed to 5 sccm hexane and 50 sccm hydrogen gas for 20 min. The reactor temperature was increased to 950 °C. After 20 min, the oven was turned off and allowed to cool.

## **2.2. Transfer of B-doped graphene and insitu B-doped graphene on ITO electrode**

The protective polymer layer polymethylmethacrylate (PMMA) was utilized for transfer graphene to ITO surface. PMMA was covered on the graphene surface. Firstly, the amount of PMMA in powder structure was weighed and suffixed to glass bottle including chloroform. Then, the graphene-coated Cu foil was placed on the rotating table. PMMA solution was added onto the graphene and the coating was initiated. After this process, the sample was get onto a plate and it was completely dried graphene surface at 90 °C for 2 min.

## **2.3. Physical Characterization**

The B-doped G/ITO and insitu B-doped G/ITO electrodes were characterized by SEM-EDX and Raman Spectroscopy. SEM-EDX measurement was obtained utilizing the zeiss sigma 300 to scan the surface of B-doped G/ITO and insitu B-doped G/ITO. Raman spectroscopy of B-doped G/ITO and insitu B-doped G/ITO was analyzed by using Raman Scope II to determine intermolecular vibration energy.

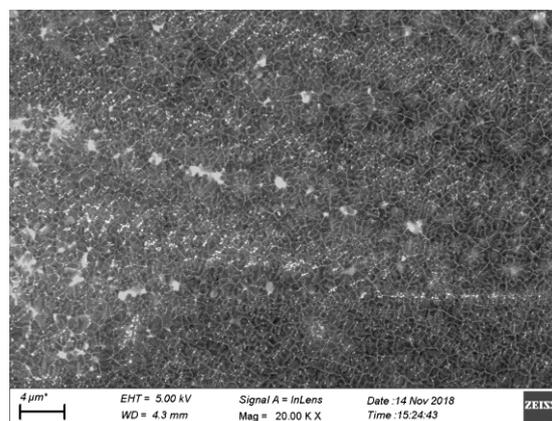
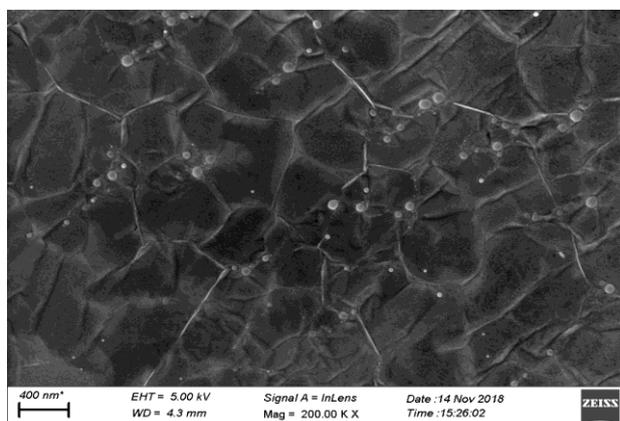
## **2.4. Electrochemical Measurements**

The H<sub>2</sub>O<sub>2</sub> sensor activity of ITO, G/ITO, B-doped G/ITO, and insitu B-doped G/ITO electrodes was investigated by CV and CA in 0.1 M phosphate buffer solution (PBS). These measurements were carried out on a CHI 660E electrochemical workstation connected to a computer. CV measurements were taken at a scan rate of 50 mV/s at -0.6–1 V potential range. The CA measurements were executed in a 0.1 M PBS under stirred condition.

## **3. RESEARCH FINDINGS**

### **3.1. Characterization**

The B-doped graphene and insitu B-doped graphene were characterized by SEM-EDX and mapping images. SEM and mapping images are given in Figures 1 and 2. Carbon and Boron are homogeneously dispersed on Cu foil. The B-doped graphene and in situ B-doped graphene, the atomic element compounds were obtained as 7.6 % C, 5.13 % B, 83.75 % Cu and 9.57 % C, 5.61 % B, 81.58% Cu, respectively.



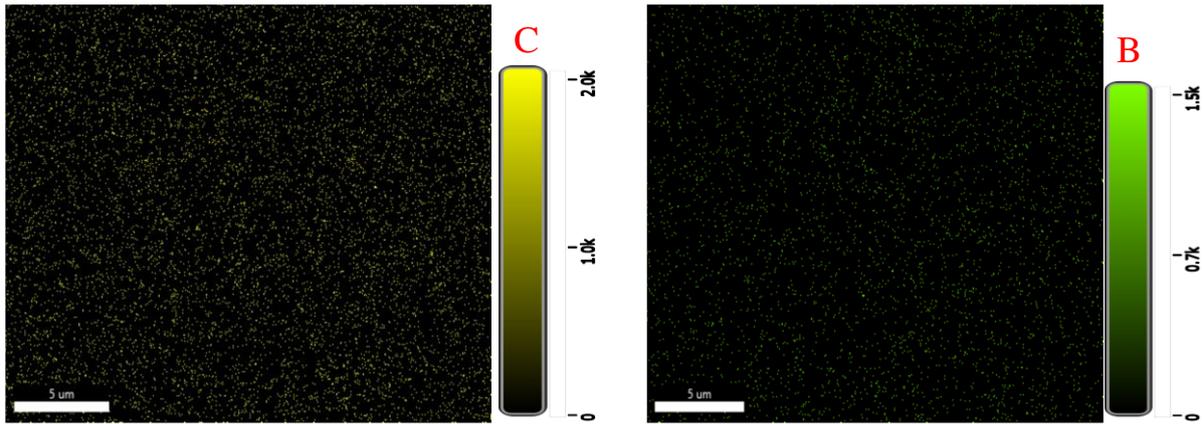


Figure 1. SEM and mapping images of B-doped graphene/ITO.

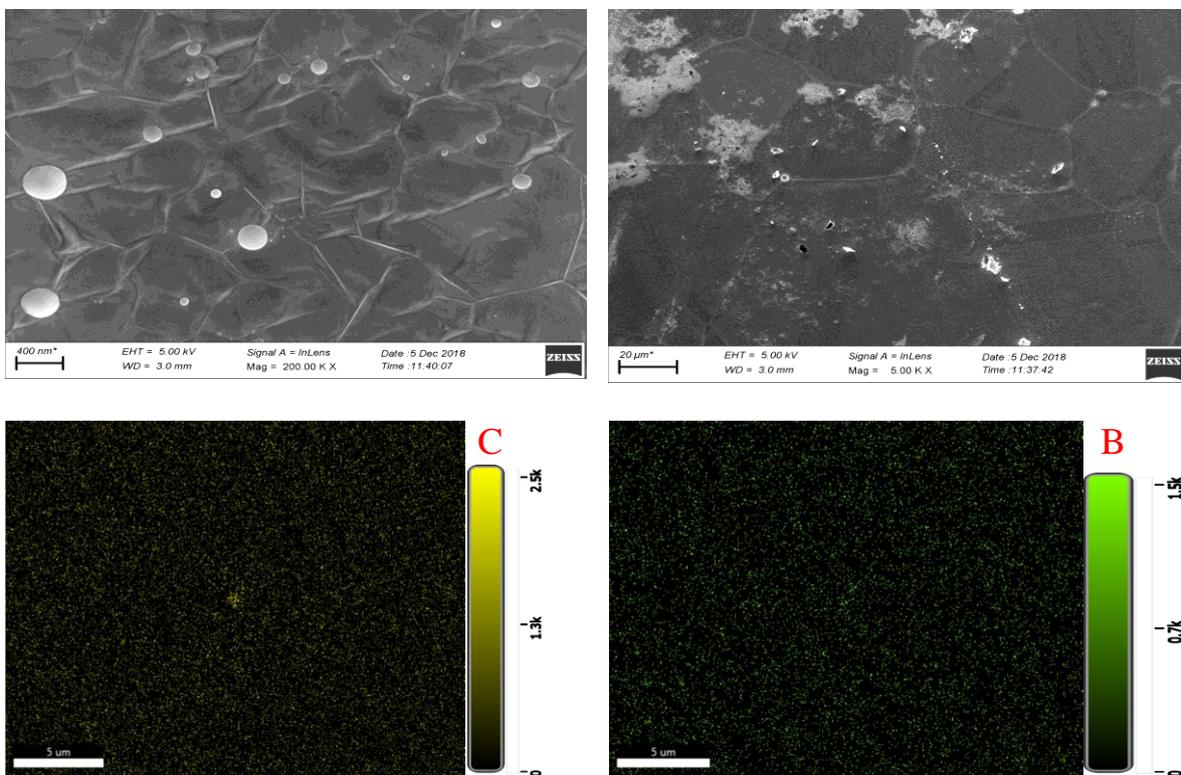
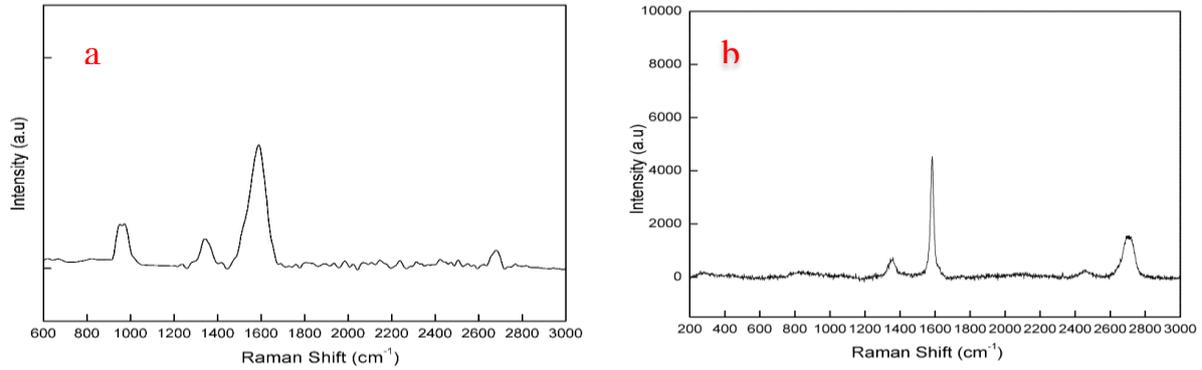


Figure 2. SEM and mapping images of insitu B-doped graphene/ITO.

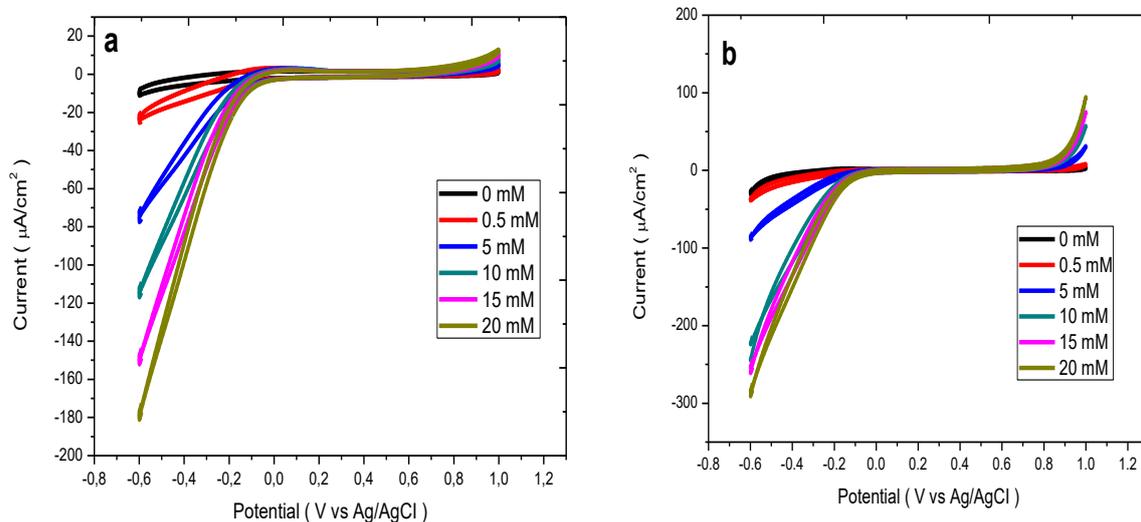
Raman analysis of B doped and insitu B doped few layer graphene was performed to determine impact of defects and layers number of graphene. Figure 3 (a) shows the result of raman spectroscopy of the B-doped graphene/ITO. The D/G and 2D/G ratio were found to be 0.239 and 0.146, respectively. The raman analysis of insitu B-doped graphene/ITO is shown in Figure 3 (b). The D/G and 2D/G ratio were found to be 0.163 and 0.345, respectively. It was observed that the D/G ratio increased slightly while 2D/G ratio decreased compared to graphene/ITO (D/G=0.138 and 2D/G=1.387 for graphene/ITO).



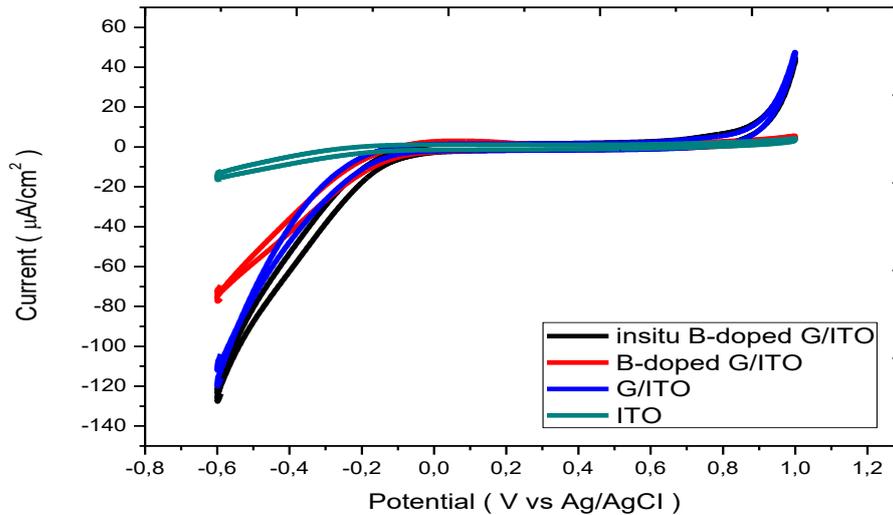
**Figure 3.** Raman spectra of a) B-doped graphene/ITO b) insitu B-doped graphene/ITO.

### 3.2. Electrochemical Measurements of ITO, Graphene/ITO, B-doped graphene/ITO, and insitu B-doped graphene/ITO Electrodes

The ITO, graphene/ITO, B-doped graphene/ITO, and insitu B-doped graphene/ITO electrodes were prepared for detection of  $H_2O_2$ . The electroreduction of  $H_2O_2$  measurements on these electrodes were realized by CV in 0.1 M pH 7.4 PBS. The  $H_2O_2$  sensor activities of B-doped graphene/ITO and insitu B-doped graphene/ITO electrodes in the presence of different  $H_2O_2$  concentration (0-20 mM) in  $N_2$ -saturated 0.1 M pH 7.4 PBS at scan rate of 50 mV/s were presented on Figure 4 (a,b). The current raises stepwise with successive additions of  $H_2O_2$ , ascribed to the sensitive and rapid response to the  $H_2O_2$  reduction of the electrodes. The cyclic voltammograms of the ITO, graphene/ITO, B-doped graphene/ITO, and insitu B-doped graphene/ITO electrodes in the presence (Figure 5) of 5 mM  $H_2O_2$  were recorded. As it could be seen in Figure 5, ITO, graphene/ITO, B-doped graphene/ITO, and insitu B-doped graphene/ITO electrodes exhibited for  $H_2O_2$  at around  $\sim 0.0$  V which corresponded to the reduction reactions of  $H_2O_2$  on electrode surface. Maximum current density for these electrodes was obtained for insitu B-doped graphene/ITO electrode.

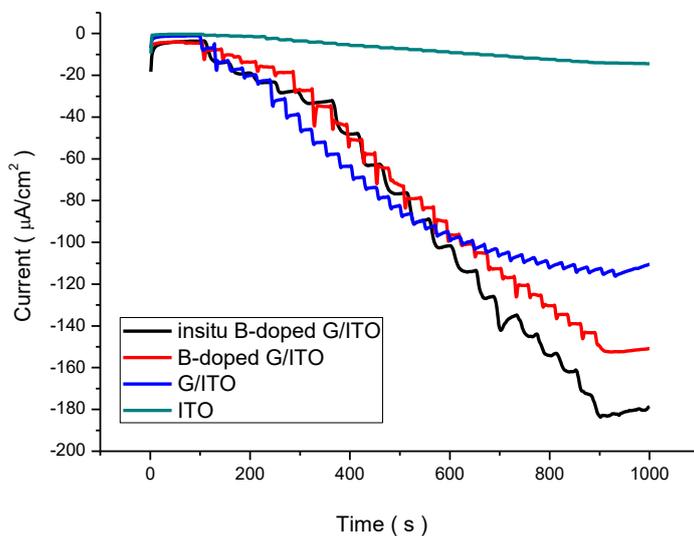


**Figure 4:** Cyclic voltammograms obtained in 0.1 M PBS (pH 7) solution for electrodes modified with B-doped graphene/ITO (a) and insitu B-doped graphene/ITO (b) (scan rate:  $50 \text{ mV s}^{-1}$ ).



**Figure 5:** Cyclic voltammograms obtained by the addition of 5 mM  $\text{H}_2\text{O}_2$  in pH 7 0.1 M PBS for electrodes modified with insitu B-doped G/ITO, B-doped G/ITO, G/ITO, and ITO (scan rate: 50 mV  $\text{s}^{-1}$ )

Moreover, the amperometric curves were taken via CA technique by successive additions of  $\text{H}_2\text{O}_2$  with different concentrations into the stirring 0.1 M  $\text{N}_2$ -saturated PBS at an applied potential of -0.5 V. Typical amperometric responses of the ITO, graphene/ITO, B-doped graphene/ITO, and insitu B-doped graphene/ITO electrodes were illustrated in Figure 6.



**Figure 6:** Amperometric response of  $\text{H}_2\text{O}_2$  successive additions at -0.5 V for electrodes modified with insitu B-doped G/ITO, B-doped G/ITO, G/ITO, and ITO (pH=7 0.1 M PBS).

#### 4. CONCLUSIONS AND DISCUSSION

Herein, the B-doped graphene and insitu B-doped graphene were coated on Cu foil by CVD method. Then, the B-doped graphene and insitu B-doped graphene on the Cu foil were coated onto few-layer the ITO electrode. The B-doped graphene and insitu B-doped graphene structures were clearly visible from SEM images. The insitu B-doped graphene/ITO electrode was exhibited an enhanced catalytic current, ascribed to the structure sensitivity compared other electrodes.

## ACKNOWLEDGEMENTS

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## **O 73. OPTIMAL TUNING OF PID CONTROLLER FOR QUADROTOR SYSTEM USING A NEW ADAPTIVE PARTICLE SWARM OPTIMIZATION**

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**ABSTRACT:** In this study, a detailed mathematical nonlinear dynamic model of the quadcopter system which is derived using the Newton-Euler method. PID controllers are used for controlling the roll, pitch, yaw, and altitude movements of the quadcopter. Manual tuning of PID controllers does not always give acceptable results, consume a long time, and difficult. Therefore, the tuning process of PID controllers is done by particle swarm optimization algorithm (PSO). A new adaptive particle swarm optimization (APSO) algorithm that gives better search efficiency and convergence speed than standard particle swarm optimization is suggested. It enables the automatic control of inertia weight which controls the global and local search abilities of the PSO algorithm. Comparing with the trial and error method and standard PSO algorithm, the adaptive PSO algorithm gives better performance in terms of convergence speed and permanent movement toward the optimal solution region.

*Keywords: Adaptive Particle Swarm Optimization, Self-Tuning PID Controller, Quadcopter System*

### **1. INTRODUCTION**

The quadcopter is the most popular unmanned aerial vehicle (UAV). Recently, it becomes an attractive platform for UAV researches. It is preferred because it has a simple mechanical structure and can perform a different set of tasks. Besides, it has the ability to hover and vertical take-off and landing (VTOL). Quadcopters are used in many civil applications including real-time monitoring, search and rescue operations, disaster management, supplying wireless coverage, remote sensing systems, infrastructure inspection, security and surveillance, delivery of goods, and perform precision agriculture (Shakhatreh et al. 2018).

PID controller is the most widespread type of controller used for ensuring quadcopter stability because it is simple to use and able to offer an effective solution. The tuning process of the PID parameters is too complex and requires enough knowledge about the system being controlled. PID controller performance totally relies on the tuning process of its parameters. A lot of evolutionary algorithms are used for optimal tuning of the PID parameters such as genetic algorithm (Gundogdu, 2005), artificial bees algorithm (Coban et al. 2012), particle swarm optimization algorithm (Berber et al. 2016).

Particle swarm optimization (PSO) algorithm is a population-based search algorithm. It has proved that it can solve many complex optimization problems. In this study, a mathematical modelling of the quadcopter system has been used and performance comparison between various strategies to find the optimal PID parameters has been tested. These strategies are trial and error, standard particle swarm optimization algorithm, and adaptive particle swarm optimization algorithm (APSO). The inertia weight is the most important parameter in particle swarm optimization algorithm. It is the most effective parameter to control global and local search processes. Adaptive particle swarm optimization algorithm (APSO) provides automatic control of inertia weight over time for each particle and iteration. In this study, a new adaptive particle swarm optimization algorithm has been suggested in order to control the local and global search processes and enhance the total performance of the PSO algorithm.

### **2. MATERIAL AND METHOD**

#### **2.1. Quadrotor Model**

The basic dynamical model of the quadcopter is the starting point for lots of researches and generally is derived by the Newton-Euler equations or Euler-Lagrange equations (Luukkonen, 2011). Assuming that

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the quadrotor has symmetrical structure the inertia matrix ( $I$ ) will be diagonal matrix with ( $I_{xx}$ ), ( $I_{yy}$ ), and ( $I_{zz}$ ) the inertia of the vehicle across each axis.

$$I = \begin{bmatrix} I_{xx} & 0 & 0 \\ 0 & I_{yy} & 0 \\ 0 & 0 & I_{zz} \end{bmatrix} \quad (1)$$

The thrust force ( $f_i$ ) created by each rotor ( $i$ ) is vertical to the X-Y plane of the body frame and in the rotor axis direction.

$$f_i = k\omega_i^2 \quad (2)$$

$$\tau_{M_i} = b\omega_i^2 + I_M \dot{\omega}_i$$

Where ( $k$ ) is the lift constant, ( $\omega_i$ ) is the angular velocity for a specific rotor ( $i$ ), ( $b$ ) is the drag constant, and ( $I_M$ ) is the inertia moment of the rotor. The angular velocity and acceleration of the rotor also create torque ( $\tau_{Mi}$ ) that acts to rotate the vehicle about the z-axis. But as the small effect of ( $\dot{\omega}_i$ ) it is usually omitted.

$$T = \sum_{i=1}^4 f_i = k \sum_{i=1}^4 \omega_i^2, \quad T_B = \begin{bmatrix} 0 \\ 0 \\ T \end{bmatrix} \quad (3)$$

The total lift forces of rotors create thrust ( $T$ ) in z axis direction of the body frame. And by decreasing ( $\omega_2$ ) and increasing ( $\omega_4$ ) the roll torque is obtained. Likewise by decreasing ( $\omega_1$ ) and increasing ( $\omega_3$ ), pitch torque is acquired. Also Yaw torque is created by increasing of ( $\omega_2, \omega_4$ ) and decreasing ( $\omega_1, \omega_3$ ). ( $T_B$ ) is thrust in the body frame.

$$\tau_B = \begin{bmatrix} lk(-\omega_2^2 + \omega_4^2) \\ lk(-\omega_1^2 + \omega_3^2) \\ \sum_{i=1}^4 \tau_{M_i} \end{bmatrix} \quad (4)$$

Where ( $\tau_B$ ) is torque in the body frame and ( $l$ ) is the arm length of the quadrotor.

$$I \dot{v} + v \times (Iv) + \Gamma = \tau \quad (5)$$

The external torque ( $\tau$ ) in the body frame created by the angular acceleration ( $\dot{v}$ ), gyro scoping forces, and moments ( $\Gamma$ ) applied by rotors. Therefor the change in roll ( $p$ ), pitch ( $q$ ), and yaw ( $r$ ) rates can be obtained from this equation:

$$\dot{v} = I^{-1} \left( - \begin{bmatrix} p \\ q \\ r \end{bmatrix} \times \begin{bmatrix} I_{xx}p \\ I_{yy}q \\ I_{zz}r \end{bmatrix} - I_r \begin{bmatrix} p \\ q \\ r \end{bmatrix} \times \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} \omega_\Gamma + \tau \right) \quad (6)$$

$$\Leftrightarrow \begin{bmatrix} \dot{p} \\ \dot{q} \\ \dot{r} \end{bmatrix} = \begin{bmatrix} (I_{yy} - I_{zz})qr / I_{xx} \\ (I_{zz} - I_{xx})pr / I_{yy} \\ (I_{xx} - I_{yy})pq / I_{zz} \end{bmatrix} - I_r \begin{bmatrix} q / I_{xx} \\ -p / I_{yy} \\ 0 \end{bmatrix} \omega_\Gamma + \begin{bmatrix} \tau_\phi / I_{xx} \\ \tau_\theta / I_{yy} \\ \tau_\psi / I_{yy} \end{bmatrix}$$

The rotation matrix ( $R$ ) from the inertial frame to the body frame using the aerospace rotation sequence, and this matrix has special importance in resolving the velocity and position state equations.

$$R = \begin{bmatrix} C_\theta C_\psi & S_\phi S_\theta C_\psi - C_\phi S_\psi & S_\phi S_\psi + C_\phi S_\theta C_\psi \\ C_\theta S_\psi & C_\phi C_\psi + S_\phi S_\theta S_\psi & C_\phi S_\theta S_\psi - S_\phi C_\psi \\ -S_\theta & S_\phi C_\theta & C_\phi C_\theta \end{bmatrix} \quad (7)$$

Where  $S_x = \sin(x)$ ,  $C_x = \cos(x)$ . The matrix  $H_\phi$  represents the transformation matrix for angular velocities from the inertial frame ( $v$ ) to the body frame ( $\dot{\Phi}$ ).

$$\dot{\Phi} = H_\phi v$$

$$\begin{bmatrix} \dot{\phi} \\ \dot{\theta} \\ \dot{\psi} \end{bmatrix} = \begin{bmatrix} 1 & T_\theta S_\phi & T_\theta C_\phi \\ 0 & C_\phi & -S_\phi \\ 0 & S_\phi / C_\theta & C_\phi / C_\theta \end{bmatrix} \begin{bmatrix} p \\ q \\ r \end{bmatrix}$$

(8)

In the body frame, the needed force for the acceleration of mass  $m \dot{V}_B$  and the centrifugal force  $v \times (mV_B)$  are equal to the sum of the gravity  $R^T G$  and the total thrust of the rotors  $T_B$ .

$$m \dot{V}_B + v \times (mV_B) = R^T G + T_B \quad (9)$$

In the inertial frame, the acceleration of the quadrotor is affected just by the magnitude and direction of the thrust and the gravitational force because the centrifugal force is cancelled.

$$m \ddot{X} = G + RT_B$$

$$\begin{bmatrix} \ddot{x} \\ \ddot{y} \\ \ddot{z} \end{bmatrix} = -g \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} + \frac{T}{m} \begin{bmatrix} c\psi s\theta c\phi + s\psi s\phi \\ s\psi s\theta c\phi - c\psi s\phi \\ c\theta c\phi \end{bmatrix} \quad (10)$$

## 2.2. PID Controller Design

PID controller is the most widespread strategy to control the quadcopter system (Bolandi et al. 2013; Mohammed et al. 2014). It is a type of feedback controller which is used to control the quadcopter altitude with the roll, pitch, and yaw angles. The transfer function of the PID controller uses the following form:

$$u = K_p e(t) + K_i \int_0^t e(t) dt + K_d \frac{de(t)}{dt} \quad (11)$$

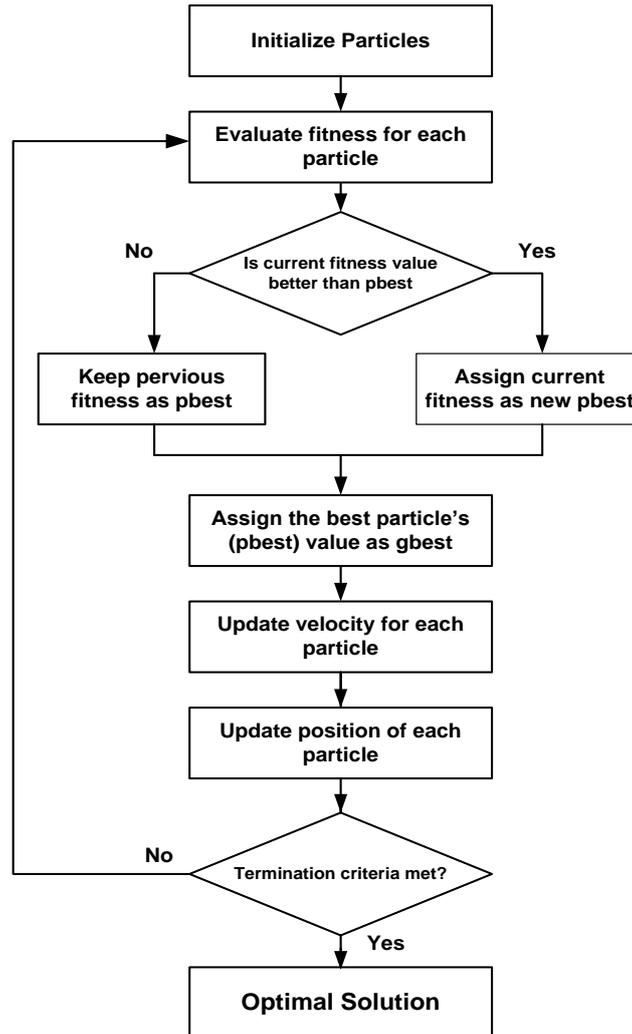
$K_p$ ,  $K_d$ , and  $K_i$  indicate to the proportional, derivative, and integral parameters respectively that need to be tuned. The PID controller goals to minimize the error signal ( $e$ ) between the reference value and the measured output.

The tuning process of the PID parameters determines the controller performance. In this paper, an adaptive particle swarm optimization algorithm is used to tune the PID parameters in order to find its optimal values. Besides, the tuning process is also done by standard particle swarm optimization and trial and error method.

## 2.3. Standard Particle Swarm Optimization

Particle swarm optimization algorithm, a population-based evolutionary computational method, was proposed by Eberhart and Kennedy in 1995 (Eberhart and Kennedy, 1995). It searches for the optimal solution of a problem by iteratively improving the available solutions inspired by the flocking of birds and schooling of fish.

PSO algorithm is initialized with a number of random particles and every single particle represents one possible solution to the related problem. These particles are evaluated each iteration according to its fitness function. Particles have velocities to steer them toward the current optimal particle. Figure 1 displays the flow chart of a particle swarm optimization algorithm.



**Figure 1.** Flow Chart of Particle Swarm Optimization Algorithm

Each particle represents three parameters which are the proportional, derivative and integral gains of PID controller. PSO algorithm starts the first iteration with a number of particles that carry random values. These particles update their values in every iteration by the pbest and gbest particles. pbest particles are the same particle's best-known position during all iterations, while the gbest particle is the swarm's best-known position in the same iteration. PSO algorithm updates the particle's values and velocities depending on the two best values with the following equations:

$$V_i^{(t+1)} = w * V_i^{(t)} + c_1 * r_1 * (x_{i,best}^{(t)} - x_i^{(t)}) + c_2 * r_2 * (x_{gbest}^{(t)} - x_i^{(t)}) \quad (12)$$

$$x_i^{(t+1)} = x_i^{(t)} + V_i^{(t+1)} \quad (13)$$

PSO algorithm uses the inertia weight ( $w$ ), the acceleration coefficients ( $c_1$ ) and ( $c_2$ ), and two random numbers ( $r_1, r_2$ ) within the range  $[0, 1]$ . Standard PSO algorithm supposes that the inertia weight  $w=1$  and the acceleration coefficients  $c_1=c_2=2$ . The fitness value of particles determines the pbest and gbest particles in each iteration. The gbest particle is the particle that holds the best fitness value among all particles in the same iteration. Also, the pbest particles are the particles that hold the best fitness value among the same particles during all iterations. The stopping condition in PSO algorithm may be a determined number of iterations or a constant value of the fitness value.

#### 2.4. Proposed Adaptive Particle Swarm Optimization

Adaptive particle swarm optimization algorithm (APSO) provides control ability of inertia weight, acceleration coefficients, and other algorithmic parameters in every iteration. Inertia weight parameter noticeably affects the global search ability (exploration) and local search ability (exploitation) in the

PSO process. Since the beginning of Inertia Weight in PSO, a large number of strategies to control inertia weight have been proposed (Bansal et al. 2011; Alhasan and Gunes, 2017).

When inertia weight has a large value, the PSO algorithm facilitates the global search more than the local search. The PSO algorithm also facilitates the local search more than the global search when inertia weight has a low value. This balancing between the global and local search processes improve the performance of PSO algorithm.

In this paper, we have adjusted the value of the inertia weight ( $w$ ) adaptively by this new equation:

$$\alpha_{1,i}^K = \frac{F_{pbest,i}^K}{2F_{p,i}^K}$$

$$\alpha_{2,i}^K = \frac{F_{gbest}^K}{2F_{pbest,i}^K} \tag{14}$$

$$w_i^K = w_{\max} - (w_{\max} - w_{\min}) \times (\alpha_{1,i}^K + \alpha_{2,i}^K)$$

The inertia weight ( $w$ ) values range from the upper limit ' $w_{\max}=0.9$ ' to the lower limits ' $w_{\min}=0.3$ '. Every particle in the swarm has a different inertia weight value in the same iteration. The values of ( $\alpha_1, \alpha_2$ ) determine the evolutionary states of the particles in the swarm. If a particle has an unsuccessful solution ( $F_{p,i} >> F_{pbest,i} >> F_{gbest}$ ), the values of ( $\alpha_1, \alpha_2$ ) will be too close to zero and the inertia weight will have a large value in order to enhance the global search ability. If a particle has a successful or a good solution ( $F_{p,i} \approx F_{pbest,i} \approx F_{gbest}$ ), the values of ( $\alpha_1, \alpha_2$ ) will be too close to (0.5) and the inertia weight will have a low value in order to enhance the local search ability.

The fitness function used to evaluate particles in PSO algorithm is sum square error (SSE) and as follows:

$$F = 0.25(\phi_r - \phi)^2 + 0.25(\theta_r - \theta)^2 + 0.25(\psi_r - \psi)^2 + 0.25(z_r - z)^2 \tag{15}$$

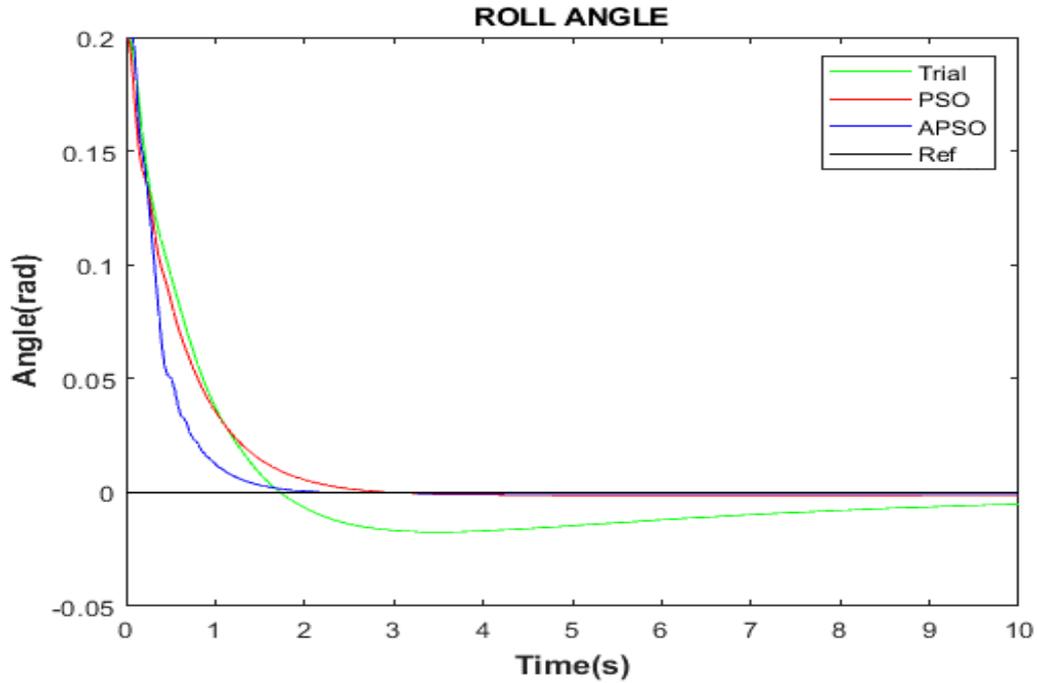
The symbols  $\phi_r, \theta_r, \psi_r$ , and  $z_r$  are the reference values of the roll, pitch, yaw, and altitude respectively.

### 3. RESEARCH FINDINGS

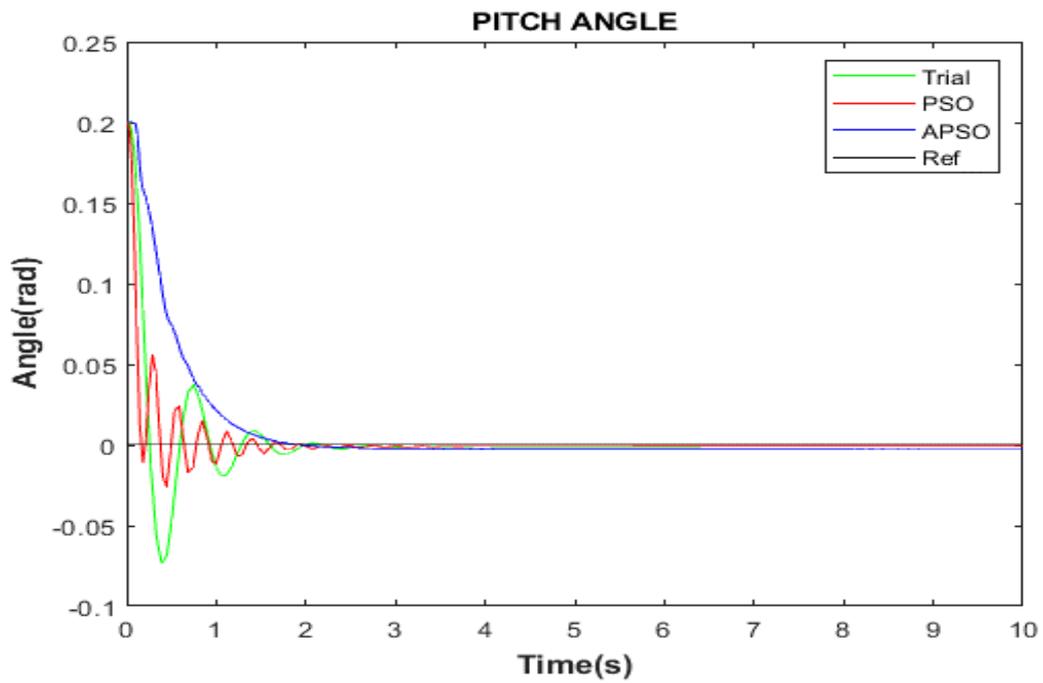
In this section a comparison and simulation results for three methods to tune the parameters of PID controllers of the quadcopter system. These methods are trial and error, standard particle swarm optimization (PSO) and the proposed adaptive particle swarm optimization (APSO).

PID controllers of quadcopter system are modelled and simulated using the MATLAB/Simulink environment. In this simulation, initially, the roll  $\phi$ , pitch  $\theta$ , yaw  $\psi$  angles are set to (0.2) radians and altitude  $z$  initialized to (3) meters. The reference value of  $\phi, \theta$ , and  $\psi$  angles is set to (0) radians, while the reference value of altitude  $z$  is set to (4) meters. Figures (2-4) show the roll ( $\phi$ ), pitch ( $\theta$ ), and yaw ( $\psi$ ) angles response using the PID controller which is tuned by three strategies. Altitude ( $z$ ) response using the tuned PID controller is shown in Figure 5.

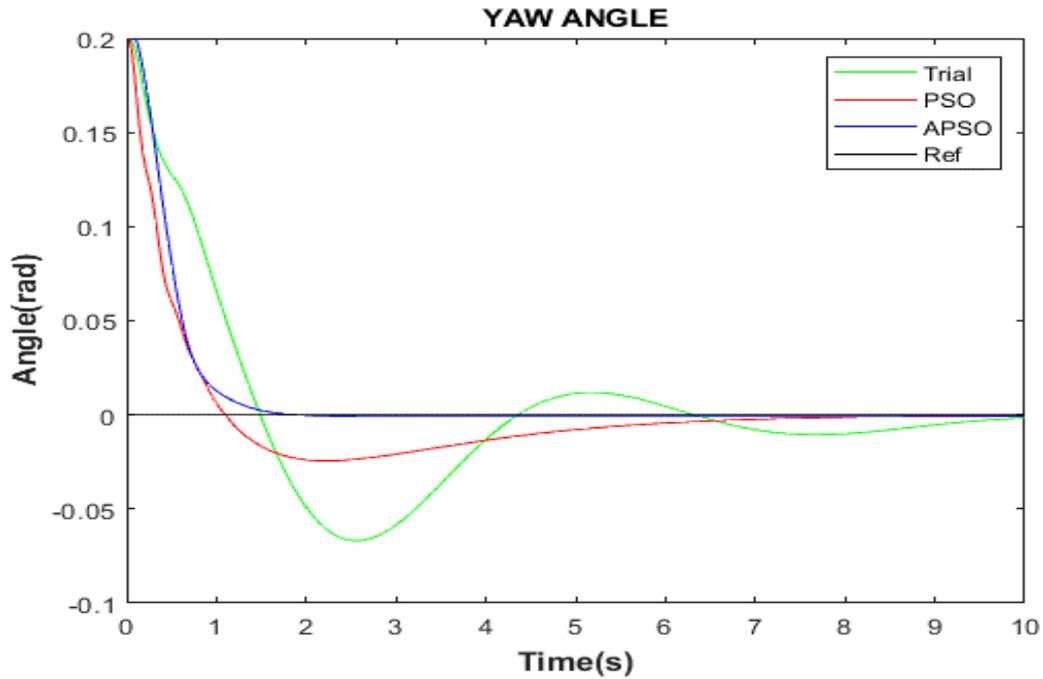
The first strategy to tune the PID controller is a trial and error method. The second strategy to tune the PID controllers is done using the standard particle swarm optimization algorithm. The inertia weight is set to '1' and the acceleration coefficients are set to '2' in the second strategy. The third strategy to tune the PID controllers is done using the adaptive particle swarm optimization algorithm where the inertia weight is adapted according to equation (14) and the acceleration coefficients are set to '2'.



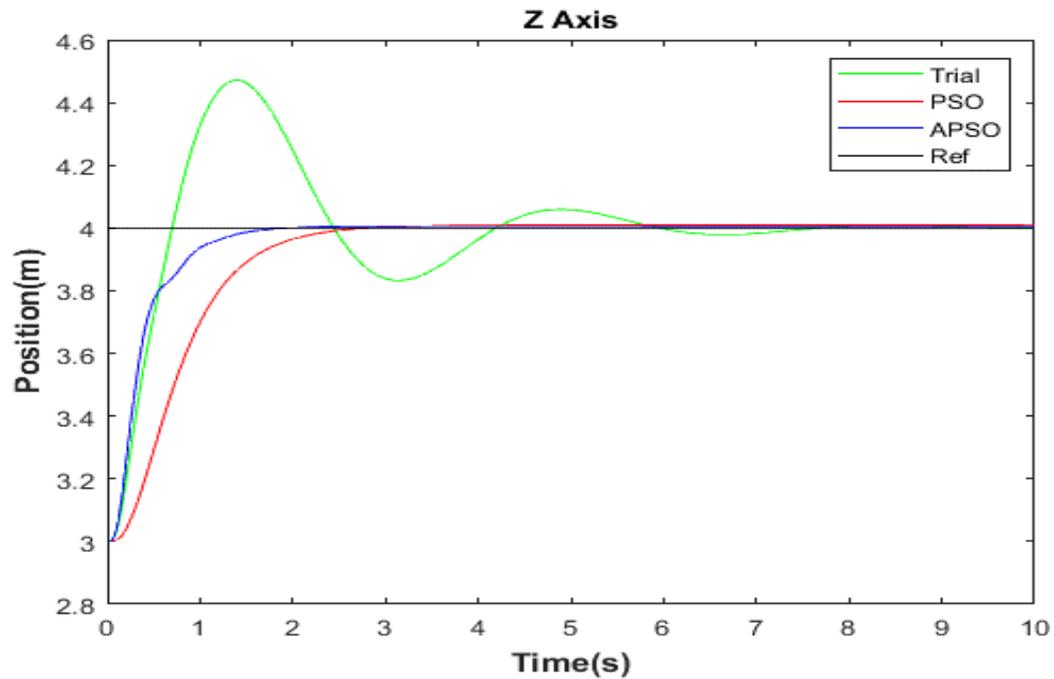
**Figure 2.** Time Response of the Roll Angle of the Quadcopter System Using PID Controller.



**Figure 3.** Time Response of the Pitch Angle of the Quadcopter System Using PID Controller.



**Figure 4.** Time Response of the Yaw Angle for the Quadcopter System Using PID Controller.



**Figure 5.** Time Response of the Altitude for the Quadcopter System Using PID Controller.

The time response specification of quadcopter system using PID controllers tuned by trial and error, standard PSO, and the proposed adaptive PSO algorithm are given in Tables 1-4.

**Table 1.** Time Response Specification for the Roll Angle of the Quadcopter System.

Roll Angle ( $\Phi$ )	Trial and Error	Standard PSO	Adaptive PSO
Settling time(s)	11.1	2.15	1.42
Rise time(s)	1.14	1.24	0.7
Overshoot (%)	8.68	0.64	0.23

Steady state error	0	0	0
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**Table 2.** Time Response Specification for the Pitch Angle of the Quadcopter System.

Pitch Angle ( $\theta$ )	Trial and Error	Standard PSO	Adaptive PSO
Settling time(s)	1.86	1.55	1.53
Rise time(s)	0.15	0.09	0.88
Overshoot (%)	36.85	12.87	1.21
Steady state error	0	0	0

**Table 3.** Time Response Specification for the Yaw Angle of the Quadcopter System.

Yaw Angle ( $\psi$ )	Trial and Error	Standard PSO	Adaptive PSO
Settling time(s)	9.27	6.14	1.37
Rise time(s)	1.16	0.75	0.65
Overshoot (%)	33.43	12.19	0.48
Steady state error	0	0	0

**Table 4.** Time Response Specification for the Altitude Z of the Quadcopter System.

Altitude Position (Z)	Trial and Error	Standard PSO	Adaptive PSO
Settling time(s)	6.82	2.22	1.39
Rise time(s)	0.47	1.24	0.72
Overshoot (%)	11.78	0.23	0.16
Steady state error	0	0	0

#### 4. CONCLUSIONS AND DISCUSSION

In this study, a PID controller is designed and tuned in order to stabilize the quadcopter system. PID controller is tuned by three strategies which are trial-and-error, standard particle swarm optimization (PSO), and the proposed adaptive particle swarm optimization (APSO). The simulation results show that the suggested adaptive PSO algorithm gives the best convergence speed and permanent movement toward the optimal solution region.

The suggested adaptive particle swarm optimization algorithm (APSO) depends on the fitness values of particles, pbest particles, and gbest particle to do an automatic control of inertia weight. The inertia weight in the PSO algorithm does balancing between the global and local search processes. Inertia weight must be large in the global search process and low in the local search process.

From the performance indices, the proposed adaptive PSO strategy gives the best PID parameters to control the roll, pitch, yaw, and altitude that offers a response with the lowest overshoot, settling time and has no steady-state error. The tuning process of the PID controllers using trial and error strategy has the worst response specifications. The standard PSO strategy to tune the PID controllers gives acceptable responses to control of the roll, pitch, yaw, and altitude. Besides, there is no steady-state error for all PID controllers using the three strategies.

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## O 74. TRACE ELEMENT DETERMINATION BY ELECTROCHEMICAL METHODS

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**ABSTRACT:** Today, heavy metals emitted to the environment have been the subject of research to cause both environmental problems and health problems. Therefore, a simple, fast and effective method for the determination of trace amounts of heavy metals has been developed. Among the techniques developed, electrochemical methods (cyclic voltammetry, differential pulse voltammetry, chronoamperometry, electrochemical impedance spectroscopy, etc.) are the most powerful and sensitive method for heavy metal detection (Khadro et.al.2011; Wassana et.al.2007). Moreover, these methods are cheap, sensitive, rapid and portable (Pujol et.al.2014). The advantage of anodic stripping technique is the pre-concentration step, which enables such low concentration analysis. Therefore, different nanomaterials with high adsorption capability and catalytic activity are usually used for electrochemical detection of heavy metals. Ferrite nanoparticles has attracted great attention for high adsorption capacity and magnetism. In this study, NiFe<sub>2</sub>O<sub>4</sub> based modified glassy carbon electrode was developed to detect copper (Cu<sup>2+</sup>) and mercury (Hg<sup>2+</sup>) by differential pulse voltammetry.

*Keywords: Differential pulse voltammetry, Trace metal detection, Cu<sup>2+</sup>, Hg<sup>2+</sup>.*

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## **O 75. SENSITIVE HYDROGEN PEROXIDE SENSOR BASED ON BIMETALLIC CATALYSTS**

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**ABSTRACT** In this study, Pd and PdAu catalysts were synthesized by NaBH<sub>4</sub> reduction method and the activity of these catalysts for H<sub>2</sub>O<sub>2</sub> reduction has been measured by cyclic voltammetry (CV) and chronoamperometry (CA) techniques. Electrochemical sensitivities of these CNT supported different atomic ratio PdAu bimetallic nanocatalysts were determined in 0.1 M pH 7.4 phosphate buffer solution towards H<sub>2</sub>O<sub>2</sub>.

*Keywords: Hydrogen peroxide, Platinum, Gold, NaBH<sub>4</sub> Reduction*

### **1. INTRODUCTION**

Hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) has importance in many areas such as clinical, food, pharmaceutical, and environmental because of its strong oxidizing and reducing ability (Yang, et al., 2015). Therefore, fast and accurate determination of H<sub>2</sub>O<sub>2</sub> is very important. Various methods have been developed for the determination of H<sub>2</sub>O<sub>2</sub> such as titrimetry (Hurdis et al., 1956), fluorescence (Cathcart et al., 2015), spectroscopy (Luo et al., 2008), chemiluminescence (Xu et al., 1999), and electrochemical methods (Guascito et al., 2008). Comparing with these methods, electrochemical method is preferred due to its high sensitivity, selectivity, and simplicity. Various chemically modified electrodes, especially enzyme modified electrodes have been widely developed for the detection of hydrogen peroxide (Wang et. all, 2015). However, the main problem is that the activity of enzyme can be easily affected by temperature, pH, humidity, and toxic chemicals. Moreover, the complicated immobilization procedures may also decrease the activity of the enzyme and have influence on the stability and reproducibility of the enzyme based electrodes. Therefore to resolve these problems, numerous studies have focused on developing non-enzymatic electrodes. In this study, Pd and PdAu catalysts were synthesized by NaBH<sub>4</sub> reduction method and the activity of these catalysts for H<sub>2</sub>O<sub>2</sub> reduction has been measured by cyclic voltammetry (CV) and chronoamperometry (CA) techniques.

### **2. MATERIAL AND METHOD**

#### **2.1. Synthesis of Catalysts**

All chemicals used in this study namely carbon Vulcan XC-72, Nafion 117, AuCl<sub>3</sub> K<sub>2</sub>PdCl<sub>4</sub>, CNT were of analytical grade and purchased from Sigma-Aldrich. Electrocatalysts were synthesized via NaBH<sub>4</sub> reduction method. CNT was used as the support material, and the percentage of metals loaded on the CNT support was 10 wt%. CNT was dispersed in 10 ml of purified water. Then, Pd and Au salts were transferred to the solution. The content was dispersed with ultrasonic bath and magnetic stirrer for 80 min. After, NaBH<sub>4</sub> was added to the catalyst ink, and the mixture was mixed with magnetic stirrer for 40 min. Following this, catalyst ink was dried and filtered. As a result, Pd/CNT and PdAu/C were synthesized at varying atomic ratios.

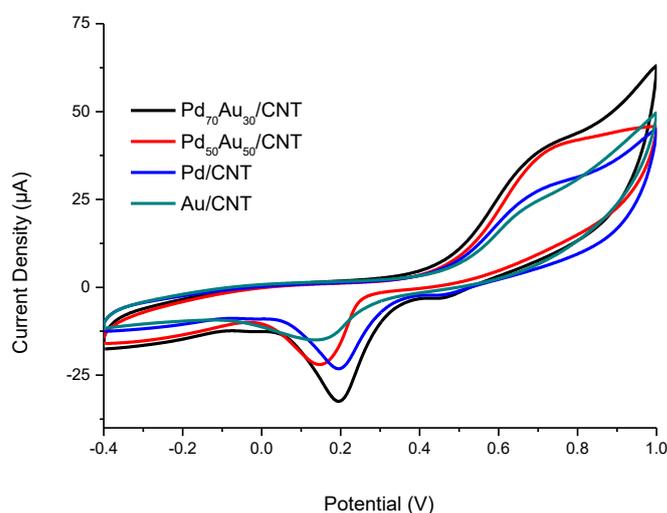
#### **2.2. Electrochemical Measurements**

Electrochemical measurements were performed on Pd/CNT and PdAu/CNT catalysts. H<sub>2</sub>O<sub>2</sub> electroreduction measurements were performed via cyclic voltammetry (CV) and chronoamperometry (CA). Electrochemical measurements were performed with CHI 6043d potentiostat, with a three electrode cell system consist of platinum wire as counter electrode, Ag/AgCl as reference electrode and Pd based catalysts modified glassy carbon electrode (GCE, 3 mm diameter) as the working electrode.

Glassy carbon electrodes were polished successively using 1, 0.3, 0.05  $\mu\text{M}$  alumina powder and then thoroughly rinsed with deionized water. All the electrochemical measurements were carried out in 0.1 M phosphate buffer solution (pH 7.4). Prior to measurements, the solution was deoxygenated with nitrogen gas.

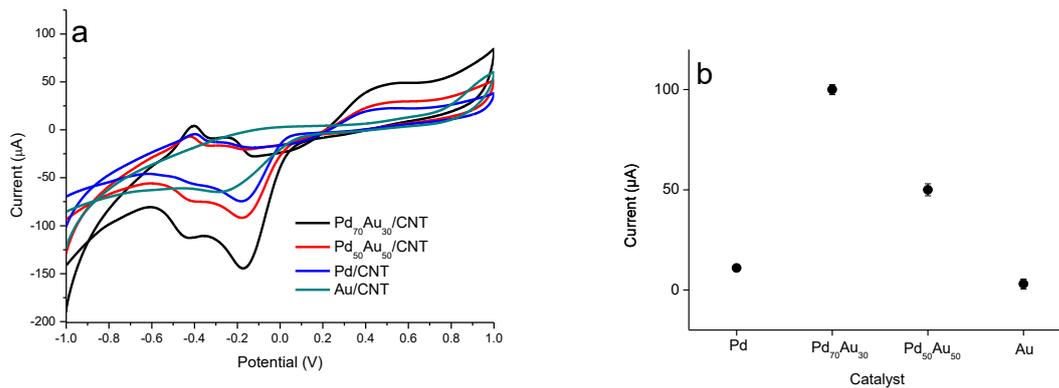
### 3. RESEARCH FINDINGS

Pd/CNT, Au/CNT, Pd<sub>70</sub>Au<sub>30</sub>/CNT and Pd<sub>50</sub>Au<sub>50</sub>/CNT catalysts were prepared for detection of H<sub>2</sub>O<sub>2</sub>. To calculate the electrochemical surface areas of the electrodes, the CVs were carried out in 5.0mM Fe(CN)<sub>6</sub><sup>3-/4-</sup> containing 0.1 M KCl (Figure 1) at different sweep rates (v) . The electrochemical surface area can be determined using the Randles–Sevcik equation. The calculated electroactive surface area of the Pd<sub>70</sub>Au<sub>30</sub>/CNT GCE was 0.16 cm<sup>2</sup>, which is about 2.0, 1.78 and 1.34 times higher than that of Au/CNT (0.08 cm<sup>2</sup>), Pd/CNT (0.09 cm<sup>2</sup>) and Pd<sub>50</sub>Au<sub>50</sub>/CNT (0.12 cm<sup>2</sup>) GCEs, respectively. These results indicated that the Pd<sub>70</sub>Au<sub>30</sub>/CNT catalyst has excellent electrochemical properties to increase the reaction surface area of the electrode and enhance the electron transfer.



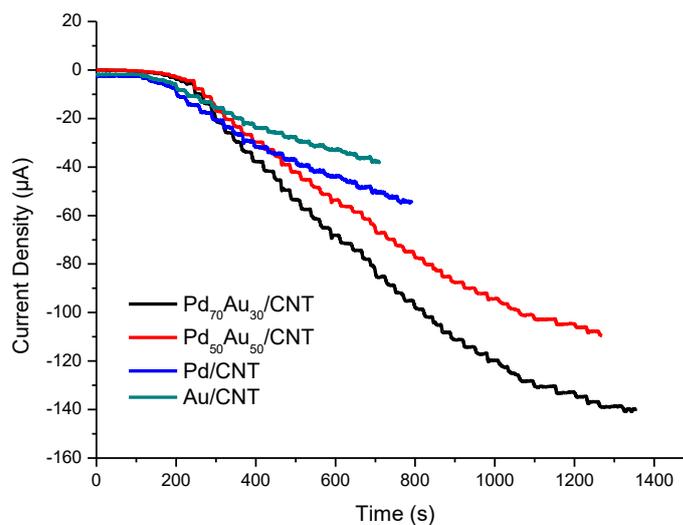
**Figure 1.** Cyclic voltammograms of the of Pd/CNT, Au/CNT, Pd<sub>70</sub>Au<sub>30</sub>/CNT and Pd<sub>50</sub>Au<sub>50</sub>/CNT GCEs in 5.0 mM Fe(CN)<sub>6</sub><sup>3-/4-</sup> +0.1 M KCl. Scan rate: 100 mVs<sup>-1</sup>

The electroreduction of H<sub>2</sub>O<sub>2</sub> measurements on these catalysts were carried out by cyclic voltammetry (CV) in 0.1 M pH 7.4 phosphate buffer solution (Figure 2a). The electro-reduction of H<sub>2</sub>O<sub>2</sub> occurs at around -0.4 V. The sensitivity of the catalysts towards H<sub>2</sub>O<sub>2</sub> (Fig. 2b) increases in the order of Au/CNT<Pd/CNT<Pd<sub>50</sub>Au<sub>50</sub>/CNT<Pd<sub>70</sub>Au<sub>30</sub>/CNT. Obviously, Pd<sub>70</sub>Au<sub>30</sub>/CNT showed the highest oxidation current among all the other catalysts. Pd<sub>x</sub>Au<sub>y</sub>/CNT bimetallic catalysts exhibit an enhanced remarkable catalytic current peak greater than the current peaks of Pd/CNT and Au/CNT catalysts. This result showed that alloying Pd with Au enhanced the electrocatalytic performance towards H<sub>2</sub>O<sub>2</sub> detection due to the synergistic effect between Pd and Au.



**Figure 2.** (a) Cyclic voltammograms, (b) sensitivity values for Pd/CNT, Au/CNT, Pd<sub>70</sub>Au<sub>30</sub>/CNT and Pd<sub>50</sub>Au<sub>50</sub>/CNT catalysts to the addition of 5 mM H<sub>2</sub>O<sub>2</sub> in N<sub>2</sub> saturated 0.1 M phosphate buffer solution at pH 7.4, scan rate: 100 mV/s.

Figure 3 shows typical amperometric response of the Pd/CNT, Au/CNT, Pd<sub>70</sub>Au<sub>30</sub>/CNT and Pd<sub>50</sub>Au<sub>50</sub>/CNT GCEs to the successive additions of H<sub>2</sub>O<sub>2</sub> at an applied potential of -0.4 V. Compared with the other catalysts modified GCEs, the response of Pd<sub>70</sub>Au<sub>30</sub>/CNT modified GCE possesses wider linear range and higher sensitivity.



**Figure 3.** Amperometric response of the Pd/CNT, Au/CNT, Pd<sub>70</sub>Au<sub>30</sub>/CNT and Pd<sub>50</sub>Au<sub>50</sub>/CNT GCEs for the successive addition of different concentration of H<sub>2</sub>O<sub>2</sub> into constantly stirred 0.1 M phosphate buffer solution, pH 7.4 . Applied potential: -0.4 V.

#### 4. CONCLUSIONS AND DISCUSSION

The new H<sub>2</sub>O<sub>2</sub> sensor was constructed by Pd/CNT, Au/CNT, Pd<sub>70</sub>Au<sub>30</sub>/CNT and Pd<sub>50</sub>Au<sub>50</sub>/CNT catalysts. Electrochemical experiments were conducted to examine the effect of second metal addition to electrochemical sensing ability. These experiments indicated that the prepared Pd<sub>70</sub>Au<sub>30</sub>/CNT sensor displayed good performance for H<sub>2</sub>O<sub>2</sub> detection with low working potential and high sensitivity.

#### ACKNOWLEDGEMENTS

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**O 76. A PRACTICAL CLASSIFICATION TO SUSTAINABLE ROAD SLOPE STABILITY  
ASSESSMENT, ALANYA-KONYA ROADWAY, TURKEY: CASE STUDY**

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**ABSTRACT:** Today, a vast range of slope stability analysis tools exist for both rock and mixed rock-soil slopes. As is well known, Rock mass classification systems (RMR, SMR, GSI, Q, CSMR..etc) that describes quality of a rock mass, can be used to assess rock slope stability, hence, this paper intended to employing SMR classification, to prove that a rigorous rock mass classification will give more reliable if uncertain parameters are dropped and considered indirectly. The present study was carried out of 19 rock cuts in which 3 different causes of instability (Planer, Wedge, Toppling) along Hadim – Gevne dam segment of the Konya –Alanya roadway, located in southwest of Turkey. This segment was a problematic due to the existence of lithological units with variable characters (recrystallized limestone, dolomite – limestone, reefal limestone, conglomerate and Quaternary deposits). However, the cut slopes are located within recrystallized limestone, reefal limestone and dolomite– limestone hard to extremely hard and highly jointed. During field studies, most of the observed failure modes planer, wedge, toppling was controlled by discontinuities. In order to determine engineering geological properties of the rocks exposed along the roadway, then assess stability of the cut slopes, nineteen cut slopes were detailed identified. A detail field investigation has been carried out according to suggested methods by ISRM and all field observations/measurements parameters were recorded, which involved a detailed discontinuity surveys discontinuity conditions (dips/strikes, persistence, spacing, aperture, infilling) with scan-line method, geometrical relationship between slope and rock discontinuities (dips angles and slope), slope excavation methods and; underground water condition. Based on the field observations, stability analyses of the cut slopes and SMR study concluded that the slopes can be categorized into partially stable (50%), unstable (30%) and completely unstable (20%) with probable planar failure mode (20%), toppling failure mode (27%) and wedge failure mode (53%). Slope flattening with various angles, wire mesh and drainage ditches are suggested as a remedial solution to ensure slope stability of the studied road.

*Keywords: Road Slope Stability, Rock mass classification, SMR, field observations, Alanya-Konya roadway*

## **O 77. ROOFTOP RAINWATER HARVESTING OPTIMIZATION IN ANTALYA, TURKEY**

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**ABSTRACT:** The water resources of the world are consuming rapidly due to the population increases and growing industrializing world. Sustainable water resources management seems a solution for managing the scarce water resources. Rainwater harvesting can reduce water shortage problems, especially in countries which suffer from water scarcity. Saving of freshwater resources is essential for water conservation. In domestic uses, the non-potable water demand especially in toilets flushing can be changed with rainwater harvesting. In this study, Water Balance Model (WBM) and Rippl Method (RM) are used to investigate the optimization of rooftop rainwater harvesting in Antalya province of Turkey. The reliability analysis of the rooftop rainwater harvesting and optimal storage estimation analysis have done for system optimization. Comparisons among annual, eight, seven and six months regularizations are made in order to make the rainwater harvesting system feasible and cost-effective. For Antalya rooftop rainwater harvesting system, individual houses (a 6 household family water demand for toilets flushing 24 L/ca/day) are assessed by using the WBM and RM. For optimal rainwater storage tanks estimation 60, 40 and 35 m<sup>2</sup> rooftop areas are selected for annual, eight, and seven/six months regularizations respectively for supplying the water demand of toilets flushing with 90-100% reliability. Comparisons between two methods for optimal rainwater harvesting storage tanks are made in order to recommend a suitable method for storage tanks estimation. For annual regularizations, 21 m<sup>3</sup> and 17 m<sup>3</sup> storage tanks are estimated with RM and WBM respectively. Thus, WBM is recommended for Antalya province. For eight, seven and six months regularizations with RM; 9, 7, and 4 m<sup>3</sup> storage tanks are estimated respectively. The storage cost and payback period for annual regularization is 3600 TL and 24 years respectively. Storage, costs about 50% of the rooftop rainwater harvesting. Hence, twofold of storage cost might give the cost of the rooftop rainwater harvesting system.

*Keywords: Alternative water resources, Rainwater harvesting, Rainwater harvesting optimizations, Sustainable water resources management, Water saving.*

### **1. INTRODUCTION**

Rainwater harvesting is one of the ancient water harvesting technique which is most common in dry regions of the world. Nowadays, rainwater harvesting is using for sustainable water resources management especially in developed countries. For none-developed countries, rooftop rainwater harvesting system is using for water supply and irrigation purposes. However, in developed countries, rainwater harvesting uses for saving the main water use. Water resources becoming scarce day by day. Turkey is among water-stressed countries and is expected to become water-poor country in the coming decade. In Turkey, the rainwater harvesting might be used for saving the main water use. Using the harvested rainwater in domestic non-potable demands can save a big amount of main water use. For rainwater harvesting system feasibility study is crucial, a feasibility study should be made prior to the system design. The most expensive part of the system is a storage tank. For rainwater harvesting system, the storage tank is the biggest factor of total installation cost (Chilton et al., 2000). For becoming the system more feasible and applicable prior to the design of the system optimizations should be made especially for optimal storage tanks design.

For water scarcity problems, investment in rainwater harvesting system seems to reduce the potable water consumption and reduce the upcoming water scarcity situations (EEA, 2012). For potable water savings, some studies about rainwater harvesting conducted worldwide. In Sweden using the collected rainwater in toilets flushing in a residential area could save about 60% of the urban water supply (Villarreal and Dixon, 2005). In the United Kingdom, rooftop rainwater harvesting system can fulfil 36% to 46% of toilets flushing water demand with 23 and 7 years payback periods respectively (Ward et al.,

2010). Using of collected rainwater in residential buildings might supply about 40% of potable water demand (Muthukumaran et al., 2011).

In this study, for rainwater harvesting optimizations in Antalya province; annual, eight months, seven months and six months regularizations are made in order to design the system more feasible and reliable for future rainwater harvesting projects in the mentioned province. In this study, a 6 household family (water consumption in 6 household family toilets flushing demand 24 L/ca/day) is selected in order to design the optimal storage tanks for the various regularizations, the most suitable regularization can be recommended for an optimal storage tank.

## 2. MATERIALS AND METHODS

Daily and monthly rainfall data are used for most rainwater harvesting studies around the world. In this study, the average total monthly rainfall data of Antalya province is used. For hydro-meteorological studies, reliable data has a great importance. For rainwater harvesting analysis long-term rainfall data should be used. One of the reasons for the use of long-term precipitation data is that the average data to be obtained is more reliable (Turoğlu, 2014). It has been proposed that rainfall data should be longer than 10 years for the rainwater harvesting studies (Martin and Watkins, 2010). The average annual rainfall in Antalya is 1082 mm which most of the rainfall occurs during the winter season of December and January months.

In this study, for rainfall regime analysis, total annual precipitation data were used for Precipitation Concentration Index (PCI). For optimum storage tanks estimation, WBM and RM are used. For optimal storage tanks estimation average total monthly precipitation data is used. The most expensive part of the rooftop rainwater harvesting system is storage tanks. For system reliability and cost-effectiveness, rainfall regime analysis and optimization are conducted. PCI is used for rainfall regime analysis. A conceptual model of the study is given in Figure 1.

### 2.1 Precipitation Concentration Index (PCI)

Precipitation Concentration Index (PCI) (Oliver, 1980), an indicator of the concentration of rainfall in Antalya province was calculated for each year. Then, the average PCI values of annual PCI were calculated for obtaining the temporal PCI.

Temporal PCI was calculated using eq. (1):

$$PCI \text{ annual} = \frac{\sum_{i=1}^{12} P_i^2}{(\sum_{i=1}^{12} P_i)^2} * 100 \quad (1)$$

Where  $P_i$ , represents the monthly precipitation in the  $i$ .th month.

The PCI values under 10 indicate the uniform distribution of rainfall throughout the year. The values between 10-20 indicate seasonality and the values greater than 20 indicate that the precipitation is irregular throughout the year (Table 1). Many methods for concentration analysis of precipitation data are used worldwide. A study conducted in Turkey for reflecting the concentration of rainfall concentration, the PCI was estimated to be more appropriate than Modified Fournier Index (MFI) (Apaydin et al., 2006). The classification of PCI is given in Table 1.

**Table 1.** Classification of precipitation concentration index (Oliver, 1980)

Precipitation Concentration Index	Temporal PCI Concentration
<10	Uniform
11-15	Moderate
16-20	Concentrated
>20	Very Concentrated

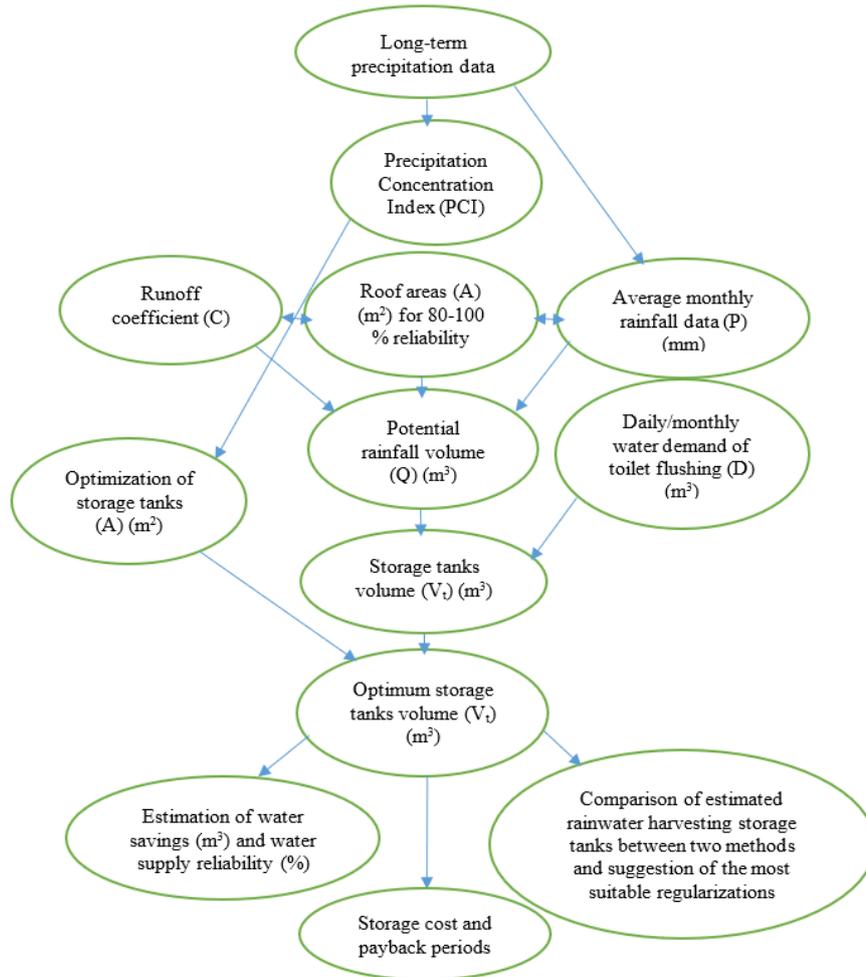


Figure 1. Conceptual model of the study

### 2.2 Water Balance Model

The most commonly used method to estimate the volume of optimum rainwater storage tanks is WBM. In this study monthly WBM was used by taking into account the monthly rainfall, water collection area, leakage and evaporation-related losses, storage volume and water usage (Imteaz et al., 2012). With this model, monthly rainwater usage, monthly volume of stored water in the tank can be calculated. The list of the data required for the estimation of the storage tank with the WBM is given in Table 2.

Table 2. WBM and necessary data for the estimation of the storage tank

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7	Column 8
Months	Average monthly rainfall (mm)	Monthly demand (m <sup>3</sup> )	Collecting area (m <sup>2</sup> )	Volume of monthly rainfall (m <sup>3</sup> )	V <sub>i month-1</sub> (m <sup>3</sup> )	(Column 5-Column 3) (m <sup>3</sup> )	V <sub>i month later</sub> (m <sup>3</sup> )
Jan							
...							
Dec							

Storage tank capacity (m<sup>3</sup>)= X(The biggest value)

To better describe the WBM, the required data for the estimating of the storage tanks is presented in Table 2:

**Column 1:** time (month),

**Column 2:** average monthly rainfall is obtained based on the average monthly rainfall of time series (mm), time series in this study for Antalya is between 1929-2017 years,

**Column 3:** Monthly consumption refers to the volume of drinking water that can be changed with rainwater (m<sup>3</sup>). In this study the daily water consumption in the toilets flushing for a family of 6 members for individual houses is 24 L/ca/day considered (DIN, 1989), a daily water demand 144 L/day, monthly water demand 4.32 m<sup>3</sup>/month and annual water demand of 53 m<sup>3</sup>/year,

**Column 4:** total collection area (m<sup>2</sup>), in this study for 6 household family 60, 40 and 35 m<sup>2</sup> collection areas are selected due to the amount of precipitation and obtaining the volumetric reliability of (80-100%),

**Column 5:** it was obtained by multiplying column 2 by column 4 and according to (DIN, 1989), with the coefficient of flow required for impermeable areas (C) being taken as 0.8. Volume of monthly rainfall (m<sup>3</sup>) is calculated by using eq. (2):

$$Q(m^3) = \frac{(P - EL) * C * A}{1000} \quad (2)$$

P: average annual rainfall,

EL: precipitation losses (2mm/month, 24 mm/year) (Martin, 1980),

C: flow coefficient of (80-85%) recommended by (DIN, 1989) for impermeable areas in this study 80% value is selected,

A: roof area (m<sup>2</sup>),

**Column 6:** corresponds to the volume of water in the tank at the beginning of a month (m<sup>3</sup>),

**Column 7:** is calculated by the difference between monthly precipitation amount (column 5) and the monthly consumption (column 3) (m<sup>3</sup>),

**Column 8:** The cumulative maximum positive difference corresponds to the optimal volume of the storage tank (m<sup>3</sup>).

In the WBM, the volume of the water in the tank at the beginning of a certain month ( $V_{i \text{ month } -1}$ ) was initially assuming the tank is empty. The largest positive value from column 8 gives the minimum storage volume.

Mathematically, the model is expressed as follow:

$$V_{i \text{ month later}} = V_{i \text{ month } -1} + (V_{i \text{ month}} - D_{i \text{ month}}) \quad (3)$$

$$V_{i \text{ month later}} = 0, \text{ if } V_{i \text{ month later}} < 0 \quad (4)$$

$$V_{i \text{ month later}} = C_{i \text{ month}}, \text{ if } V_{i \text{ month later}} > C_{i \text{ month}} \quad (5)$$

$V_{i \text{ month later}}$ : The volume of accumulated water stored in a tank after a certain month (m<sup>3</sup>),

$V_{i \text{ month}}$ : Volume of rainwater stored in a given month (m<sup>3</sup>),

$V_{i \text{ month } -1}$ : The volume of water in the tank at the beginning of a given month (m<sup>3</sup>),

$D_{i \text{ month}}$ : Water demand in a given month (m<sup>3</sup>),

$C_{i \text{ month}}$ : Capacity of rainwater storage tank (m<sup>3</sup>).

Volumetric reliability can be calculated by using eq. (6):

$$R_v = \frac{\text{Water Supply}}{\text{Water Demand}} * 100 \quad (6)$$

For optimization of rainwater harvesting storage tanks of Antalya province by using the WBM and RM an individual house of (a 6 member family toilets flushing water use 24 L/ca/day) annual water demand of 53 m<sup>3</sup>/year is selected.

### 2.3 Rippl Method

In order to determine storage tanks for rooftop rainwater harvesting, it can be determine with RM which provides the storage volume required to ensure a regular flow during the longest drought period (Quadros, 2010). Among the most suitable methods to determine the storage volume for rainwater harvesting are the daily simulation using the 80% efficiency criteria, which is the most appropriate rate of economic saving/installation cost and the RM (Santos and Taveira-Pinto, 2013). The RM corresponds to the maximum (positive) accumulated difference between the water demand and the collected rainwater. The list of data required for the estimation of the storage tanks by RM is given in Table 3.

**Table 3.** Data required for estimation of the storage tank by RM (Tomaz, 2003)

Column 1	Column 2	Column 3	Column 4	Column 5	Column 6	Column 7
Months	Average monthly rainfall (mm)	Monthly demand (m <sup>3</sup> )	Collecting area (m <sup>2</sup> )	The volume of monthly rainfall (m <sup>3</sup> )	(Column 3– Column 5) (m <sup>3</sup> )	Cumulative differences from column 6 (m <sup>3</sup> )
Jan						
...						
Dec						

Storage tank capacity (m<sup>3</sup>)= X(The biggest value)

The procedure of estimation of optimum rainwater storage tanks with RM is similar to WBM from column 1 to column 5. In RM the procedure of calculation for column 6 and column 7 is different from the WBM. For a better understanding of RM column 6 and 7 are described as below:

**Column 6:** is obtained by the difference between the monthly consumption (column 3) and the monthly precipitation amount (column 5) (m<sup>3</sup>),

**Column 7:** Cumulative differences are calculated by ignoring the negative values obtained from column 6 in the first months. The cumulative maximum positive difference corresponds to the minimum volume of the storage tank (m<sup>3</sup>).

### 3. RESULTS AND DISCUSSIONS

As the result of rainfall regime analyses, Antalya has very concentrated precipitation with 21.15 PCI value (Himat, 2019). For the desired demand of water supplying by rainwater, the biggest storage tanks among Turkey provinces are required in Antalya province due to the very concentrated precipitation patterns. In this study, the daily water consumption in the toilets flushing for a 6 household family of individual houses is 24 L/ca/day considered (DIN, 1989), a daily water demand 144 L/day, monthly water demand 4.32 m<sup>3</sup>/month and annual water demand of 53 m<sup>3</sup>/year family is selected. Accordingly, a comparison for Antalya province will be made between the WBM and the RM used for optimal rainwater harvesting storage tanks estimation.

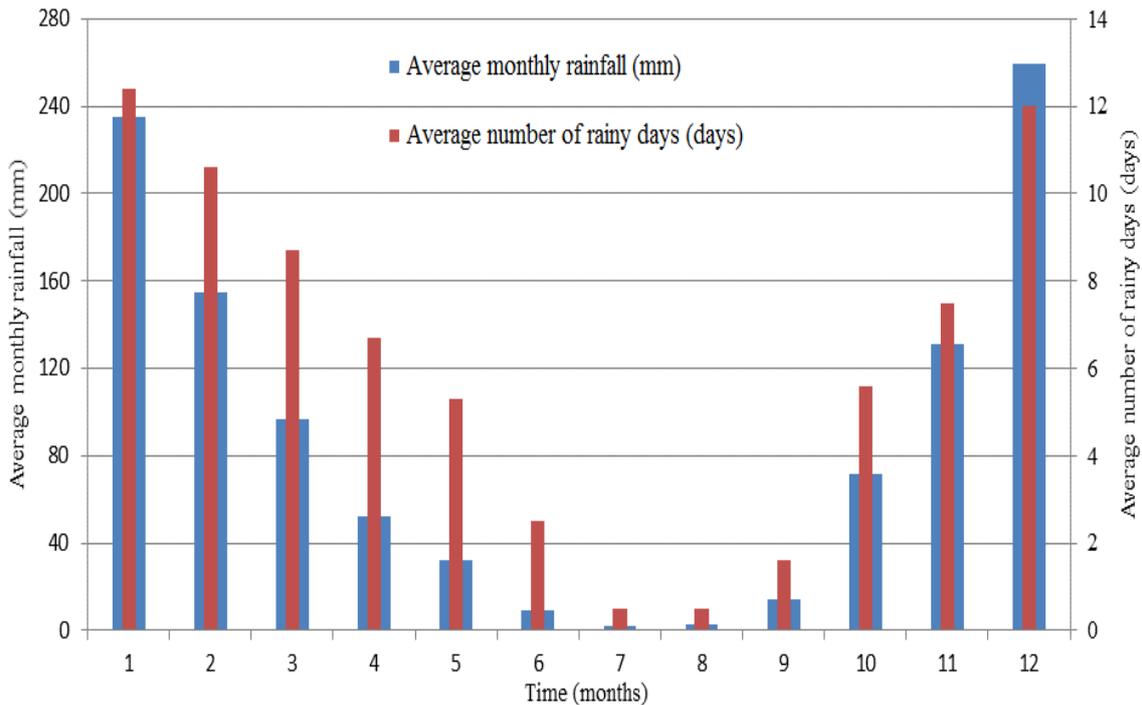
Provinces which require big storage tanks for rainwater harvesting system feasibility and economically design optimizations should be made prior to the projects implementation. WBM and RM, annual, 8, 7 and 6 months regularizations for Antalya province are given in (Table 4, Table 5, and Table 6). It was estimated by RM that 21 m<sup>3</sup> of the storage tank and 60 m<sup>2</sup> roof area are required in order to obtain 53 m<sup>3</sup>/year of water supply with 96% volumetric reliability (Table 4). Furthermore, for 8 months regularization, it was estimated by RM that 9 m<sup>3</sup> of the storage tank and 40 m<sup>2</sup> roof area are required in order to obtain 35 m<sup>3</sup>/8 months of water supply with 94% volumetric reliability (Table 5). With the 8 month regularization for Antalya province, it is possible to estimate 42% smaller storage tanks with the RM. Estimation of the storage tanks for individual houses by the RM with annual regularizations for Antalya province (water consumption in 6 household family toilets flushing demand 24 L/ca/day) is given in Table 4.

**Table 4.** Estimation of the storage tanks for individual houses by the RM with annual regularization for Antalya

Method	Average annual rainfall(mm)	Roof area (m <sup>2</sup> )	Demand (m <sup>3</sup> )	Supply (m <sup>3</sup> )	Volumetric Reliability (%)	Selected storage tank (m <sup>3</sup> )
<b>RM</b>	<b>1082</b>	<b>60</b>	<b>53</b>	<b>51</b>	<b>96</b>	<b>21</b>

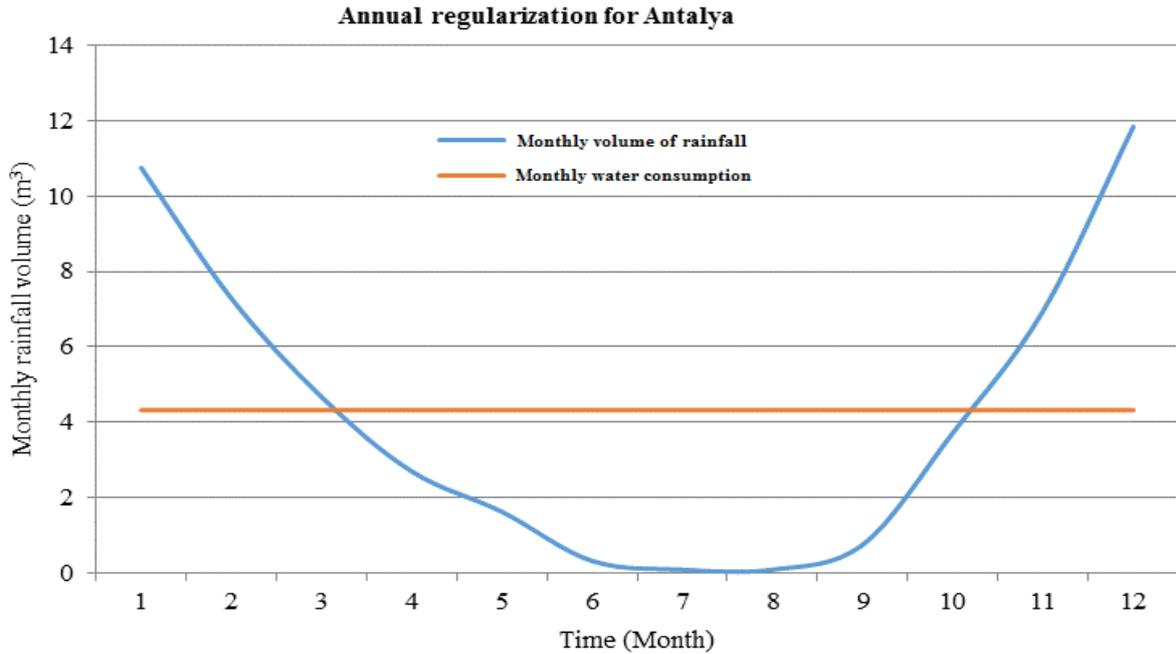
Long-term monthly average rainfall distribution and a number of average rainy days in Antalya (1929-2017) is illustrated in Figure 2. As shown in Figure 2, the average monthly precipitation distribution of Antalya has very big fluctuations. The fluctuations in the rainfall distribution might increase the storage

requirements of the rainwater harvesting system. Summer season in Antalya is very dry. In June, July and August there is an average monthly rainfall of less than 10 mm (Figure 2). Rainwater harvesting is not effective in summer due to the very low rainfall during the season. Rainwater harvesting is more effective in autumn, winter and spring seasons of the year. In Antalya, the average number of rainy days show 12 rainy days in December and January, 11 rainy days in February and less than 10 rainy days in other months (Figure 2). July and August are the driest months of the year with the average monthly precipitation of 2.5 mm and 0.5 rainy days. During the year, there are only 74 rainy days the rest of the year is dry. Thus, it is mentioned as 20% wet season and 80% dry season in Antalya.



**Figure 2.** Monthly average rainfall distribution and number of average rainy days in Antalya (1929-2017)

Annual regularization for the differences between monthly water demand and monthly rainfall volume of Antalya is illustrated in Figure 3.



**Figure 3.** Annual regularization for the differences between water demand and rainfall volume of Antalya

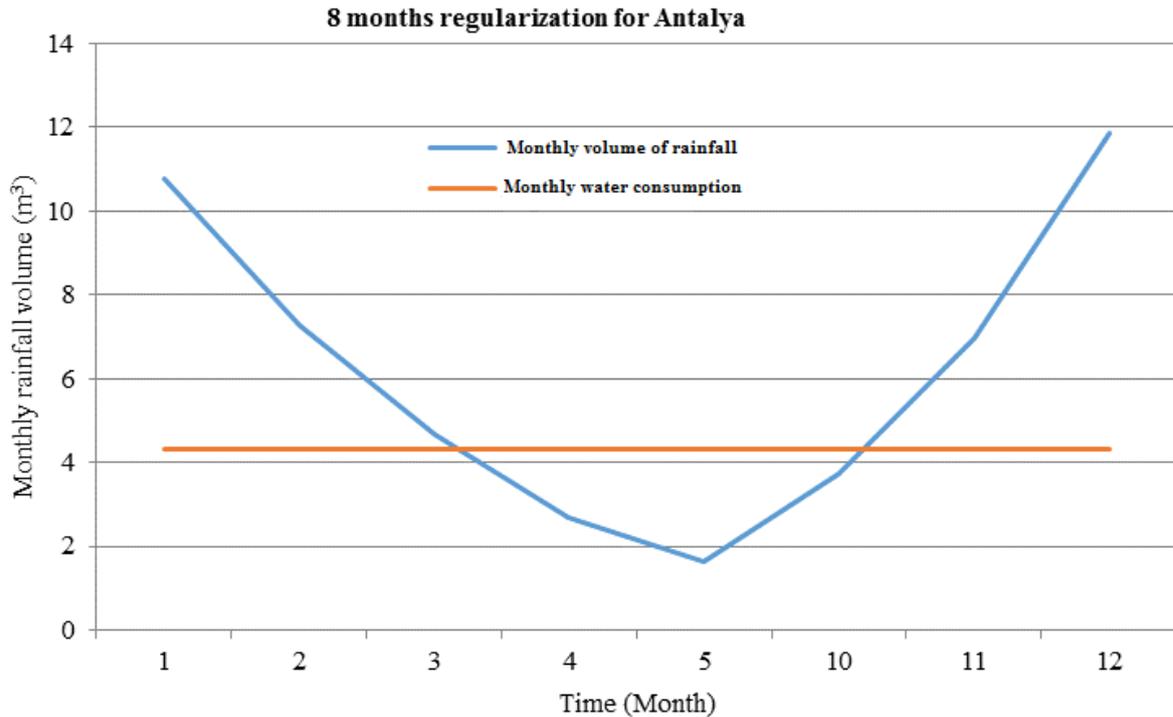
As seen in Figure 3, the difference between monthly water volume and monthly water consumption is enormous. This is the reason for the big storage requirement. Hence, by using some regularizations it can be possible to decrease the difference between water supply and water demand. Regularizations of different months should be used to select the most appropriate time periods of the year for rainwater harvesting with a small storage tanks.

Estimation of the storage tanks for individual houses by the RM with 8 months regularizations for Antalya province is given in Table 5.

**Table 5.** Estimation of storage tanks for individual houses by the RM with 8 months regularizations for Antalya

Metho d	Average 8 months rainfall(mm)	Roof area (m <sup>2</sup> )	Demand (m <sup>3</sup> )	Supply (m <sup>3</sup> )	Volumetric Reliability (%)	Selected storage tank (m <sup>3</sup> )
<b>RM</b>	<b>1048</b>	<b>40</b>	<b>35</b>	<b>33</b>	<b>94</b>	<b>9</b>

Eight months regularization for the differences between monthly water demand and monthly rainfall volume of Antalya is illustrated in Figure 4. The difference between water demand and volume of rainfall is smaller than annual regularization. So, it can be possible to supply the water demand by smaller storage tank.



**Figure 4.** Eight months regularization for the differences between water demand and rainfall volume of Antalya

It was estimated that 17 m<sup>3</sup> of the storage tank is required by the WBM in order to supply 53 m<sup>3</sup>/year of water with 96% volumetric reliability in Antalya (Table 6). However, for 8 months regularization by the RM, it was estimated that 9 m<sup>3</sup> of the storage tank is required in order to supply 35 m<sup>3</sup>/8 months of water with 94% volumetric reliability in Antalya (Table 5). Furthermore, it was found that for annual regularization 30% smaller storage tanks can be estimated by the WBM than RM. It is recommended to use the WBM for the estimation of storage tanks of rainwater harvesting, as the WBM gives better results than the RM. Estimation of the storage tanks for individual houses by the WBM with annual regularizations for Antalya province is given in Table 6.

**Table 6.** Estimation of storage tanks for individual houses by the WBM with annual regularization for Antalya

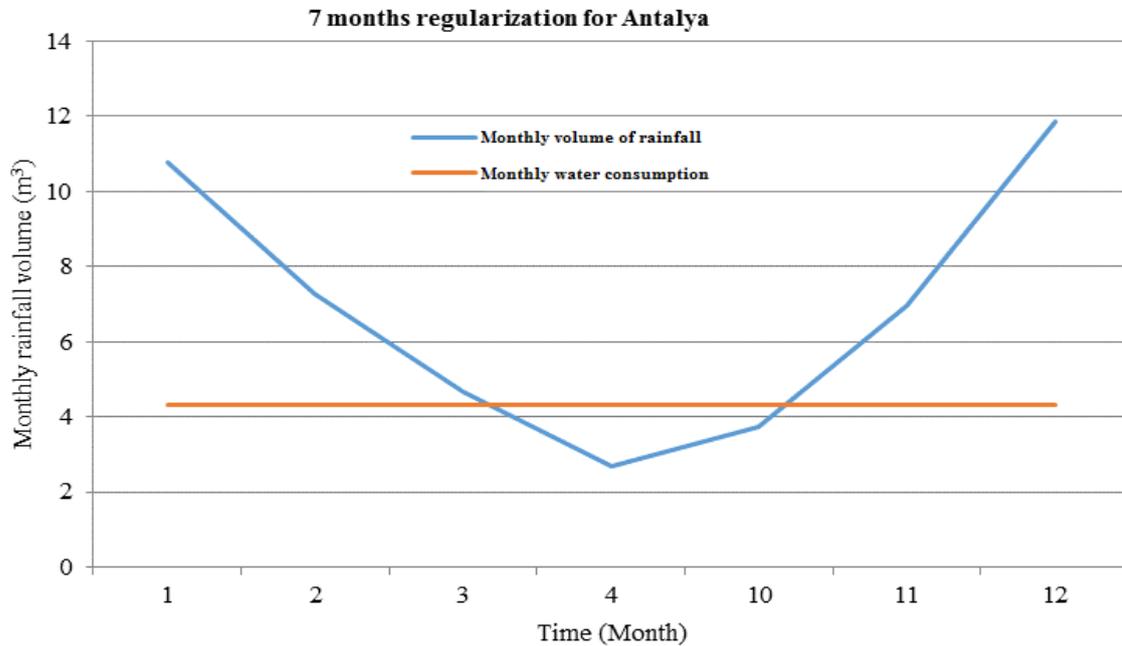
Method	Average annual rainfall(mm)	Roof area (m <sup>2</sup> )	Demand (m <sup>3</sup> )	Supply (m <sup>3</sup> )	Volumetric Reliability (%)	Selected storage tank (m <sup>3</sup> )
<b>WBM</b>	<b>1082</b>	<b>80</b>	<b>53</b>	<b>51</b>	<b>97</b>	<b>17</b>

Estimation of the storage tanks for individual houses by the RM with 7 months regularizations for Antalya province is given in Table 7. For seven months, 28 m<sup>3</sup> water can be supplied from the rainwater using a 35 m<sup>2</sup> roof area with 7 m<sup>3</sup> storage tank (Table 7).

**Table 7.** Estimation of storage tanks for individual houses by the RM with 7 months regularizations for Antalya

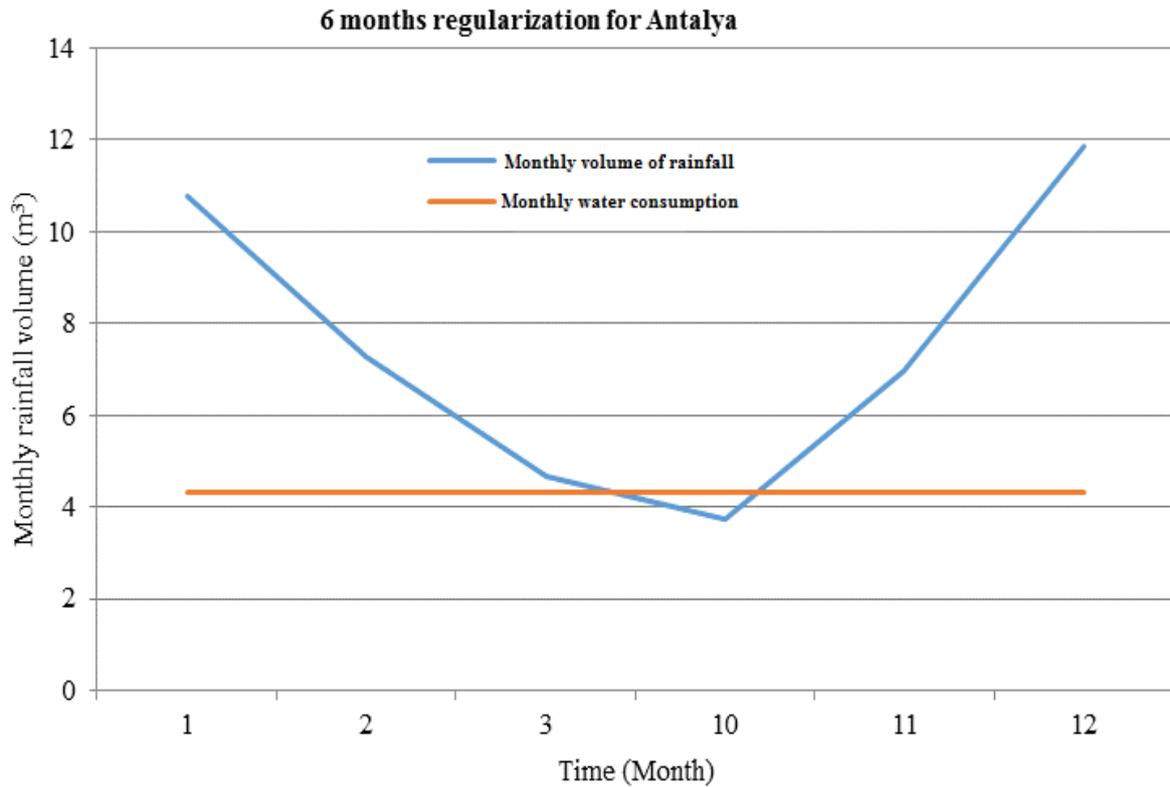
Method	Average 7 months rainfall (mm)	Roof area (m <sup>2</sup> )	Demand (m <sup>3</sup> )	Supply (m <sup>3</sup> )	Volumetric Reliability (%)	Selected storage tank (m <sup>3</sup> )
<b>RM</b>	<b>1012</b>	<b>35</b>	<b>31</b>	<b>28</b>	<b>92</b>	<b>7</b>

Seven months regularization for the differences between monthly water demand and monthly rainfall volume of Antalya is illustrated in Figure 5. The difference between water demand and volume of rainfall is smaller than 8 months regularization. Hence, smaller storage tank can supply the demand.



**Figure 5.** Seven months regularization for the differences between water demand and rainfall volume of Antalya

Six months regularization for the differences between monthly water demand and monthly rainfall volume of Antalya is shown in Figure 6. The difference between water demand and volume of rainfall is smaller than 7 months regularization. So, it is possible to supply the demand of water from rainwater with smaller storage tank. For the rainwater harvesting in Antalya, we can make the system more economical by 6 months regularizations (January, February, March, October, November, and December) (Table 8).



**Figure 6.** Six months regularization for the differences between water demand and rainfall volume of Antalya

Estimation of the storage tanks for individual houses by the RM with 6 months regularizations for Antalya province is given in Table 8. For six months, 26 m<sup>3</sup> water can be supplied from the rainwater using a 35 m<sup>2</sup> roof with 4 m<sup>3</sup> storage tank (Table 8).

**Table 8.** Estimation of storage tanks for individual houses by the RM with 6 months regularizations for Antalya

Method	Average 6 months rainfall (mm)	Roof area (m <sup>2</sup> )	Demand (m <sup>3</sup> )	Supply (m <sup>3</sup> )	Volumetric Reliability (%)	Selected storage tank (m <sup>3</sup> )
<b>RM</b>	<b>954</b>	<b>35</b>	<b>26</b>	<b>26</b>	<b>100</b>	<b>4</b>

In Antalya province by installing a 4 m<sup>3</sup> storage for rooftop rainwater harvesting it will be possible to supply the demand of 6 family toilets flushing in a six rainy months of the year. By installing the rooftop rainwater harvesting system in public/commercial buildings, it is possible to harvest a big amount of water and supply most of the toilets flushing water demand.

#### 4. CONCLUSION

For rainwater harvesting, feasibility studies are crucial, so prior to the design of the system feasibility and optimization studies should be made in order to make the system applicable and cost-effective. Comparisons among two methods and regularizations for the rainwater harvesting in Antalya province are made in order to make the system more feasible and applicable for the mentioned province. For annual regularizations, 21 m<sup>3</sup> and 17 m<sup>3</sup> storage tanks are estimated with RM and WBM respectively. Thus, WBM is recommended for Antalya province. For eight, seven and six months regularizations with RM; 9, 7, and 4 m<sup>3</sup> storage tanks are estimated respectively. The storage cost and payback period for annual regularization is 3600 TL and 24 years respectively. Storage, costs about 50% of the rooftop rainwater harvesting. Hence, twofold of storage cost might give the cost of the rooftop rainwater harvesting system. For Antalya province, according to the comparisons between RM and WBM it was

found that WBM estimated smaller storage tanks than RM. In Antalya, it is possible to harvest rainwater by installing 5-20 m<sup>3</sup> storage tanks from the roof areas of 30-60 m<sup>2</sup> for supplying the demand of toilets flushing of 6 member family houses. It was estimated that for annual regularization there is a need for 17 m<sup>3</sup> storage tank. The obtained results for regularizations show that 4 m<sup>3</sup> storage tank is required for half year supplying the desired demand of toilets flushing. Thus, for Antalya porovince six months regularization is recommended. In public/commercial buildings by installing the rooftop rainwater harvesting system it is possible to harvest a big amount of water and supply most of the toilets flushing water demand. According to the obtained results, it is possible to harvest rainwater even in Antalya province which has very concentrated precipitation. Regions which has concentrated and very concentrated PCI, optimization studies are essential for cost-effective system design.

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**O 78. "GREEN SYNTHESIS" OF SILVER NANOPARTICLES AND EVALUATION OF THEIR CATALYTIC ACTIVITY ON REDUCTION OF METHYLENE BLUE**

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**ABSTRACT:** Synthesis of metallic nanoparticles can be realized by various methods such as chemical vapour deposition, physical vapor deposition, microwave-assisted synthesis, sol-gel method, ultrasonication method, electrochemical synthesis and chemical reduction of metallic ions. However, these techniques are expensive, non-ecofriendly and often contain harmful chemicals. As a result of increasing interest in green chemistry and other biological processes, scientists have turned to an eco-friendly nanoparticle synthesis that is simple, affordable, compatible with biomedical and pharmacological applications. Different contents existing in plant extracts such as polysaccharides, polyphenols, aldehydes, ketones, proteins/enzymes, amino acids and caffeine can reduce metal ions and stabilize the nanoparticles to preferred sizes and shapes.

A green approach for the synthesis of silver nanoparticles (AgNPs) using water extract of *Tussilago farfara* plant under ambient conditions is reported in this study. The formation of AgNPs was analyzed by UV-visible spectrophotometer. Further, the effects of pH, temperature, and time on the formation of AgNPs were studied. From the results, it can be claimed that the formation of AgNPs mainly depends on the pH of the reaction medium. The formation of AgNPs occurs in neutral and basic pH which is evident from visual observation. Moreover, the catalytic effectiveness of the synthesized green catalyst, AgNPs, was also investigated in catalytic reduction of Methylene Blue (MB) dye. The reduction of dyestuff is confirmed by the decrease in absorbance maximum values of MB with respect to time using UV-visible spectrophotometer. The reaction was completed within 10 min, inferring excellent catalytic properties of silver nanoparticles in the reduction of MB.

*Keywords:* Silver, nanoparticle, methylene blue, reduction, green synthesis

**O 79. EVALUATION OF THE ASH BEHAVIOR SIMULATING COFIRING OF COAL AND BIOMASS**

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**ABSTRACT:** Cofiring is the combustion of more than one fuel and it is specifically a process of combustion of biomass together with coal for the industrial applications such as power plants. Cofiring has many advantages: these are environmental, economical or technical. The environmental advantages of cofiring include the mitigation of types pollution such as air, soil and water. Cofiring reduce water pollution depending on the chemical composition of biomass. Cofiring process can cause some problems such as sintering, fouling, slagging or ash deposition because of the high content of alkali metals in biomass and some coal. Sintering cause the ash deposition because of that initial ash sintering temperatures should be understood in order to prevent the problem and that is detected by cold compression strength tests. All in all, mineral phases of biomass and coal ash after cofiring influence the power plants and types of biomass ash that are preferred significantly depends on its heating value. Biomass that has high heating value, provides more energy recovery and better system performance that gives more efficiency and economical saving to power plants.

*Keywords: Cofiring, Biomass, Coal, Slagging, Fouling*

## O 80. USABILITY OF ARTIFICIAL NEURAL NETWORKS FOR SEDIMENT ESTIMATION

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**ABSTRACT:** Sediment estimation is very important as water resources projects with high costs cause the economic life of projects to decrease more quickly. In order to prevent the decrease in the economic life of the dam reservoirs and to reduce the sedimentation in the dam reservoirs, it is also necessary to determine the sediment carried by the river. Recently Artificial Neural Network (ANN) is widely used to solve the complex problems such as sediment. In this study, the flow (m<sup>3</sup>/sec) and sediment (ton/day) data of the Söğütlühan Observation Station during the 1994-2011 periods in the Kızılırmak Basin are used for the sediment estimation. The results of ANN models and sediment rating curve method were compared. As a result of the comparison, it was seen that ANN models were more successful than sediment rating curve for sediment estimation.

*Keywords: Artificial Neural Network, Kızılırmak Basin, Sediment, Sediment Rating Curve*

### 1. INTRODUCTION

The utilization rate of hydraulic potential, which is one of the most important renewable energy sources, has become an indicator of the development and industrialization of countries. While the rate of utilization of hydraulic potential is 80% in developed countries, this rate is 25-30% in developing countries (EIE, 2000). Therefore, studies on the use of hydraulic potential are expected to increase in the future in developing countries. Dams are built on the rivers in our country for purposes such as agriculture, industry and drinking water, flood control and energy production. The sediment, such as soil, sand, silt, clay and gravel, which are carried by the streams that feed the lakes of dams, fill the dam reservoirs, reduce their storage capacity and consequently shorten the economic life of the dams (Kişi et al., 2003). In countries with semi-arid climate and a complex topography, such as Turkey, the correct calculation of sedimentation is quite important.

Determining the amount of sediment transported in rivers is of great importance for engineering as well as being a very difficult problem to examine. Due to the large number of geological, topographic and climatologically factors affecting sediment transport and their interrelationships being complex, it is difficult to calculate the amount of sediment carried by any river analytically.

The amount of suspended sediment load (SSL) in rivers can be determined by different methods such as direct measurements at sediment observation stations, sediment rating curve, regression, artificial intelligence methods and empirical approaches based on experimental studies (Ulke et al., 2010). Lafdani et al (2013) used ANN and SVM models as input for precipitation and flow data in daily SSL estimation in Doiraj River located in western Iran.

Although the sediment measurements performed at sediment monitoring stations are the most reliable way, they are disadvantageous in terms of time and cost. It is necessary to avoid possible errors by renewing the measured section in each measurement. Nowadays, with the development of computer technology, Artificial Neural Networks (ANNs) are widely used in prediction of sediment amount as in many fields. There are many studies on this subject in the literature (Nourani et al. 2016; Cigizoglu 2000; Yang, 1996; Melesse et al. 2011; Goyal 2014; Singh et al. 2013; Buyukyildiz and Kumcu, 2017). In this study, the usability of ANN models was studied to predict daily SSL of Kızılırmak River-Söğütlühan observation station in Kızılırmak Basin in Turkey.

## 2. MATERIAL and METHOD

### 2.1. Study Area

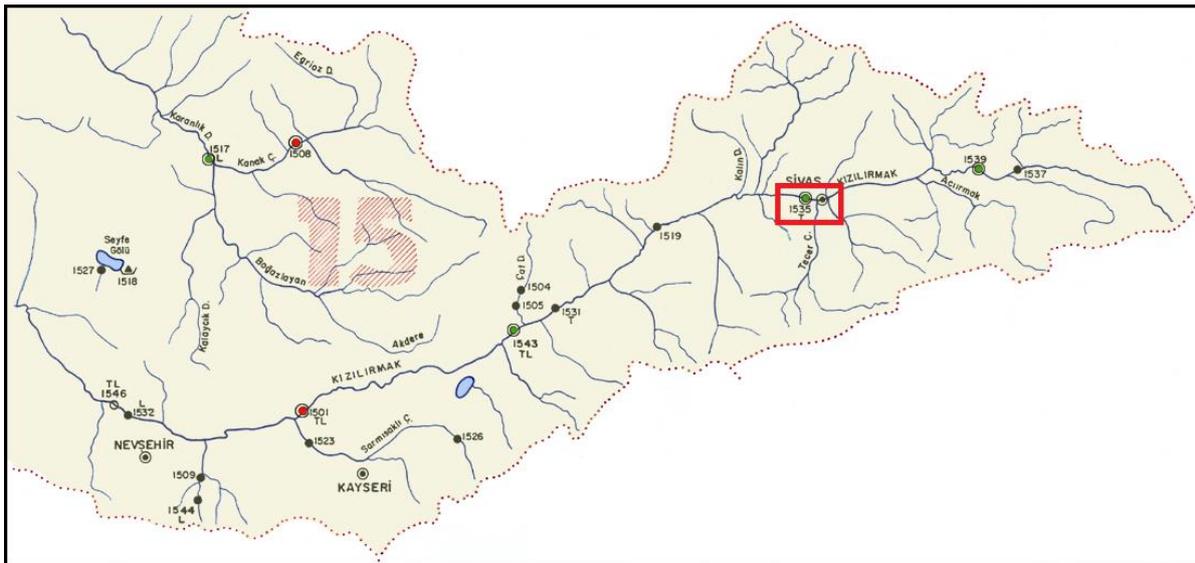
In this study, sediment estimation was made by using ANN models. Models were created in MATLAB program by using various combinations of inputs and flow and sediment data of Kızılırmak River-Söğütlühan sediment observation station in Kızılırmak Basin.

Some properties of the sediment observation station, whose data are used to estimate the sediment amount, are given in Table 1 and the location of the station in Kızılırmak Basin is given in Figure 1.

**Table 1.** Characteristics of Sediment Observation Station

Station No	Station Name	Altitude (m)	Location	Precipitation Area (km <sup>2</sup> )	Observation Period
1535	Kızılırmak River-Söğütlühan	1243	36° 50' 34" E 39° 43' 02" N	6,472.4	1994-2011

Kızılırmak Basin is located between 41°44' - 38°25' N latitudes and 32°48' - 38°25' E longitudes. Kızılırmak Basin covers 10.49% of Turkey with 82,181 km<sup>2</sup> area. The annual total precipitation is 442.5 mm and the annual mean temperature is 10.5°C in the Kızılırmak Basin.



**Figure 1.** The Location of Kızılırmak River – Söğütlühan Observation Station (Station No:1535) in Kızılırmak Basin

### 2.2. Artificial Neural Network

ANNs, which are designed with inspiration from the human biological nervous system, can be considered as a black box that produces outputs against inputs. Learning in biological systems is made by the connections between nerve cells. ANNs, which are not limited to application areas, have a wide application area by successfully solving the problems encountered in many part of life. ANNs are characterized by the neuron model used, network connections of these neurons, the determination of the learning rule for adjusting the weight coefficients, and recall (Ülker ve Civalek, 2002). Many learning algorithms are used in ANNs. In this study, Multilayer Perceptron (MLP) and Radial Based Neural Networks (RBNN) were used.

In MLP working with supervised learning, the learning rule is the generalized version of the Delta Learning Rule based on the least squares method. In predicting performance of MLP, the number of hidden layers, the number of neurons in the hidden layer, learning rate, momentum coefficient, iteration number and activation function are effective.

RBNN, an ANN model based on human neurons in neurons, is a special case of multi-layer feed forward networks and was developed by Broomhead and Lowe (1988). It has two characteristics: having a single hidden layer and using radial based functions as activation function in hidden layer neurons (Akbiğiç, 2011). As in the classical ANN model, training takes place between input and output (Okkan and Dalkılıç, 2012). In RBNN models, fast solutions can be produced due to the small number of parameters required by the user.

### 2.3. Performance Criteria

The performance of the models was evaluated using the coefficient of determination ( $R^2$ ), Nash Sutcliffe efficiency coefficient ( $E_{Nash}$ ), mean absolute error (MAE) and root mean square error (RMSE). The equations are given below.

$$MAE = \frac{1}{N} \sum_{i=1}^N |Y_{i_{observed}} - Y_{i_{estimated}}| \quad (1)$$

$$RMSE = \sqrt{\frac{1}{N} \sum_{i=1}^N (Y_{i_{observed}} - Y_{i_{estimated}})^2} \quad (2)$$

$$R^2 = \frac{[\sum_{i=1}^N (Y_{i_{observed}} - \bar{Y}_{observed})(Y_{i_{estimated}} - \bar{Y}_{estimated})]^2}{\sum_{i=1}^N (Y_{i_{observed}} - \bar{Y}_{observed})^2 \sum_{i=1}^N (Y_{i_{estimated}} - \bar{Y}_{estimated})^2} \quad (3)$$

$$E_{Nash} = 1 - \frac{\sum_{i=1}^N (Y_{i_{observed}} - Y_{i_{estimated}})^2}{\sum_{i=1}^N (Y_{i_{observed}} - \bar{Y}_{observed})^2} \quad (4)$$

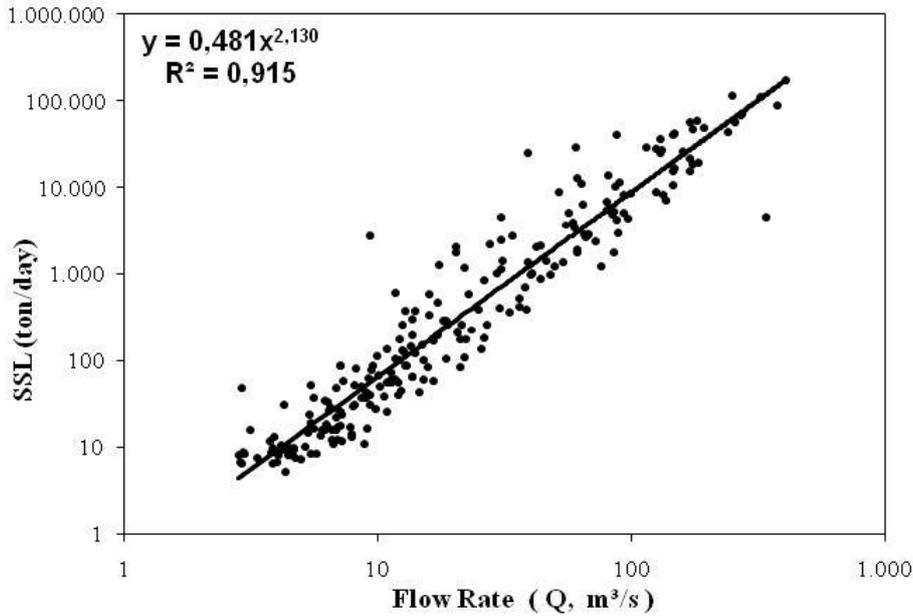
### 3. RESEARCH FINDINGS

In this study, 256 sediment and flow data belonging to 1994-2011 period in Kızılırmak-Söğütlühan station were used. 70% (178) of the 256 data was used as training and 30% (78) was used as test data. In order to estimate the amount of SSL, data consisting of different delay time series of daily flow (Qt) and SSL (St) were used as input and SSL was used as output. The input combinations used are given in Table 2.

**Table 2.** Input combinations used in the study

Model Name	Inputs	Output
M1	St,Qt	
M2	St, St-1	
M3	St, St-1,Qt	
M4	St, St-1, St-2	
M5	St, St-1, St-2, Qt	
M6	St, St-1, St-2, Qt, Qt-1	St
M7	St, St-1, Qt-1	
M8	St, St-1, Qt, Qt-1	
M9	St, St-1, St-2, Qt-1, Qt-2	
M10	St, St-1, St-2, Qt, Qt-1, Qt-2	

MLP-GDX and RBNN methods were used for daily sediment estimation of Kızılırmak-Söğütlühan sediment observation station. The models were also compared with the sediment rating curve (SRC) of Kızılırmak-Söğütlühan station. The SRC of Kızılırmak-Söğütlühan station is shown in Figure 2.



**Figure 2.** The rating curve of Kızılırmak River-Sogutluhan observation station (Station No: 1535)

Before creating ANN models, the logarithms of the data were taken to eliminate the unit difference in the parameters used in the input and output layer, and then the data was dimensioned between 0 and 1 using the equation below.

$$X_{norm} = \frac{X_i - X_{min}}{X_{max} - X_{min}} \quad (5)$$

Where;  $X_{norm}$ ,  $X_i$ ,  $X_{min}$  and  $X_{max}$  are the normalized, observed, minimum and maximum values for all parameters, respectively.

### 3.1. Application of MLP-GDX

The MLP-GDX model is designed as an input layer, two hidden layers and an output layer. The tangent sigmoid and logarithmic sigmoid activation functions were used in the hidden layers and the output layer respectively. In the models, the number of neurons in hidden layers was determined as 1-20 and the learning rate (lr) was determined by trial and error method in the range of 0.1-1. The number of iterations was 1000 and the momentum coefficient (mc) was 0.8. The most successful model was determined according to the highest  $E_{Nash}$  value of the test data in the models formed according to ten different input combinations (Table 3).

According to MLP-GDX results, M8 input combination was the most successful model with (4,3,14,1) model structure and 0.9 learning ratio.  $R^2 = 0.924$  and  $E_{Nash} = 0.907$  were obtained in this model.

**Table 3.** Results of MLP-GDX models

Station Name	Model Name	Model Structure	Leraning rate (lr)	MAE (ton/day)	RMSE (ton/day)	R <sup>2</sup>	E <sub>Nash</sub>
Kızılırmak River-Sogutluhan	M1	(2,1,5,1)	0.9	0.672	0.833	0.912	0.883
	M2	(2,6,15,1)	1	1.438	1.960	0.360	0.352
	M3	(3,9,13,1)	0.1	0.667	0.801	0.922	0.892
	M4	(3,3,3,1)	0.1	1.428	1.904	0.390	0.389
	M5	(4,2,11,1)	0.6	0.680	0.807	0.919	0.890
	M6	(5,2,14,1)	1	0.662	0.821	0.907	0.886
	M7	(3,3,16,1)	0.1	1.515	1.970	0.369	0.345
	<b>M8</b>	<b>(4,3,14,1)</b>	<b>0.9</b>	<b>0.595</b>	<b>0.744</b>	<b>0.924</b>	<b>0.907</b>

M9	(5,9,13,1)	0.3	1.383	1.784	0.479	0.463
M10	(6,5,12,1)	0.5	0.667	0.841	0.903	0.881

### 3.2. Application of RBNN

In RBNN models, three layers are used as input layer, hidden layer and output layer. In the determination of the most successful RBNN model, the number of neurons in the hidden layer was 1-20 and the spread number was examined in the range of 0.01-5 by trial and error method. As a result of the models obtained according to ten different input combinations, the most successful model was determined according to the largest  $E_{Nash}$  value of the test data (Table 4).

According to Table 4, the RBNN-M3 model was the most successful model for sediment estimation with the number of spreads 1.24, the number of neurons in the hidden layer 14,  $R^2= 0.922$  and  $E_{Nash} = 0.903$ .

**Table 4.** Results of RBNN models

Station Name	Model Name	Model Structure	MAE (ton/day)	RMSE (ton/day)	$R^2$	$E_{Nash}$
Kızılırmak River-Söğütühan	M1	(2,0.35,3,1)	0.663	0.826	0.912	0.885
	M2	(2,0.1,5,1)	1.469	1.977	0.353	0.341
	<b>M3</b>	<b>(3,1.24,14,1)</b>	<b>0.628</b>	<b>0.758</b>	<b>0.922</b>	<b>0.903</b>
	M4	(3,0.96,10,1)	1.541	1.944	0.367	0.363
	M5	(4,0.64,17,1)	0.676	0.827	0.907	0.885
	M6	(5,0.52,10,1)	0.687	0.825	0.900	0.885
	M7	(3,0.25,4,1)	1.490	1.945	0.378	0.362
	M8	(4,0.41,5,1)	0.611	0.760	0.918	0.903
	M9	(5,0.32,10,1)	1.510	1.901	0.410	0.391
	M10	(6,0.48,18,1)	0.693	0.849	0.896	0.878

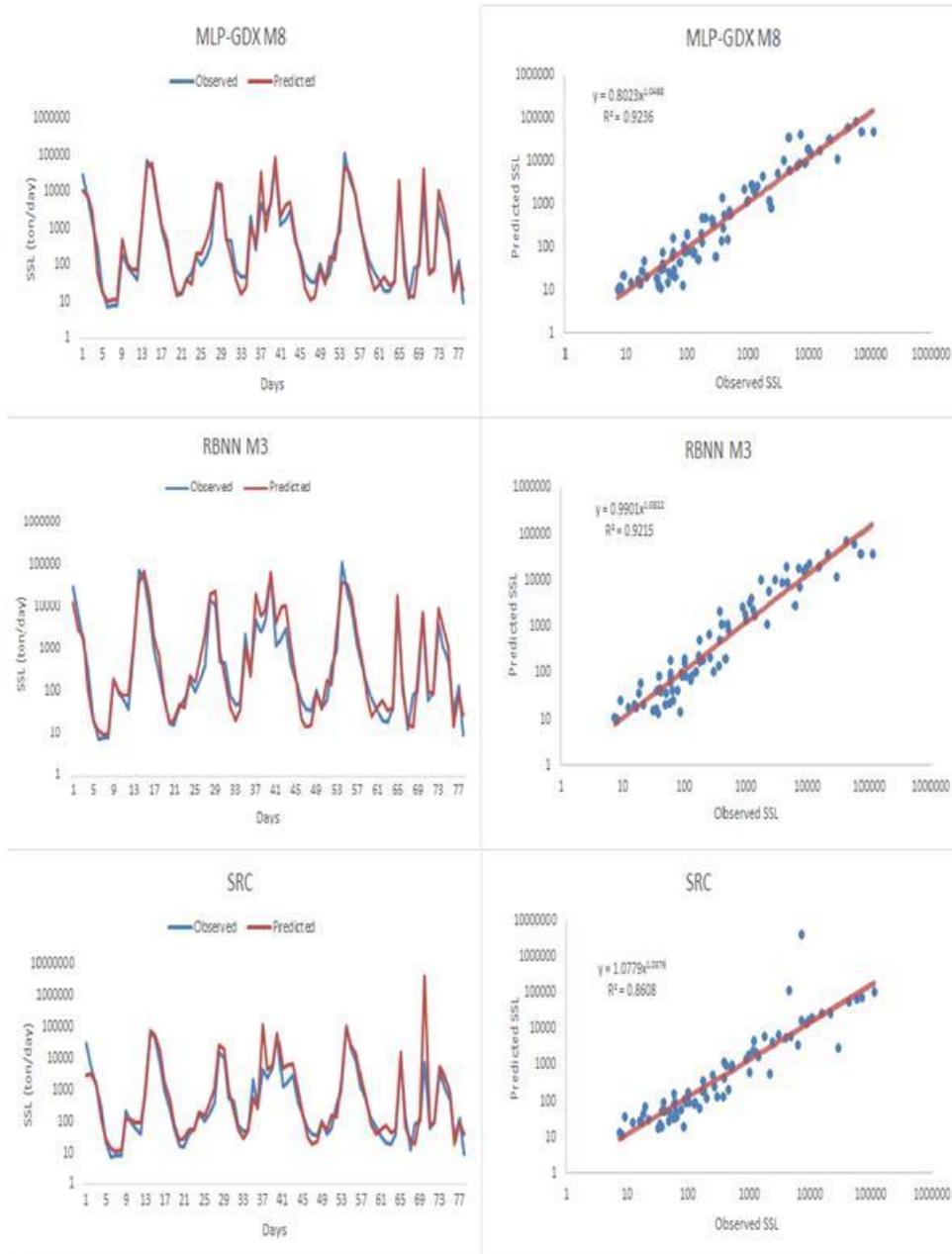
### 3.3. Comparison of ANN Models and SRC

The performance criteria for the most successful input combination model obtained in ANN models and SRC are given in Table 5.

**Table 5.** Performance criteria for the most successful ANN models and SRC in testing period

Station Name	Model Name	Model Structure	MAE (ton/day)	RMSE (ton/day)	$R^2$	$E_{Nash}$
Kızılırmak River-Söğütühan	MLP-GDX	M8(4,3,14,1)	0.595	0.744	0.924	0.907
	RBNN	M3(1,1.24,14,1)	0.628	0.758	0.922	0.903
	SRC	-	-1.064-	4.314	0.736	0.435

According to Table 5, MLP-GDX model with M8 input combination was more successful than other models according to all performance criteria. The scatter diagrams and time series for the most successful ANN models and SRC are given in Figure 3.



**Figure 3.** The scatter diagrams and time series for the most successful ANN models and SRC

#### 4. CONCLUSION

Accurate estimation of the sediment amount is very important as it causes a decrease in the economic life of water resources projects constructed at high costs. In this study, the usability of ANN models for daily SSL estimation was investigated. For this purpose, 10 different input combinations consisting of different delay time series of daily flow and SSL values of Kızılırmak River-Sogutluhan sediment observation station (Station No: 1535) were used. ANN models were obtained by using MLP-GDX and RBNN learning algorithms. MLP-GDX and RBNN models showed the most successful performance in M8 and M3 input combinations respectively. The most successful models obtained for each ANN method were also compared with the traditional SRC method. In conclusion, MLP-GDX-M8 (4, 3, 14, 1) model with  $R^2=0.924$ ,  $E_{Nash}=0.907$ ,  $MAE=0.595$  ton/day and  $RMSE=0.744$  ton/day was the most successful model with sediment estimation.

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**O 81. THE FUTURE ROLE OF CARBON NANOTUBES IN ENERGY SECTOR**

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**ABSTRACT** Energy poverty has become one of the most important problem to be concerned recently due to depletion of energy resources and unconscious consumption. Therefore, governments and other stakeholders have taken action to find out new energy sources. Thanks to their energy storage capability, carbon nanotubes promise considerable contribution to energy sector. In this study, a qualitative research has been conducted by holding interviews with a variety of experts working on carbon nanotubes and energy in addition to literature review. The qualitative study aims to highlight current energy usage of carbon nanotubes and the future role these materials. In conclusion, it has been observed that nanotubes are perfect for energy storage thanks to their suitable geometry and surface properties. Its potential to absorb hydrogen would be one of the most striking point for energy sector. Another promising ability is to convert electric current to chemical energy. This ability could enable nanotubes to be used in artificial muscles. It can be easily seen that further developments in carbon nanotubes will be of beneficial for energy sector and other many fields.

*Keywords: Carbon Nanotubes, Energy, Energy Storage, Energy Conversion*

**O 82. A NOVEL COMPOSITE BY COATING ACORN SHELL (QUERCUS VULCANICA) WITH CHITOSAN FOR REMOVAL OF CR (VI) FROM AQUEOUS SOLUTION**

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**ABSTRACT:** Water contamination raised with rapid and irregular industrialization growing, so elimination of Cr (VI) ions from contaminated water before discharge is vitally important. The purpose of this study; using acorn shell (AS) and Chitosan-coated acorn shell (Cts⊙AS) as a biomaterial in the removal of Cr (VI) from aqueous solutions. Cts⊙AS composite was prepared by adding glutaraldehyde as a cross-linking agent and operational feasibility of Cts⊙AS for Cr (VI) biosorption from aqueous environment was investigated by using different kinds of factors. The effects of contact time, initial solution pH, initial Cr (VI) concentration, and biosorbent amount on the elimination of Cr (VI) for AS and Cts⊙AS composite were investigated by batch experiments. The biosorption system was tested using various isotherm models. The optimum conditions for the removal of Cr (VI) were found to be the amount of biosorbent 0.1 g, pH 2.0 and equilibrium time of 120 min for AS. On the other hand, the optimal conditions for the biosorption of Cr (VI) by Cts⊙AS were found to be: 2.0-2.1 initial pH, 90 min of exposure duration, 0.05 g biosorbent amount, 150 mg/L of initial Cr (VI) concentration at 25 °C. The maximum biosorption capacity calculated from the Langmuir was found to be 89.29 mg/g and 44.25 mg/g for Cts⊙AS and AS, respectively. The characterization of Cts⊙AS and AS were performed using two techniques; Scanning Electron Microscope (SEM) and Fourier Transform Infrared Spectroscopy (FT-IR). The produced a novel Cts⊙AS composite is offering an alternative biosorbent for Cr(VI) removal from aqueous mediums.

*Keywords: Biosorption, Composite, Chitosan, Acorn Shell, Cr (VI)*

## **1. INTRODUCTION**

The increases in industrial activities are caused to accumulate different kinds of environmental pollutants, which are one of the most significant results of environmental contamination and damage to the natural ecosystem (Ghasemi et al. 2015). Hazardous chemicals contact with soil and groundwater resources and cause serious problems for the human health and the environment (Banerjee, 2017). Especially, industrial wastewaters include heavy metals, which are seen as hazardous contaminants. Many heavy metals show toxic properties even if they are found in low concentrations in industrial wastewater. They are not biologically degraded in aqueous solutions, thus they accumulate in the body via the food chain and damage them. When toxic substances are released into water sources, mass fish deaths arise most of time in lake, sea, and rivers.

Chromium is very toxic heavy metal, which can be taken in different ways such as inhaled in the air, drift into drinking water and with the food chain. In addition, it can also be absorbed from the skin to a limited extent. Cr (VI) is easier to absorb than Cr (III) regardless of the contact path. The world health organization (WHO) reports that inhale high amounts of chromium may increase the risk of lung cancer or liver diseases and it causes stomach ulcers (Fawell, 2004). The Environmental Protection Agency (EPA) has set limits for the presence of chromium in drinking water. This standard limit set for chromium by the EPA is 0.05 mg/L (EPA 2010).

Many industrial sectors such as plastics, leather tanning, welding, paint pigments, wood treatments, drilling muds, and copy-machine toners use chromium as a raw material for many different purposes and their wastewater includes chromium. The treatment methods are classified as; chemical extraction (Yao et al. 2019), chemical oxidation-reduction (Huang et al. 2019), reverse osmosis (Mahendra et al. 2017), membrane separation (Laqbaqbia et al. 2019), ion exchange (Cao et al. 2018), adsorption (Cherdchoo et al. 2019) and biosorption (Xining et al. 2015). Many of these methods are not highly

preferred in the industry because the traditional methods can lead to high operating costs of the treatment process and the need for secondary treatment. The biosorption method is one of the commonly used methods for the removal of heavy metal from the aqueous solutions because they are economically more suitable than other processes and provide good quality treatment (El-Reash et al. 2016). Compared with other traditional removal techniques, biosorption is the most applied technique because of its low cost, abundance, high efficiency, and easy-regeneration.

The natural biosorbents are found in huge amounts in many places, and they can easily be modified with some chemicals. Egg powder (Ikram et al. 2016), banana shell (Sharma et al. 2016), walnut shell (Zafarani et al. 2015), cucumber peel (Basu et al. 2017), palm shell (Thangappan et al. 2016), hazelnuts (Karaçetin et al. 2014), garlic stem and horse chestnut shell (Parlayıcı and Pehlivan, 2015) have been applied for the removal of chromium in water sources.

The processing of oak trees in the forest industry reveals a large amount of acorn bark. Acorns, important wildlife in forests, are seeds that are necessary for the renewal of oak trees. It is known that there are approximately 900 types of oak trees in the world on average, and the annually harvested acorn capsule is over 30 million tons (Vinha et al. 2016). The acorn bark is rich in cellulose, lignin and hemicellulose, compared to the vegetable fibers used outside the non-food field. AS is known to have special properties such as strong structure, high chemical stability and strong hydrophobicity (Ishida et al. 2015; Zhang et al. 2018). AS contains lignin, holocellulose, pentosan, tannin and ash and the percentages of them are determined as 34.22%, 56.69, 21.09, 9.18 and 2.56%, respectively (Li et al. 2013).

Cts is a significant amino polysaccharide obtained by deacetylation of chitin which is the most commonly situated biopolymer in the environment after cellulose (Uthaya, 2016). Therefore, Cts contributes significantly to the cellulosic matrix in the real structure and exhibits several perfect chemical properties, such as biocompatibility, being non-toxic, harmful (Wang et al. 2017). One of the advantages of Cts is that it has a renewable structure and is an environmentally friendly natural biopolymer. Recently, it has been used to remove dyes and toxic metal ions from industrial wastewater (Rashid et al. 2017; Wang, 2017). Cts, a cationic polysaccharide, is a linear form with an indiscriminately distributed  $\beta$ -(1-4)-linked D-glucosamine and N-acetyl-D-glucosamine (Wang, 2017). Cts is a positively charged hydrophilic polymer due to the weak basic groups. The amino group in the Cts has a value of 6.5 pKa, in this case leading to a protonation with a charge density depending on the pH and % DA in the acidic and neutral solution. Cts has various functional groups such as amino and hydroxyl groups and plays an important role in the biosorption of heavy metal ions by electrostatic attraction or ion exchange (El-Reash et al. 2016). GA was applied as an eco-friendly material for crosslinking. These solid aggregates are biologically functional compounds and are mainly used for chemical modification of polymers (Silve, 2004).

In this study, AS and Cts are not poisonous, cheap and environmental friendly biomaterials. Cts has hydroxyl (-OH) and amino (-NH<sub>2</sub>) groups in the structure and it increases the efficiency of binding Cr (VI) from the aqueous medium to the surface of composite material. In the biosorption experiment, AS and Cts⊙AS composite were used and their performance was compared by changing such factors as the initial Cr (VI) concentration, pH of the solution, contact time and the amount of biosorbent. The Cts⊙AS composite was used to remove and reduce Cr (VI) in the prepared synthetic wastewater. A model on the isotherm studies was tried for Cr (VI) biosorption and the characteristics of Cts⊙AS composite were conducted before and after treatment using FT-IR. The present study focuses on reducing the concentration of Cr (VI) by biosorption using Cts⊙AS composite. All experiments were carried out in a batch process with the synthetic effluents at ambient conditions. It was concluded that Cts⊙AS composite can find many applications to remove Cr (VI) from industrial wastewater or polluted streams.

## **2. MATERIALS AND METHOD**

### **Materials and Instruments**

The substances used in the experiments are in analytical purity and Cts (average molecular weight), NaOH and K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> are obtained from Sigma-Aldrich. Glutaraldehyde solution (25% in water, v:v), hydrochloric acid, methanol and acetic acid obtained from Merck. For the biosorption experiments, Orion 900S2 Model pH meter, a thermo explicit shaker of GFL 3033 model, and IKAMAG- RO15

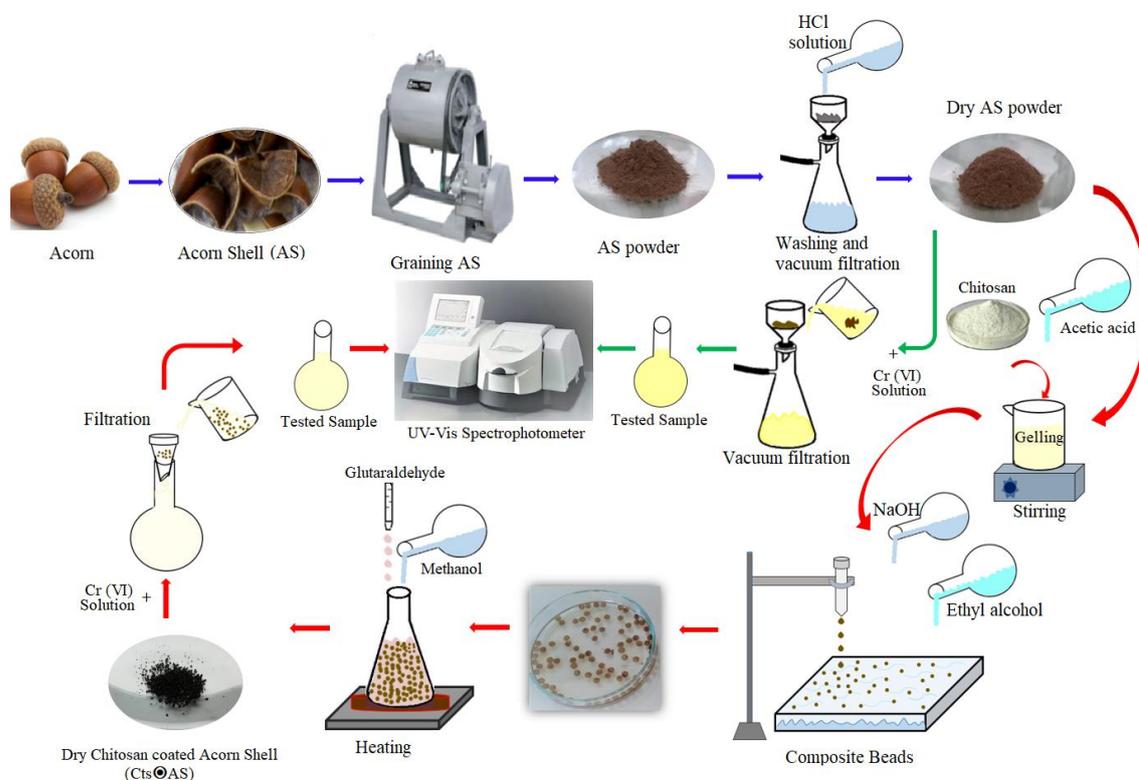
model magnetic stirrer were used for simply adjustment of pH and mixing the solutions. The FT-IR spectra for AS, Cts $\odot$ AS composite and Cr (VI) loaded-Cts $\odot$ AS composite were recorded with Bruker-Platinum ATR-vertex 70 (Germany) between 500-4000  $\text{cm}^{-1}$  wavenumbers at a resolution of 4  $\text{cm}^{-1}$  using an attenuated total reflection (ATR) accessory. SEM (SEM, Nova Nano SEM 200) is from FEI Company and the samples were covered with a gold layer. The remaining Cr (VI) in the solution was measured by using a UV-Visible Spectrophotometer (Shimadzu UV-1700).

### Preparation of Raw Material

Acorns were obtained from Konya-Selcuklu region of Turkey. AS powder particles (125  $\mu\text{m}$ ) were prepared in our laboratory and they were washed with pure water and dried at 60  $^{\circ}\text{C}$  in the drying oven. The dried AS was ground in the ball bar grinder. After sieve analysis, the certain powder size between 125-150  $\mu\text{m}$  was used for the experiments.

### Preparation of Cts $\odot$ AS Composite

3 g Cts and 1% 300 mL acetic acid solution were stirred with the magnetic mixer until the Cts gelling. Then, 3 g AS was added and then the slurry was stirred about 1 hour continuously until the mixture was homogenous. The prepared mixture was poured into 200 mL, 1 M NaOH solution for coagulation. By adding 6% (V/V) 300 mL ethyl alcohol solution in the solution, Cts $\odot$ AS composite was obtained (Figure 1.). Cts $\odot$ AS composite was kept about 12 hours in the coagulation solution. After the formation of Cts $\odot$ AS composite, the slurry was filtered. Cts $\odot$ AS is washed with pure water until pH became neutral. The produced Cts $\odot$ AS composite was treated with 3 mL GA and 100 mL methanol solution and they were mixed for 30 min at 70  $^{\circ}\text{C}$ . In this way, with covalent bonds was created and the functional group of the structure was increased at the same time. Cts $\odot$ AS composite was filtered to remove the non-reacted GA solution, and after washing several times with pure water and ethanol, they were left to dry at room temperature for 24 hours. The prepared cross-linked Cts $\odot$ AS composite was stored to evaluate the performance of Cr (VI) removal under the different experimental conditions.



**Figure 1.** Preparation Schema of Cts $\odot$ AS Composite

### Batch Biosorption Studies

The batch method was used to perform the biosorption experiment. The different initial concentrations of Cr (VI) (for AS; 25, 50, 100, 150, 200, 250, 300, 350 ppm; for Cts⊙AS; 25, 50, 100, 150, 200, 300, 400, 500 ppm) were studied and the initial pH of the solution was adjusted to 2. The effect of initial pH on the biosorption was studied by adding 0.1 g AS and 0.05 g Cts⊙AS into a series of beakers containing 50 ppm Cr (VI) solution and the initial pH from 2 to 6 was adjusted by adding 0.1 M NaOH and 0.1 M HCl solution. The beakers were shaken (200 rpm) at room temperature. After the centrifugation, the residual Cr (VI) concentration in the supernatant liquid was analysed spectrophotometrically at 540 nm using UV-visible spectrophotometer and 1,5 diphenylcarbazide as a complexing agent. This agent reacts with Cr (VI) in a low pH medium and Cr (III)–diphenylcarbazone complex was obtained (Eq. (1)).



H<sub>4</sub>L: 1,5-Diphenylcarbazide

H<sub>2</sub>L: Diphenylcarbazone

The percent biosorption of Cr (VI) was calculated as in Eq. (2) below:

$$\% \text{ Biosorption} = \frac{C_i - C_f}{C_i} \times 100 \quad (2)$$

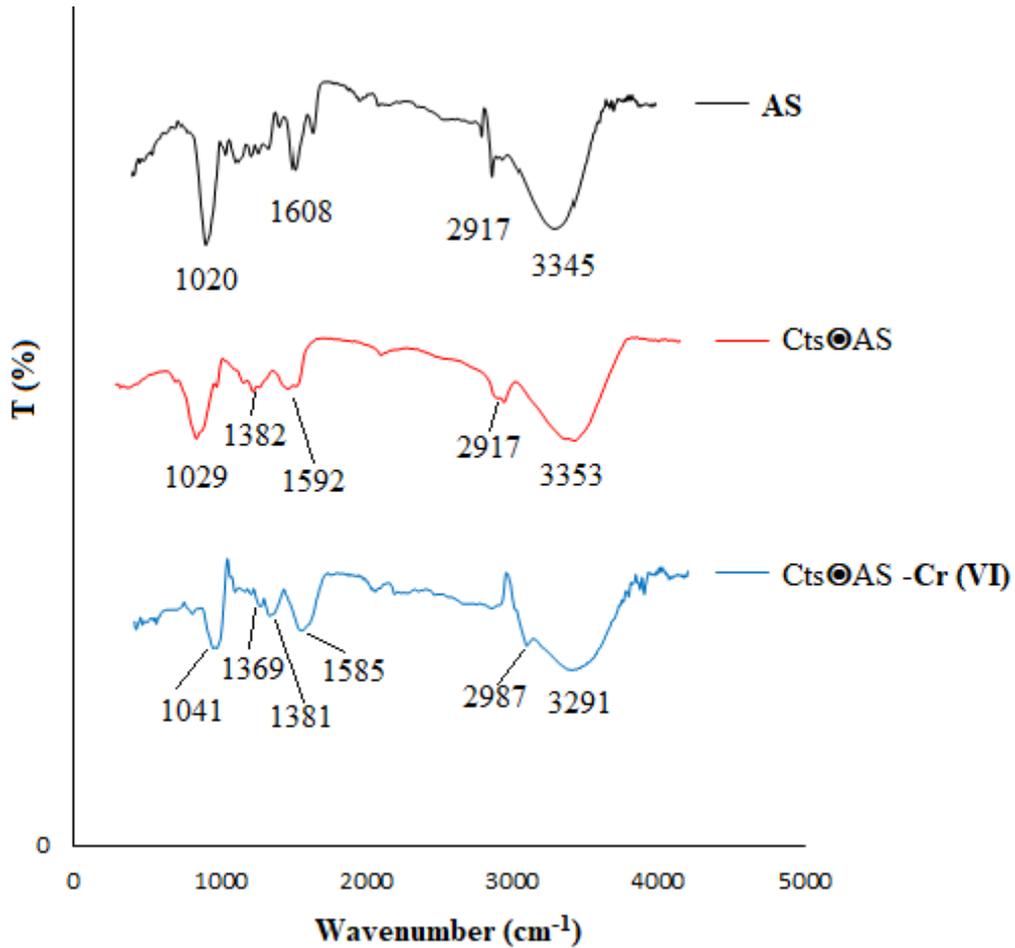
$$\text{Biosorption Capacity} = \frac{C_i - C_f}{m} \times V \quad (3)$$

Where C<sub>i</sub> and C<sub>f</sub> are the initial and final Cr (VI) concentrations, respectively. The biosorption capacity per unit mass of the biosorbent (q<sub>e</sub>) was calculated using Eq. (3).

## 3. RESULTS AND DISCUSSIONS

### Characterization of Cts⊙AS

Figure 2. shows that the FT-IR spectra of AS, Cts⊙AS composite and Cr (VI) loaded Cts⊙AS composite. The spectrum was recorded within the range of 500-4000 cm<sup>-1</sup>. In the FT-IR spectrum of the AS; the band of the -OH stretching vibrations appeared at 3345 cm<sup>-1</sup> and the wavelength at 2917 cm<sup>-1</sup> is caused by the aliphatic C-H stretching vibrations of lignocellulosic components (Yallappa et al. 2017). -COOH indicates strong peaks of strain vibrations at 1608 cm<sup>-1</sup>. The peak of -C-O vibration at 1020 cm<sup>-1</sup> wavelength supports the presence in the cellulose and hemicelluloses (Aljoumaa et al. 2017). On the other hand, the FT-IR spectrum of the Cts⊙AS; the alcohol groups (-COH) from the Cts structure appeared at 3353 cm<sup>-1</sup>, -C-N vibration at 1382 cm<sup>-1</sup> and -NH<sub>2</sub> at 1592 cm<sup>-1</sup> were related to the vibration in the amide group (Zhou et al. 2014). The peak at 1029 cm<sup>-1</sup> shows the presence of the ether group corresponding to the form of glutaraldehyde. After the Cr (VI) biosorption on Cts⊙AS; it was seen that some bands shifted and there were changes in the intensity of some bands. -OH, stretching vibrations band shifted from 3353 cm<sup>-1</sup> to 3291 cm<sup>-1</sup>, -CH stress band shifted from 2917 cm<sup>-1</sup> to 2987 cm<sup>-1</sup>, -NH<sub>2</sub> vibration band shifted from 1592 cm<sup>-1</sup> to 1585 cm<sup>-1</sup> and increased in the intensity. The intensity of the C-N band at 1382 cm<sup>-1</sup> wavelength decreased and was divided into 1369 cm<sup>-1</sup> and 1381 cm<sup>-1</sup>, the band at 1029 cm<sup>-1</sup> shifted to 1041 cm<sup>-1</sup> and it decreased in the intensity. This showed that these changes in the FT-IR spectrum of Cts⊙AS with Cr (VI) biosorption confirm the biosorption of Cr (VI) with the functional groups in Cts⊙AS composite.



**Figure 2.** The FT-IR spectral characteristics of AS, Cts@AS composite and Cts@AS-Cr (VI)

SEM analysis was made in order to explore the surface morphology of the Cts@AS composite. The results of the surface morphology of SEM images before and after the biosorption of Cr (VI) are given in Figure 3. After the biosorption of Cr (VI) ions, the surface of the Cts@AS composite is rough and indented. It is understood that the gaps in this structure are full and the indentation protrusion decreases.

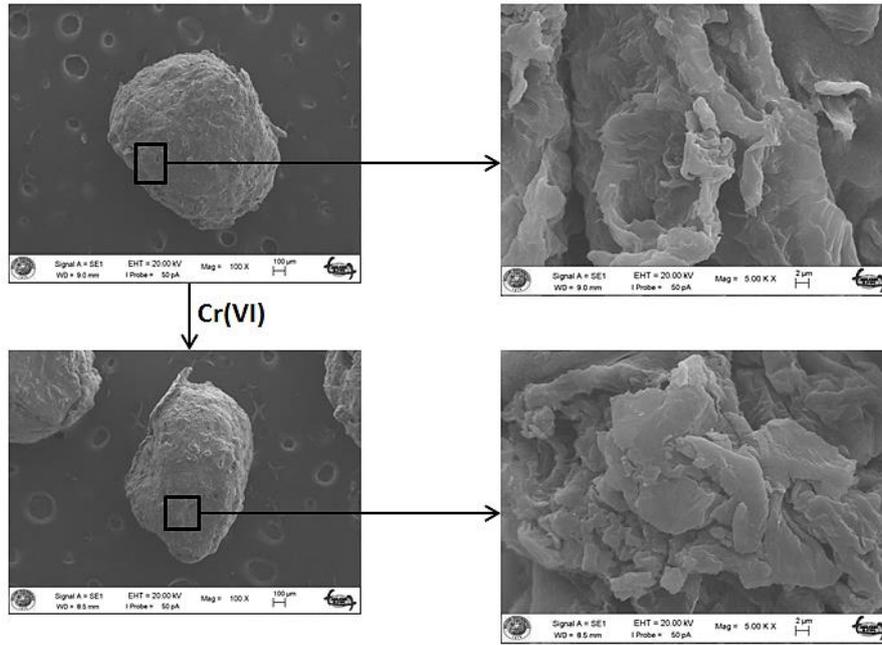
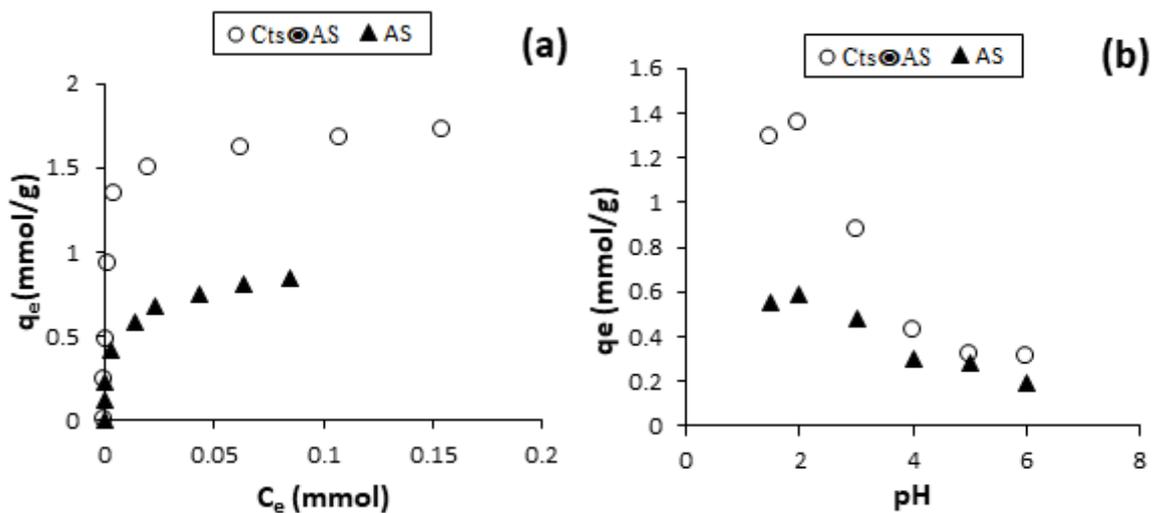
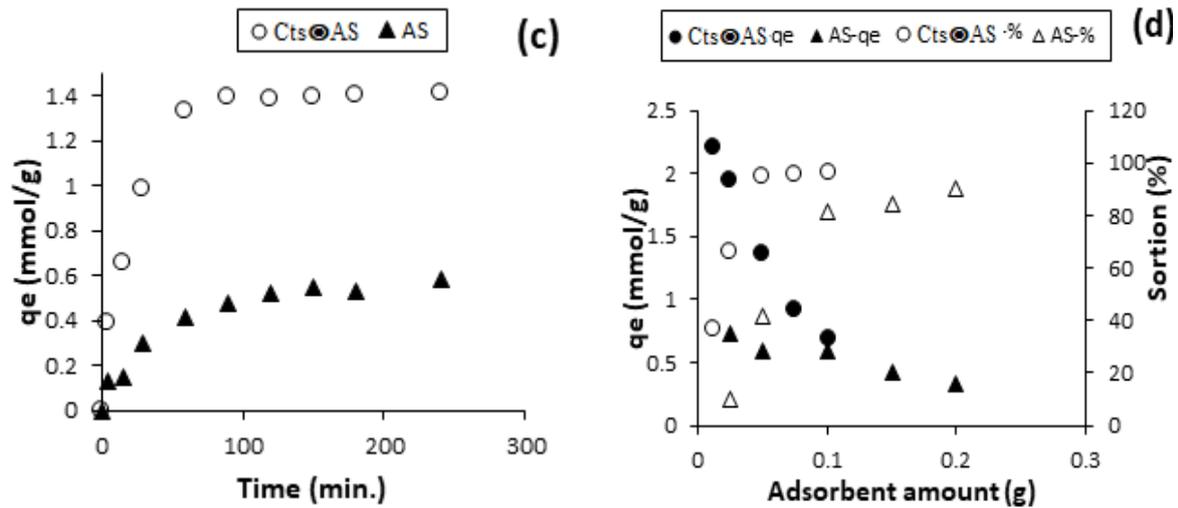


Figure 3. The SEM images of Cts@AS composite before and after Cr (VI) biosorption

### Effect of The Cr (VI) Initial Concentration on The Biosorption

The biosorption of Cr (VI) in various concentrations were changed to determine the effect of adsorbate initial concentrations on the biosorption (Figure 4a.). Therefore, 25, 50, 100, 150, 200, 250, 300, 350 ppm Cr (VI) solutions were prepared in the experiments using AS and 25, 50, 100, 150, 200, 300, 400, 500 ppm Cr (VI) solutions were prepared in the experiments using Cts@AS composite. The biosorption experiments were carried out by treating the solutions with AS and Cts@AS composite. The amount of Cr (VI) remaining in the solution phase by using different concentrations after the filtration was measured with UV-Vis. spectrophotometer. As seen in Figure 4a., as the initial Cr (VI) concentration increased, the biosorption capacity increased. The increase in the capacity was slowed by the fact that the bonding parts in the Cts@AS structure were saturated.





**Figure 4.** a) Biosorption isotherms of Cr (VI) adsorbed by the AS and Cts@AS composite b) The effect of pH on the biosorption of Cr (VI) by AS and Cts@AS composite c) The effect of contact time on the biosorption of Cr (VI) by AS and Cts@AS d) The effect of biosorbent dosage on the biosorption capacity and the percentage removal of Cr (VI) ions on the biosorption by AS and Cts@AS composite

Langmuir, Freundlich, Temkin and Scatchard model (Table 1.) were applied for the equilibrium (Eq. (4, 5, 6, 7)). The Freundlich isotherm shows a physical biosorption. According to Freundlich, the Cr (VI) filled sections on the surface of biosorbent are heterogeneous.  $K_f$  and  $n$  parameters were calculated for Freundlich isotherm. If the  $n$  values between 1 and 10 indicating that biosorption is favourable. In this study,  $n$  values were found as 4.29 for Cts@AS composite and 3.33 for AS. The  $R^2$  values obtained from Freundlich isotherm are 0.901 for AS and 0.958 for Cts@AS composite. Langmuir isotherm expressed chemical and single layer biosorption. This model is defined as the simplest theoretical model for a single layer biosorption. The values of  $Q_{max}$  calculated from the Langmuir isotherm of AS, Cts@AS composite are 44.25 mg/g and 89.29 mg/g, respectively. Hence, the results can be considered to be viable biosorbent for the removal of Cr (VI) from aqueous solutions.

**Table 1.** Parameters of Langmuir, Freundlich, Scarthard and Temkin Isotherms for Biosorption of Cr(VI) on AS and Cts@AS Composite

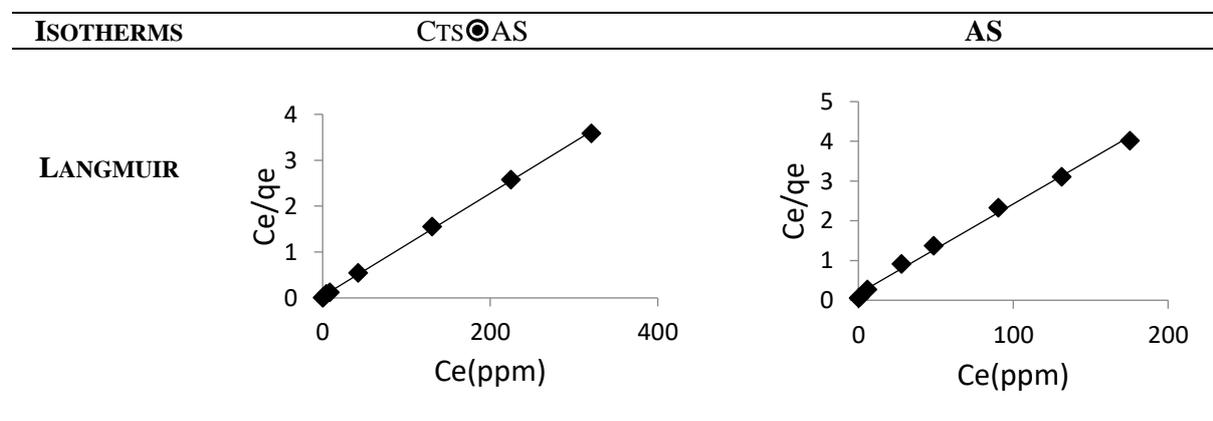
Model	Equation	Eq.	Biosorbent	Parameters for dye			References
Langmuir	$\frac{C_e}{q_e} = \frac{C_e}{A_s} + \frac{1}{K_b A_s}$	(4)	Cts@AS	$A_s$	$K_b$	$R^2$	$R_L$ (Langmuir 1918)
			AS	89.29	0.29	0.999	
Freundlich	$\ln q_e = \ln K_f + \frac{1}{n} \ln C_e$	(5)	Cts@AS	$K_f$	$n$	$R^2$	(Freundlich 1906)
			AS	28.57	4.29	0.901	
Temkin	$q_e = B \ln K_T + B \ln C_e$	(6)	Cts@AS	$B$	$K_t$	$R^2$	(Temkin and Pyzhev 1940)
			AS	10.01	36.70	0.942	
Scatchard	$q_e / C_e = Q_s K_s - q_e K_s$	(7)	Cts@AS	$Q_s$	$K_s$	$R^2$	(Scatchard 1949)
			AS	6.07	6.84	0.997	
				84.20	1.72	0.942	
				40.99	0.56	0.941	

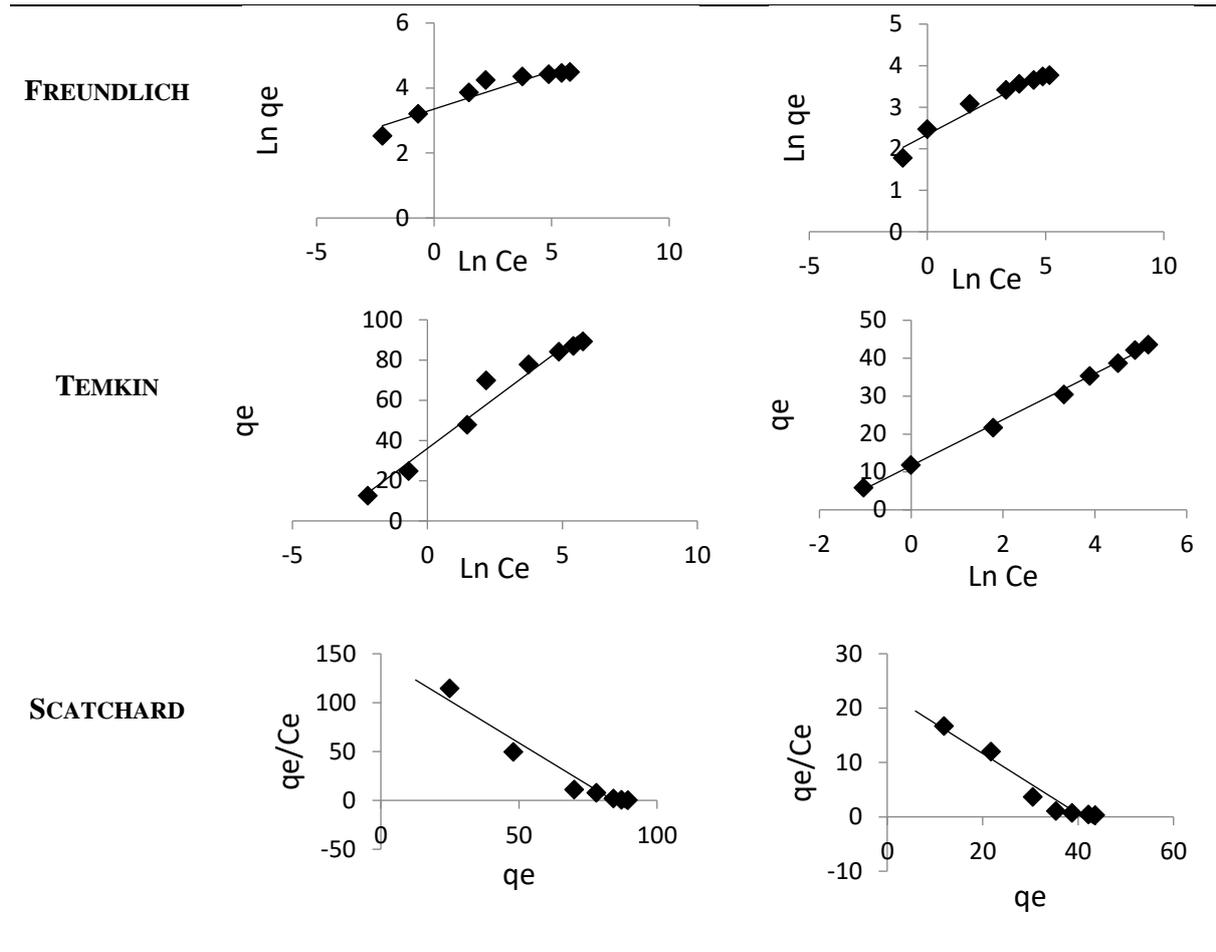
The  $R^2$  values obtained from Langmuir isotherm plots are 0.999 for Cts@AS composite and 0.995 for AS (in Table 1). Langmuir isotherm was found to be more suitable for the biosorption. If the value of  $R_L$  lies between 0 and 1, the biosorption process is favourable, if  $R_L$  is greater than 1, the process is unfavourable. The  $R_L$  values received in this study (Table 1.) lies between 0 and 1, which points to a high attraction of Cts@AS composite and AS for Cr (VI) ions. Temkin isotherm is the model that the

biosorbent–adsorbate interactions into consideration. Temkin isotherm model assumes that the heat of biosorption decreases linearly with coverage due to the biosorbent–adsorbate interactions and the biosorption is characterized by a uniform distribution of binding energies. Both  $K_T$  and  $B$  can be determined from a plot  $q_e$  vs.  $\ln C_e$  (Figure 5.) and the constants were determined from the intercept and slope, respectively. The related parameters are presented in Table 1. To evaluate and compare the saturation capacities of the composite toward the Cr (VI) ions, the biosorption isotherms were analysed and fitted using the Scatchard equation ( Figure 5.). When the Scatchard plot showed a deviation from linearity, greater emphasis was placed on the analysis of the biosorption data in terms of the Freundlich model, in order to construct the biosorption isotherms of the Cr (VI) at particular concentrations in the solution. In the biosorption of Cr (VI) ions, Scatchard analysis of the equilibrium binding data for Cr (VI) on the composite gave rise to a linear plot, indicating that the Langmuir model could be applied. The biosorption capacity of Cr (VI) onto the AS and Cts⊙AS composite were compared with other biosorbents reported in the literature and are summarized with their maximum Cr (VI) biosorption capacity in (Table 2.). It is easy to find that the biosorption of AS and Cts⊙AS composite are better than other agricultural waste biosorbents in (Table 2.) which fully demonstrate the successful of Cr (VI) elimination.

**Table 2.** Biosorption Capacity of AS and Cts⊙AS Composite Compared to The Other Published Low-Cost Biosorbents for Cr (VI) Removal

Biosorbent material	$Q_{max}$ (mg/g)	References
Rubber leaves	22.97	(Nag et al. 2015)
Pistachio shell	27.95	(Banerjee et al. 2018)
Anthill-eggshell composite	12.99	(Yusuff et al. (2018)
Potato peels	1.97	(Mohammed et al. 2017)
Tea waste	7.29	(Sharma et al. 2016)
Peanut hull	14.13	(Ali et al. 2016)
Cts particles	31.4	(Dima et al. 2015)
Chestnut shell	4.44	(Niazi et al. 2018)
<b>AS</b>	<b>44.25</b>	<b>This study</b>
<b>Cts⊙AS composite</b>	<b>89.29</b>	<b>This study</b>





**Figure 5.** Langmuir, Freundlich Temkin and Scatchard models for the biosorption of Cr (VI) onto AS and Cts@AS composite.

### Effect of pH on The Biosorption

The change in the pH value of the solution affects the biosorption sites on the biosorbent surface and the charge profiles of the adsorbate, thus significantly affecting the biosorption. The solution phase was considered in the different pH values (1.5, 2, 3, 4, 5, 6) for the biosorption of Cr (VI). The distinctive mechanical, chemical and electrical properties of interfaces of the solid and solution phase create great and highly varied effects on the biosorbent behaviour. The surface layer of the Cts@AS composite and AS exhibits an electrical charge effect in the response section of Cr (VI) and the biosorbent. The interfaces dividing electrically neutral bulk phases can appear to bear a charge, positive or negative charges spread relative to the biosorbent and Cr (VI) interface, resulting in the formation of an electrical double layer (Berg, 2010). The change in the biosorption capacities of Cr (VI) ions against pH change from the results is plotted in Figure 4b. The acidity of the solution is effective in the biosorption of Cr (VI) since it will be able to race between the Cr (VI) with  $H^+$  ions to the active areas on the AS and Cts@AS composite surfaces. The biosorption capacity of Cr (VI) at pH 6 was 0.52 mmol/g and increased to 0.59 mmol/g at pH 2 for the AS. On the other hand, the biosorption capacity of Cr (VI) at pH 6 was 1.28 mmol/g and increased to 1.36 mmol/g at pH 2 for the Cts@AS composite. In the biosorption experiments, the biosorption values of Cr (VI) ions were found to be maximum around pH 2 for the pH range 1.5-6.0. The similar pH-depended trend was also observed by some other researchers for the Cr (VI) removal by various biosorbents (Koushkbaghi et al. 2018; Khalid et al. 2018). The better biosorption capability discovered at a low hydrogen ion concentration value is related to a large number of  $H^+$  ions present at around low pH values, which successively neutralize the negatively charged hydroxyl groups ( $-OH$ ) ions causing an increasing hindrance to the diffusion of positively charged dichromate ions. Once increasing pH values from 2.0 to 6.0,  $HCrO_4^-$  gradually converts to the divalent

$\text{CrO}_4^{2-}$ . The amine groups ( $-\text{NH}_2$ ) in Cts are mainly responsible for Cr (VI) biosorption and can be protonated to  $\text{NH}_3^+$  in a slightly acidic medium (Salih & Ghosh, 2018). As pH increases, the surface of biosorbent become a lot of negatively charged ions and therefore, the number of positively charged sites diminished. This causes an increased repulsion between Cr (VI) and AS or Cts $\odot$ AS composite. A negatively charged surface site on the biosorbent doesn't favour the biosorption of Cr (VI) because of the static repulsion. Adjusting the pH of the solution greater than 6.0 by adding NaOH causes flocculation and deprotonation of the biosorbent (Rinaudo, 2006). Additionally, pH lower than 1.5; the amine group of Cts is easily protonated and which causes electrostatic repulsion to Cr (VI) ion.

### **The Effect of Contact Time on The Biosorption of Cr (VI)**

The effect of contact time on the biosorption of Cr (VI) in the biosorption experiments using AS and Cts $\odot$ AS composite is shown in Figure 4c. In this study, 25 mL, 150 ppm Cr (VI) solution was added to 0.1 g of AS and 0.05 g of Cts $\odot$ AS composite, separately for the biosorption process. The mixture was stirred in the magnetic stirrer at the specified time intervals (5, 15, 30, 60, 90, 120, 180, 240 min) and the Cr (VI) contents of the remaining solution after the filtration were measured with the UV-Vis spectrometer. As seen in Figure 4c., the biosorption of Cr (VI) into AS increased rapidly in the first 5-30 min. and then reached the equilibrium between 30-120 min. The longer contact time was not effective on the biosorption, and the contact time was taken as 120 minutes. On the other hand, Cr (VI) adsorption on the Cts $\odot$ AS composite increased rapidly in the first 5-30 min. and then reached a stable value in 30-90 min. The longer contact time was not effective on the biosorption, and the contact time was taken as 90 minutes. It has been observed that the biosorption is fixed to the point of reaching the equilibrium for both of them. Due to the large surface area of the Cts $\odot$ AS composite/AS and the existence of functional groups in the matrix, the first part (15 min.) of the biosorption is fast because Cr (VI) ions tend to interact with the functional groups of the biosorbent. At the end of the applied contact time, the optimum time was determined as 120 min for the AS and 90 min. for Cts $\odot$ AS composite. It was seen that the Cts $\odot$ AS composite reached the equilibrium in a shorter time compared to the AS.

### **Effect of The Biosorbent Dose on The Biosorption**

An optimal biosorbent dose should be determined to maximize the interactions between the Cr (VI) and biosorption sites of the AS and Cts $\odot$ AS composite in the solution phase. The relationship between the AS and Cts $\odot$ AS composite dose and the biosorption capacity, as much as the removal efficiency of Cr (VI), are illustrated in Figure 4d. 0.025; 0.050; 0.100; 0.150 and 0.200 g of the weighed AS were separately bottled and 150 ppm of 25 ml of Cr (VI) solutions were added, then stirred for 120 minutes at 200 rpm in a magnetic stirrer. On the other hand, 0.012; 0.025; 0.050; 0.075 and 0.100 g of the weighed Cts $\odot$ AS were separately bottled and 150 ppm of 25 ml of Cr (VI) solutions were added then stirred for 90 minutes at 200 rpm in the magnetic stirrer. Cr (VI) contents of the remaining solution after the filtration were measured with the UV-Vis spectrometer. The results of the experiment (Figure 4d.) showed that the biosorption process is strongly dependent on these parameters. A relatively slow increase in the biosorbent amount range of 0.012 - 0.1 g Cts $\odot$ AS, Cr (VI) removal (R, %) from 36.63 to 95.93% was achieved and slow increase in the biosorbent amount range of 0.025-0.2 g AS, Cr (VI) removal (R, %) from 10.28 to 90.32% was achieved. The biosorption capacity of Cr (VI) follows with the increase of biosorbent dose and a tendency has been observed in the biosorption process of AS and Cts $\odot$ AS composite. Therefore, the biosorption capacity of AS decreases from 2.20 to 0.67 mmol/g by increasing the biosorbent rate between 0.012 and 0.1 g and the biosorption capacity of AS decreases from 0.72 to 0.33 mmol/g by increasing the biosorbent rate between 0.025 and 0.2 g. The maximum biosorption mass was found as 0.05 g and 0.1 g for Cts $\odot$ AS composite and AS, respectively.

### **CONCLUSION**

The AS and a new Cts $\odot$ AS composite was designed to be an effective biosorbent for the biosorption of Cr (VI) from aqueous solutions. The biosorption behavior of Cr (VI) onto AS and Cts $\odot$ AS composite was investigated and it was found to be dependent on pH, biosorbent dosage, initial Cr (VI) concentration and contact time. The functional groups such as amino, carboxyl and hydroxyl groups on the surface of Cts $\odot$ AS played an important role in the binding of Cr (VI) from the medium. Langmuir, Freundlich, Stachard and Temkin isotherms were tried and the biosorption constants were calculated.

Langmuir isotherm model best described the biosorption process ( $R^2$  is 0.99) and the values of the  $R_L$  factor indicating a strong binding at the active sites of the Cts@AS composite. By applying the Langmuir model equation, the maximum Cr (VI) capacities of Cts@AS composite and AS were found to be 89.29 and 44.25 mg/g, respectively. Cts@AS composite displayed a higher biosorption capacity than AS. The biosorption studies revealed that the optimum contact time for the equilibrium was found to be 90 min. and 120 min. for Cts@AS and AS, respectively. pH 2 was an optimum value for the biosorption of Cr (VI). The coordination, electrostatic attraction and complexation of Cr (VI) with the functional groups can be accepted for the interaction. Cts@AS is recommended for the treatment plants to remove the toxic Cr (VI) species from effluents. The produced biosorbent was generated from natural sources that claim it is an environmental friendly biosorbent for the application of Cr (VI) removal from the polluted solution.

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### **O 83. PHOTOCATALYTIC Cr (VI) REMOVAL WITH NANOMATERIAL COATED ON NATURAL STONE**

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**ABSTRACT:** Chromium is one of the most common elements in the earth which found in the inner layers of the ground and in the body of living organisms. Certain industrial processes cause serious environmental problems and produce waste streams containing contaminants such as heavy metals. The removal of heavy metal ions, which exhibit a significant toxic effect in wastewater is particularly important in the field of water pollution. Chromium plating, leather tanning, wood shielding and stainless-steel manufacturing industries wastewater mainly contain chromium with valance of 6<sup>+</sup> and 3<sup>+</sup>. Especially discharging of Cr(VI) to the environment is very dangerous and causes health problems. Therefore, different methods are applied for the treatment of wastewater containing Cr(VI). The most commonly applied methods are reduction of Cr(VI) to Cr(III). Although there are several widely used methods such as chemical precipitation, reduction, dialysis, ion exchange, evaporation, solvent extraction, reverse osmosis and ultrafiltration for Cr(VI) removal in wastewaters, photocatalytic oxidation method has gained great importance in recent periods. In photocatalytic removal, Cr(VI) reduced to Cr(III) with the help of photocatalyst and UV light. In this study, photocatalytic Cr (VI) removal was aimed and Ag and Ni doped TiO<sub>2</sub> nanoparticles were coated on natural volcanic stones as a photocatalyst. Volcanic stones containing Ag and Ni doped TiO<sub>2</sub> (0.5%, 1.0%, 2.5% and 5%) in four different compounds percentages were prepared by sol-gel method. In order to form a solid layer on the natural stone, the coated stones were kept in an oven of 600 °C for 1 hour to produce photocatalyst material and the nanomaterial percentages on the stones were determined by SEM-EDX analysis. Synthetic Cr (VI) containing water was used for removal experiments by using batch reactor. Cr (VI) removal was much higher in the experiment using nanomaterial produced with 0.5% doping. As a result of this study, in water it was determined that the increase in the percentage of Ag and Ni doping has showed a negative effect on the removal of Cr (VI).

*Keywords: Chromium, Wastewater, Photocatalyst, Photocatalytic Removal, TiO<sub>2</sub>, Ag, Ni.*

## **1. INTRODUCTION**

### **1.1. Chromium Removal Processes**

Chromium is one of the most common elements in the earth which found in the inner layers of the ground and in the body of living organisms. The high amount of chromium is found in the iron-containing chromite ore occurring in the magmatic environment. Chromite is the sole commercial source of chromium. When industries go through a certain process, they cause serious environmental problems and produce waste streams containing pollutants such as heavy metals. It is particularly important in the field of water pollution for the removal of heavy metal ions which show significant toxic effects in wastewater. Chromium plating, leather tanning, wood shielding and stainless-steel manufacturing industries wastewater mainly contain chromium with valance of 6<sup>+</sup> and 3<sup>+</sup>. The discharge of Cr (VI) to the environment is also very dangerous and causes health problems. Hence, various methods are used for the treatment of wastewater containing Cr (VI). The most commonly applied methods are reduction of Cr(VI) to Cr(III). Generally, it is observed that chrome plating, automotive, leather and paint industrial wastes are the main sources of chromium pollution (Balçı, 2019).

Among the methods which are used for the chromium removal from industrial wastewater; chemical precipitation, reduction, dialysis, ion exchange, evaporation, solvent extraction, reverse osmosis, ultrafiltration, flotation, membrane technologies and adsorption are the most commonly used methods. For selecting these methods, the acidic or basic character of the wastewater, the type and concentration

of the chromium compound the content in waste, cost, chemical and energy consumption, management of the new wastes and the efficiency of the wastes are taken into consideration. One of the most commonly used approaches for chromium removal is chemical precipitation. In this method, primarily Cr(VI) ion in the wastewater are reduced to Cr(III), the most stable type of thermodynamics which are using as a reducing agent. (URL 1). The reducing agents used for the reduction of Cr(VI) are salts such as iron(II) sulphate (FeSO<sub>4</sub>), sulfur dioxide (SO<sub>2</sub>), sodium sulfite (Na<sub>2</sub>SO<sub>3</sub>) and sodium bisulfite (NaHSO<sub>3</sub>) and alkali sulfides. Reduction can be carried out by a reducing agent as well as by light and photocatalyst.

In this study, photocatalytic Cr (VI) removal was aimed and Ag and Ni doped TiO<sub>2</sub> nanoparticles were coated on natural volcanic stones as a photocatalyst. Volcanic stones containing Ag and Ni doped TiO<sub>2</sub> (0.5%, 1.0%, 2.5% and 5%) in four different compounds percentages were prepared by sol-gel method. In order to form a solid layer on the natural stone, the coated stones were kept in an oven of 600 °C for 1 hour to produce photocatalyst material and the nanomaterial percentages on the stones were determined by SEM-EDX analysis. Synthetic Cr (VI) containing water was used for the removal experiments by using batch reactor.

### 1.2. Photocatalytic Oxidation

TiO<sub>2</sub> is among one of the most important materials in our daily lives. It is widely used in paints, cosmetics and food products. The photocatalytic activity of TiO<sub>2</sub> has helped for further expand of the use of this material.

Photocatalism is called the accelerating of a photoreaction with the presence of a catalyst (Mills and Lehunte, 1997). In the semiconductors, the anatase form of TiO<sub>2</sub> shows the highest photocatalytic activity (Hoffmann et al., 1995). Many studies has been done intensively, since this feature of TiO<sub>2</sub> can be a solution to environmental pollution problems. In another aspect of the TiO<sub>2</sub>, it is the superhydrophilic property of the surface with the effect of light and this property provides the non-fogging and self-cleaning surfaces. Photocatalytic reactions occur on the surfaces of titanium dioxide thin films. When TiO<sub>2</sub> is stimulated by light, the reaction starts (Şam et al., 2007). The following reactions occur in the photo-reduction of metals:



In eq. (1), when an energy bigger than the band gap of the semiconductor photocatalyst (TiO<sub>2</sub>) is given to the fluid distribution of the photocatalyst, the formation of electrons in the conducting band and the opening of the holes in the valence band are indicated. A possible recombination of the electrons produced in eq. (2) and the heat-forming holes which is an unfavorable reaction are indicated. Eq. (3) states that M<sup>n+</sup> value any metal ions in the system are reduced by the electrons released in the presence of light. Eq. (4) indicates the oxidation of water. In this study, it is aimed to remove Cr (VI) heavy metal by using modified TiO<sub>2</sub> (Ag and Ni Doped) photocatalyst (Aarthi, 2008).

Cr<sup>+6</sup> is reduced to Cr<sup>+3</sup> in the presence of UV light and photocatalyst. Experimental conditions such as pH, temperature, photocatalyst properties and organic compounds in the environment are the main factors which can affect the photocatalytic efficiency. During the study, pH and temperature were kept constant and the water used in experiments were synthetically prepared in laboratory. Experiments were performed in the batch system by using TiO<sub>2</sub> photocatalysts which had different percentages.

Nowadays, it has been shown that there are intensive studies on different applications such as heterogenous photocatalysis, hydrogen generation, water and air purification systems and self-cleaning surfaces. Titanium dioxide ( $\text{TiO}_2$ ) is the most useful compound for photocatalytic semiconductor applications due to its high efficiency, low cost, high chemical stability and biocompatibility under ultraviolet light (Mills and Leunte, 1997). During  $\text{TiO}_2$  stimulation by ultraviolet light, electron-gap pairs are formed. These electron gap pairs,  $\cdot\text{OH}$  radicals and  $\text{O}_2\cdot^-$  superoxide produced by the adsorbed to the surface of the photocatalyst causes to oxidize the pollution (Mills and Le Hunte, 1997; Tryk et al., 2000).

In addition to the industrial pollution; it also cause to affect the life of the buildings with the environmental pollution. Another important situation is the pollution of the environment, bacteria, viruses, such as human health in a negative situation, which causes the increasing structures. For this reason, it vital to develop self-cleaning environment-friendly photocatalytic systems that reduce air pollution and decompose bacteria, viruses and toxic organics. For these functions, the photocatalytic feature is provided by the use of anatase  $\text{TiO}_2$  powder, while the antibacterial property will provide a permanent antimicrobial effect to the glaze composition, especially Ag, Zn and etc. ions are obtained by adding the appropriate conditions (Gürbüz et. al., 2012).

If the photocatalytic cleavage reaction occurs in the suspension where the catalyst and impurity molecules are in the same location, the change in the amount of catalyst is also observed to change in the photocatalytic activity. Only the maximum amount of the catalyst, the synthesis method of the catalyst on the surface; it is known that it depends on properties such as particle size and surface area and the structure of molecules to be cleaved. As a result, as the amount of catalyst in the environment increases after the known ratio, it is seen that the photocatalytic cleavage rate of the known molecules is increased (Mahmiani, 2016).

Synthesis methods of semiconductor photocatalysts are shown as bellow:

- Sulfate method
- Chloride method
- Micro-plasma oxidation (MPO) method
- Ultrasonic method
- Hydrothermal method
- Sol-gel method

### **1.3. Sol-Gel Method**

The so-called sol-gel process such as soft chemistry is based on the phenomenon of preparing solids from the solution at very low temperature by using the sol or the gel as a medium step which has been observed to date. In fact, it shows the transformation of the sol-gel, hydrolysis and condensation reactions of the molecular precursors of the oxide network. The alkoxide groups in the alcohol and water solution are removed by the hydrolysis in case of acidic or basic catalyst and at the same time hydroxyl groups forming the -M-O-M- bonds are substituted. The gelation indicates that the polymer networks, which continue to grow in order to form the relation indicating the total coverage of the solution are formed. We can see that the viscosity and elastic modulus gradually increase at the time of gelation (Toygun et al., 2013). The gel is then dried by supercritical fluid extraction to evaporate and produce xerogel or to find airogel. It has also been explained that the sol-gel method is a method that can be carried out well under laboratory conditions and the use of the applied method in large-scale production increases day by day.

The basic steps of sol-gel method are as bellow:

- 1- Hydrolysis
- 2- Alcohol or water condensation
- 3- Gelling moment
- 4- Aging moment
- 5- Drying process
- 6- Application of high temperatures process

Sol-Gel method and  $\text{TiO}_2$  also used in the synthesis of semiconductor. As the starting material metal alkoxides are used in almost all studies and the basic state of the reaction is known to occur in the hydrolysis and condensation reactions of metal alkoxides in the catalytic medium at 25 °C at room temperature.

The applied method is as:

- 1) To be able to work at a very low temperature,
- 2) Possibility to use organic solvents,
- 3) By using liquid solutions of pure substances homogeneity at molecular levels can be ensured,
- 4) Providing low temperature to produce hydrolysis and condensation reactions, thus avoiding losses that can be observed by evaporation at very high temperatures,
- 5) In experimental studies, even though many other advantages such as being able to be formed with simple glass materials under atmospheric conditions have been observed, the demerits of semiconductors used in photocatalysis reactions are the disadvantages of using their targets as roughness. The gel material formed at the end of the hydrolysis and condensation reaction is a product having a metal alkoxide oxide hydroxide structure.

The conversion of the product to  $\text{TiO}_2$ , which is the most widely used anatase in photocatalytic studies, must also be dependent on the calcination procedure such as at temperatures too high at oxygen atmosphere e.g; above 450 °C. As the produced substance cannot form a polar or apolar group at random on its surface, it can also be considered as pure  $\text{TiO}_2$  in powder form. Only in such cases, after the photocatalysis process has been carried out in the solution phase, the measurements to be made should be separated from this environment by filtration. After every other measurements, it should be applied again. Once the separation from the medium has taken place, the reduction of the surface properties of the catalyst can be seen from the initial dimension, if the surface characteristic of the catalyst may vary. Thus, it will be evident that significant changes in photocatalytic activity will occur.

Nowadays in conducted studies, photocatalytic thin films have attracted considerable influence and attention has been paid to this area in almost every study. The important problem in the films produced is that the surface to be used in the coating process provides the coating solutions and  $\text{TiO}_2$ , which will exhibit photocatalytic activity to form transparent sols. The  $\text{TiO}_2$  particles synthesized by the sol-gel method, as described in previous do not show on the surface of the polar/apolar groups which play a significant role in the formation of the transparent sols. According to Mahmiani. (2016), it has been reported that perhaps the sol of these particles is not produced or sols are not transparent.

## **2. MATERIAL AND METHOD**

### **2.1. Preparation of Ag-Ni Doped $\text{TiO}_2$ Photocatalyst on a Volcanic Stone**

**The Procedure of Experiment:** In this method,  $\text{TiO}_2$  nano-material is first obtained for doping and then the desired metals are doped onto  $\text{TiO}_2$  with the help of other solution. Therefore, the aim here is to prepare two different sols. The molar ratios used during the preparation of these sols are given below. The unassembled  $\text{TiO}_2$  was obtained by preparing only the sol A.

Sol A:  $(\text{Ti}((\text{OC}_4\text{H}_9)_4):1\text{-butanol}:2\text{-propanol}:\text{pure water}:\text{acacH} = 1:7:3:4:0.5)$ .

Sol B: (ethanol:  $\text{Ni}_2(\text{NO}_3)_4 = 20:1$ , ethanol:  $\text{AgNO}_3 = 20:1$ ).

- For preparation of Sol A Titanium butoxide and acetyl acetone were dissolved in 1-butanol.
- The prepared solution was stirred.
- Then the required amount of water was dissolved in 2-propanol and added to the other solution.
- While preparing the sol A, sol B containing Ag and Ni at the planned concentrations was prepared with ethanol. (0.5%, 1.0%, 2.5% and 5% - percentages of  $\text{AgNO}_3$  and  $\text{Ni}_2(\text{NO}_3)_4$ ) according to titanium precursor  $[\text{Ti}((\text{OC}_4\text{H}_9)_4)]$ .
- Sol B is added into Sol A and stirred certain time together.
- The obtained sol was ready for the coating process. (Figure 1)

For the volcanic stones, pre-sieving was performed. These stones were then again cleaned with propanol and passed through pure water and dried in the ash oven (Figure 2). The drying process was expected

while preparing the sol without performing the removal into the sol. The volcanic stones (determined by the sieve of their size) were thrown into the sol and waited for 2 minutes. After these processes, they were dried in a desiccator at room temperature for 1 hour (Figure 3). It subjected to heat process to achieve solidification. The synthesized material was kept at 600 °C for 1 hour and the photocatalysts were prepared (Figure 4). The percentages of Ag, Ni and Ti, which were fixed on the prepared material, were determined by EDX analysis.



**Figure 1.** Mixing process



**Figure 2.** Drying of volcanic stones in ash oven



**Figure 3.** Drying process in desiccator



**Figure 4.** Ag-Ni TiO<sub>2</sub> coated volcanic stones

## **2.2. Photocatalytic Cr<sup>+6</sup> Removal Experimental Procedure**

In the first step, a water sample containing synthetic chromium was prepared. For this purpose, a Cr solution was prepared in the laboratory and diluted with distilled water to a concentration of 5 mg/L and adjusted to a volume of 500 mL. The pH of the prepared solution was brought to about 2.4 by adding 0.1 ml H<sub>2</sub>SO<sub>4</sub>. To determine the inlet concentration, 1 mL of this solution was diluted 1/5 and measured using the LCK 313 cuvette test (Figure 5). Volcanic stones of 15 gr weight were thrown into the prepared sample and then mixed (Figure 6). In order to bring the system to equilibrium, stirring was performed in dark environment for 15 minutes. At the end of this period, 11W UV light was turned on and photocatalytic reactions were expected to be completed (Figure 7). The system was operated intermittently and the total waiting time reported as 5 hours. Samples were taken from the system at 90,180,240 and 300 minutes and Cr(VI) measurements were made. The parameters considered during the experiments are given in Table 1.



Figure 5. LCK 313 Chrome cuvettes

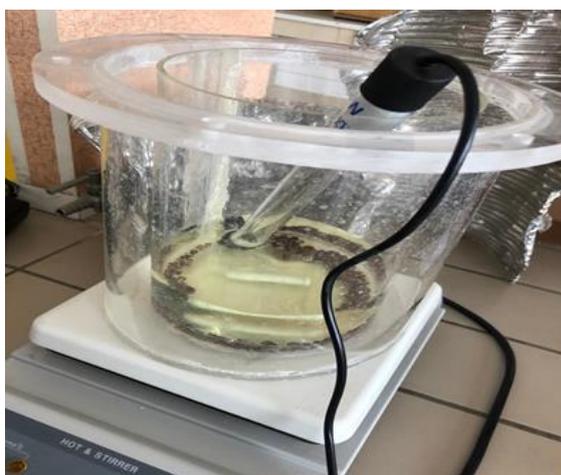


Figure 6. The batch reactor before closing



Figure 7. Mixing in batch reactor with UV light

Table 1. Parameters which set during the experiments

Photocatalyst	Sample Volume (ml)	pH	Photocatalyst Weight (gr)	Mixing velocity (rpm)	Temperature (°C)
0.5% Ag-Ni TiO <sub>2</sub>	500	2.40	15	30	25
1% Ag-Ni TiO <sub>2</sub>	500	2.43	15	30	25
2.5% Ag-Ni TiO <sub>2</sub>	500	2.41	15	30	25
5% Ag-Ni TiO <sub>2</sub>	500	2.42	15	30	25
Non-doped TiO <sub>2</sub>	500	2.43	15	30	25

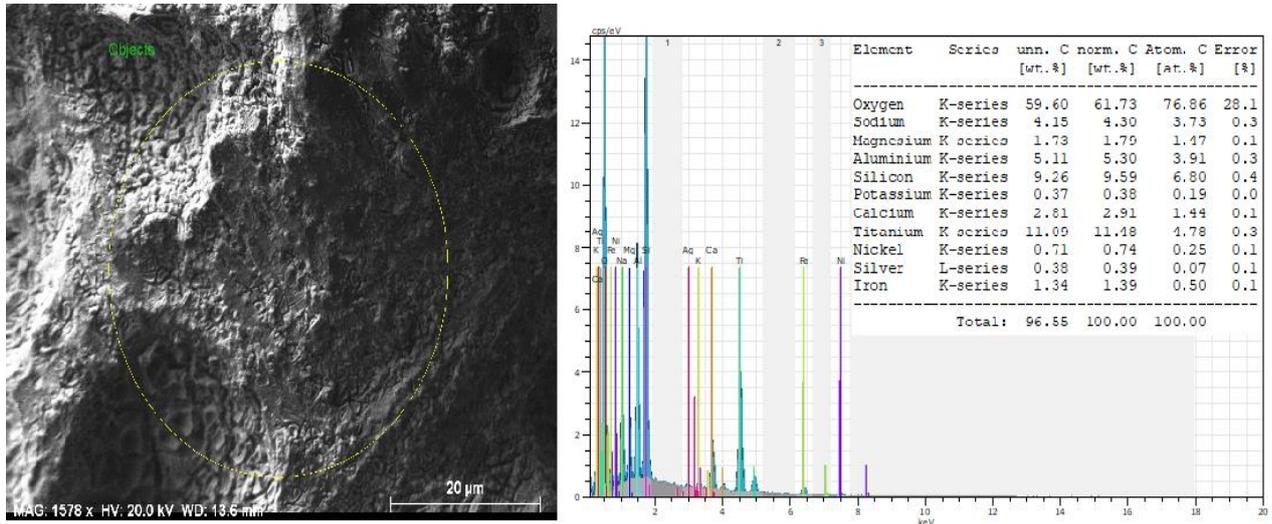
### 3. RESULTS AND DISCUSSION

#### 3.1. Material Properties

The retention percentages of Ag, Ni and Ti on the prepared photocatalyst were determined by SEM-EDX analysis. SEM-EDX result graphs obtained by changing the doping percentages are given in the

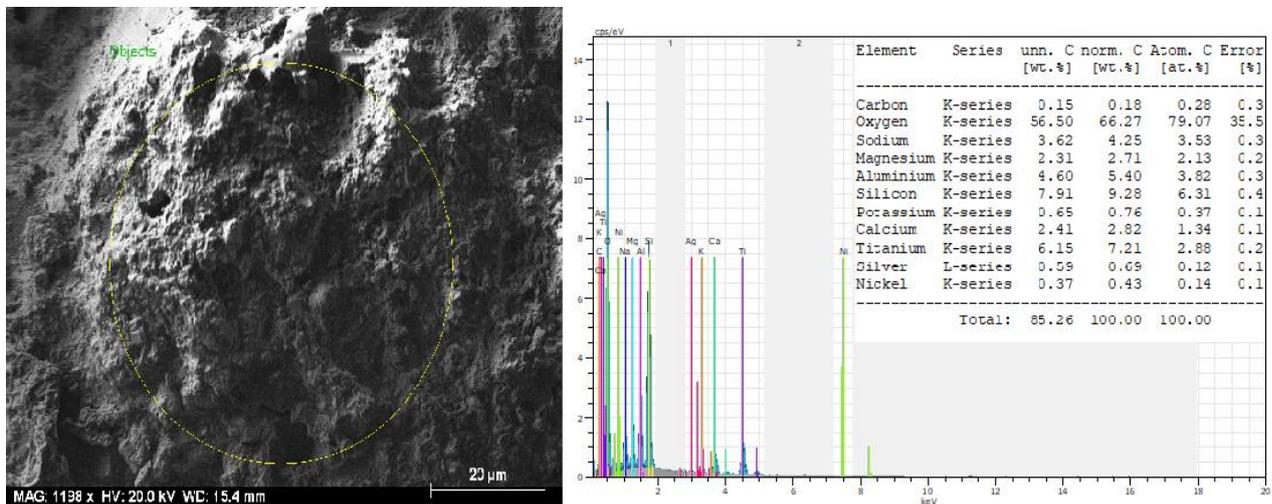
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following figures (Figure 8, Figure 9, Figure 10 and Figure 11). By evaluation of the obtained results, it was seen that adding more amount of  $\text{AgNO}_3$  and  $\text{Ni}_2(\text{NO}_3)_6$  in doping process did not affect adherence efficiency very much and it increased regionally Ag and Ni ratio. In particular, it is clear from the results that the adsorption of Ni increases as the doping percentage increases. Since the material structure is amorphous, it is not possible to get closer to the surface, only the elemental percentages of substances added on the stone can be examined. It is understood from the obtained results that the material obtained as the result of this study has nano properties and contains Ag, Ni and  $\text{TiO}_2$ . EDX result graph of 0.5% Ag and Ni doped material is illustrated in Figure 8.



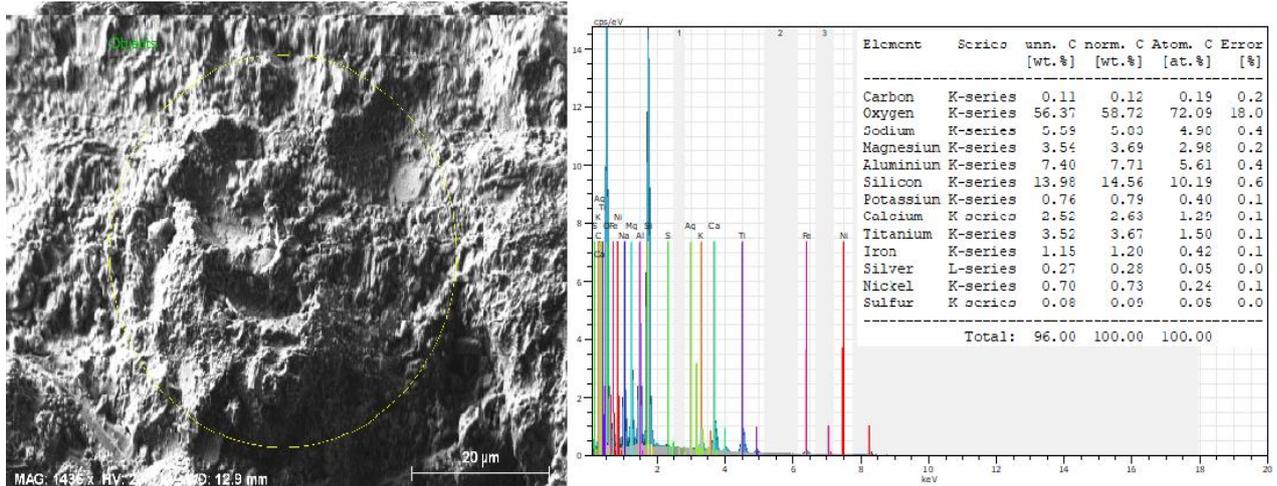
**Figure 8.** EDX result graph of 0.5% Ag and Ni doped material

EDX result graph of 1.0% Ag and Ni doped material is shown in Figure 9.



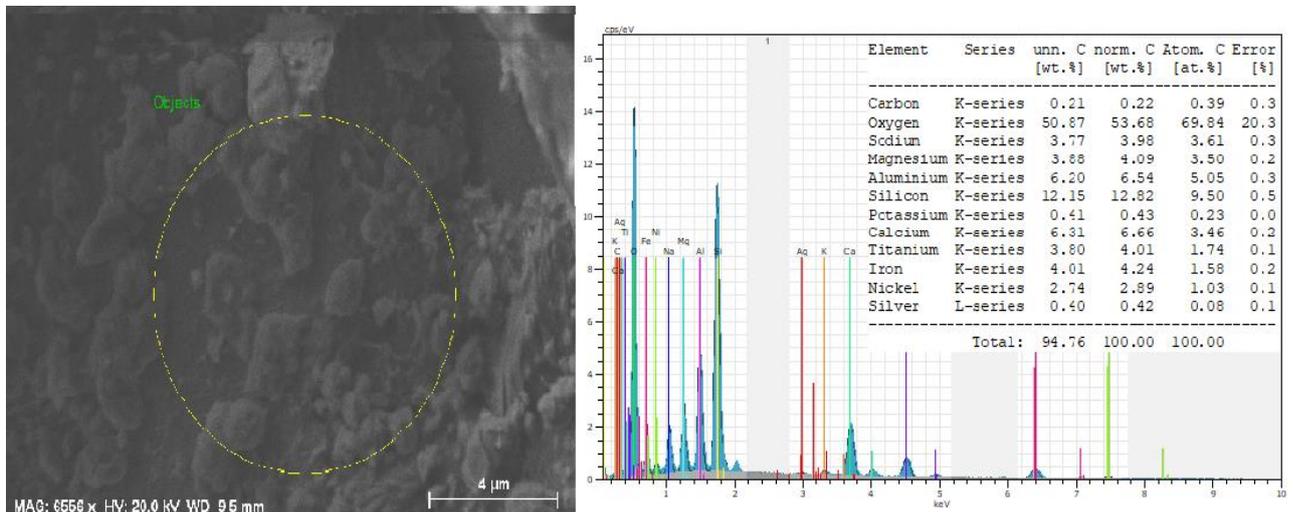
**Figure 9.** EDX result graph of 1.0% Ag and Ni doped material

EDX result graph of 2.5% Ag and Ni doped material is illustrated in Figure 10.



**Figure 10.** EDX result graph of 2.5% Ag and Ni doped material

EDX result graph of 5% Ag and Ni doped material is illustrated in Figure 10.



**Figure 11.** EDX result graph of 5.0% Ag and Ni doped material

### 3.1. Photocatalytic Cr (VI) Removal

The Cr<sup>6+</sup> concentrations obtained from the conducted experiments during the study are given in Table 2.

**Table 2.** Concentrations of Cr<sup>6+</sup> obtained from experiments

Time (minute)	0.5% Ag-Ni TiO <sub>2</sub> (mg/l)	1.0% Ag-Ni TiO <sub>2</sub> (mg/l)	2.5% Ag-Ni TiO <sub>2</sub> (mg/l)	5.0 % Ag-Ni TiO <sub>2</sub> (mg/l)	Non-doped TiO <sub>2</sub> (mg/l)
C <sub>inlet</sub>	4.31	5.15	5.80	6.55	7.10
C <sub>90</sub>	3.73	4.55	4.65	6.05	5.75
C <sub>180</sub>	3.27	3.89	4.27	5.45	5.20
C <sub>240</sub>	2.34	3.27	3.50	5.15	4.83
C <sub>300</sub>	1.54	2.93	3.17	4.51	4.45

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The removal efficiencies of the samples were calculated from the eq. (5):

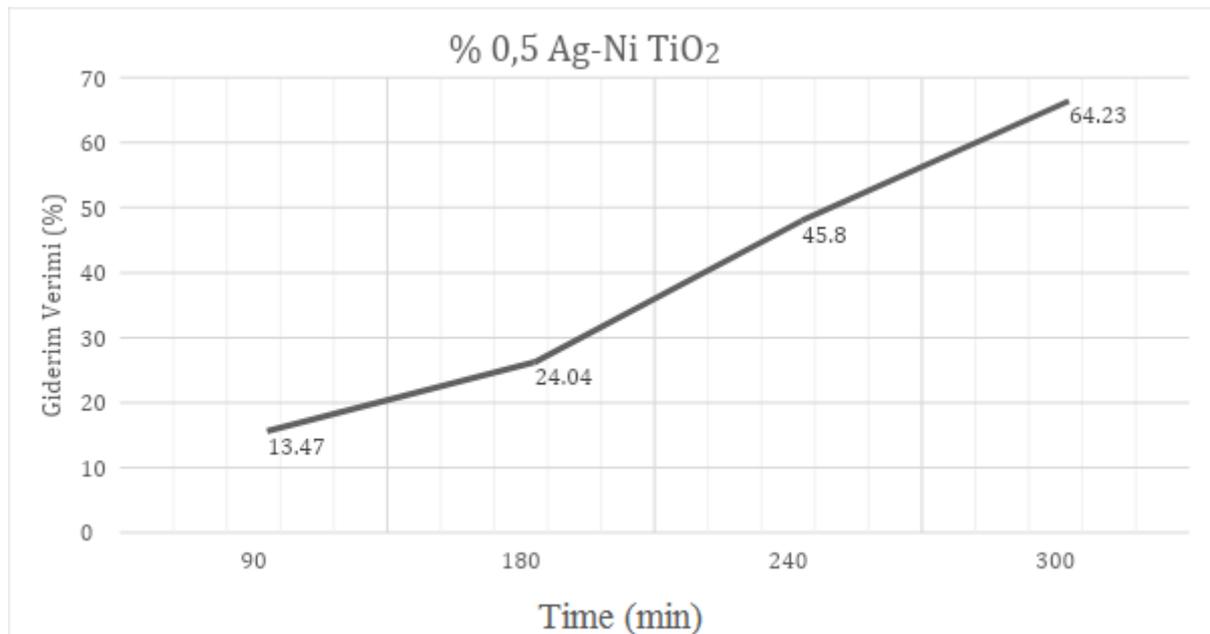
$$\text{Removal efficiency} = \frac{C_{inlet} - C_t}{C_{inlet}} * 100 \quad (5)$$

Table 3 shows the removal efficiencies obtained from these experiments. The plotting efficiency graphs for the nano-material coated volcanic stones used in the experiments are given in Figures 12-16. Figure 17 shows the obtained yield graphs all together.

**Table 3.** Cr<sup>+6</sup> removal yields obtained from experiments

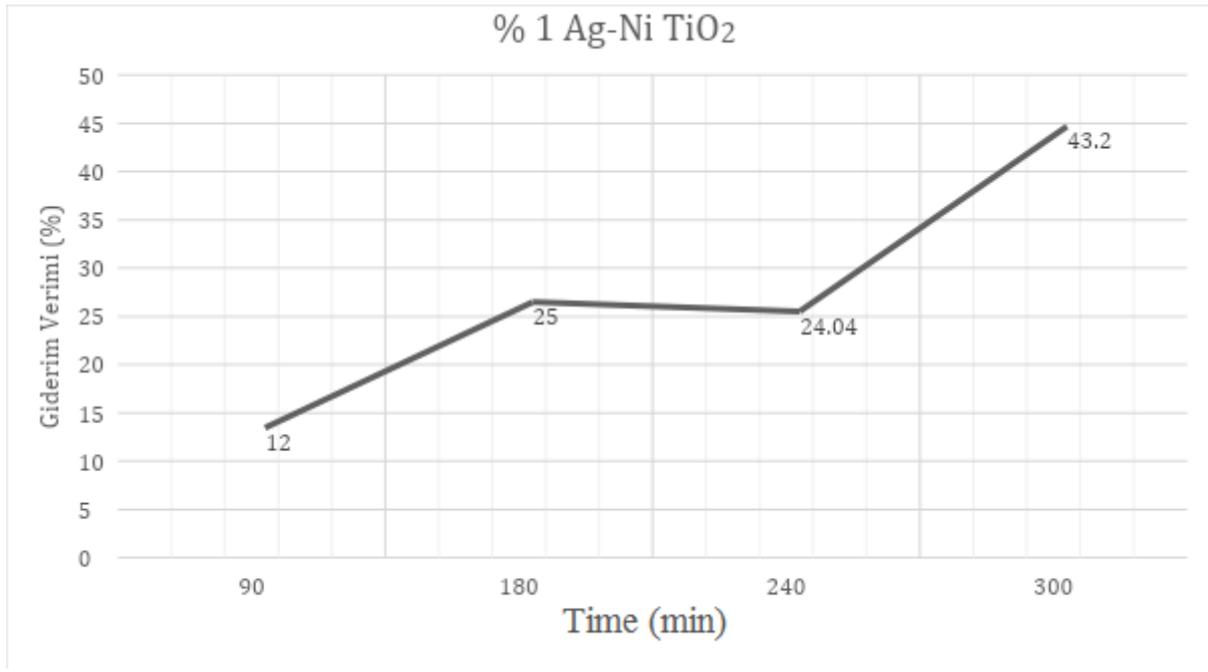
Samples	Efficiency after 90 min (%)	Efficiency after 180 min (%)	Efficiency after 240 min (%)	Efficiency after 300 min (%)
0.5% Ag-Ni TiO <sub>2</sub>	13.47	24.04	45.80	64.23
1.0% Ag-Ni TiO <sub>2</sub>	12.00	25.00	24.04	43.20
2.5% Ag-Ni TiO <sub>2</sub>	20.00	26.50	40.00	45.40
5.0% Ag-Ni TiO <sub>2</sub>	7.60	16.80	21.40	31.22
Non-doped TiO <sub>2</sub>	19.01	27.00	32.00	37.40

Plotted removal efficiency versus time which obtained in the experiment using 0.5% Ag-Ni TiO<sub>2</sub> coated volcanic stone is illustrated in Figure 12.



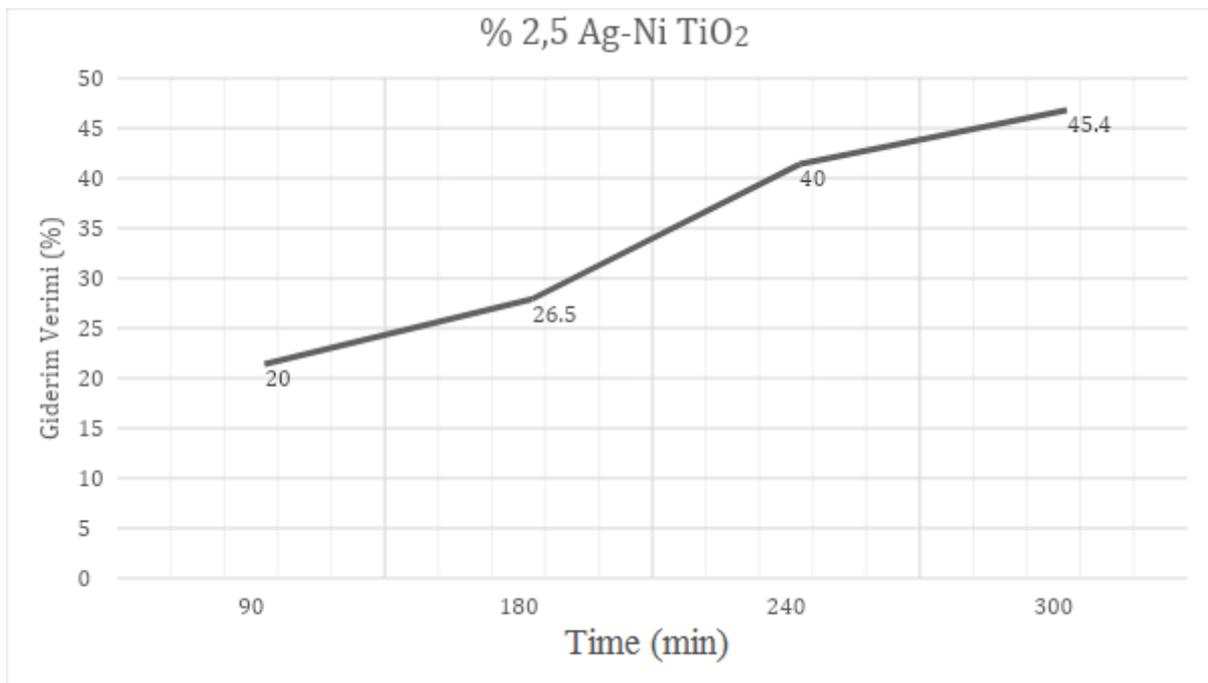
**Figure 12.** Plotted removal efficiency versus time which obtained in the experiment using 0.5% Ag-Ni TiO<sub>2</sub> coated volcanic stone

Plotted removal efficiency versus time which obtained in the experiment using 1.0% Ag-Ni TiO<sub>2</sub> coated volcanic stone is illustrated in Figure 13.



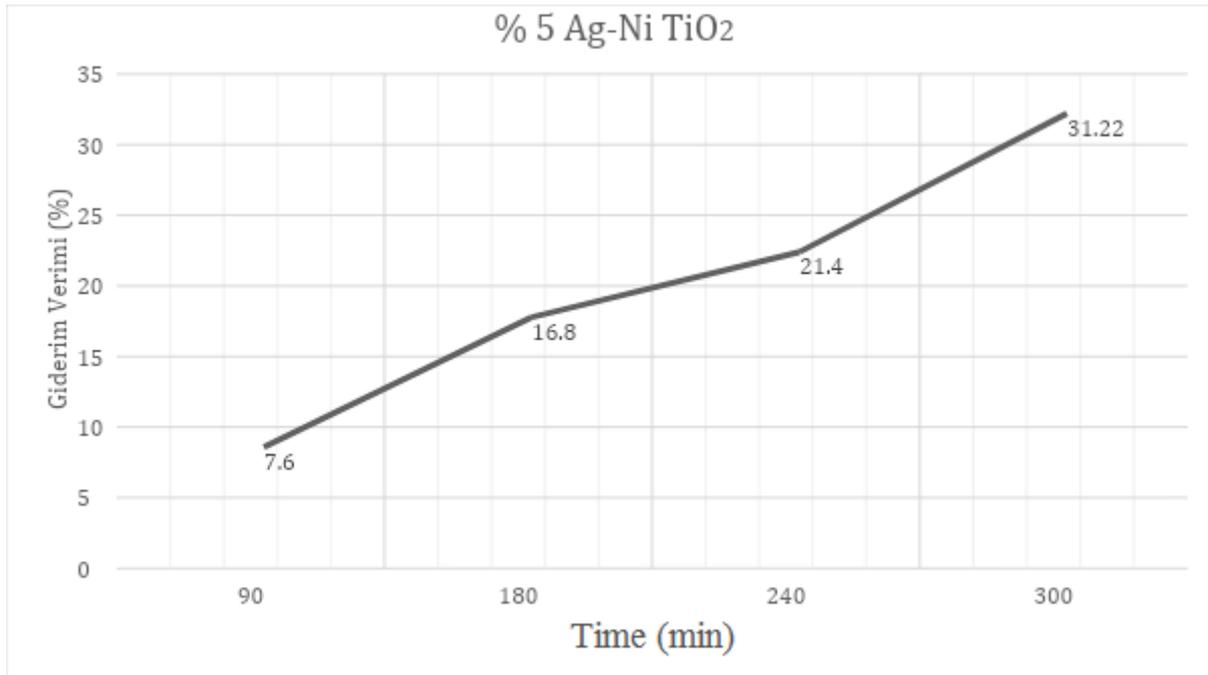
**Figure 13.** Plotted removal efficiency versus time which obtained in the experiment using 1.0% Ag-Ni TiO<sub>2</sub> coated volcanic stone

Plotted removal efficiency versus time which obtained in the experiment using 2.5% Ag-Ni TiO<sub>2</sub> coated volcanic stone is shown in Figure 14.



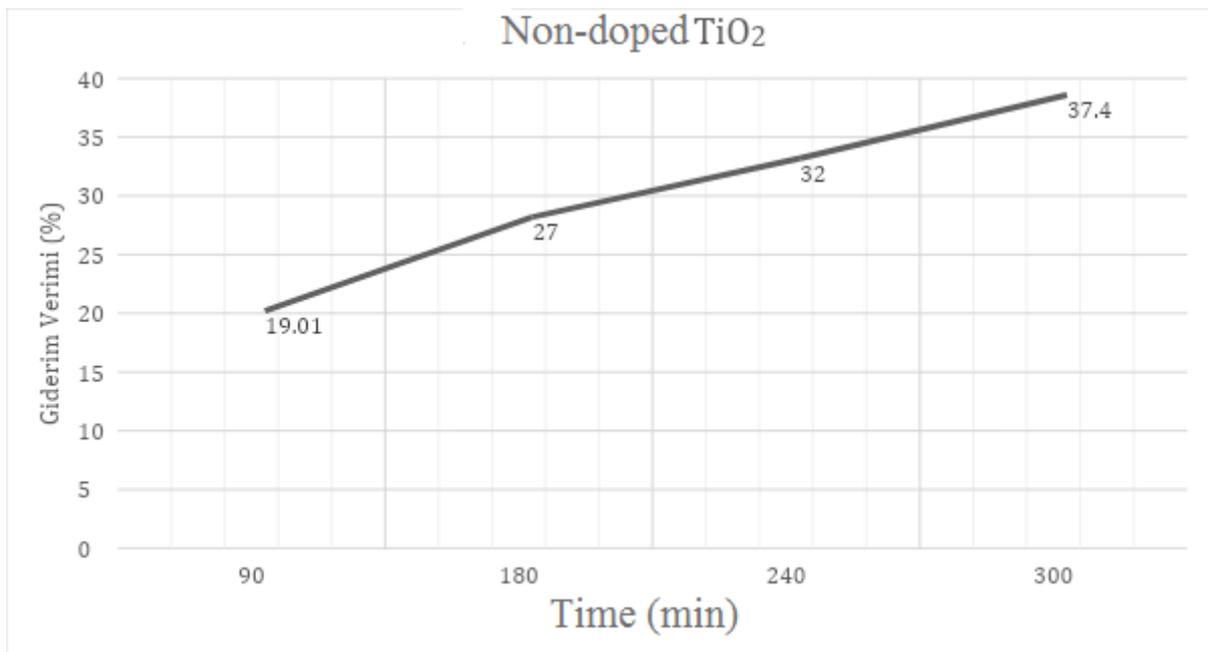
**Figure 14.** Plotted removal efficiency versus time which obtained in the experiment using 2.5% Ag-Ni TiO<sub>2</sub> coated volcanic stone

Plotted removal efficiency versus time which obtained in the experiment using 5.0% Ag-Ni TiO<sub>2</sub> coated volcanic stone is illustrated in Figure 15.



**Figure 15.** Plotted removal efficiency versus time which obtained in the experiment using 5.0% Ag-Ni TiO<sub>2</sub> coated volcanic stone

Plotted removal efficiency versus time which obtained in the trial using non-doped TiO<sub>2</sub> coated volcanic stones is shown in Figure 16.



**Figure 16.** Plotted removal efficiency versus time which obtained in the trial using non-doped TiO<sub>2</sub> coated volcanic stones

Removal efficiency versus time graph is shown with all materials used in the experiments is illustrated in Figure 17.

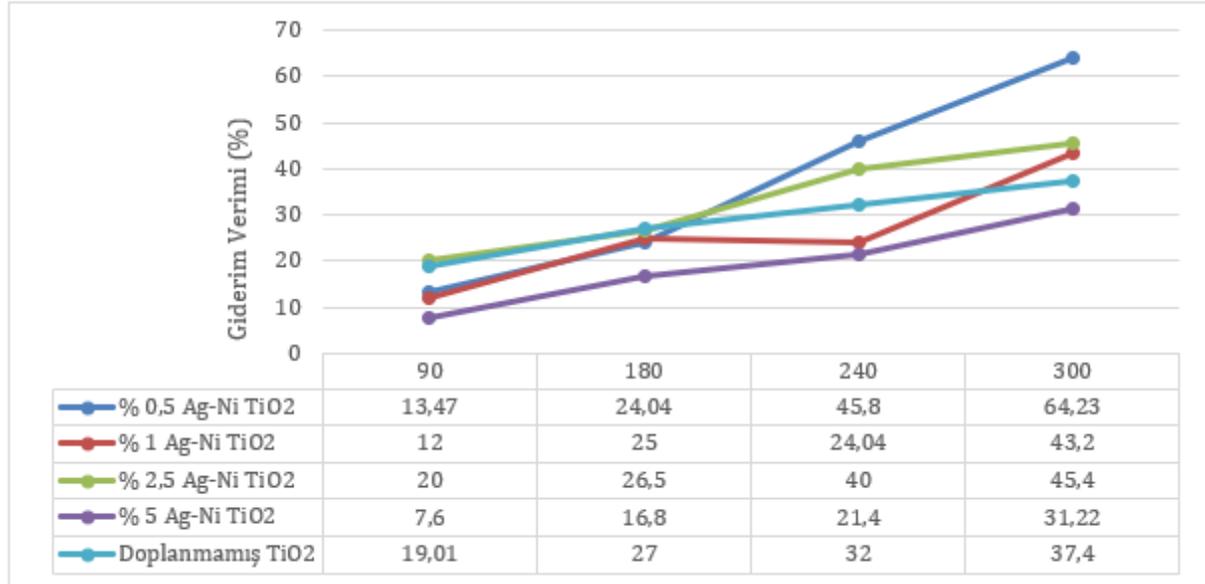


Figure 17. Removal efficiency versus time graph is shown with all materials used in the experiments

The obtained results in this study were evaluated, the highest removal efficiency was obtained by using TiO<sub>2</sub> coated volcanic stones with 0.5% Ag and Ni doping. Increasing the doping percentage was found to slightly reduce Cr(VI) removal. By exploring the literature it was determined that the efficiency increased in the Ag doped studies and no Ni related sample was found. In this study, it is seen that the percentage of doping increases Ni adherence, so Ni is more likely to be the parameter that negatively affects removal efficiency. Further reduction in the yield using TiO<sub>2</sub> obtained without doping proves that doping has a positive effect on efficiency. As a result, it is a logical solution to make Cr<sup>+6</sup> removal in the wastewater with the correct adjustment of the optimum percentage to be doped with photocatalytic methods that are more environmentally friendly and do not produce additional waste.

#### 4. CONCLUSION

In this study, photocatalytic oxidation of Cr (VI) removal is intended by photocatalytic expense in Cr(VI) to Cr(III) wherein the reduction process is done using a photocatalyst and UV light. Ag and Ni doped TiO<sub>2</sub> nanoparticles were coated on natural volcanic stones for use as photocatalysts. Volcanic stones containing Ag and Ni doped TiO<sub>2</sub> (0.5%, 1%, 2.5%, 5.0%) and non-doped TiO<sub>2</sub> in four different percentages were prepared by sol-gel method. For the solution of nano material to form a solid layer on natural stones, the coated stones were kept in 600 °C ash oven for 1 hour and photocatalyst material production was achieved and the percentages of adhesion on the material were determined by SEM-EDX analysis. Synthetically prepared Cr(VI) containing water removal experiments were carried out by using the batch system. It was found that the yield and the removal were not good as the Ag and Ni doping percentage on the volcanic stones used during the experiments increased. In the experiment with non-doped TiO<sub>2</sub> coated stones much lower yield was obtained than the doped TiO<sub>2</sub> coated material of 0.5%. It was found that the high percentage of material doped on TiO<sub>2</sub> had a negative effect on Cr(VI) removal in water while doping had a positive effect. It is possible to achieve higher yields by using a material set at lower levels of doping and by increasing the amount of photocatalyst material which are used.

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## **O 84. INDOOR FORMALDEHYDE EMISSION IN AIR AND HEALTH IMPACTS**

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**ABSTRACT:** In this review, formaldehyde emission sources in indoor air and its effects on human health are examined. The most important sources of formaldehyde compound, which has several different varieties, have many different usage areas such as kitchen materials, binders in wooden materials and chemical materials. Nowadays, people spend most of their time in a closed environment. There are 3 kinds of formaldehyde according to usage area. Formaldehyde is polymerized to produce urea formaldehyde, melamine formaldehyde and phenol formaldehyde. These substances are volatile and have harmful effects on indoor air.

*Keywords: Formaldehyde, indoor air quality, health, emissions*

### **1. INTRODUCTION**

The structure and characteristics of the urban climate affect the air pollution in the building. Before building the buildings, it is necessary to determine whether people will be affected in the future by looking at the city air pollution data. In the urban planning process, it is important to know, understand and interpret air quality data in planning. Knowing air pollution from transport and industry plays an important role in minimizing vulnerability. Modeling is used to make air pollution analyzes and prepare pollution maps. In addition to air pollution models, GIS is utilized. Models and methods developed to find intermediate values for pollutants in air pollution maps through GIS are applied on a large-regional scale. There are many types of models. The purpose of each is to reveal different data. In these maps, NO<sub>2</sub>, acid rain, ozone concentration, PM ratio and so on. related data. At the same time, temperature differences, changes in wind speed, rain pattern, moisture content and so on. simulations of climatic conditions can also be obtained. Increased climatic and air emissions affect the topographic and meteorological conditions in the region and the air quality in the building. (Balık & Duman, 2014). Indoor air pollution is one of the areas where indoor air pollutants such as houses, schools, commercial and administrative office buildings and government buildings. People spend most of their time these places. The overall burden of disease is almost five times the burden of disease due to outdoor pollution. (Güllü, 2013).

In urbanization, measures should be taken to control indoor air pollution in areas with high levels of outdoor air pollution. In order to evaluate the areas allocated for urbanization and population growth, it is inevitable to construct buildings in areas where vehicle use is high. In this case, to ensure proper ventilation in the building; improvement of the materials used in the construction of buildings, ventilation entries of buildings must be made away from the source of pollution and ventilation system should be considered (Elbir et al, 2010).

The insulation materials used in the building, paint and plastic materials, wall paint, cleaning materials, furniture, coatings, adhesives affect the indoor quality. In confined spaces, harmful gases and particulate matter can accumulate. In this case, it affects the indoor air quality negatively. Chemical materials are used in the materials used to make them more durable and long lasting. The chemicals used are harmful to human health when evaporated. Particles and gases accumulated in a closed environment must be disposed of. To prevent accumulation, it is necessary to minimize the chemical used and to ventilate the indoor environment continuously. It is an important parameter affecting the temperature and humidity gases in the indoor air environment (Table 1). It affects the boiling point of gases with increasing temperature. According to the Gay –Lussac law: As the temperature increases, the pressure increases,

and in this case the temperature and pressure are directly proportional. As the temperature increases, the kinetic energy of the gas increases.

**Table 1.** Boiling point temperature, density and dissolved substances of pollutant gases (URL 2)

<b>Pollutant Gases</b>	<b>Boiling Point Temperature (°C)</b>	<b>Density</b>	<b>Dissolved substances</b>
CO	-191,5 °C	1,14 kg/m <sup>3</sup>	Ethanol, water, benzene acetic acid, chloroform, ethyl acetate, ammonium hydroxide
CO <sub>2</sub>	-57 °C	1,874 kg/m <sup>3</sup>	Water
NO <sub>2</sub>	21 °C	1,45 g/cm <sup>3</sup>	Water
SO <sub>2</sub>	-10 °C	2,63 kg/m <sup>3</sup>	Water
Benzene	80,1 °C	876 kg/m <sup>3</sup>	Alcohol, acetic acid, acetone, chloroform, carbon tetrachloride, diethyl ether
Toluene	110,6 °C	867 kg/m <sup>3</sup>	Insoluble
Ozone	112 °C	2,14 kg/m <sup>3</sup>	-
Radon	-61,7 °C	9,73 g/cm <sup>3</sup>	-
Formaldehyde	-19 °C	815 kg/m <sup>3</sup>	Water

Indoor pollutants are known to cause respiratory diseases. Among these, asthma, headache, allergies and respiratory system effects are prominent. Especially in excess of formaldehyde in human health, headache, nausea, cancer, respiratory system diseases, such as cause many health problems. Formaldehyde has many uses including laboratory, indoor, combustion, livestock and industrial areas. Formaldehyde; is an organic, colorless, pungent and poisonous gas. Formaldehyde is used as a protective and sterilizing agent in the medical field, as well as in anatomy, histology and pathology laboratories. It is an inexpensive and simple method that protects the cell tissues and ensures that organic matter does not deteriorate in such methods as mummification. Detergents and cleaning materials, hand soaps, and formaldehyde are used in the cosmetics industry. It contains formaldehyde in preservatives used in adhesives, wall paints, insulation materials, stationary press fabrics, paints, coatings and paper products in indoor construction materials. At the same time, living things inside the building affect the environment. For example; Smoking inside the building increases formaldehyde emissions. Formaldehyde is used in many industrial areas because it extends the expiration date and protects the product.

There are 3 types of formaldehyde used in the industrial field. Formaldehyde polymerizes to form urea formaldehyde, melamine formaldehyde and phenol formaldehyde. Formaldehyde; urea formaldehyde, melamine formaldehyde and phenol formaldehyde resins are used as binders in kitchen utensils, electrical appliances, paper coating, insulation materials, cardboard, particle board, wood fiber board. Typical sources of formaldehyde in homes are wood products produced with urea formaldehyde glue. Of these, especially fiberboard products emit most formaldehyde. In the experiments, it was determined that it could be spread for months from office furniture made of formaldehyde fiber board. Formaldehyde emission from furniture to the environment increases with increasing ambient temperature and humidity. Resins used in the production of composite wood products are usually produced using urea formaldehyde glue. Emissions caused by urea formaldehyde-produced panels and furniture pose serious risks to human health, especially in confined environments. There is no limit value for formaldehyde in national legislation. Formaldehyde limit values in the internal environment are evaluated according to international legislation.

## **2. METHODS**

In order to determine formaldehyde emissions, it is known that gaseous emissions are first determined by gas chromatographic studies. These Gas chromatography methods; thermal conductivity, flame ionization, nitrogen phosphorus, electron capture, atomic emission, photoionization, mass spectrometry.

Gaseous atoms, ions and molecules are stimulated by electrical discharge or heat to irradiate UV and visible areas.

Formaldehyde emission in indoor air is determined by technological devices. The gas chromatography used in the devices is the photoionization detector. Photoionized detector breaks molecules with high energy photons and converts them into positively charged ions. Because the ionization potential of formaldehyde molecule bombarded with UV light is lower than the energy of photon, positive ions are formed by breaking (URL1).

### **3. DISCUSSION AND CONCLUSION**

People spend most of their time indoors. As the air flow is less in indoor environments than in outdoor environments, so pollution in the environment easily accumulates in indoor environments. If pollution is not controlled and reduced, it threatens human health. internal pollutants; CO, CO<sub>2</sub>, SO<sub>2</sub>, NO<sub>2</sub>, benzene, toluene, ozone, radon, formaldehyde. To control indoor pollutants, pollution must be detected at the source. The air flow entering the building from the outside air environment affects the pollution. Exhaust gases, industrialization, heating and the types of fuels used affect the outdoor environment and accumulate in the indoor environment when we ventilate the building.

For this reason, knowing the plan during the urbanization process prevents the indoor air pollution caused by industry and transportation. In order to ensure proper ventilation in the building; The materials used in the construction of buildings should be improved, the ventilation entries of the buildings should be made away from the source of pollution and the ventilation system should be considered. Ventilation is important for removing harmful gases and particles in indoor air quality and cleaning the ambient air. Today, ventilation is possible with natural air flow or ventilation systems inside the building.

In order to reduce the amount of formaldehyde in the building, smoking should not be allowed indoors, cabinet, furniture and parquet should be used without wood glue. Air flow must be provided in the building so that formaldehyde accumulated in the building can be dispersed. Attention should be paid to the cleaning materials used in the buildings, cosmetics, soaps, shower gels should be checked by checking the content. Plastic materials should not be used in kitchen utensils and the materials used in the kitchen should be steel or glass products. Seasonal changes should be taken into account when ventilating the building. Pollutants from combustion and exhaust emissions may enter the building during ventilation.

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**O 85. KARAPINAR (KONYA) THE LAST THREE YEARS OF SINKHOLES AND CHARACTERISTICS**

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**ABSTRACT:** Karapınar is located in the southeast of Konya and is 110 km away. The number of sinkholes with different diameters and depths, which we can call the world wonder, increased by 300 every day. These natural structures, which are formed as a result of internal karstification near settlements or in the middle of the fields, continue to be a threat for the people of the region. In the last three years, Karapınar has started to occur at more frequent intervals in the KB and there has been a significant increase in the number. In 2017, there were 17, 7 of which were 8, 2018 and 7 of which were in 2019.

Miocene-Pliocene, Pleistocene and Holocene aged rocks are in the study area. The lithological characteristics of the land, the drop in groundwater level, the current direction of the groundwater, the chemical composition of the rock and the volcanic rocks of the Pliocene Uzecek Mountain and the other volcanoes around Karapınar are solved by the groundwater enriched by the carbonic acid. In the last three years, the ponds were formed in Karapınar's KB, in the vicinity of Üzecek Mountain, in Eşeli Karakul, Güllükkuyu, Çakırca, Üçler kamışağıl, Sırnık, Kızılcakuyu and Küçükuyu. The distance between the settlements is 7-37 m. The circle is shaped 3-60 m. in diameter and 3-50 m in depth between. The depth of the sinkholes can not reach the level of groundwater in the region is waterless only one water is water.. In February, March, April and May, in the period when precipitation was high, the soil forming the agricultural lands became saturated with water. In July August and September, the increase in the weight on the soil cover was caused by the decrease of ground water level. Excessive attraction of groundwater in the region and the existence of a plant pattern that requires water accelerate the formation of sinkhole.

*Keywords: Karapınar, Sinkhole, Groundwater, Volcanism depth*

**1.INTRODUCTION**

Karapınar district is in the middle of Konya Closed basin, 110 km southeast of Konya. The high mountainous areas formed by the Middle Taurus belt and the Pliocene Quaternary volcanism in the west and south of Karapınar are bordered by the Obruk Plateau and Tuzgöl (Figure 1). The number of different diameters and depths that we can call the wonder of the world formed in Karapınar has increased with each passing day and exceeded 300. These natural structures, which are formed as a result of internal karstification near the settlements or in the middle of the fields, continue to be a threat to the people of the region. Obruks have started to occur more frequently in Karapınar yıldas NW in the last three years and there has been a significant increase in their numbers. In 2017, 17 potholes were formed, 2 in 2018, 8 in 2018 and 7 in 2019.



**Figure 4.** Location map of the studied area.

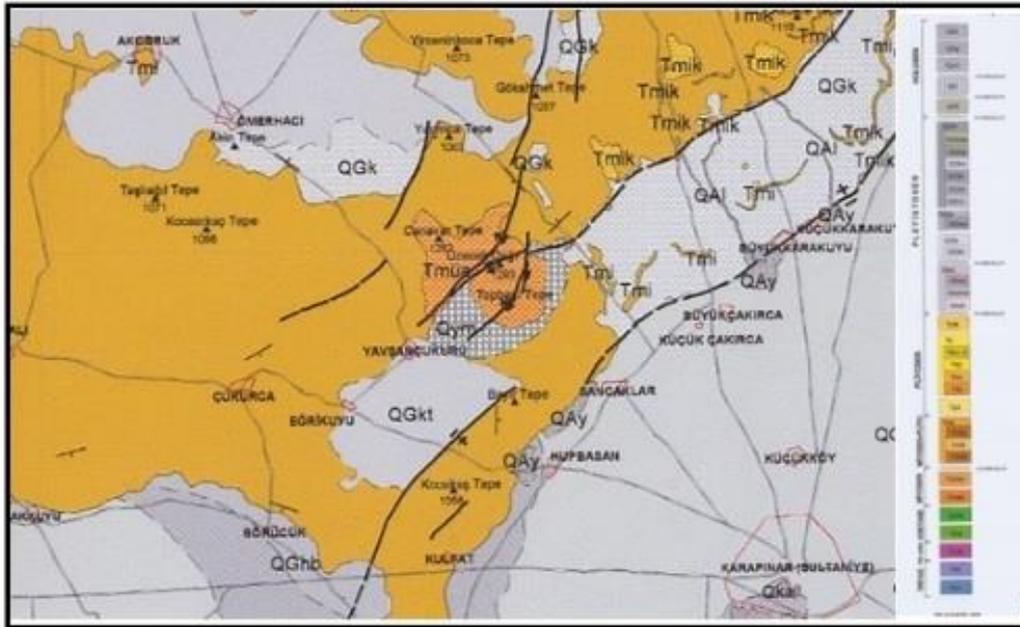
## **2. MATERIAL AND METHOD**

In the geological studies carried out in the study area, 1 / 100.000 scale geology map prepared by the General Directorate of Mineral Research and Exploration (MTA) was used. During the study period, the pores were periodically monitored and the depths of the mouth diameters were measured. The processes of completing the formation of the sinkholes were followed.

## **3. RESEARCH FINDINGS**

Miocene-Pliocene, Pleistocene and Holocene rocks are observed in the area. The Miocene Üzecekdağı andesites (Tmua) are composed of light burgundy colored andesites with frequent cracks and fractures. Üzecek Mountain (1293m.) Is an ellipse-shaped volcano cone. The long axis of this volcano cone in the southeast-northwest direction is 12 m. The other peaks are Topbaşı Hill (1200m.), Monster Hill (1252m.). For the first time by Lahn (1945), Karacadağ volcanics are named as. The unit is part of the Karacadağ volcano group outside the area. Basalt flows and tuff sediments around the ellipse-shaped volcano mountain, dark black color, hard and compact appearance (Bas 1984). The Miocene-Pliocene İnsuyu formation (Tmi) overlies the unconformably. İnsuyu formation consists of conglomerate, sandstone, claystone marl and limestone. divided into three members. The claystone member (Tmikl) is composed of pink colored loosely bonded weakly strengthened carbonated claystones. Limestone member (Tmik) is composed of gray-white medium thick bedded cracked limestones. The conglomerate member (Tmiç) is composed of yellow carbonate cemented andesite and basalt pebbles.

Sinkholes is formed within İnsuyu formation. This unit is unconformably overlain by the Komatyayla formation (QGk), which consists of Pleistocene aged sandy gravels and a stony member (QGkt) consisting of horizontally bedded silts and marls. Komatyayla formation is overlain by the same aged Hotamış formation. Hotamış formation (QGh) is composed of pebbles, gravelly sand, fine sand, clay and silt. The Börücek plateau member (QGhb), which is a member of the Hotamış formation, consists of cross-bedded horizontally bedded pebbles and sand. All these units are unconformably covered by Holocene sediments. Holocene sediments consist of Alluvium (QA1), Stream fan sediments (QAY) and slope debris (Qym). Holocene sediments consist of unblocked blocks, gravel, sand, clay and silts.



**Figure 2.** Geological Map of the study area (MTA Map archive no: 44673)

In the study area, major tectonic structure forms from two fault lines that are two-fold axis parallel fault lines. Faults are dip-slip faults. Common directions are the NE-SW, NW-SE

The sinkholes in the study area are large depressions formed deep into the ground as a result of internal karstification. The mouth diameters of the pores are circular or ellipsoidal in shape and the horizontal cross-sectional area increases to the depths. The slopes of the slopes are very steep. In some of them, it is close to 90 °, if it collapses up to the groundwater level while the sinkhole is formed, it contains water and it is called as sinkhole lake by the local people. They are also locally called opanes. Those who do not reach the groundwater level are called dry sinkholes.

The formation of the sinkholes is influenced by Pliocene groundwater, which is enriched in carbonic acid by dissolving CO<sub>2</sub> from other volcanoes around Üzecek Mountain and Karapınar.

Acidic groundwater flows from the south to the north as the groundwater flows along the flow path, affecting the limestone and melting the limestones and forming caves underground. Thus, as a result of the rising karstification and internal karstification event, the caves formed in the limestones underground are gradually growing. These gaps are 20-25 m. As it approaches, the cave cannot stand its weight on the marl and clay ceiling and collapses. Large explosion sounds are heard during their formation. If this subsidence reaches the groundwater level in the region, the pothole carries water.

Climatic factors such as temperature, precipitation and evaporation, geological and lithological characteristics of the region, tectonic properties, volcanism in the region, flow direction of groundwater, chemical composition of groundwater, plant pattern are effective on the formation of sinkholes.

The sinkholes formed in the last three years were formed in the NW of Karapınar, around Eşeli, Eşeli, Karakuyu, Güllükkuyu, Çakırca, Üçler reed, Sırnık, Kızılcakuyu and Küçükuyu highlands. The distance of the sinkholes to the settlements is between 7-37 m. It has a circular shape with a diameter of 3-60 m and depth of 3-50 m. between. The depths of the sinkholes are dehydrated since they cannot reach the groundwater level in the region only one of them is juicy (Table 1, Figure 3).

The sinkholes formed in the last three years have been formed as a result of the increase in the weight of the ground cover during the harvest period in July, August and September, and the increase in the weight of the ground cover during the harvest period during the periods of rainfall in February, March, April and May. Excessive attraction of groundwater in the region and the presence of water-demanding plant patterns accelerate the formation of sinkholes.

**Table 1.** Values of the boreholes formed in the study area

Sinkhole name	Place	Mounth date	Geometry	Longitdinal axis	Depth	Topoğ. hight	distance	water
karakuyu	reşadiye	9-2017	circle	25	3	1011	10	dry
hotamış	hotamış	5-2017	circle	10	20	1005	10	dry
Güllükuyu	reşadiye	2-2018	circle	5	10	1038	15	dry
Eşeli obruk	Eşeli y.	5-2018	Circle	7	8,4	1042	7	dry
Üçler obruk	Üçler yayla	7-2018	Circle	68	64	1028	9	dry
kökenoğlu	Karakuyu yayla	8-2018	Circle	15	2	1007	9	dry
Karakuyu-1	Karakuyu yayla	5-2018	Circle	34	9	1009	10	dry
Karakuyu-2	Karakuyu yayla	9-2018	Circle	3	8	1009	10	dry
Karakuyu-3	Çiğil-karakuyu	9-2018	Circle	60	20	1009	38	dry
<b>Tilki obruğu</b>	<b>Kamışağıl</b>	<b>9-2018</b>	<b>Circle</b>	<b>60</b>	<b>20</b>	<b>1009</b>	<b>16</b>	<b>wet</b>
Kızılcaкую	Kızılcaкую	2-2019	Circle	20	10	1100	37	dry
Eşeli-3	Eşeli yayla	2-2019	Circle	7	1	1041	956	dry
Eşeli-4	Eşeli yayla	2-2019	Circle	7	6	1038	7	dry
Eşeli-5	Eşeli yayla	2-2019	Circle	25	3	1038	20	dry
Çingir	Eşeli yayla	2-2019	Circle	7	10	1053	20	dry
Küçükkuyu	Reşadiye	4-2019	Circle	10	10	1053	10	dry
Çakırca	Reşadiye	-2019	Circle	15	30	1050	15	dry

There are many licensed, unlicensed drilling wells drilled in the study area for irrigation purposes. In recent years, the change of plant pattern in the region, growing and encouraging plants that require a lot of water, such as corn, have increased water use. Apart from the licensed wells drilled by DSI, many unlicensed wells were drilled and unconsciously groundwater was drawn. Excessive withdrawal of groundwater caused the groundwater level to decrease. The groundwater level decreased the carrier effect of the water and accelerated the formation of Sinkholes (Figure 4).



**Figure 3.** Tilki and eşeli sinkholes



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**O 86. HYDROGEOCHEMICAL INVESTIGATION OF THE SPRINGS IN SILLE (KONYA) REGION**

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**ABSTRACT** Sille (Konya) is an important settlement where different cultures with traces of Roman, Byzantine, Seljuk and Ottoman periods live together. With the restoration work carried out in recent years, Sille Culture Valley has been opened to tourism. There are many water springs in and around Sille. These springs are widely used as drinking water by the people of the region and Konya. In addition, the Sille dam pond located in the region is used for both irrigation water and tourism purposes.

In the study area are the units belonging to the Sızma, Ardıçlı and Dilekçi groups. Bozdağ and Bağrıkurt formations belonging to the penetration group are Paleozoic and consist of limestone and metacarbonates.

The metacarbonates belonging to the Ardıçlı group and the dolomites and limestones are of Mesozoic age. The Dilekçi group consists of Cenozoic aged dacite, tuff, tuffite, sandstone, mudstone and limestones. All these units are unconformably overlain by the Quaternary alluvium.

The temperature of the springs in the study area is between 10-14 °C, the discharges are 0,02 – 1,71 lt / s, the pH is 7,19-8,04, the EC values are 210-882 µs / cm, the hardness is 9-43 FS and the total mineralization is 269,15 – 817,24 mg / l. The mineral rich spring in the study area has a pH of 7.19, EC value 1932, hardness 87 FS and total mineralization 2148,66 mg / l. The aquifers of the springs are composed of volcanics and limestones. According to the Schoeller diagram, waters are of the same origin and the springs 4 and 6 are ionic rich. Weld water according to the Wilcox diagram Good and good water class springs 4 and 6 are in good water class.

*Keywords: Sille, hydrogeochemical, total mineralization, discharge, spring*

## **1. INTRODUCTION**

Sille (Konya) is an important settlement where different cultures with traces of Roman, Byzantine, Seljuk and Ottoman periods live together. With the restoration work carried out in recent years, Sille Culture Valley has been opened to tourism. There are many water sources in and around Sille. These sources are widely used as drinking water by the people of the region and Konya. In addition, the Sille dam pond located in the region is used for both irrigation water and tourism purposes.

Considering the characteristics of Sille, the ancient antique settlement, the southern hillsides of Aya Elenia Church, monasteries and graveyards were registered by the Konya Conservation Council for Cultural and Natural Heritage in 1995, and the main settlement area was registered as the Urban Conservation Area.

The study area is located within the borders of Selçuklu district in the Central Anatolia Region, about 10 km northwest of Konya (Figure 1). 1/25000 scale topographic map of Konya m28b1 and m28b2 is located in the Map and covers an area of approximately 110 km<sup>2</sup>. The lithological units outcropping in the study area are defined on the basis of lithostratigraphy.



**Figure 3.** Location map of the study area

The aim of this study was to determine the physicochemical properties of spring waters around Sille (KONYA) and to interpret them in terms of hydrochemical and pollution. The average annual temperature in the study area between 1929-2018 is 11.6 °C and the total annual precipitation is 323.3 mm (Table 1).

**Table 2.** Temperature and precipitation values of the study area (1929 – 2018)

Konya	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Average Temp. (°C)	-0,2	1,4	5,6	11,1	15,8	20,1	23,5	23,2	18,5	12,5	6,3	1,7	11,6
Average monthly total precipitation (mm)	37,6	28,5	28,9	31,9	43,6	25,5	6,3	4,6	12,3	30	32	42,1	323,3

## 2. MATERIAL AND METHOD

1/25000 scale geology map and generalized stratigraphic section of the study area were prepared. Temperature (T), pH, EC, total mineralization and dissolved CO<sub>2</sub> values were measured at the beginning of welding with Hanna brand pH and conductivity meter. Welding discharges were measured by certain volume method. Physico-chemical analyzes of water samples taken from the sources were carried out in Koski Water-Quality Laboratory. The obtained values were evaluated according to various diagrams and TSE 266, WHO and EPA standards.

## 3. RESEARCH FINDINGS

The total annual rainfall in the study area in 2017 is 329.9 mm and the average temperature is 13.18 °C. Using temperature and precipitation values, according to Thornthwaite (1948), precipitation is 329.9 mm, potential evaporation - perspiration is 684.14 mm, actual evaporation - perspiration is 304 mm, excess water is 77.27 and water defect is 472.45 mm. Evaporation - transpiration in the study area is equal to 92.2% of precipitation.

The Silurian - Lower Carboniferous Bozdağ formation is the basis of the study area. Bozdağ formation consist of recrystallized limestone in different colors and tones ranging from black, dark and light gray, cream and white, dolomitic limestone, dolomite and marbles. Bozdağ formation, generally composed of flysch type rocks, shows lateral and vertical transition to Devonian - Lower Permian aged Bağrıkurt formation.

Bağrikurt formation consists of green, gray colored phyllite, schist, turbiditic metasandstone, metaconglomerate, recrystallized limestone and metachert alternation and exotic metacarbonate blocks of different sizes. Bağrikurt formation, which presents lateral and vertical transitions with Bozdağ formation and covers this unit in conformity, is unconformably covered by the Bahçecik formation at its upper parts.

Bahçecik formation, which consists of terrestrial sediments, is the basis of the Ardıçlı group. The unit consists of purple, red, brown metaconglomerate, metasandstone and phyllite alternations. Bahçecik formation of Ardıçlı group, which unconformably overlies the Sızma group, shows lateral and vertical transition to Ertuğrul formation.

Ertuğrul formation consists of recrystallized limestone, dolomite and dolomitic limestones. The unit, which is in conformity with the lower parts, is intricately related to the Kızılören formation.

Kızılören formation consists of dark gray, blackish, occasionally light gray colored, laminated, bituminous, cracked and fractured and brecciated dolomites with fresh cracked surfaces. Kızılören formation is unconformably overlain by units belonging to the Dilekçi group from the top.

Lorasdağı formation is generally composed of recrystallized limestone, dolomite and dolomitic limestones. Lorasdağı formation overlies the Permian aged units with angular unconformity. It passes from the top to the Upper Cretaceous limestones.

Sille formation is composed of red - brown colored, occasionally gray conglomerate sandstone and mudstone intercalations, which are observed in different parts of the study area. Sille formation unconformably overlies the rocks that make up the Lorasdağı formation at the base and laterally and vertically shows the transition to Ulumuhsine and Küçükmuhsine formation.

The lithology of the Ulumuhsine formation consists of limestone, clayey limestone, marl, mud, conglomerate and sandstone. Ulumuhsine formation presents lateral and vertical transitions with the Sille formation at the lower parts of the formation.

The lithologies of Küçükmuhsine formation are generally white, light gray, pink, massive tuff, layered tuffites, agglomerate, volcanic breccia and volcanogenic sandstones. In the study area, Küçükmuhsine formation presents lateral and vertical transitions with terrestrial Sille and lacustrine Ulumuhsine formations. This unit cut by Sulutas volcanics is also unconformably covered by Topraklı formation to the west of the study area.

Sulutas volcanics are generally composed of calc-alkaline dacite, rhyodacite, rhyolite and andesite as well as to a lesser extent basaltic rocks. Sulutas volcanics cut Ulumuhsine, Küçükmuhsine and Sille formations in the southern parts of Sille.

Topraklı formation, conglomerate, mud, pebble and sand deposits are formed by brown, red, yellowish soil. Topraklı formation is overlain by angular unconformity over all older units.

It consists of alluvial, poorly sorted pebbles, sand, silt and clay grains containing all kinds of crumbs derived from the lithology. The unit is Quaternary aged. It covers all units older than it unconformably (Figure 2, 3).

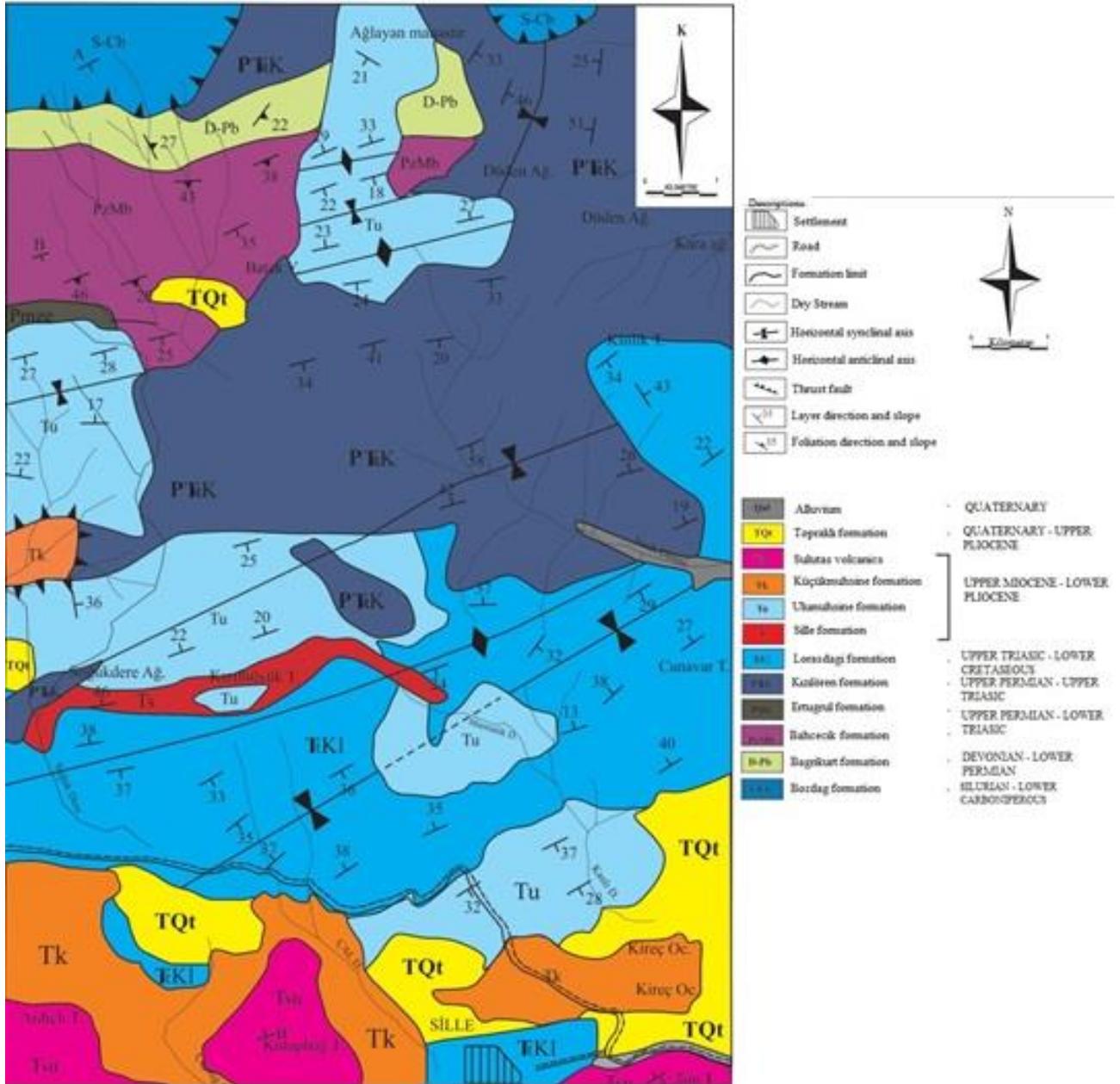


Figure 4. Geological map of the study area (Eren, 1993)

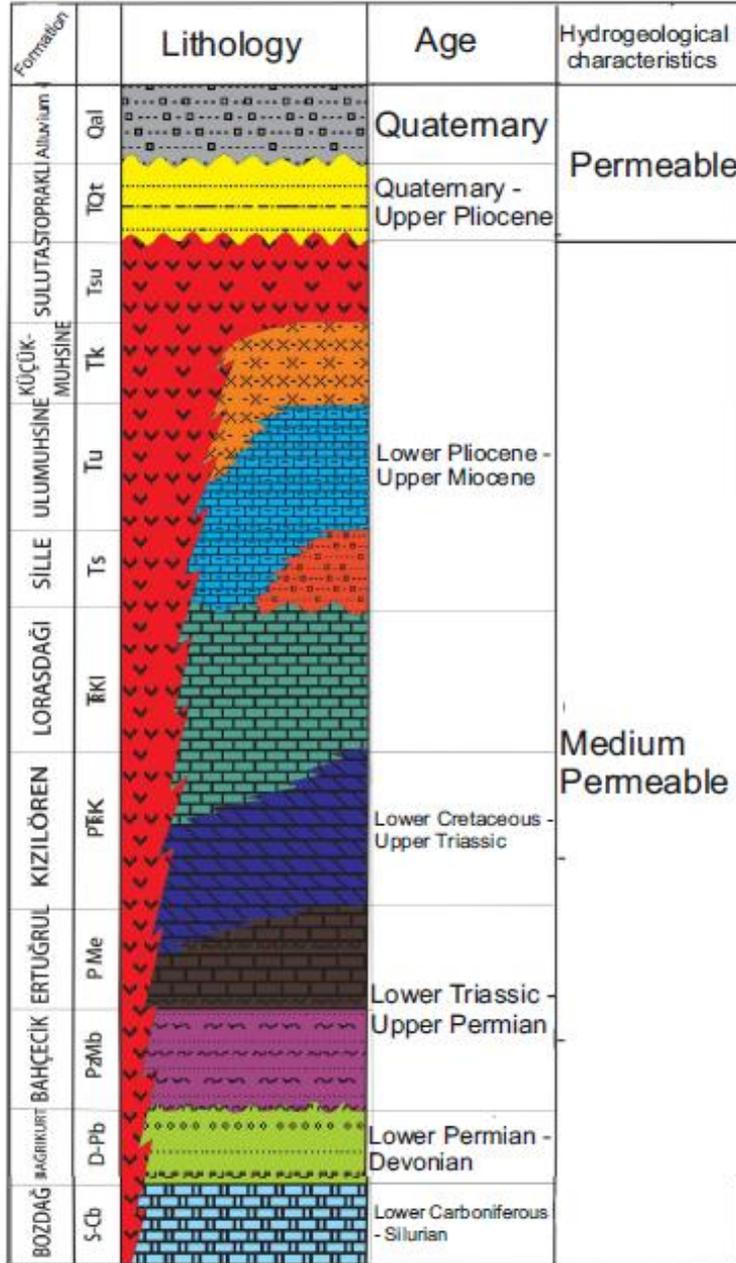


Figure 5. Generalized stratigraphic section of the study area (Eren, 1993)

According to the lithological and structural features of the units in the study area, the limestones forming the Bozdağ, Ertuğrul, Kızılören, Lorasdağı and Ulumuhsine formations have a fractured - cracked and melt cavities and have a secondary porosity. Therefore, these limestones have the characteristics of being aquifer.

The precipitation waters falling to the earth are filtered and form underground waters. Groundwater undergoes physical and chemical changes while passing through geochemical processes from the feeding area to the discharge area, and gains different characteristics. The dissolution of minerals from the rocks where groundwater is in contact continues until the equilibrium concentration in the water is reached. The chemical composition of groundwater depends on the mineralogical and chemical properties of the aquifers through which they pass, the flow rate of the water in the aquifers, the flow conditions and the residence time in the aquifers ( Freeze and Cherry, 1979; Appelo and Postma, 1993; Andreo and Carrasco, 1999). Major ions ( $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Ca}^+$ ,  $\text{Mg}^+$ ) and anions ( $\text{Cl}^-$ ,  $\text{SO}_4^-$ ,  $\text{HCO}_3^-$ ,  $\text{CO}_3^-$ ) make up more than 90% of the total ionic content of natural waters (Erguvanlı and Yüzer, 1987).

The electrical conductivity (EC) values of the springs in the study area vary between 210-882  $\mu\text{S} / \text{cm}$ . pH values of the springs are in the range of 7.19-8.04. The discharges are 0.02 - 1.71 lt / s. Hardness values ranged from 9-43 FS and total mineralization values ranged from 269.15 to 817.24 mg / l.

Number 4 spring is rich in minerals and its pH value is 7.19, EC value is 1932  $\mu\text{S} / \text{cm}$ , hardness value is 82 FS and total mineralization value is 2148.66 mg / l (Table 2).

Anion, cation, EC (electrical conductivity), sodium percentage (% Na), sodium adsorption rate (SAR) of the samples taken from the study area are shown in Table 3 Schoeller and piper diagrams were prepared and interpreted in terms of water usability and quality.

**Table 3.** Anion, cation, EC,% Na and SAR values of samples taken from the study area

		<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>
<b>C A T I O N S</b>	<b>Ca</b>	44,24	27,65	54,75	323,29	51,47	131,38
	<b>Mg</b>	2,44	4,08	3,94	15,62	3,60	25,86
	<b>Na</b>	2,12	13,42	11,63	92,39	11,42	36,50
	<b>K</b>	0,24	1,72	5,48	32,84	4,41	3,16
<b>A N I O N S</b>	<b>Cl</b>	1,56	7,04	8,43	216,55	8,66	84,85
	<b>SO<sub>4</sub></b>	6,85	13,12	16,16	188,21	16,11	143,44
	<b>HCO<sub>3</sub></b>	121,92	99,84	149,76	258,24	156,00	277,44
	<b>CO<sub>3</sub></b>	0	0	0	0	0	0
	<b>EC</b>	214	210	323	1932	326	882
	<b>%Na</b>	3,58	23,4	19,92	159,82	19,52	62,97
	<b>SAR</b>	0,082	0,625	0,425	1,357	0,409	0,757

**Table 4.** Physico-chemical analysis results of water (mg / l)

PARAMETERS	SAMPLES					
	1	2	3	4	5	6
TEMPERATURE (°C)	10	12	14	10	11	13
DISCHARGE	0,236	1,71	0,22	0,022	0,530	-
PH	8,04	7,57	7,64	7,19	7,52	7,78
TURBIDITY (NTU)	1,87	0,80	0,75	0,20	0,55	0,18
EC (20°C DE µS/CM)	214	210	323	1932	326	882
NO <sub>2</sub>	0,00	0,00	0,00	0,01	0,00	0,00
NH <sub>4</sub>	0,00	0,00	0,00	0,00	0,00	0,00
T. ALKALINITY (CaCO <sub>3</sub> -MG/L)	121,92	99,84	149,76	258,24	156,00	277,44
CA (PPM)	44,24	27,65	54,75	323,29	51,47	131,38
MG (PPM)	0,2	0,34	0,32	1,3	0,3	2,15
TS (FS)	12	9	15	87	14	43
NO <sub>3</sub> (PPM)	3,80	6,26	21,32	441,39	21,74	1,14
SO <sub>4</sub> (PPM)	6,85	13,12	16,16	188,21	16,11	143,44
CL (PPM)	1,56	7,04	8,43	216,55	8,66	84,85
NA (PPM)	0,09	0,58	0,5	4,01	0,49	1,58
K (PPM)	0,24	1,72	5,48	32,84	4,41	3,16
F (PPM)	0,03	0,24	0,22	0,16	0,22	0,75
PO <sub>4</sub> (PPM)	0,00	0,23	1,38	1,59	0,58	0,01
LI (PPB)	0,58	3,6	2,66	20,33	2,61	17,46
BE (PPB)	0,01	0,02	0,02	0,03	0,00	0,00
B (PPB)	11,36	54,63	40,02	296,39	40,72	24,37
AL (PPB)	33,31	18,06	0,79	0,00	0,78	0,00
V (PPB)	0,52	9,55	6,31	17,45	6,20	1,46
CR (PPB)	0,20	0,07	0,23	0,10	0,25	0,06
MN (PPB)	0,82	0,15	0,03	0,06	0,07	0,09
FE (PPB)	14,78	13,16	0,00	0,00	0,00	0,00
CO (PPB)	0,18	0,17	0,03	0,10	0,01	0,03
NI (PPB)	0,27	0,11	0,00	0,32	0,03	1,39
CU (PPB)	0,71	0,16	0,08	1,42	0,16	0,45
ZN (PPB)	4,31	19,42	1,21	0,27	1,37	-0,24
AG (PPB)	0,00	0,00	0,00	0,00	0,00	0,00
AS (PPB)	1,04	4,40	5,85	14,81	5,74	3,25
SE (PPB)	0,94	0,66	0,54	1,65	0,91	0,67
SE (PPB)	0,75	1,36	1,37	1,55	1,79	0,82
MO (PPB)	0,10	0,74	1,51	4,19	1,43	3,58
CD (PPB)	0,02	0,03	0,00	0,01	0,00	0,01
SB (PPB)	0,38	0,39	0,23	0,33	0,17	0,15
BA (PPB)	15,47	41,30	123,95	219,36	119,48	59,6
HG (PPB)	0,06	0,05	0,04	0,02	0,04	0,00
TL (PPB)	0,03	0,02	0,00	0,00	0,00	0,00
PB (PPB)	0,11	0,02	0,00	0,00	0,01	0,00
BI (PPB)	0,00	0,00	0,00	0,00	0,00	0,00
TDS	269,15	341,75	457,93	2148,66	455,98	817,24

According to the data obtained from the physico-chemical analysis of the waters in the study area, the anion and cation values of the waters were marked on the Piper diagram and the water class was determined. Waters are grouped in zone 1 and are Ca + Mg > Na + K carbonated and sulphated waters (Figure 4).

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According to the Schoeller diagram, the sequence of ions in example 1 and 6 is  $Ca > Mg > Na + K > HCO_3 > SO_4 > Cl$  and has the same origin. The sequence of ions in example 2, 3 and 5 is  $Ca > Na + K > Mg > HCO_3 > SO_4 > Cl$  and has the same origin. The sequence of ions in example 4 is  $Ca > Na + K > Mg > Cl > SO_4 > HCO_3$  and of different origin. In the evaluation of the samples taken from the study area, these samples are generally in the class of waters with Ca and  $HCO_3$ , since the water generally shows similarity and is rich in Ca and  $HCO_3$  ions (Figure 5). The result in the Piper diagram and the result in the Schoeller diagram overlap. According to this, water is mostly fed from carbonated rocks (limestone, marble).

According to the Wilcox diagram, the waters are very good - good class, sample number 6 good - permissible class and sample number 4 is unsuitable class (Figure 6).

US Salinity Laboratory Diagram is divided into 16 zones according to salinity and sodium hazard level. Water is classified using SAR (Sodium Adsorption Ratio) on the vertical axis and EC (electrical conductivity) on the horizontal axis. According to the US Salinity Diagram, the waters in the study area are classified as C1-S1, C2-S1 and C3-S1 (Figure 7). The water of C1-S1 and C2-S1 is low-medium salinity and the water of C3-S1 class can be used for irrigation activities.

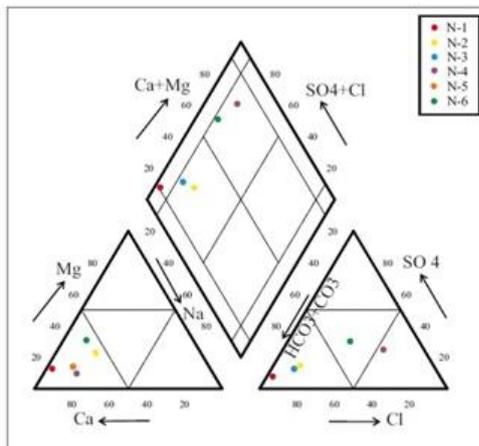


Figure 4: Piper diagram of waters in the study area

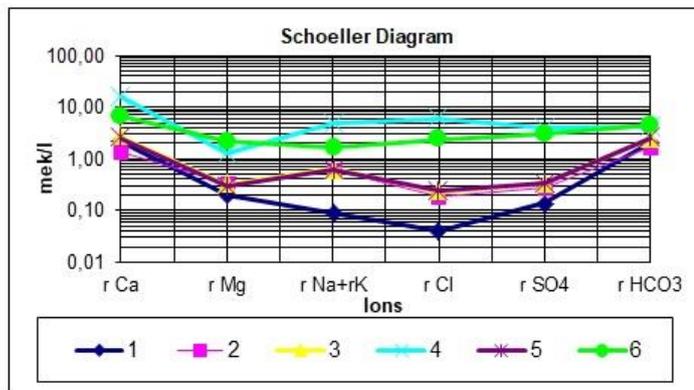


Figure 5: Schoeller diagram of waters in the study area

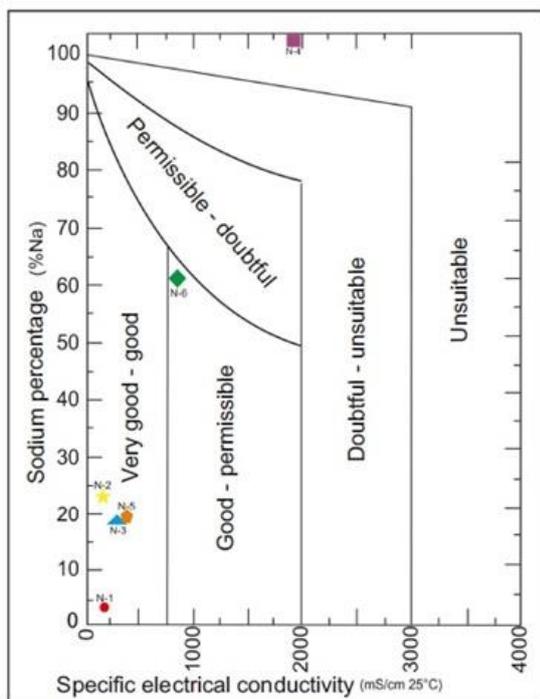


Figure 6: Wilcox diagram of waters in the study area

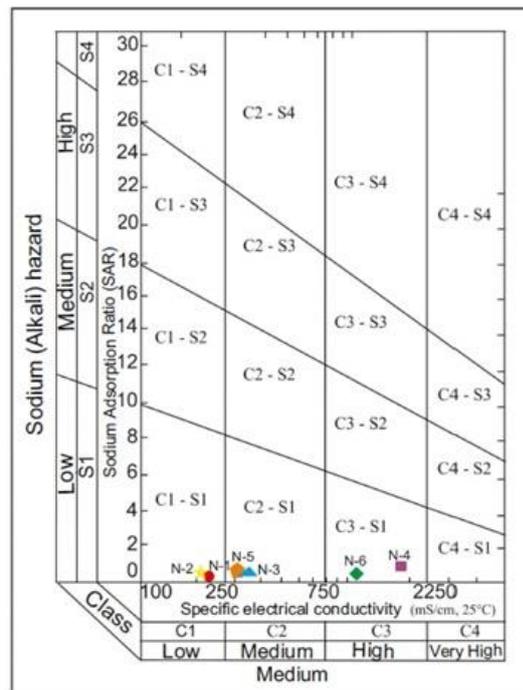


Figure 7: US Salinity Laboratory diagram of waters in the study area

#### 4. CONCLUSIONS

Historical and cultural values such as churches, mosques, streets, fountains and traditional Sille houses in Sille have been invented by Konya Conservation Council for Cultural and Natural Heritage and declared as 1st degree Urban Conservation Area.

In the study area are the units belonging to the Sızma, Ardıçlı and Dilekçi groups.

The aquifers of the waters in the study area are composed of limestones of Bozdağ, Ertuğrul, Kızıllören, Lorasdağı and Ulumuhsine formations having a fractured - cracked structure.

The total mineralization range from 269,15 to 2148,66 mg/l, pH values are in between 7,19 to 8,04, electrical conductivity values range from 210-1932  $\mu\text{s} / \text{cm}$ , temperatures range from 10-14 °C

According to the US Salinity laboratory classification, water taken from the study area is C1S1, C2S1 and C3S1 and it can be used in irrigation activities. In the wilcox diagram classification, the waters in the study area are very good - good, good - permissible and unsuitable.

The waters in the study area are rich in Ca and  $\text{HCO}_3$  ions. The result obtained in the Piper diagram corresponds to the results of the Schoeller diagram. It is understood that carbonated rocks are effective in the chemical composition of water.

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**O 87. THE EVALUATION OF URBAN ENVIRONMENTAL PERCEPTION OF UNIVERSITY STUDENTS IN KONYA CBD BY COGNITIVE MAPPING METHOD**

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**ABSTRACT:** The cities as being a techno-ecosystem is designed by urban and regional planner, the urban environment perceptions of urban planners is an important indicator of sustainability. The aim of this study is to evaluate urban and regional planning students' perception of urban environment about Konya CBD. Especially the central business districts (CBDs) are the most densely structured city centers and the most populated areas are day and night. In this study, students were asked to add ecological urban environmental performance criteria to the image components of Lynch's (1960) urban image cognitive mapping technique in order to measure the perception of CBD urban environment.

The theoretical framework of the research consists of determining the ecological environmental image elements in the students' minds and determining which ecological performance principles are combined with these elements. Data was collected from city and regional planning department's students the third and the fourth classes with 12% sampling size.

The findings of the study showed that the most important reference points and paths were given priority in the cognitive maps of Konya CBD, and environment-sensitive building orientations, climate sensitive designs characteristics, quality of open space areas and the principles of green city design were weak.

*Keywords: Urban environmental perception, cognitive map, Central business district*

## **1. INTRODUCTION**

The cities as being a techno-ecosystem is designed by urban and regional planner, the urban environment perceptions of urban planners is an important indicator of sustainability. The cognitive map technique is generally used to measure people's thoughts, attitudes and behaviors about spatial or behavioral problems (Eden, 2004). The cognitive mappings is a process for describing causality of the issues by using the figures, a network of nodes and arrows. According to Harary (1965) and Eden (1988) cognitive maps are cause maps by instruction of a group people, is not individual's cognition. Cognitive maps is a dynamic systems' modelling for explaining the former development in related to influence diagrams (Ackerman et. al,1991). Lynch (1960) was one of the first to study the evolving perceptions of the built physical environment. Lynch found that the perception of urban pattern is formed by urban images in the human mind. Lynch, looking for answers to the question of how people perceive the city center, focuses on the priorities of urban images in the minds of the city's inhabitants, on which proportions they exist and how they change over time.

### **The Using Areas of Cognitive Maps**

Cognitive maps use from the political science to the business management, from the psychology to geography in various fields of science. Cognitive maps are widely used scientific measurement tools because conceptual analyzes are intended to explain cause and effect networks. The aim of cognitive maps is to determine the problems by qualitative and quantitative analysis within the cause and effect relationship (Eden,2004, Eden, 1988).

Evans (2010) states that cognitive maps explain spatial relationships with the place. According to Lynch (1960), these relationships are related to the legibility of space. Lynch states that the 5 items of urban images that make up the space in the whole place different spatial readings by individuals. These **5 items**

**of urban images of Lynch** consist of **paths, edges, districts, nodes and landmarks**. **Path** is transport channels linking urban functions. **Edges** draws attention with its linear characteristic that separates urban and natural areas. **Districts** are the urban areas in which individuals visualize the physical boundaries of the regions they combine with similarities they feel. **Nodes** are the focal points where the roads intersect. **Landmarks** are structures or buildings that differentiate from the common feature of urban fabric. Lynch underlines that the individual reads the space by associating these urban images with identity, structure and meaning. The reason for differentiation of these images from individual to individual stems from the fact that the memory and spatial idioms of the individual using the space are different. In the Lynch study, the findings show that the individual who has less spatial experience emphasizes the general characteristics of the place, regional characteristics, and secondly emphasizes the paths. On the other hand, it was found that individuals who knew the place defined the place depending on landmarks.

## **2. METHOD**

In this study, the City and Regional Planning Department's students were asked to prepare a cognitive map of Konya City Central Business Area by evaluating Lynch's urban images and ecological urban environment planning principles together. The effects of ecological urban environment principles on the legibility of the space, identification and identification were questioned. This research focused on urban environmental perception of cities designer for sustaining the urban environment. The theoretical framework of the research consists of determining the ecological environmental image elements in the students' minds and determining which ecological performance principles are combined with these elements. Data was collected from city and regional planning department's students the second, the third and the fourth classes with 12% sampling size.

## **3. RESEARCH FINDINGS**

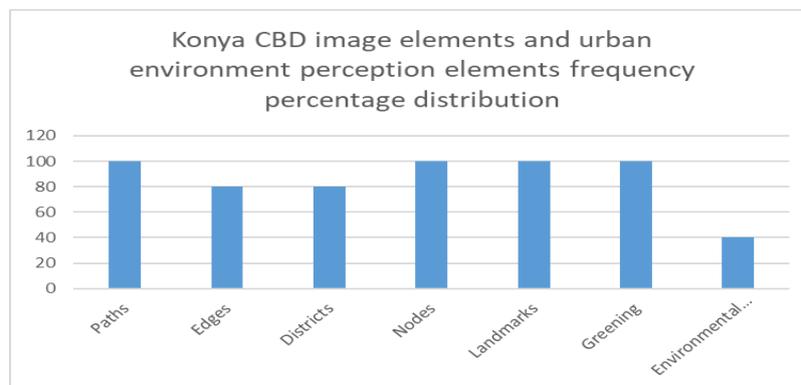
The number of students Department of City and Regional Planning in Necmettin Erbakan University is 253 in 2018-2019 academic year. Cognitive maps technics with sample 12 % applied to the student of Department City and Regional Planning. Research sampling consists of 42 people randomly selected from the population. The central business area of the city of Konya, which students use continuously in their social and daily life off campus, is the most crowded area of the city consisting of a combination of the old and the new center. The concept of eco-CBD in planning literature is shaped by the size and structure of the new and old CBD. Nowadays, in the planning of old and new city centers, "ecological approach (eco-CBD)" is important for environmental sciences as well as urban planning discipline as a requirement of environment-friendly planning approach. Eco-CBD aims to investigate the concept of "Sustainable Center Planning" such as evaluating and developing natural / ecological data depending on the location, climatic data of the city, saving substance and energy in the centers, sanitizing the infrastructure in an environmentally sensitive manner, and recycling waste. In the development of eco-CBD; scientific determination of environmentally responsible planning strategies and environmental standards (air, water, soil quality, noise, etc.) has priority. It should be determined to what extent, to what extent and how these strategies should be involved in planning, projecting and implementation. In this direction, legal, administrative and monetary measures should be considered and established. In this study, the perception of eco-centered planning approaches in Konya CBD urban image of the students of the planner candidate was questioned. According to classes' degree is measured the students's perceptions about characteristics eco-CBD of Konya by using the cognitive maps.

## **4. DATA ANALYSIS**

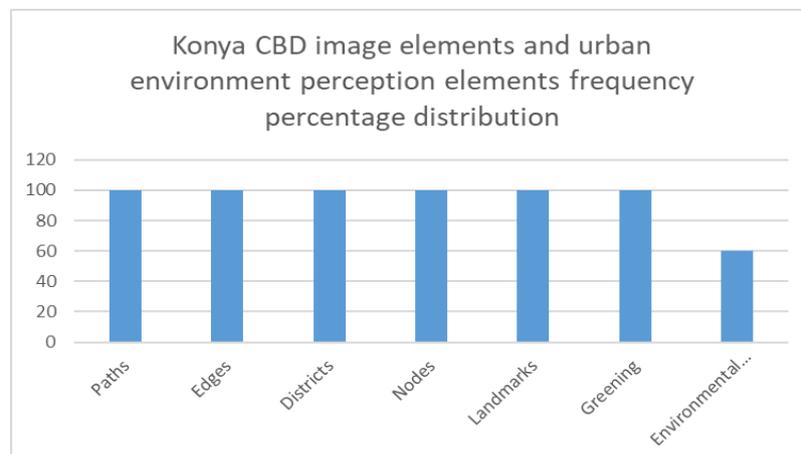
All sketch maps of Konya CBD texture of the students were grouped in relation to the number of concepts in the maps according to Lynch's imaginary elements and eco-CBD planning factors. Group of Konya CBDs image elements (paths, edges, districts, nodes, landmarks) and the city center, geographical location, climatic, building island arrangements occupancy gap, wind, sunbathing, green area construction rates, sound, air, noise parameters such as environmental pollution urban environment perception elements based on eco-CBD factors were taken into consideration in proportion to their frequencies.

## 5. RESULTS

In this study, 42 cognitive maps were evaluated. Of the third grade students who participated in the study, 100% of Lynch's image elements considered paths, nodes, landmarks, 80% edges and districts, 100% green areas from ecological urban environment components, and 40% cared about environmental pollution problems. As can be seen in **Figure 1**, Lynch's image elements and the memory of the city are good at, their perception of urban environment is fully developed, and their awareness of quality urban environment standards is moderately developed. 100% of the fourth grade students who participated in the study cared about all Lynch's image elements and the presence of green spaces as an ecological urban environment component, and 60% of environmental pollution problems. As can be seen in **Figure 2**, Lynch's image elements and the memory of the city are excellent, their perception of urban environment is fully developed, and their awareness of quality urban environment standards is well developed. When the drawing styles of cognitive maps are examined, it is seen that spatial sketches emphasize Lynch urban image elements in perfect or good level (**Figure 3-4**). Sequential drawings also show moderate Lynch elements and good eco-CBD definitions.



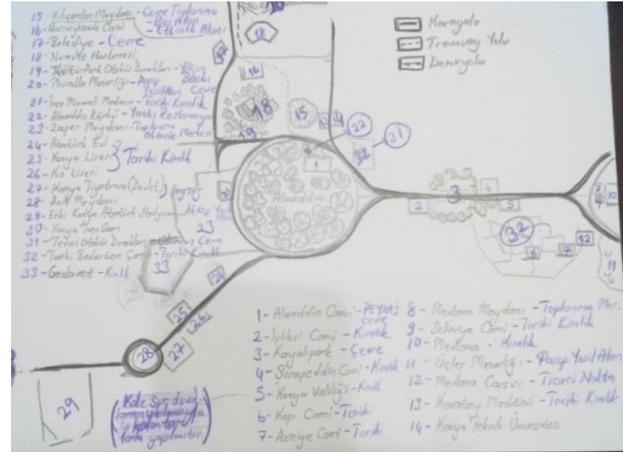
**Figure 1.** According to third classes Konya CBD image elements and urban environment perception elements frequency percentage distribution



**Figure 2.** According to fourth classes Konya CBD image elements and urban environment perception elements frequency percentage distribution

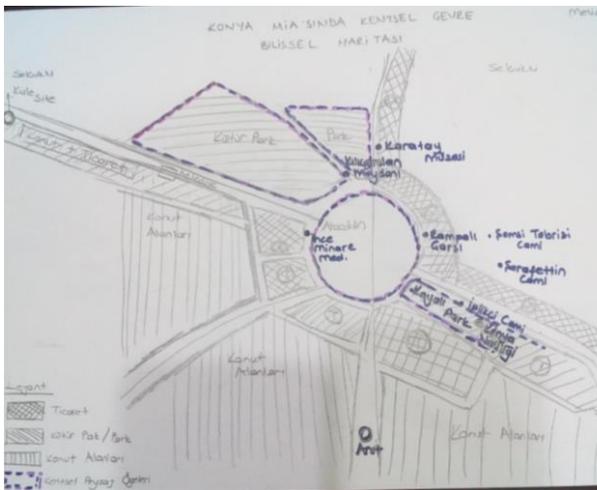


Good definition about CBD image but poor urban environment perception

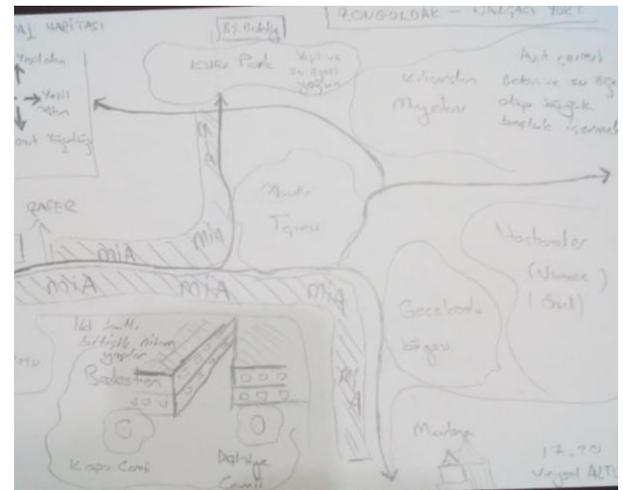


Better than fist map as to urban environment (green corridors, air ventilation, public space, noise pollution)

Figure 3. Some of Cognitive maps in Konya CBD



Good definition about CBD image but poor urban environment perception



Better than fist map as to urban environment (green corridors, air ventilation, public space, noise pollution)

Figure 4. Some of Cognitive maps in Konya CBD

## 6. DISCUSSION AND CONCLUSION

There is no doubt that one of the most important factors affecting the perception of urban image and eco-CBD is related to CBD of Konya where students spend most of their free time outside campus education. Over time, because of their communication with CBD, they have come across different objects and have learned them by experiencing them. Especially the green areas in the city center, trade areas, socio-cultural facilities and historical building groups were the elements that the students' image maps were primarily concerned with. This approach is consistent with Lynch urban image elements.

In the cognitive maps drawn about Konya CBD, where historical structures are predominant, third-class city planners perceive paths and reference points as a priority, and then highlight districts and nodes, while in the eco-CBD, they concentrate on green areas and remain at a moderate level in urban environmental pollution. It is understood that the fourth classes perceive the city with the Lynch image elements at a very good level with spatial drawing styles in urban tissue perceptions and that the eco-CBD perceptions develop at a much better level than the third classes.

Konya CBD, which is put forward with cognitive maps, has to approach with environmental sensitive planning, project design and implementation within the concept of sustainable center planning in urban planning and urban design disciplines.

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## **O 88. AN ENVIRONMENTALLY-FRIENDLY BLEACHING FOR HEMP AND LINEN FABRICS**

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**ABSTRACT:** The hemp and linen fibers and the fabrics produced with these materials have great importance in the textile industry due to their lots of beneficial properties. The raw hemp and linen fabrics are bleached in the harsh conditions and these conventional scouring and bleaching processes are costly, non-environmentally friendly and lengthy operation, since it is multistage in nature. For this reason, in the present study, the ecological bleaching facilities for the hemp and linen fabrics, with reinvigorated oxygen molecules were researched. For this purpose, tetraoxygen molecule (O<sub>4</sub>), meant reinvigorated oxygen molecules were used. After the process, the bleaching performances of the both samples were compared to conventional bleaching through Berger whiteness value.

*Keywords: Hemp, Linen, bleaching, whiteness index, tetraoxygen molecules*

### **1. INTRODUCTION**

The cellulosic fibers are commonly used in the textile industry because of the excellent properties. Among the cellulosic fibres, bast fibers such as linen, hemp and jute are so important due to their biodegradable and ecofriendly characteristics (Que et. al, 2005). The bleaching treatments of these fibres are difficult because of the having more impurities in their structure than cotton. However the bleaching proses for the cellulosic materials could be applied with sodium hypochloride, sodium hydroxide or sodium chloride, in the industrial operations, hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>) is the most common bleaching agent. In the bleaching process of these materials, hydrogen peroxide is generally used by consuming a large quantity of chemicals, various auxiliaries and water at the high temperature. Thus, the conventional bleaching of the linen and hemp materials is costly, non-environmentally friendly and lengthy process, since it is multistage (Perincek et. al., 2013).

During the recent years, every branch of industry has taken precautions in order to use the nature sources more beneficial and went towards to the clean technologies due to the problems of environmental pollution, limited water sources, and wasting of energy, etc. (Beşen, 2012; Beşen and Balçı, 2016; Gülümser et.al., 2009; Perincek, 2006; Perincek et.al., 2009; Sancar and Balçı, 2013). The environmental impacts of industry can be substantially reduced via using advanced techniques and technologies, which help to decrease wasting of energy and water, and cut emissions (Öztürk and Eren, 2010; Pazarlıoğlu et.al., 2005; Perincek et. al., 2007). Through the advanced technologies, ozone application has had high popularity for many years (Beşen, 2012).

The ozone (O<sub>3</sub>) is the most extremely strong oxidant known after the fluorine (Perincek, 2006; Beşen, 2012) and it is prone to participate in many chemical reactions with inorganic and organic substances due to strong oxidizing property (Perincek et.al., 2007; Hsu et.al, 2001; Sancar and Balçı, 2013). Due to this property, it is used in many industrial applications. Recently, reinvigorated oxygen molecules have been used as an alternative of the ozone gas. The reinvigorated oxygen molecules were reported as more effective and consuming less energy than ozone, as well as non-toxic.

In the present study, in order to bleach the linen and hemp fabrics via environmental-friendly way, the possibilities of bleaching these fabrics with the reinvigorated oxygen molecules were investigated. This environmental friendly bleaching process was compared with the conventional H<sub>2</sub>O<sub>2</sub> bleaching. After the process, the whiteness degrees (Berger) and CIELab color values of the fabrics were measured.

## 2. MATERIAL AND METHOD

### 2.1. Material

In the environmental friendly bleaching processes, the reinvigorated oxygen molecules generator having 50 g/h capacity, a glass colon having 2-liter capacity and a stone diffuser were used. In the conventional bleaching processes, H<sub>2</sub>O<sub>2</sub>, NaOH, organic stabilizer, and washing agent were used. All the chemicals were used without purifications. The distilled water was used in the experiments.

Raw woven linen and hemp fabrics were used. Both fabrics were plain woven (1x1) having 20 yarn/cm weft and warp density (yarn count: Nm20).

### 2.2 Method

In the environmental friendly bleaching, the fabric samples were placed in to the glass colon which was filled with 1 liter distilled water. The reinvigorated oxygen molecules produced by the generator was directed to the fabric samples through the diffuser placed at the bottom of the glass colon. The application was applied at the room temperature till the fabric samples had white color. The applications lasted 1 hour for the linen fabric while 4 hours for the hemp one.

The conventional bleaching was applied with exhaust process, and the liquor ratio was determined as 1:40. The process was carried out with the application recipe given in Table 1 at 80 °C during 90 minutes. After the process, the fabric samples were washed with boiling water for 10 minutes, then overflow cold washing for 5 minutes.

**Table 1.** The application recipe of the conventional bleaching

Chemical	Amount (ml/l)
H <sub>2</sub> O <sub>2</sub>	2
NaOH	1
Organic stabilizer	4
Washing agent	2

After the processes, the fabric samples were dried at the room temperature and the whiteness degrees and CIELab color values of the samples were measured via spectrophotometer (Datacolor). All of the samples were measured for three times and the average of the results were calculated. The whiteness degrees were measured in order to investigate the bleaching effect of the reinvigorated oxygen molecules on the linen and hemp fabrics while the CIELab color values were measured in order to research whether the reinvigorated oxygen molecules caused the yellowing effect on the fabrics.

## 3. RESEARCH FINDINGS

### 3.1. The Whiteness Degrees of the Fabric Samples

The whiteness degrees of the raw and both conventional and environmentally-friendly bleached fabric samples were given in Table 2.

**Table 2.** The whiteness degrees of the fabric samples

Fabric Sample	Whiteness Degree (Berger)
Raw Linen Fabric	16,20
Conventional Bleached Linen	26,11
Environmentally-Friendly Bleached Linen	25,11
Raw Hemp	9,20
Conventional Bleached Hemp	19,91
Environmentally-Friendly Bleached Hemp	31,74

When Table 2 was focused, it could be seen that the environmentally- friendly bleached linen fabric sample had approximate Berger value with the conventional one while the hemp fabric had higher. Thus, it could be said that it was possible to bleach linen and hemp fabrics via reinvigorated oxygen molecules as environmentally-friendly way. In addition, the whiteness degrees of the fabric samples could be adjusted according to the requested amount by the way of changing of the application time of the reinvigorated oxygen molecules.

### 3.2. The CIELab color values of the Samples

The CIELab color values of the fabric samples were given in Table 3.

**Table 3.** The CIELab values of the fabric samples

Fabric Sample	CIELab Values				
	L*	a*	b*	C*	h°
Raw Linen Fabric	71,53	1,82	8,17	8,37	82,96
Conventional Bleached Linen	80,85	1,21	8,20	8,29	83,66
Environmentally-Friendly Bleached Linen	80,71	1,27	8,42	8,51	83,63
Raw Hemp	68,76	1,62	10,08	10,21	83,49
Conventional Bleached Hemp	85,20	1,16	11,24	11,30	84,09
Environmentally-Friendly Bleached Hemp	75,64	0,79	4,90	4,96	80,80

In the CIELab color system, while the L\* value indicates the lightness and darkness, the b\* value gives information about the yellowness and blueness of the fabric samples. The L\* value changes between 0 and 100, and the color becomes lighter as the L\* value increases. The increment in the b\* values mean that the color goes to the yellowness. The a\* value is about the reddish and greenish of the fabric and the reddish of the sample increases as the value rises. Table 3 showed that the reinvigorated oxygen molecules did not cause the yellowing effect on the samples, contrary yellowness of the samples declined by the applications.

### 4. CONCLUSIONS AND DISCUSSION

Recently, due to environmental consciousness, it has been necessity to move towards environmentally-friendly processes for every branches of industries. At this scope, there are a lot of actions in the textile industries. The ozone applications are one of them and they are applied at the bleaching in the pretreatment process, garment washing in denim production or fading process for many years. In the present study, the possibilities of bleaching the linen and hemp fabric samples through the reinvigorated oxygen molecules as an alternative way to the ozone gas were investigated. For this purpose, the

reinvigorated oxygen molecules were applied to the fabric samples in the water till the fabric samples had white color. In order to compare the results, the bleaching process was also carried out with the conventional one. After the processes, the whiteness degrees and CIELab color values of the fabric samples were measured. The results showed that it was possible to bleach linen and hemp fabric samples with reinvigorated oxygen molecules, and the whiteness degrees of the fabrics could be adjusted according to the requested amount by the way of changing of the application time.

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**O 89. EVALUATION OF REINFORCED CONCRETE HIGH BUILDINGS WITHIN THE  
CONTEXT OF TBDY-2018**

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**ABSTRACT:** In this study, it is aimed to examine the reinforced concrete high buildings (RCHB) which are widespread in the world and in our country. To begin with, reviewing the literature is completed to see important points in the analysis of high structures. In this context, the historical development of high building class structures and the structural system design and classification of the high buildings are discussed. In addition, loads affecting high building class structures were examined. As the earthquake loads applied to high building class structures are calculated in the best way and the accurate action is made according to the current regulations, the current regulations are examined and their deficiencies are emphasized. The historical development of the regulations used in the analysis of high structures and the steps taken in line with the requirements in this direction were examined. The limits and differences of the regulations in our country for high buildings are highlighted. Lastly, the requirements of performance analysis are explained in order to achieve more accurate analysis results.

*Keywords: Turkey earthquake building regulations, high rise buildings, earthquake, performance-based design*

**O 90. THE FEASIBILITY OF “ZERO WASTE PROJECT” IN THE FIVE-STAR HOTELS  
OPERATING IN ANTALYA**

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**ABSTRACT:** According to the Zero Waste Regulation Exposure Draft prepared by the Republic of Turkey Environment and Urban Ministry in 2018, 4 & 5 star hotel establishments have to pass to Zero Waste Management System by providing the prerequisites in Annex 7/A of the regulation in 2019. Based on this statutory obligation, feasibility of zero waste project in the five-star hotels operating in the province of Antalya, seen as the tourism centre of Turkey, is investigated. In this study, 23 five-star hotels in Antalya were subjected to a survey study so as to evaluate their proximity to Zero Waste Management System. In the first part of the survey, questions were asked about the general information of hotel managements. In the second part of the survey, questions were asked about whether they meet eight criteria given as the preconditions in Annex 7/A of the Zero Waste Regulation Draft for the establishment of Zero Waste Management System in hotels. In the third part of the survey, questions were asked to determine whether the hotels applied six options in the US EPA Food Recovery Hierarchy so as to evaluate the activities of hotel businesses within the scope of zero food waste. According to the results of the study, the five-star hotels operating in Antalya are determined to be able to meet the conditions for establishing a Zero Waste Management System due to their existing waste management systems and to provide food recovery by establishing a procedure within their own facilities.

*Keywords: Antalya, Five Star Hotel Businesses, Zero Waste Project, Zero Waste Management System*

**O 91. UTILIZATION OF UNSATURATED POLYESTER IN IMPROVING THE  
GEOTECHNICAL PROPERTIES OF THE CLAYS**

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**ABSTRACT:** Soil properties under civil engineering structures; in case of insufficiency in bearing capacity, settlement, liquefaction and stability criteria, ground improvement or deep foundation construction is carried out. Many different soil improvement techniques are applied and the method to be applied is decided according to criteria such as cohesionless or cohesion of the ground, local conditions, layer thickness to be improved and cost. Generally, cohesive soils are drained of the water in the cavities, cohesionless soils are reduced by compression or gaps are filled with a different material. The polymer is defined as the natural or artificial substance found in the structure of large molecules composed of small molecules called monomers. Polyesters, which are a kind of polymer based material, are widely used especially in maritime and construction fields and can gain permanent properties with hardening process. In recent years, research on the use of polyesters in different geotechnical engineering applications has increased. Within the scope of the project, the effect of unsaturated liquid polyester, which is relatively new in geotechnical applications, on stabilization of cohesive soils was investigated by experimental studies. In this context, observed how unsaturated liquid polyester, which will participate in different proportions of cohesive soils with different water content, affects the unconfined compression strength of the cohesive soil.

*Keywords: Cohesive Soil, Unsaturated Polyester, Soil Stabilisation, Unconfined Compression Strength*

**O 92. INVESTIGATION OF OPERATOR EFFECT ON DETERMINATION OF PLASTIC  
LIMIT**

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**ABSTRACT:** Water has a significant impact on the soil. Changes in the water content of soils are mostly seasonal changes. During the rainy seasons, the water content of the soils increases as water infiltrate underground. Water content decreases due to evaporation in hot season. As a result of this change in water content, especially in fine-grained soils, swelling - shrinkage, sitting and strain increase occur. Therefore, it is important to accurately determine consistency limits. The main method used to measure Plastic limit across the globe is developed by Casagrande. The standard manual rounding method can often give inconsistent or unreliable results, as the tester is dependent on the experience of the operator, the rate of rounding, being dry and wet of surface. In this study, using different clays with three different plasticity and different water contents to determine plastic and liquid limits were made standard manual rounding method and cone penetration test. The using cone tool have standart measure 80 g weight and angle of 30 °. To determine that the plastic limit depends on the operator, 12 geotechnical experts and 8 beginner students has been made with same soil. The results were compared. Thus, the consistency limits of the operator were determined.

*Keywords: Cone penetrometer, Liquid limit, Plastic limit.*

**O 93. UTILIZATION OF UNSATURATED POLYESTER IN IMPROVING THE  
GEOTECHNICAL PROPERTIES OF THE SANDS**

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**ABSTRACT:** It is stabilized by adding chemical additives (cement, lime, bitumen etc.) to the soil to increase the strength and physical properties of soils. But these traditional soil stabilizers usually require long curing time and excess of material for large scale improvement. Therefore, researchers have turned to alternative stabilizers to be used in soil stabilization. The most important of these materials are liquid unsaturated polyesters which have curing effect in a short time and are used in little amounts. In this study, in order to determine the optimum ratio of sandy soils stabilization with unsaturated polyester, samples were prepared in the laboratory by using parameters and levels prepared according to the Taguchi method. The purpose of using the Taguchi method is to save time and cost by reducing the number of experiments. According to Taguchi method, water, polyester, accelerator and accelerator/hardener ratios are selected as 4 parameters. Depending on these parameters, 4 levels were determined. A table with orthogonal array L16 was made. Water and polyester content were taken as percentage of dry sand weight; accelerator and hardener ratios were taken as percentage of the amount of polyester used. Then unconfined compressive test was performed on these samples. According to the results of the experiments, the strength of the ratios determined was compared. According to the results, the use of unsaturated polyester for improving the engineering properties of sandy soils and optimum mixing ratios were investigated.

*Keywords: Soil stabilization, Unsaturated polyester, Taguchi method*

**O 94. INDUSTRIAL BY-PRODUCTS AND REEVALUATION**

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**ABSTRACT:** Demand of the energy and raw material is being increased with development of industrial, nowadays. The wastes generated as a result of these requirements increase the environmental problem. In order to reduce costs and increase high performance (concrete, cement, etc.) evaluation of the by-products in many sectors has become attractive and many organizations have started to do research about this topic. Iron-steel and energy sectors are those which the by-products are most produced. More than half of the material is used as input in production is transformed into gas and solid waste/by-product, so by-products such as fly ash, slag, oxide layer and EAF dust are evaluated in order to reduce the use of natural materials and to minimize the problems that may occur in the environment if the materials are storage for disposal. In this thesis, the process of re-evaluation of the mainly by-products and the process of re-conversion to raw materials were investigated. The effects of the used by-products on the products have been searched and especially in the construction sector, the resistance of materials is examined.

*Keywords: fly ash, oxide layer, slag, EAF dust, Waelz Process, By-Products*

**O 95. EVALUATION OF URBAN SPACE PERCEPTION IN SUSTAINABLE HISTORICAL ENVIRONMENT ON THE CHILDREN OF PRIMARY SCHOOL AGE, THE CASE OF ILGIN/KONYA**

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**ABSTRACT:** The sustainability of the historical and cultural values of a city helps us to connect the past and the future. Changing living conditions, technological developments, globalization and rapid population growth affect the urban and urban systems continuously and puts the historic city center under pressure and change. Urban Conservation and Renewal Science, a major discipline of urban planning discipline, aims to ensure the transfer of cultural heritage to future generations and aims to control this change and transformation through planning. Thus, conservation the historical value of the city and sustainable of the identity value of the city is strengthened. However, the perceptibility of urban identity cannot be achieved only by conservation the physical dimension of the space. At the same time, the cultural structure of the user, expectations and experiences are shaped by the sense that the user loads. The basis of raising sensitive, responsible and responsible individuals in the historical environment is possible by giving trainings on conservation to children from primary school age. For this reason, the primary objective of this study was to examine the attitudes of primary school children towards sustainable environment. In the scope of the study, three primary schools in Ilgın / Konya were selected as the sample area. In the selected sample area, survey questions were asked to evaluate the perceptions of environmental sustainability of 140 students in the 10-11 age group. As a result of the research, a high level of relationship was found between the level of family living and primary school courses and sustainable historical environmental consciousness, and it was found out that this age population should be educated about sustainable historical environment.

*Keywords: Sustainable History Environment, Space Perception, Urban Identity, Cultural Values, Child-Space Relationship*

**O 96. SUSTAINABILITY AND ENERGY MANAGEMENT**

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**ABSTRACT:** We use more energy to produce new energy. A statistics whose biophysical status can be measured is the Incoming Energy / Outgoing Energy value, ie the ratio of the energy gain to the energy investment. While media and many government statistics refer to gross energy, the important thing is net energy. Low-cost fossil energy is the basis for profits, high salaries and cheap goods and services. According to current trends, the share allocated to the energy sector in total gross national product is increasing continuously. The trick is that if the energy price is doubled or tripled, the economic benefit of trade is rapidly declining. Renewable energy and efficiency gains are important, but they do not meet the expectations of benefits and, ultimately, the financial demands created within the current system. Therefore, with a low carbon future plan, we have to make a low consumption future together. The pursuit of endless economic growth based on fossil fuels is a threat to sustainability. Rapid population growth, climate change and technological developments are not only critical to our global society, but also to complex, interdependent relationships. One of the biggest challenges to the widespread adoption of renewable energy sources is to include these resources in an energy system designed for fossil fuels (concentrated fuels). Energy efficiency measures the ability of an economy to generate useful services from the energy it uses. Energy Management, a discipline, began to develop after the first oil crisis in 1973, and it really came into effect after a dramatic rise in real energy prices after the second oil crisis in 1979. Main objectives of Energy Management; resource saving, climate protection and cost savings.

*Keywords: Aksaray, Environmental Engineering, Symposium, energy management, energy*

## O 97. DETECTION OF VOLATILE ORGANIC COMPOUNDS IN INDOOR INDUSTRIAL AIR

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**ABSTRACT:** With the rapid population growth, the industrial revolution and the developments in the industrial sector, the quantity and diversity of human demands have increased. In order to maintain healthy life which is the most basic requirement of human being, it has needed fresh air, it has left natural materials in order to meet increasing demands and it has accelerated production of synthetic and artificial products. The use of chemical materials in these products is very important for both cheap and easy production of the product. However, these chemicals, which are used to avoid cost and work load and can easily become volatile at ambient temperature, have started to be used in the indoor environment and have a negative impact on human health. In the past, the idea that "indoor air quality is cleaner than the outdoor air quality" was demolished by the current research. "What's the volatile organic compounds, what are the sources of spread and what are the effects on human health" began to be the subject of research.

In this study, to determination of volatile organic compounds that continue to spread at room temperature from the materials and processes used in industrial environment such as paint, wood, insulation materials and cleaning products production processes, evaluate the environmental standards, determine the impacts on environmental health and it is aimed to determine the activities that what can be done to reduce pollution.

*Keywords: Industrial environment, Closed environment, Volatile organic compounds, VOC detection*

### 1. INTRODUCTION

With the industrial revolution, mankind has followed a migration from village to city and more than 85% of the population has settled in cities. Human beings spend more than 90% of their time indoors. This has made the issue of indoor air a need to investigate. Indoor air; It is the breathable ambient air in the environments where daily life is experienced such as houses, workplaces without industrial production, schools and hospitals. Indoor environments; they must be able to meet the basic needs of people, healthy, sufficient sunshine, avoiding extreme temperatures and constantly getting fresh air. The indoor air quality is related to the cleanliness of the indoor air. For many years, it has been adopted that indoor air quality is cleaner than outdoor environment. However, as a result of the researches, indoor building materials, cleaning products, dyestuffs and pollutant concentrations caused by heating have a significant effect on indoor air quality (Soysal and Demiral, 2007).

#### **Volatile Organic Compounds**

Chemical structures that contain at least one carbon and hydrogen atoms in their structure are called organic compounds. Organic compounds are classified in three main branches: volatile organics, semi-volatile organics, and non-volatile organics. Volatile organic compounds are hydrocarbons of aliphatic or aromatic structure whose boiling points range from 50-260 °C. Volatile organic compounds are low-soluble compounds in water and can easily convert to volatile form at room temperatures due to their high vapor pressure. Table 1 gives information about boiling point temperatures and vapor pressures of some volatile organic compounds. (Alyüz and Sevil, 2006; URL-1)

**Table 5.** Boiling points and vapor pressures of some organic compounds (Alyüz and Sevil, 2006)

<b>Volatile Organic Compound</b>	<b>Boiling Point Temperature (°C)</b>	<b>Vapor Pressure (mm Hg)</b>
Benzene	80.1	95.2 (25 °C)
Toluene	111	22 (20 °C)
Chloroform	62	160 (20 °C)
o-ksilen	144	7(20 °C)
1,1,1, Trichloroethane	74.1	10 (20 °C)
1,2,4- Trimethylbenzene	169	2.03 (25 °C)
p-ksilen	138	9 (20 °C)
Undekan	196	0.28 (20 °C)
1,3,5 Trimethylbenzene	165	1.86 (20 °C)
Ethylbenzene	136	10 (20 °C)
Styrene	145	5 (20 °C)
Carbon tetra chloride	76.8	91.3 (20 °C)
Dichloro benzene	174	10 (55 °C)
p-dichloro-benzene	174	10 (55 °C)
Methyl chloride	39.8	350 (20 °C)
Ethylene dibromide	131.5	11.0 (25 °C)

According to the reports of the European Commission Joint Research Center-Environmental Institute; chemical structures (alkanes, aromatic hydrocarbons, aldehydes, etc.), physical properties (boiling point, vapor pressure, carbon number, etc.) and potential health effects (irritants, neurotoxic, carcinogenic, etc.).

**Table 6.** Volatile organic compounds [Adapted from Darçın, 2014]

<b>Organik bileşik</b>	<b>Grup adı</b>	<b>Sık karşılaşılan kirlenmeler</b>
Volatile Organic Compounds	Aliphatic Hydrocarbons	Methane, ethane, propane, butane, pentane, hexane, heptane, octane, nonane, cyclohexane, isobutane, isopentene, n-tridecane, decane, dodecane, undecane
	Single-Ring Aromatic Hydrocarbons	Benzene, ethylbenzene, diethylbenzene, trimethylbenzene, dimethyl-ethyl benzene, toluene, xylene, styrene, ethyl toluene
	Polycyclic Aromatic Hydrocarbons	Naphthalene, phenanthrene, benzo [a] pyrene, DDT, dieldrin, permethrin, benz [a] anthracene
	Halogenated Hydrocarbons	Chloroform, dichloromethane (methylene chloride), trichloroethylene, tetrachloroethylene, p-dichlorobenzene (1,4-dichlorobenzene), methyl bromide, vinyl bromide, benzyl chloride, 1,1,1-

		trichloroethane (methyl chloroform), carbon tetrachloride
	Amines	2-naphthylamine, 4-aminobiphenyl
	Alcohols	N-butyl alcohol, 1-dodecanol, phenol, methyl alcohol (methanol), ethyl alcohol (ethanol), nonanol, isopropyl alcohol (isopropanol), propargyl alcohol, 2-ethyl-1-hexanol
	Ethers	Ethyl ether
	Aldehydes	Decanal, nonanal, formaldehyde, propenol (acrolein), acetaldehyde, furfural, hexanal
	Ketones	Acetone, methyl ethyl ketone (2-butanone)
	Terpenes	Pin-pinene, $\beta$ -pinene, limonene, isoprene
	Esters	Ethyl acetate, 1-hexyl butanoate
	Glycol ethers	2-ethoxy ethanol
	Organic acids	Acetic acid, propanoic acid, hexanoic acid, pentanoic acid
	Compounds containing sulfur	Carbon disulfide
	Other compounds	1,3-butadiene, nitrosamines

### Spread Sources of Volatile Organic Compounds

The type of volatile organic substances and their sources are important information for determination. These compounds generally have concentrations below the perceptible level of odor and are about five times greater than the level of the external environment (Alyuz and Sevil, 2006). Volatile organic compounds can be caused by many materials such as paint, varnish, adhesives, construction materials, cleaning products, heat exchanger systems, insulation materials, leaks in wood stoves and pipes. In the studies conducted, it is considered that volatile organic substances are frequently encountered in the indoor environment (Liotta, 2010; Soylu et al., 2010; Drobek et al., 2015). In office environments, printers and photocopiers are the most serious volatile organic material dispensers. In a photocopy process, there are 60 types of volatile organic matter (Wolkoff et al., 1993). Natural sources of volatile organic compounds are; anaerobic processes in trees, plants, wild animals, natural forest fires and swamps.

As a result of the studies conducted by the Environmental Protection Organization (Figure 1) shows that 29% of volatile organic compounds emitted from the environment are emitted from solvent use, 28% from vehicles, 19% from home/office equipment, 11% from industrial processes and 13% from other sources.

The chemicals used in the production of some materials can cause many types of volatile organic compounds to be released into the interior air (Table 2).

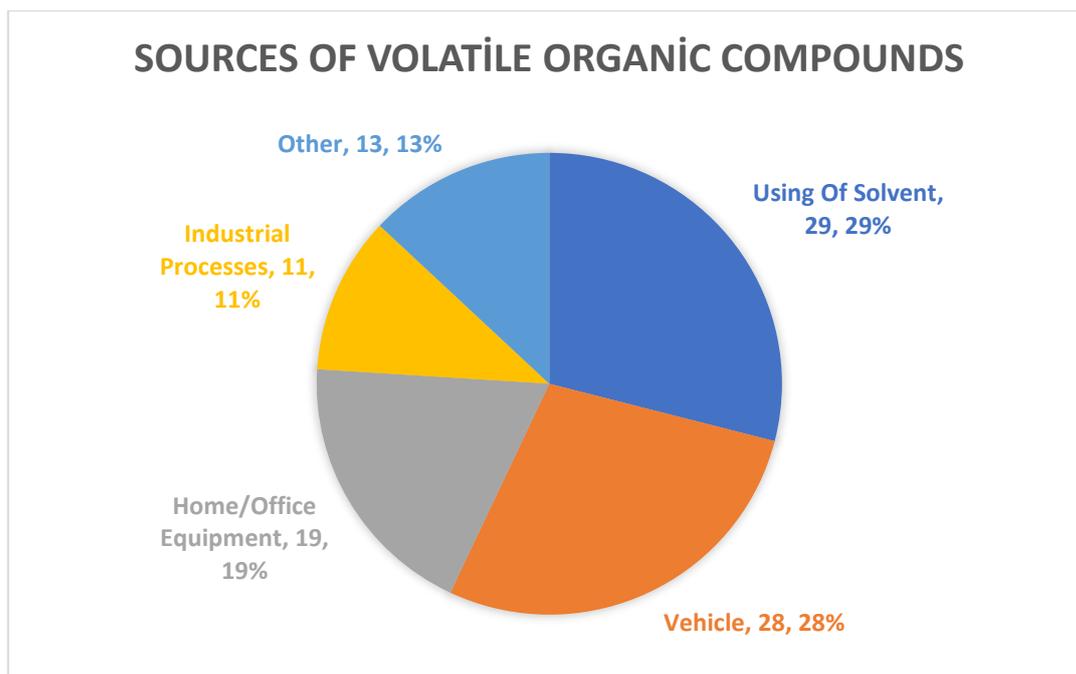


Figure 6. Sources of Volatile Organic Compounds

Table 4. Building products with indoor air pollutants [Darçın, adaptation from 2018]

Resources	Pollutants
Paints and Solvents	Hexane, benzene, xylene, styrene, toluene, trimethyl benzene, ethyl toluene, methylene chloride [Tucker, 2001], formaldehyde [Bernstein, et al., 2008], $\alpha$ -pinene, limonene [Zabiegala, 2006], tris (2-chloroethylene) phosphate, phosphorous organic ester [Wensing, Uhde and Salthammer, 2005]
Varnishes and Varnishes	Nonane, decane, dodecane, undecane [Zabiegala, 2006], hexane, benzene, ethylbenzene, ethyl toluene, xylene, styrene, toluene, trimethyl benzene, methylene chloride [Tucker, 2001]
adhesives	Hexane [Zabiegala, 2006], ethyl benzene, ethyl toluene, xylene, toluene, trimethyl benzene [Tucker, 2001], formaldehyde [Bernstein, et al., 2008]
Sealers	Toluene, tetrachlorethylene [Tucker, 2001]
plasters	Ethylbenzene, xylene, toluene [Tucker, 2001]
Natural and Artificial Wood Sheets	Hexane, benzene, ethyl benzene, xylene, styrene, toluene, trimethyl benzene, p-dichlorobenzene, acetaldehyde [Tucker, 2001], formaldehyde [CEC, 1992], $\alpha$ -pinene, $\beta$ -pinene, limonene [Salthammer and Fuhrmann, 1996], tris (2-chloroethylene) phosphate, phosphorous organic ester [Wensing, Uhde and Salthammer, 2005]
Paper Coatings	Ethylbenzene, xylene, toluene [Tucker, 2001], formaldehyde [Balanli, Vural and

	Tuna Taygun, 2006], tris (2-chloroethylene) phosphate, phosphorus organic ester [Wensing, Uhde and Salthammer, 2005]
Plastic Sheets	N-tridecane, hexane, nonane, decane, dodecane, undecane [Gustafsson, 1992], benzene, ethylbenzene, xylene, styrene, toluene, trimethyl benzene, p-dichlorobenzene, acetaldehyde [Tucker, 2001], phenol [Wallace and Gordon, 2007 ], ortho-phthalic acid diester, fibutyl phthalate, di-2-ethyl-hexyl phthalates, 2-ethyl-1-hexanol [Clausen, et al., 2007]
Linoleum Sheets	Toluene, 2-butanone [Salthammer and Bahadir, 2009], hexanal, nonanal, octanal, propanoic acid, hexanoic acid, pentanoic acid [Jensen, Wolkoff and Wilkins, 1995]
Cork Sheets	Toluene, phenol, furfural, formaldehyde [Salthammer and Bahadir, 2009]
Carpets	Hexane, ethylbenzene, xylene, styrene, toluene, p-dichlorobenzene, acetaldehyde [Tucker, 2001], $\alpha$ -pinene, limonene [Godwin and Batterman, 2007], formaldehyde [Maroni, 1998]
Fabric Coatings	Hexane, benzene, xylene, toluene, styrene, chloroform, methylene chloride, trichlorethylene [Tucker, 2001], formaldehyde, tris (2-chloroethylene) phosphate, phosphorous organic ester [Wensing, Uhde and Salthammer, 2005]

### Effects of Volatile Organic Compounds on Human Health

Indoor environments are the places where people meet many needs during the day and spend most of their time. Therefore, the indoor air must be clean. Unfortunately, indoor air is often 10 times more polluted than outdoor air. Pollutants that disrupt indoor air quality by the Environmental Protection Organization (EPA) include volatile organic compounds and formaldehyde as the major pollutants (EPA, 1998; Hines et al., 1993). Volatile organic compounds are constantly exposed to the indoor environment as a result of human activities and goods. In the last 10 years, the type and amount of volatile organic compounds have increased due to the increasing use of chemical and synthetic structures. Humans may be affected by volatile organic compounds by inhalation, odor and skin or eye contact. Pollutants must accumulate in the body at a certain concentration in order to pose a health problem. As a result of the high concentration of volatile organic compounds in the interior and the presence of people in these spaces for a long time, a series of symptoms have been observed (Viegi, et al., 2004). The global health organization calls the general name of these symptoms “Patient Building Syndrome”. In people with this syndrome, headache, nausea, eye irritation, respiratory system diseases, drowsiness and general weakness is seen (Kostiainen, 1995). As a result of VOC exposure, diseases such as neurological toxicity, lung cancer, eye and throat irritation may also be encountered (Guo et al., 2004).

Norbäck et al. Investigated the relationship between asthma symptoms and building properties and concentration of volatile organic compounds in residences. It was concluded that indoor VOCs and formaldehyde may cause asthma-like symptoms. In order to keep the VOCs at a reasonable level, attention should be paid to the selection of construction materials, building construction and indoor activities (Norbäck et al., 1995).

### **Sampling and Storage Methods for Determination of Volatile Organic Compounds**

The first condition for realistic measurement of volatile organic compounds is that sampling and storage are performed correctly and in accordance with standards. Flue gas sampling and ambient air sampling methods for analysis differ. When sampling the flue gas, it is necessary to take samples under conditions where the plant is stable. After sampling, leakage check should be performed. The flue gas temperature during sampling should not exceed 40 ° C. In order to avoid condensation in the sample cup, the flue gas can be passed through a cooling chamber and then cooled to take the sample. If the concentration of organic compounds is at risk of exceeding the capacity of the sorbent tubes, sampling should be carried out by dilution in the sampling process. A sampling process of at least 10 minutes is important for the realistic results of the analysis. Blank samples should be taken twice as much as the sample volume taken.

Samples taken from the flue gas should be taken immediately to a cool, dark environment. For prolonged storage it should be stored in a container that is not contaminated by solvent below 4 ° C (TS EN 13649, 2003).

For a sample to be taken from ambient air; For passive sampling, a sampling tube suitable for analysis should be collected and used within one month of sampling. If sampled with a circular plate, it can be stored in microporous activated carbon. After sampling, it can be stored in a cool and dark environment and used during analysis (TS EN 13528, 2003).

### **Removal Methods of Volatile Organic Compounds**

Many methods have been developed for the control of volatile organic compounds. These methods include the modification of processes and equipment to which the VOC is deployed, as well as the addition of control techniques. Control techniques are divided into two as destruction and recovery. Destruction; It is eliminated by digestion of VOCs by microorganisms of different types of oxidation, such as thermal and catalytic oxidation under aerobic conditions. During the recovery phase, VOCs are removed by densification, absorption, adsorption and membrane separation processes.

Before performing volatile organic matter removal in industrial environments, cost-benefit analysis should be carried out in the environment and the amount of VOC at which point, the best detection method and the most appropriate sampling method should be selected. Since economic constraints and technologies are limited in an improvement to be implemented in the environment, it is important to perform the most appropriate removal method at the most appropriate point.

In the literature, the removal of VOCs by oxidation and adsorption is widely mentioned. It is seen that the removal of volatile organic compounds is also very effective in photocatalysts with high oxidation properties and activated carbon with high adsorption properties. VOC removal is also possible with the ozonation system. Ozonation systems are a method that provides oxidation by applying ozone directly to the air drawn by an air motor (OLGUN et al. ; TÜRKER et al., 2015).

## **2. RESULTS**

The only effective way to remove pollutants from indoor environments is at source control. Furthermore, the complete elimination of indoor air pollutants is generally not feasible or practical. In this context, a different way should be preferred without using materials such as equipment, paints, cleaning products and wooden surfaces to be used indoors. In the environment, a special ventilation system should be provided to the voc source and protective equipment should be provided to the personnel or person working there. Continuous voc control in the environment can be carried out by means of suitable commercially available sensors (conductometric solid state sensors). In addition, removal of voc in the medium can be realized by adsorption and oxidation methods.

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**O 98. ENVIRONMENTAL PSYCHOLOGY FOR ARCHITECTURAL DESIGN: COGNITIVE-BEHAVIORAL APPROACHES TO SPATIAL COGNITION**

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**ABSTRACT:** Environmental psychology, human-space relations between physical environment and human behavior. How do spatial variables direct human behavior? Environmental psychology; it has been defined by names such as architectural psychology, psychological ecology, ecological psychology. The aim of this article is to try to capture two main objectives of environmental psychology: to try to understand human-environment mutual actions and to use this information as an aid in solving space design problems. It first looks at Environmental psychology has focused its interdisciplinary discourse with those who design and plan the physical environment toward architects. Also, environmental psychology is interested in environmental perception and cognition, in feelings all focus on the spaces relevant to architecture and designer. Next it discusses the Spatial behaviors are influenced by human images of space. Cognitive mapping studies aim to clarify these phenomena and understand our perceptions as a result of environment-human interaction. The discussion in relation to If the principles of how people perceive and shape the physical environment can be known, the environmental behavior of individuals can be better understood; more perceptible, representative, and finally livable spaces for people. The article concludes with the discussion of human–environment interaction, the perception of the environment and understanding of the space in the human mind will contribute to understanding the subject of cognitive processes while giving information about the "spatial legibility/intelligibility" hence the development of design principles suitable for the design process.

*Keywords: Environmental Psychology, Architectural Design, Architectural Psychology, Spatial Perception, Spatial Cognition*

## **O 99. ENVIRONMENTALLY FRIENDLY ALTERNATIVE FUEL TO REDUCE TURKEY'S PETROLEUM IMPORTS: E85 (FLEX FUEL)**

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**ABSTRACT:** Due to the rapid depletion of petroleum-derived fuels, the reduction of consumption of these fuels and increasing the use of fuels produced from renewable sources are one of the important objectives in all countries. One of the alternative fuels that are less harmful to the environment, renewable and sustainable is bioethanol. Bioethanol is a clean fuel that can be obtained from agricultural products, agricultural production residues or other products containing cellulose. When bioethanol is mixed with gasoline at low proportions as %5-10, it can be used without any changes in spark-ignition engines. The E85 fuel consists of a mixture of 85% bioethanol and 15% gasoline. The use of this fuel in vehicles requires a small and low-cost change in the engine. Once the vehicle has been modified, the vehicle is defined as a flexible fuel vehicle and the desired fuel can be used (gasoline, E10, E15 or E85). The price of E85 fuel is approximately 25% cheaper than gasoline in international markets, while E85 fuel consumption is approximately 30% more. However, because the octane number of E85 fuel is too high, it can produce more power than gasoline. In addition, the exhaust emissions of this fuel are very low. Large agricultural areas and wide agricultural product range in Turkey is a very big advantage to produce E85. In this way, fuel need can be supply from domestic sources in Turkey.

*Keywords: Flex fuel, Alternative fuel, Bioethanol, Agricultural waste*

### **1. INTRODUCTION**

With the rapid depletion of fossil fuels, many countries are looking for alternative fuel sources. Recently, a lot of research has been done about electric cars, hybrid vehicles, hydrogen cell vehicles, and vehicles using alternative fuel such as natural gas, biodiesel, and ethanol.

Flexible fuel vehicles (FFV) have an internal combustion engine designed to operate with more than one fuel. These vehicles generally use an alternative fueled gasoline mixed with ethanol or methanol fuel. In these vehicles, both fuels are stored in the same common tank. Modern flexible fuel engines automatically adjust fuel injection and spark timing according to the actual mixing ratio detected by a fuel composition sensor. FFVs have dual fuel systems that simultaneously spray both fuels into the combustion chamber. The most common fuel used by FFVs today is gasoline and ethanol. FFVs may use pure gasoline (E0), pure ethanol (E100) or a mixture fuel of both (E10, E20, E85, etc.).

In the United States of America (USA), flexible fuel vehicles are also known as "E85 vehicles". In Brazil, FFVs are popularly known as "total flexible" or simply "flexible" cars. In Europe, FFVs are also known as "flexible fuel" vehicles. Automobile manufacturers in the Brazilian and European markets, in particular, use the word "Flex" in FFV models, such as Ford Flexifuel, Volvo Flexifuel, Volkswagen Total Flex, Chevrolet FlexPower or Renault Hi-Flex. In the USA, since 2008, FFV models have the "E85/Gasoline" label on the fuel filler flap to distinguish it from gasoline models.

In Europe, flexifuel vehicles are sold in 18 European countries, including Austria, Belgium, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, the Netherlands, Norway, Poland, Spain, Sweden, Switzerland and the United Kingdom. Ford, Volvo and Saab are the oldest car manufacturers to offer the oldest flexible vehicle in the region. Other brands have started to produce in the last few years. The most E85 fuel stations in Europe are located in Sweden. Germany is ranked second in the maintenance of the number of E85 fuel stations. In 2017, Brazil produced 300 thousand vehicles using only gasoline, 30 thousand vehicles using diesel fuel and 2 million ethanol flexible fuel vehicles (Anonymous, 2019a). As of 2017, there are more than 21 million FFVs in the United States (Anonymous, 2019b).

## 2. PROPERTIES OF BIOETHANOL FUEL AND ITS USE IN ENGINE

Bioethanol (C<sub>2</sub>H<sub>5</sub>OH) is a clean, colourless liquid with low toxicity. Bioethanol is chemically and physically indistinguishable from synthetic ethanol, all its properties are similar. Although synthetic ethanol and bioethanol have the same chemical structure, they are used under different names in order to understand the sources of raw materials easily. Synthetic ethanol is produced from ethylene, a petroleum product. Bioethanol, on the other hand, is a type of alcohol obtained by fermentation of substances such as sugar, cellulose or starch which can be converted to sugar, which contain ethyl alcohol. Bioethanol is added as an octane enhancer instead of lead, owing to its high octane characteristic. When bioethanol is mixed with gasoline, bioethanol is preferred as a performance enhancer because the fuel mixture burns more efficiently. The physical and chemical properties of gasoline and ethanol fuels are given in Table 1.

**Table 5.** The physical and chemical properties of gasoline and ethanol fuels (Balki, 2013)

Specifications	Gasoline	Ethanol
Chemical formula	C <sub>6,97</sub> H <sub>14,02</sub>	C <sub>2</sub> H <sub>5</sub> OH
Molecular mass (g/mol)	98.03	46.07
Oxygen weight (%)	-	34.73
Carbon/Hydrogen (C/H) ratio (%)	0.444	0.333
Density (g/cm <sup>3</sup> , 20 °C)	0.740	0.790
Lower thermal value (kJ/kg)	42600	26900
Stoichiometric air-fuel ratio	14.6	9
Thermal value of stoichiometric mixture (kJ/kg-mixture)	3034.25	2998.89
Research octane number (RON)	95	108.6
Motor octane number (MON)	85	89.7
Octane number	90	99.15
Fuel sensitivity	10	18.9
Ignition temperature (°C)	257	363
Flash point (°C)	25	12
Vapor pressure (kPa, 20 °C)	45-90	5.9
Evaporation latent heat (kJ/kg)	349	838
Boiling point (°C, 101.3 kPa)	27-225	78.3
Ignition limits (% volume)	1.4-7.6	3.5-15
Laminar combustion rate (cm/s, HFK: 1.0, NSA)	28	40
Adiabatic flame temperature (°)	2002	1920

Bioethanol has a lower stoichiometric fuel/air ratio and a lower thermal value compared to gasoline. Therefore, when bioethanol or gasoline-bioethanol mixture is used instead of gasoline in spark ignition engines, more bioethanol or gasoline-bioethanol mixtures are required to achieve the performance achieved with gasoline. Bioethanol, which has a high octane number, has a very low cetane number and therefore can cause problems in diesel engines due to its self-ignition resistance. For this reason, it is recommended to add cetane enhancing additives if used in diesel engines. The use of bioethanol is more suitable for gasoline engines since self-ignition resistance allows the compression ratio to be increased (Koçtürk, 2011). Due to the presence of oxygen in the structure of bioethanol and low post-combustion temperatures, there are low rates of carbon monoxide and nitrogen oxides among the combustion products. The high evaporation temperature of bioethanol has a cooling effect on the absorbed fresh fuel. In this case, the volumetric efficiency of the engine increases. Due to the high volumetric efficiency, engines operating with bioethanol or gasoline-bioethanol mixture are generally higher in torque and power than gasoline-powered engines. The decrease in the temperature of the absorbed fresh

fuel and the operation of the engine in poorer mixtures cause significant reductions in CO and NO<sub>x</sub> emissions (Koçtürk, 2011). The price of E85 fuel is approximately 25% cheaper than gasoline in international markets, while E85 fuel consumption is approximately 30% more.

The use of bioethanol in engines has many advantages. It is possible to list these advantages as follows (Aydoğan, 2011):

- It is renewable and a clean fuel source.
- It opens up new economic opportunities for many developing countries.
- Reduces dependence on petroleum-based fuels.
- Reduces dependence on foreign energy.
- Can be easily used in all engines.
- Easy to manufacture and store.
- Reduces emissions causing environmental pollution.
- Improves the agricultural activities of countries.
- Provides new employment areas for the agricultural sector.

In addition to these advantages, some disadvantages of using bioethanol in engines are mentioned. One of these is that it cannot be used directly or high-proportion in internal combustion engines. If a high proportion of bioethanol and gasoline are to be mixed, the engine must be modified. These modifications also result in additional costs. These disadvantages do not affect the use of bioethanol at a high rate. Modifications to the engine can be easily made by the vehicle users and some kits have been developed for this purpose. These kits contain control unit, ethanol sensor, wiring harness, connectors, fuel hose, and clamps. By replacing these parts, the gasoline engine becomes compatible with the use of fuels such as E85, E50, and E10. Thus, the vehicle becomes a flexible fuel vehicle. In addition, it has been the most preferred method in the world by blending with petroleum based fuels at low rates without the need for modification in engines. Another disadvantage is that the product price of bioethanol is higher than that of petroleum-based fuel. However, it is stated that in recent years, bioethanol is produced from cheap raw materials and its prices have decreased. Thus, it can be sold to prices very close to petroleum-based fuels. The use of agricultural products consumed as foodstuffs as raw materials in bioethanol production causes both food prices to rise and fuel prices to be higher than petroleum-based fuels. In recent years, some studies on bioethanol production from cellulose-containing wastes have been carried out to overcome this problem. Particularly in agricultural areas, residues from crops appear to be the largest bioethanol potential during harvest.

The raw materials used in bioethanol production are divided into three classes:

- Raw materials containing sucrose (sugar beet, sugar cane, sorghum, etc.),
- Starchy products (wheat, corn, barley etc.),
- Lignocellulosic biomass (wood, straw, grass, etc.).

It is possible to convert agricultural wastes and cellulose-containing wastes (trees, straw, etc.) economically into bioethanol. Biomass is converted to bioethanol by pre-treatment, hydrolysis, fermentation and distillation process steps. Bioethanol obtained from sugar and starch is a technology that has been experienced for many years in terms of production technology. Therefore, bioethanol produced from the raw materials of sugar and starch is called first generation bioethanol. The production processes of bioethanol produced from lignocellulosic raw materials, defined as the second generation, are still not fully optimized. Today, the production technology of the second generation bioethanol is still in development.

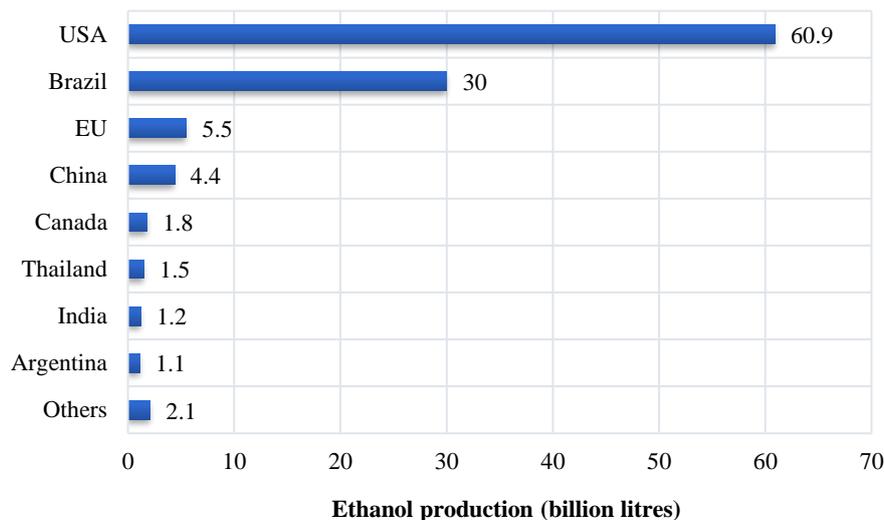
Our country is a rich country in terms of agricultural areas and cultivable agricultural products. Agriculture of energy-producing oilseed plants, non-food parts of agricultural products or harvest residues can be used for bioethanol production. If bioethanol is used in blended gasoline or diesel engines in low ratios, it is very important both in terms of reducing environmental pollution and remarkably reducing oil imports of our country. Although the use of bioethanol is perceived as new to begin, its history goes back to the invention of the engine. At the end of the 1800s, internal combustion engines developed by Nicholas Otto and Henry Ford were working with ethanol (Melikoğlu and Albostan, 2011). In recent years, due to its high octane number, ethanol has been used as an octane

enhancer in gasoline and has replaced lead. In the event that 10% by volume of ethanol is blended with gasoline, the resulting blended fuel (E10) can easily be used in spark ignition engines. If more than 10% of bioethanol is added to gasoline, the fuel line pipes in the engine must be replaced with ethanol-compatible pipes. If more than 20% of bioethanol is added to the gasoline, the engine may also require changes to the injection elements. The fuel injection time and frequency should be readjusted according to the oxygen content of the fuel, especially when using E85.

### **3. BIOETHANOL PRODUCTION IN THE WORLD AND TURKEY**

Petroleum-derived fuels are depleting rapidly. Reducing the consumption of these fuels and increasing the fuels produced from renewable sources and less harmful to the environment are the main targets of almost all country administrations. One of the alternatives developed to achieve these targets is bioethanol. Bioethanol is a renewable, sustainable fuel that can be obtained from agricultural products and agricultural production residues and is a clean fuel that can reduce polluting emissions.

The United States of America (USA) has the largest share in biofuel production worldwide. The majority of biofuels produced worldwide in 2017 are produced by the USA (47%) and Brazil (23%), with the remainder being produced by Germany, France, Spain (EU-13%) and China (3%) (Anonymous, 2019c). According to the 2018 data, the USA ranked first in ethanol production with 60.9 billion litres, while Brazil ranked second with 30 billion litres (Figure 1). Thanks to the agreements made between the USA and Brazil, 66% of the bioethanol produced in Brazil is sold to the USA (Koçtürk, 2011). The European Union (EU) and China are among the largest producers with ethanol production of more than 4 billion litres. In Turkey, significant improvements were observed in the production of biofuels from domestic vegetable sources over the last decade, it has entered the rapidly rising trend in the last few years.

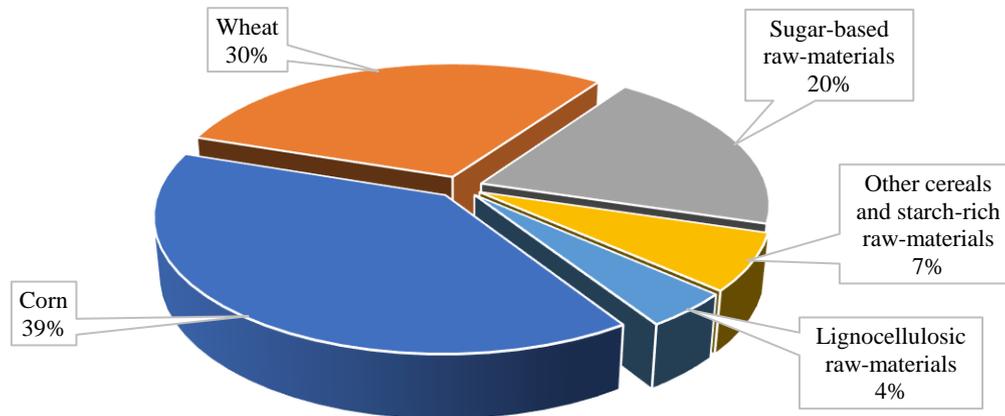


**Figure 5.** Ethanol production in the world (Anonymous, 2019d)

In the EU, the use of biofuels is being gradually increased, and in 2020, at least 10% of the fuel used in transportation is intended to be supplied from biofuels. In 2030, this ratio is planned to be increased to 25%. According to 2017 data, there are a total of 6.84 billion litres of bioethanol plants in the EU, including 2 billion litres in France, 1.18 billion litres in Germany and 0.98 billion litres in the United Kingdom (UK). In these facilities, 5.84 billion litres of bioethanol was produced. As can be seen in Figure 2, 39% of the raw materials used in bioethanol production are corn and 30% are wheat. 4% of the raw materials consist of raw materials containing lignocellulose (Anonymous, 2019e). Among the EU countries, France ranks first with 29% in terms of production capacity, while Germany ranks second with 17%.

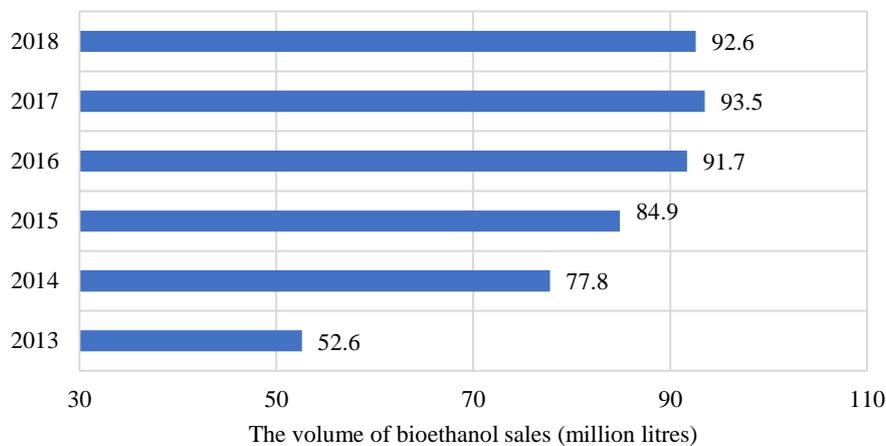
In terms of bioethanol consumption in EU countries, Sweden is the country that uses the most bioethanol. In Sweden, 85% of bioethanol can be used by blending with gasoline (E85). In fact, the Saab automobile manufacturer produces special vehicles that run on E85 fuel. Afterward, Ford's vehicles

were also made compatible with E85. After Sweden, the E85 was beginning to sold in the USA, Canada, Brazil, and the UK and used in compatible vehicles. The use of bioethanol in Turkey has been mandatory since 1st January 2013. According to the first communiqué issued by the Energy Market Regulatory Authority in Turkey, 2% by volume of bioethanol produced from domestic agricultural products is required to be blended with gasoline. On 1st January 2014, the required mixing ratio of bioethanol was updated to 3%.



**Figure 2.** The raw materials used in bioethanol production

According to the data of the Ministry of Agriculture and Forestry, Department of Tobacco and Alcohol, the amount of bioethanol produced in our country and the sales of bioethanol in our country are very close to each other. Although very low exports have been achieved in some periods, the needs are met through internal resources. According to these data, the amount of bioethanol production increased by 48% in 2014, when the compulsory bioethanol mixing ratio increased from 2% to 3%. As shown in Figure 3, the volume of bioethanol sales rose to 77.8 million litres in 2014, while it was 52.6 million litres in 2013. According to the data of 2017, 93.5 million litres of bioethanol were produced and sold in the three facilities which produce bioethanol in our country. According to the 2018 data, production and sales volumes decreased slightly. Approximately 92.6 million litres of bioethanol were produced in 2018. According to the records of the Ministry of Agriculture and Forestry, the number of producer enterprises increased to four in the last quarter of 2018 (Anonymous, 2019f). With the increase in the number of facilities, bioethanol production is expected to increase in 2019.



**Figure 3.** The volume of bioethanol sales in Turkey (Anonymous, 2019f)

When agricultural products are used as raw materials, the lowest bioethanol amounts to be produced are given in Table 2 (Koçtürk, 2011). Bioethanol fuels produced from different raw materials generally exhibit similar physical and chemical properties. Table 1 shows the physical and chemical properties of ethanol. The properties of bioethanol are very close and similar to the values given in this table.

**Table 2.** Bioethanol production potential of various raw materials (Koçtürk, 2011)

<b>Raw Materials</b>	<b>Bioethanol yield (litres/ton)</b>	<b>Raw Materials</b>	<b>Bioethanol yield (litres/ton)</b>
Sugar cane	70	Rice	430
Sugar beet	110	Barley	250
Sweet potato	125	Wheat	340
Potato	110	Sweet sorghum	60
Cassava	180	Pulp and other	280
Corn	360	cellulosic biomass	

Agricultural residues such as sawdust and crop residues (rice straw, wheat straw, corn stalk, sugar cane waste, etc.) are abundant, renewable and cost-effective raw materials for ethanol production. Bioethanol samples produced from agricultural residues are available in the literature. For example; bioethanol was produced experimentally from rice straw (Das et al. 2013), corn residue (Saha et al. 2013), sorghum pulp (Cao et al. 2012) and empty fruit bunches of palm trees (Jung et al. 2013). 550 grams of fermentable sugar was obtained from one kilogram of corn residue, from which bioethanol was produced. 270 grams (340 millilitres) of ethanol was obtained from one kilogram of corn residue (Saha et al. 2013). In another research project conducted in our country, the total potential of agricultural wastes and residues in our country was investigated. Table 4 shows the research results and the energy potential of these raw materials (Uzun, 2013). According to the information given in Table 4, if 221.2 litres of bioethanol can be produced from one ton of wheat stalk, 5.8 billion litres of bioethanol can be produced from total waste wheat stalks in our country. Considering the other agricultural wastes and residues, it is seen that there is a potential to obtain up to 10 billion litres of alternative fuel in our country.

**Table 3.** Theoretical bioethanol yield of various raw materials (Acar, 2019)

<b>Raw materials</b>	<b>Theoretical bioethanol yield (liter/ton-raw material)</b>
Tea Powder	91.7
Hazelnut husk	115.5
Rice straw	192.4
Rice paddy waste	156.8
Corn stalk	212.9
Cotton Stalk	139,4
Sugar beet leaves	81.9
Wheat stalk	221.2
Sunflower stalk	180.1
Olive residues	127.4

**Table 4.** The total potential of agricultural waste and residues in Turkey (Uzun, 2013)

<b>Agricultural waste</b>	<b>Annual potential (million tons)</b>
Wheat stalks	26.4
Barley stems	13.5
Corn stalks	4.2
Cotton stalks and bolls	2.9
Sunflower stalks	2.7
Sugar beet scraps (leaves)	2.3
Hazelnut shells	0.8
Oat stems	0.5
Rye stalks	0.4
Rice stalks	0.4
Fruit shells	0.3

#### 4. CONCLUSION AND DISCUSSION

Especially in the USA, Brazil, and Sweden, the use of flexible fuel vehicles is very high. Almost 90% of the vehicles produced in Brazil are produced as flexible fuel vehicles. In this country, bioethanol obtained from agricultural products is used in flexible fuel vehicles. In addition, Brazil exports a large portion of its bioethanol to the USA.

In 2018, nearly 3 billion litres of gasoline were consumed in Turkey. In our country, there is a potential to produce more than 10 billion litres of bioethanol by using agricultural products and agricultural wastes. Our country's realization of this potential as soon as possible will make a major contribution in reducing its dependence on foreign sources.

When the size of the agricultural areas in our country and the agricultural production potential are taken into consideration, the agriculture of the raw materials that can be produced bioethanol should be increased. Existing agricultural residues can produce more bioethanol than gasoline consumed in our country. The government can require the production of flexible fuel vehicles to diminish petroleum imports in Turkey. At the same time, the government may make legal arrangements for the production of flexible fuels such as E85 from domestic sources, work can be initiated to open E85 fuel stations, and may prepared new incentives for the construction of bioethanol production facilities.

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**O 100. INVESTIGATION OF THE SAMPLE CONCEPTS OF THE SMART CITY CONCEPT  
ON THE LITERATURE IN OUR WORLD AND COUNTRY**

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**ABSTRACT:** Together with the changing living conditions and emerging new technology branches, there is an increase in the environmental problems in the face of the increasing population, the needs of the urban residents, the urbanization rates and the consumption elements. From this point of view, it is necessary to make use of the innovations brought by technology to produce solutions to human needs and urban problems and to maximize the quality of life of the city. The smart city has emerged in order to ensure that all negative effects reflected in the city can be solved. With this concept, it is aimed that the concepts of transportation, environment, infrastructure and energy which are owned by the city are consumed at minimum level and provide the highest level of benefit. The increase in the population living in cities, the big developments in the field of technology, the change in the expectations and needs in the human race cause the change in the urban management and planning. A sustainable environmental planning can be made by benefiting from the advantages offered by smart technology to planning. The performance of a city does not depend on the physical potentials it has. It is concerned with the ability to serve the growing needs with information, communication, social and technological infrastructure. Therefore, cities and administrations with different geographic conditions are turning to smart urban practices. Taking advantage of the advantages offered by smart technologies to planning, it is thought that cities will be managed more effectively in ecological and social terms. a number of measures can not be taken together with the growing urban population in Turkey has emerged in issue and hence there was a need to use the best technology. With the advantages of smart city, smart city project across applications in the world, began to pay attention to smart city in Turkey and academic studies and work practices for this Uygul has soared. In this context, the basis of the study, the concept of Smart City in the world and the examples of our country are examined. What are the smart city applications? Where are the Smart City Samples in the world? What are the Smart City Applications in Turkey? investigation in this questions.

*Keywords: Sustainable Planning, Smart City, Smart City Ecological Growth, Intelligent City Growth, Technology and City*

## **O 101. EFFECTS ON SOIL QUALITY OF COMPOSTING TOGETHER OF SEWAGE SLUDGES WITH AGRICULTURAL WASTES**

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**ABSTRACT:** In parallel with the increase in population, the increasing need for food with urbanization and industrialization requires to new and renewable production techniques as well. In environmental problems, as well as the disposal of solid wastes is significant, it is important that their use in food production too. In this respect, it has been allowed to use in the agricultural land of the sludges by Ministry of Environment for soil improvement if it is provided necessary conditions for sewage sludges.

The aim of this study investigates the effects on the agricultural land by mixing with bulking materials of sewage sludge. It has been investigated how affected the soil structure and plant growth by composting in different ratios with cornstalk which is used as a bulking agent of sewage sludge which provided from the sugar industry. The investigation; it was carried out in 5 different parcels (2m \* 2m) and as 3 replications by mixing different amounts of agricultural waste and sewage sludge. It was studied parameter values such as pH, EC, COD, dry matter amount (KM), organic matter amount (OM), penetration resistance, infiltration rate at the investigation undergoing approximately one year. Further, spinach plant has been used in order to examine to plant development, in this study. Generally, it has been observed that there is an effective growth in parcels used sewage sludge and cornstalk when evaluated in terms of plant development. It was observed that sludge disposal or recycling is appropriate the composting together of the sewage sludge and bulking materials for this research.

*Keywords: Sewage sludge, cornstalk, disposal, recycling, soil quality and plant growth*

### **1. INTRODUCTION**

The increasing population and developing technology constitute many problems. One of these problems that threaten our world is wastewater treatment sludge. Of course, there are many ways of disposal of sewage sludges. The sludges which consist of wastewater treatment plant can be used after passing through various stages. For example; the sludges can be given in the soil, burned, discharged into the sea, or used as terrestrial filling material (Uzun and Bilgili, 2011). Nevertheless, many environmental scientists have recently adopted more environmentally friendly approaches.

The use of sewage sludge as compost material is widespread worldwide. The reason why the sludges are considered as compost material is the macro and micro nutrients contained. The use of the sludge due to the high water content can give rise to problems in agricultural areas. However, the use of the sludge due to the high water content can give rise to problems in agricultural areas. Therefore, if the sludge will use for compost, it should be used to bulking agents such as wood husks, corn stalks, maize cocoa, hazelnut husks, sawdust so as to improve the physical structure and properties of the sludge and increase the porosity (URL 1).

The composting process depends on many parameter values. These values can be varied according to the working type (Tchobanoglous, Burton and Stensel, 2003).

**Table 1.** Design Requirements for Aerobic Sludge Composting Process (Tchobanoglous, Burton and Stensel, 2003)

Item	Comment
Type of sludge	Both untreated sludge and digested biosolids can be composted successfully. Untreated sludge has a greater potential for odors, particularly for windrow systems. Untreated sludge has more energy available, will degrade more readily, and has higher oxygen demand
Amendments and bulking agents	Amendment and bulking agent characteristics (i.e., moisture content, particle size, and available carbon) affect the process and quality of product. Bulking agents should be readily available (Özdemir, Dede, and Dede, 2014; Uçaroğlu, 2014; Uçaroğlu and Alkan, 2016).
Carbon-nitrogen ratio	The initial C/N ratio should be in the range of 20:1 to 35:1 by weight. At lower ratios ammonia is given off. Carbon should be checked to ensure it is readily biodegradable (Öztürk, 2014; URL2.)
Volatile solids	The volatile solids of the composting mix should be greater than 30 percent of the total solids content. Dewatered sludge will usually require an amendment or bulking agent to adjust the solids content
Moisture content	Moisture content of the composting mixture should be not greater than 60 percent for static pile and windrow composting and not greater than 65 percent for invessel composting (Gajalakshmi and Abbasi, 2008; Yıldız, Ölmez and Kiriş, 2009).
pH control	pH of the composting mixture should generally be in the range of 6 to 9. To achieve optimum aerobic decomposition, pH should remain in the 7 to 7.5 range (Vanlalmawii and Awasthi, 2016).
Temperature	For best results, temperature should be maintained between 50 and 55°C for the first few days and between 55 and 60°C for the remainder of the active composting period. If the temperature is allowed to increase beyond 65°C for a significant period of time, biological activity will be reduced (Öztürk, Çallı, Arıkan and Altınbaş, 2016).
Control of pathogens	If properly conducted, it is possible to kill all pathogens, weeds, and seeds during the composting process. To achieve this level of control, the temperature must be maintained between 60 and 70°C for 24 h. For temperatures and times of exposure required for the destruction of common pathogens.
Mixing and turning	To prevent drying, caking, and air channeling, material in the process of being composted should be mixed or turned on a regular schedule or as required. Frequency of mixing or turning will depend on the type of composting operation
Heavy metals and trace organics	Heavy metals and trace organics in the sludge and finished compost should be monitored to ensure that the concentrations do not exceed the applicable regulations for end use the product

In order to obtain a good compost product, the parameter values in Table 1 must be provided. The table it can be inferred from this that the standardization of a composting process is not a simple task, especially if optimum results are obtained. For this reason, most of the developed commercial composting processes have been highly mechanized and executed in specially designed plants ((Eriçyel, 2008).

## **2. MATERIAL AND METHOD**

### **2.1. Materials**

The present study area is get involved in Konya province in Turkey. The study area consists of at "14m \* 8m" size and 15 parcels. The parcels were randomly placed and designed to have a clearance of 0.5 m between each parcel. Sewage sludge (SS), which is one of the basic materials in the study, was supplied from Cumra Sugar Factory in Konya. It was used as bulking agent the corn straw (CS) residues, harvesting by local farmers in the Büyükaşlama neighbourhood. The corn straw (CS) residues were brought to the dimensions of 5-10 cm.

## 2.2. Composting process

Samples was prepared 5 different mixtures which including 100 kg of sewage sludge (SS) and 50 kg of corn straw (CS) residue. It was planned to have 3 replicates for each mixture. Each parcel forming 1 set was constituted area of 15 sets. In general, the study plan area to be performed is given in Table 2. Figure 1 shows the first preparation time of the current trial site.

**Table 2.** The study plan area

1 (0-0)	2 (SS- CS)	3 (0-CS)	4 (SS-CS2)	5 (SS-0)
6 (SS-CS)	7 (SS-CS2)	8 (SS-0)	9 (0-0)	10 (0-CS)
11 (0-CS)	12 (0-0)	13 (SS-CS2)	14 (SS-0)	15 (SS-CS)

- Sewage sludge (SS) + Corn straw (CS) [1×1] [(SS- CS) - (parcels containing 100 kg from sewage sludges and 50 kg corn straw residues)] / (3 replications)
- Sewage sludge (SS) + Corn straw (CS2) [1×2] [(SS- CS2) (parcels containing 100 kg sewage sludges and 100 kg corn straw residues)] / (3 replications)
- Sewage sludge (SS) + Corn straw (CS) [1×0] [(AÇ-0) (parcels containing 100 kg sewage sludges)] / (3 replications)
- Sewage sludge (SS) + Corn straw (CS) [0×1] [(0-CS) (parcels containing 50 kg from corn straw residues)] / (3 replications)
- Sewage sludge (SS) + Corn straw (CS) [0×0] [(0-0) (control parcels)] / (3 replications)

The compost application was accomplished by applying directly on area. The study was gone on about 1 year. experiments were started 3 months later after the compost material was placed on the area. Aeration of the sludge-corn stalk-soil mixture was supplied with manual spadework. This procedure was repeated least 3 times. The initial parameter values of the study area and the materials used are given in Table 3 and Table 4.

**Table 3.** Initial pH and EC values of the study area and materials used

Samples	pH	EC(μS/cm)
Corn straw residues	8,13	265
Soil sample	8,31	124
Sewage sludge	8,72	169

**Table 4.** Initial elemental values for study area and used materials

Measured Ion values	The Initial Samples		
	The raw of soil (mg/kg)	The raw of corn straw (mg/kg)	The raw of sewage sludge (mg/kg)
<b>B</b>	25,74	32,74	39,3
<b>Ca</b>	132853	10974	174391
<b>Cd</b>	0,073	0	0,074
<b>Co</b>	0	0	0
<b>Cr</b>	18,44	0	26,49
<b>Cu</b>	11,13	4,2	16,77
<b>Fe</b>	9541	601,16	14849
<b>K</b>	10916	18554	15140
<b>Mg</b>	4002	2809	6258
<b>Mn</b>	268	82,92	344
<b>Mo</b>	7,28	0,38	3,7
<b>Na</b>	6937,21	17645	11407

<b>Ni</b>	32,73	3,054	43,41
<b>P</b>	634,61	181,2	975
<b>Pb</b>	77,21	24,44	77,15
<b>S</b>	351,82	1072	516,38
<b>Zn</b>	92,37	57,46	103,43

In order to evaluate the effect of compost material on the field, plant cultivation was also performed on the field. According to also the results of plant cultivation, compost mixtures were evaluated. Experiments were carried out for 3 months.

In order to determine the studying yield applied to the field, several parameters were measured. It was analyzed the parameters such pH value, EC (conductivity), moisture content, organic matter content, dry matter content, C / N ratio, COD, infiltration rate, penetration resistance and some ions.



**Figure 1.** Preparation time of the workspace / images from in march month (3= 0-CS, 4= SS-CS2, 5= SS-0, 7= SS-CS2, 8=SS-0, 9=0-0, 10=0-CS, 13= SS-CS2, 14= SS-0, 15= SS-CS)

### 2.3. Analytical Methods

100 ml of distilled water was added to 1 g of soil sample. The samples were mixed 5-6 times with a magnetic stirrer at 10 minute intervals. The pH and EC values of the prepared samples were measured using a pH meter and conductivity meter (Zengin,2013; Rhoades, 1982; Mc Lean, 1982). Also, it was [performed measurement](#) for pH and moisture on the study area. The amount of dry matter and moisture content were calculated upon drying at  $105 \pm 5$  ° C for 5 to 6 hours (Bayraklı, 1987; URL3; Uzuner, 2007; American Public Health Association [APHA], American Water Works Association [AWWA], and Water Pollution Control Federation [WPCF], 1998). The OM contents and the OC contents of all of the samples were determined as follows:  $OM (\%) = 100 - \text{ash} (\%)$  and  $OC (\%) = OM (\%) / 1.8$  (Barrington et al., 2002; (Haug, 1993)). COD measurements of samples were calculated according to standard methods (Standard Method-Method No 5220-COD).The  $NO_3$  analyses were performed with nitrate kit test method. Spectrophotometer reading was performed for each of the same group samples. Ion analyzes were calculated by using ICP-OES reading and sample dissolving device in Faculty of Agriculture Laboratory in Selcuk University. Soil samples coming to the laboratory are analyzed with ICP-OES after dissolved in acid. It was analyzed ions such as B, Ca, Cd, Co, Cr, Cu, Fe, K, Mg, Mn, Mo, Na, Ni, P, Pb, S, and Zn. So as to measure the infiltration rate of the soil was designed the device. The part of the device that will enter the soil is made of iron and the part made to measure water velocity is made of fiber pipe. The height of each of the 4 devices were 20 cm, the outer diameter were 60 mm and the inner diameter were 55 mm. The penetration resistance of compost samples was measured by using volumetric measurement method. For the porosity value, it was used the volumetric measurement method used for penetration measurements. In addition, it was benefited from (Zengin, 2013) for calculation.

### 2.4. Statistical Analysis

Anova and LSD programs were used to evaluate the statistical significance of the data obtained.

### 3. RESULTS and DISCUSSION

pH is one of the important parameter values in composting process. Figure 2 (a,b) shows the values obtained from each plot study for July, August-September and October months for pH measurements both at laboratory scale and on study field. pH values vary between 8 and 9.2 in laboratory measurements. It is seen that the pH values of the parcels increase compared to months. The highest increase is observed in parcels 2 (0-CS), 12 (0-0) and 13 (SS-CS2). The pH value is between 7-8 in the study field. In general, the desired pH in the composting process is in the range of 6-9 (Vanlalmawii and Awasthi, 2016). It can be said that the values obtained from both measurements are in the range value range. In addition, it can be said due to microbial activity that the increase and decrease in measurements.

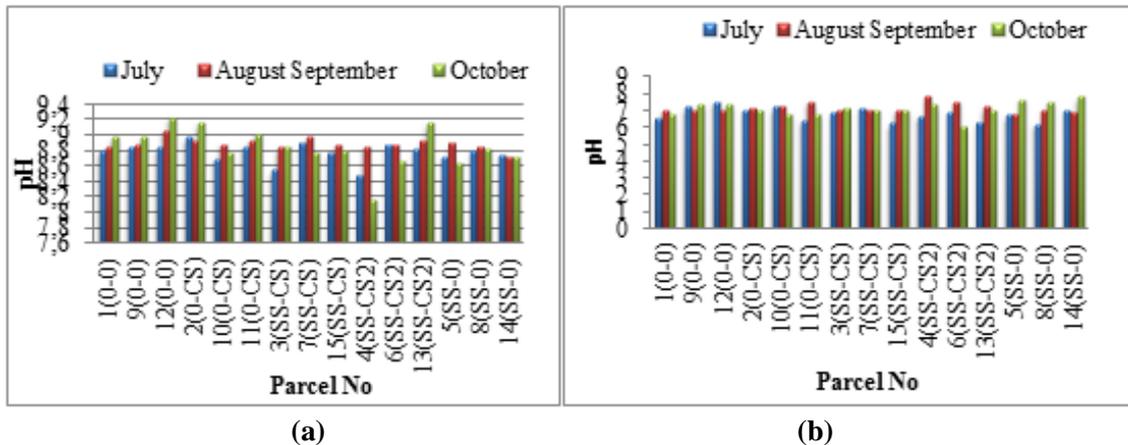


Figure 2. pH measurements both at laboratory scale and on study field

EC is an important parameter value for plant growth. It is also an indicator of salinity. In Figure 3, a decrease was observed in EC values in August-September, while an increase occurred in each plot study in October. In parcels with 1: 2 mixtures, an increase was observed compared to other parcels. It can be said that the study field and the parcel samples are in the range of 2-4 dS / m and enter the salt free class (URL2; Zengin, 2013).

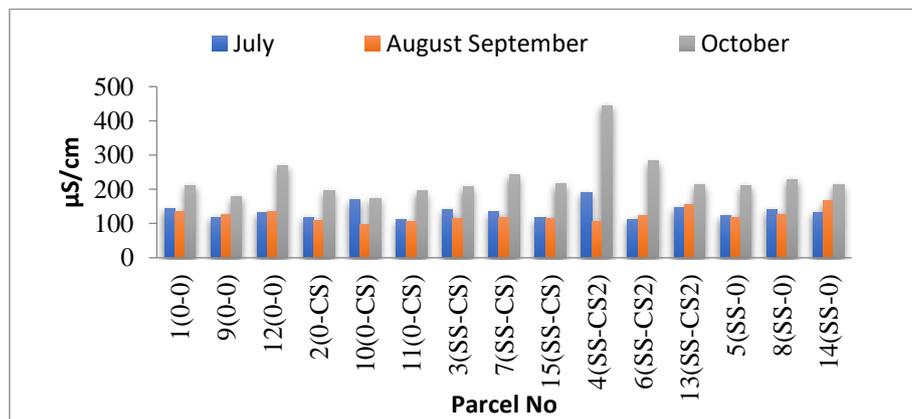


Figure 3. EC measurements

Moisture content (%); moisture content affects microbial activity. The presence of microbial activity is associated with the amount of moisture content. Therefore, moisture content is very important in the composting process. The moisture percentages of the parcels by months are given in Figure 4(a, b) both at laboratory scale and on study field respectively. It is seen that 1, 9, 12 (0-0) control parcels have less moisture holding capacity compared to sewage sludge and corn straw applied parcels.

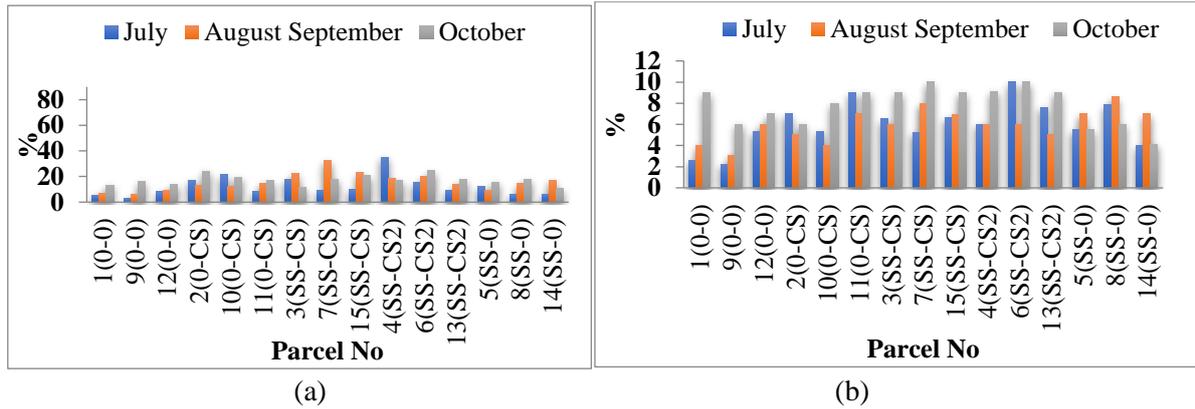


Figure 4. The moisture percentages of the parcel samples

The COD is an indicator of the chemical oxygen demand. This parameter value indicates the presence of organic matter. According to Strandart methods, the COD value calculated is given in Figure 5. The decrease in COD value indicates that chemical events occur in the environment. The Figure 5 shows that COD decreases over time. As a result, it is concluded that microbial activity in the parcels applied to the sewage sludge and corn s is more effective than the others.

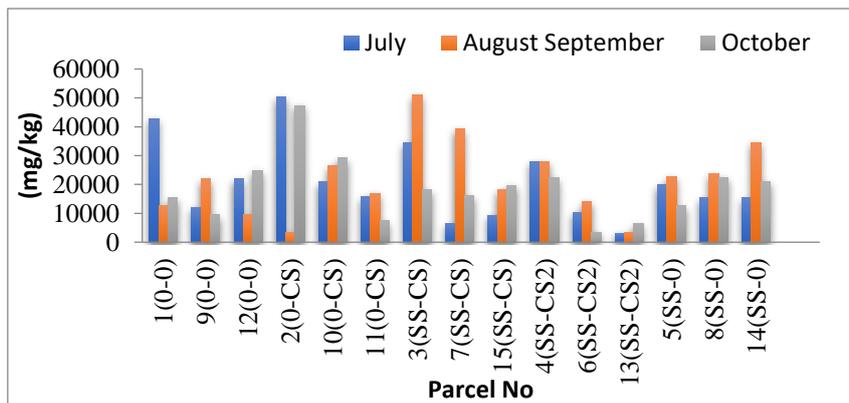


Figure 5. COD values of parcels

The C/N ratio is an important parameter value to be considered in the composting process. If this ratio is higher or lower than the recommended value, it means that no good compost material can be obtained. The C/N ratio should be between %25-50. The recommended range is %25-30 (Öztürk, 2014). Figure 6 shows the C/N ratios of the parcels. Accordingly, it is seen that there is an increase in the parcels where only corn straw is applied on a monthly basis. The decrease in other parcels is thought to be caused by microbial activity.

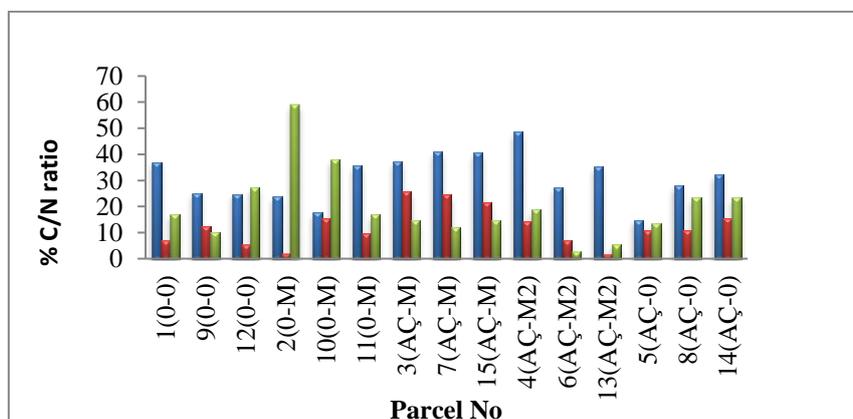
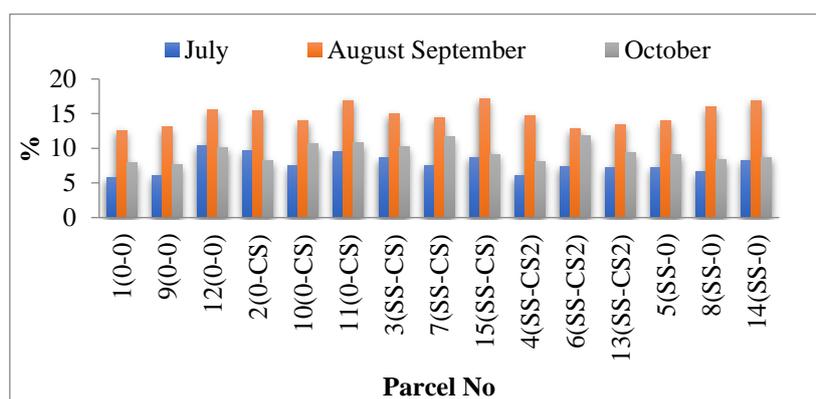


Figure 6. % C/N ratio of parcels

The amount of organic matter, the low value of this parameter in the soil disrupt the soil structure. If this parameter value is not sufficient for both soil and plant, it means that macro nutrients required for plant and soil are low. As an indicator of microbial activity, the amount of organic matter is expected to be primarily high and then low. Figure 7 shows the variation of the amount of organic matter over months. Accordingly, a decrease is observed in all parcels after the increase in the initial months. The highest value is observed in the parcels 0-CS (2, 10, 11) and a less increase is observed in the parcels 0-0 (1, 9, 12). On the other hand, it is seen that there is a higher increase in the parcels treated with sewage sludge and corn straw. This can be originated from bulking agent material and sewage sludge yielding organic matter to the soil.



**Figure 7.** The organic matter quantity on the parcel samples

The penetration resistance, this parameter value varies depending on the moisture content of the soil. Soil compaction occurs in soils with low humidity (Negiş et. al., 2016). This soil compaction provides a negative effect on plant growth by preventing root growth in the plant (Turgut and Öztaş, 2008). The volumetric measurement results of the penetration resistance are given in Figure 8. According to this; high penetration resistance was not obtained at the end of the study. The reason for this is thought to be due to the increase in soil moisture content due to winter and autumn conditions. Although it cannot say clearly due to weather events, the use of maize alone is predicted to cause soil compaction. In addition, at least one year is required for this composting on the area.

Porosity is related to soil structure, texture, organic matter content and bulk weight. The porosity value, which represents the ratio of the void volume to the whole volume in the ground, is always expected to be less than 1 (100%) (Uzuner, 2007). The porosity value of the medium constitution of soils is in the range of 50% (Demiralay, 1993). In the study, the porosity rates of parcels SS-CS (3-7-15) and SS-CS2 (4-6-13) are higher. This high value is expressed as an indication of water and gas storage in the soil. In this study, it can be said that it has an effective result when compared to control parcels. Along with porosity value alone isn't sufficient, it does not give precise information about soil structure too.

The rate of infiltration is related to the rate uptake water of soil. Environmental conditions such as soil structure and texture affect the rate of water uptake, ie infiltration rate. For the infiltration rate, this study was carried out on the velocities of water intake velocities at depths of 5, 7.5, 10, 15 and 20 cm. When all parcels were irrigated for moisture balance during the same period, it was observed that water accumulation occurred on the upper surface of parcels 0-0 (2, 9, 12). In the parcels 0-CS (2, 10, 11), it is seen that less water intake rate occurs in more time than the others. It can be said that this situation causes less water permeability due to the compression of the soil structure of the parcels 0-0.

Ion analysis, macro and micro nutrients are important for both soil and plant. When some parcels are compared with control parcels, it is seen that there is a decrease. There are many reasons for these diminish. However, the most obvious reason is that it is not a farmland but a residential garden. It was later learned that the garden area was used as stove residue place and waste collection place in the area where the application was made in previous times. This suggests that these values also vary due to the study area.

#### **4. CONCLUSION**

The widespread use of these practices in arid climates such as Konya Plain is very important both in terms of soil quality and other nutrients required for soil. In this study, the effects of corn stalk and sewage sludge on soil quality were investigated. As a result of the study, it can be said that the use of mixture of sludge and corn straw in different ratios gives effective results on soil quality. It is believed that the treatment sludge (SS) and corn straw (CS) samples are more effective than the control samples. Apart from physical and chemical analyzes, plant material was cultivated in the study parcels. It was used spinach as plant material. According to the results of plant cultivation, the most effective application can be said to be parcels applied the sludge and corn straw. Also, in terms of variation and LSD analysis, it can be said that give effective results.in SS-CS2, SS-CS and SS-0 parcels

With this research, it is concluded that the composting of sludge and bulking materials is suitable for sludge disposal. In order to be able to evaluate the results of the study and to reveal more detailed results about the yield, application studies should be carried out on a broader scale in agricultural land. In addition, this study was started in April. It is thought that this period can be kept in winter to obtain more efficient results for compost. Further research on the industrial sludge used in the study should be conducted and composting with different volume increasing materials should be carried out.

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**O 102. THE EFFECT OF THE SOUTHERN OSCILLATION ON YEŞİLIRMAK BASIN**

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**ABSTRACT:** Recent studies have shown that climate changes have important effects on the components of the hydrological cycle. Large-scale oscillations as a result of the atmosphere movement are climate anomalies with periodic characteristics. In this sense, understanding the mechanisms controlling the variability of the Southern Oscillation will help us to understand the systems that control climate change. For this reason, in this study, the effect of Southern Oscillation was investigated on the region by comparing the homogeneity and trend analysis of the rainfall data of the meteorological stations 17085, 17086, 17084, 17030 of the Yeşilirmak basin in the Black Sea region with the extreme phases of the Oceanic Nino Index table. In the statistical analysis of rainfall data were used for homogeneity analysis; Buishand, Pettitt and Run tests and for nonparametric trend analysis; Mann-Kendall test, Modified Mann-Kendall test, Spearman Rho test and Sen-T test. The slope direction of the data was determined by using a trend slope method suggested by Sen, and the beginning years of the statistically meaningful changes were determined by using the Mann-Kendall rank correlation test. As a result of the study, while the fracture years obtained from the Pettitt Test and the years that high index values were parallel, the method addressed as iterated Mann-Kendall cannot detect a clear intersection across the basin.

*Keywords: Black Sea, Southern Oscillation, Trend Analysis, Precipitation*

**O 103. THE EFFECT OF SOUTHERN OSCILLATION ON ANNUAL PRECIPITATION  
TRENDS IN CENTRAL ANATOLIA**

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**ABSTRACT:** The changes occurring in the world's climate year by year are seen randomly; however, it has been proved that one of the many reasons of these changes was ocean-atmosphere interaction repeating in every few years in the Tropical Pacific during the studies carried on the historical data. Even though these severe ocean-atmosphere events take place in the Tropical Pacific, their influences can be seen many kilometers away from the Pacific. In this study, the influences of Southern Oscillation which is an ocean-atmosphere event have been searched on the annual total precipitation trends of Central Anatolia Region. The stations in the Central Anatolia Region used in this study have at least 30 years data length; the stations are Eskişehir (17126), Ankara (17130), Aksaray (17193), Çankırı (17080), Kayseri (17196), Kırıkkale (17135), Kırşehir (17160), Konya (17244), Karaman (17246), Niğde (17250), Akşehir (17239), Nevşehir (17193), Sivas (17090) and Yozgat (17140). Out of homogeneity methods, Pettitt, Buishand and Run have been used in the analyses. Mann-Kendall and Spearman Rho trend methods were used to determine the trends of the precipitation data of the aforementioned stations. Moreover, the years of the beginning of the trends have been found by using Mann-Kendall Rank Statistic tests for the stations. To detect the relation between the trend values and the extreme phases of Southern Oscillation, Mann Kendall trend analysis method was applied again by reducing one year. When the outcomes of the study obtained for %95 confidence interval are examined, the data were observed as homogeneous. Furthermore, the precipitation tendencies in the northern and eastern parts of the region increased and the precipitation tendencies in the western and southern parts decreased. As a result of the study, the effects of the Southern Oscillation on the precipitation data of the Central Anatolia were obtained.

*Keywords: El Nino Southern Oscillation, Homogeneity, Central Anatolia Region, Trend, Precipitation*

**O 104. THE EFFECT OF DIFFERENT SEISMIC ISOLATOR TYPES AND FLOOR NUMBER TO EARTHQUAKE BEHAVIOR ON MULTI-STOREY REINFORCED CONCRETE STRUCTURES**

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**ABSTRACT:** Earthquakes are uncontrollable natural disasters that cannot be predicted in time. Turkey, located in a region of high seismicity. Seismic isolation is an earthquake resistant structure design approach based on the principle of increasing the resistance of the structure against earthquakes or reducing the seismic forces transferred from the ground to the structure. In this study, an exemplary health center RC building system, carriage elements are dimensioned according to TS-500 (Turkey Concrete Structures Design and Construction Rules) and TBDY-2018 (Turkey Building Earthquake Regulation). 3 models were created for the same building according to three different types of support (with friction pendulum isolation system, lead core rubber bearing isolation system, fixed base dual system). The most important aim of this study is to find out which of the seismic isolator type is more effective than fixed base dual systems. These models were analyzed nonlinear (FNA) in time domain in SAP2000 program. When compared with seismic isolator bearing systems and fixed base dual systems; the internal forces, the relative drift ratio(%) of the floor and the acceleration of the floor were decreased, but the natural vibration period was increased. The system with friction pendulum isolator has better earthquake behavior than the system with lead core rubber.

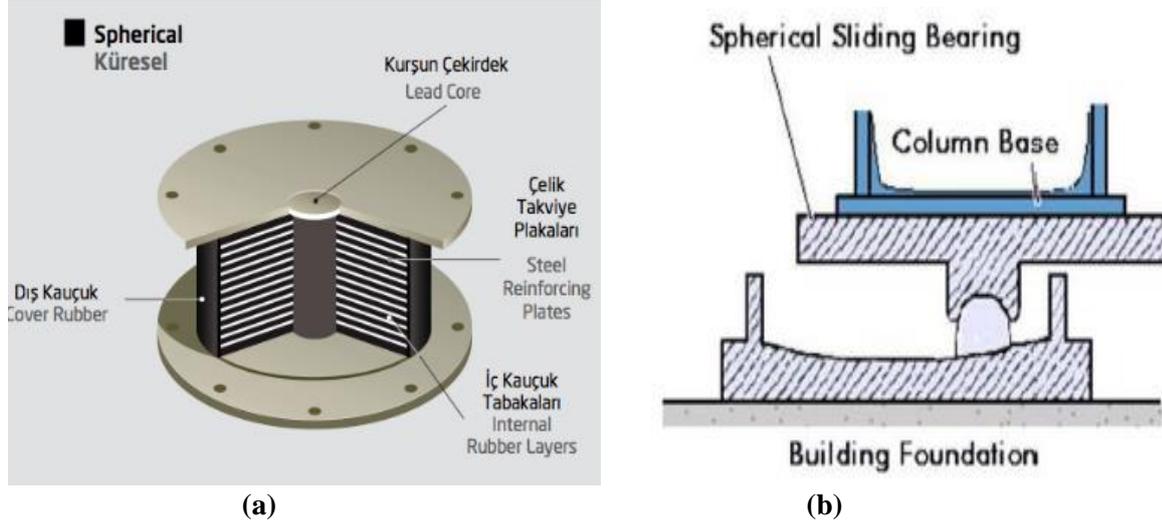
*Keywords: Core, Isolator, Seismic, Pendulum, Rubber*

## **1.INTRODUCTION**

The main aim of the present study is to investigate the effects of one of the structural control systems; mainly base isolation systems that open a new era in the earthquake resistant structure designs on bearing systems responses on of the reinforced concrete structures. Seismic isolation is earthquake resistant structure design approach based on the principle of reducing the seismic forces transferred from the ground to the structure (Güner,2012).The aim of seismic isolation systems is to ensure that all the displacements are based on the foundations of superstructures and in the presence of damping element, to absorb and damp the earthquake energy. The Ministry of Health has requested the use of the isolator system with Circular 2013/3 hospital building (A Minimum Standards Applied to the Project and Construction Works of Earthquake Isolator Structures).

In addition ,Rules and design criteria of the new seismic isolation buildings in static projects are given in the regulation (TBDY-2018) that came into force for the first time on 01.01.2019. The earthquake behavior of the structure will be examined according to two different types of seismic isolators (Figure 1.) that can be used in the isolation buildings given in Section-14 in the new earthquake regulation (TBDY-2018). Some calculations, graphics and tables used in the modeling of the structure and in the design of the seismic isolators are not included in the TBDY-2018 (Turkish Earthquake Code). Therefore, the ASCE-7-10 (Minimum Design Load for Buildings and Other Constructions) regulation, which is an updated version of the UBC-97 regulation, will be applied when necessary. Seismic isolation is more suitable for short-period structures. Less than 10 floors of reinforced concrete structures, less than 5 floors of steel structures, low rigidity structures are suitable for seismic isolation. With the increase in the height / width ratio of the structure, the increase of the tipping moment increases the possibility of the structure to overturn or collapse. This complicates the use of isolation in very high-rise buildings. Compared to the two different isolators used, the advantages of lead core isolators are wide bed capacity, lead core and elastomeric bearings can be designed as desired. Other advantages are its ability to flow under stresses such as 10Mpa due to shear stress and to be resistant to metal fatigue in

repetitive loads. Although the lead core rubber bearing is likely to be damaged during strong earthquakes, the fact that it performs well in some severe earthquakes weakens this possibility. Friction pendulum isolator, due to its design feature, isolator does not break even in case of an earthquake which is larger than the earthquake intensity which is expected to affect the structure. In case of breaking of the rubber bearings during horizontal displacement, there is a need for safety mechanisms called "back up" which will carry the upper structure for this reason (Karakurt,2014). Also , It provides structural optimization due to its two-way capability.



**Figure 1.** Lead Core Rubber Bearing(a) ; Friction Pendulum Isolation (b) (FEMA-356)

**2. ANALYTICAL STUDY**

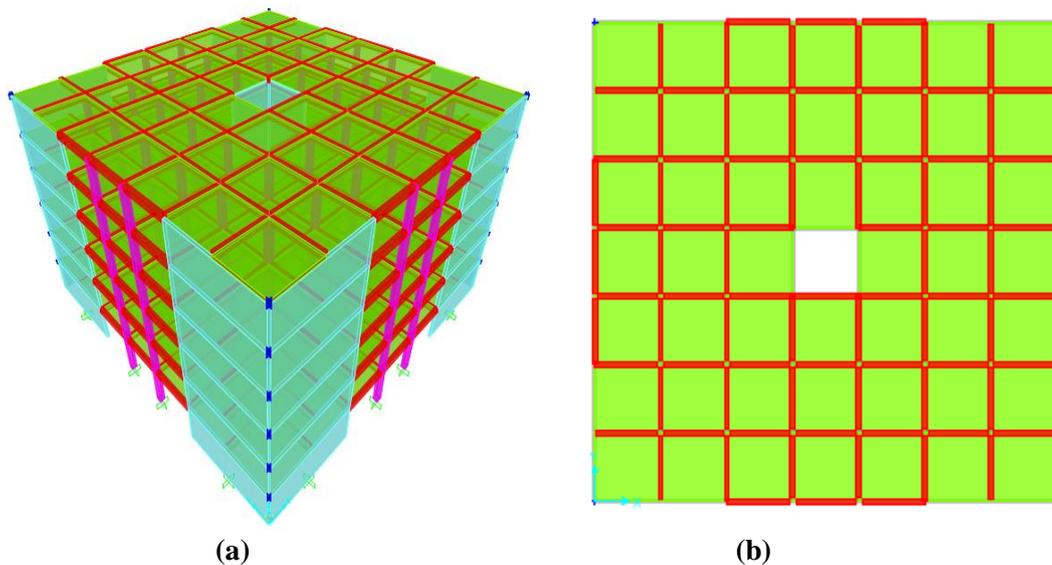
In this study, 6-storey shear wall-frame hospital building was designed and the analysis was performed with SAP2000 computer program. The carrier elements are dimensioned based on the dimensions of TBDY-2019, TS 498-500 regulations and standards. A private health center In Istanbul-Kadikoy with its coordinates was examined within the scope of the study. Turkey earthquake maps interactive web applications (AFAD) earthquake report in (DD-1) for selected local point for the project was established. The earthquake response-spectrum curve at the (DD-1) level was established with the earthquake acceleration values that vary depending on the time given in this report. Kocaeli Earthquake occurring in Istanbul region (1999) earthquake acceleration records were used. These records, and the previously generated response spectrum curve (DD-1) were included and simulated in the SeismoMatch program. These acceleration-time recordings were effected simultaneously in both north-south and east-west directions. Buildings are designed as 28x28 m plan dimensions, 7 spans in X direction and 7 spans in Y direction.

**Table 1.** Modal Parameters of 6-Storey Building According to (TBDY-2018)

Propertys	Symbol	Unit	6-Storey Building
Dead Load (Uniform Area)	G	KN/m <sup>2</sup>	6
Live Load (Uniform Area)	Q	KN/m <sup>2</sup>	5
Live Load Participation Coefficient	n	-	0.3
Building Importance Coefficient	I	-	1,5
Bulding User Class (Isolation Design)	BKS	-	1
Building Height Class	BYS	-	5

Earthquake Design Class	DTS	-	1a
Building Weight (Dead+0.3Live)	W	KN	35424
Map Spektral Acceleration (DD-2)	$S_{DS}$	G	0,79
Design Spektral Acceleration (DD-2)	$S_{DI}$	G	0,216
Map Spektral Acceleration (DD-1)	$S_{DS}$	G	1,374
Design Spektral Acceleration (DD-1)	$S_{DI}$	G	0,383
Isolator Target Active Vibration	$T_M$	sn	1
Maximum Load On Isolator (1,4G+1,6Q)	$P_3$	KN	4394,6

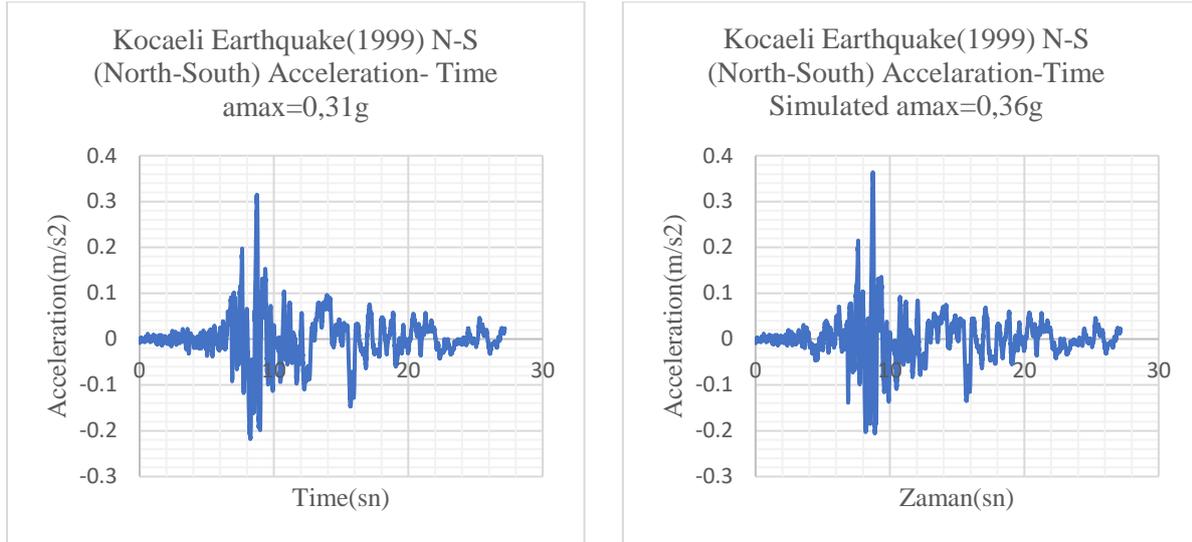
While modeling, the beams are 30x45 cm, the columns are 40x40 cm and the shear-wall sections are modeled as 800x20 cm. The building is designed as a soil class (ZA) in the high seismicity region degree earthquake zone. The concrete compressive strength used in the whole structure was considered as C30. The thickness of the slab is considered as 15 cm (Figure 2). No reduction in seismic forces has been made in order to see the effects of seismic isolators on the structure earthquake performance thus,  $R = 7$  was taken for pre-design of (DD-2) and  $R = 1$  for (DD-1) isolator design. Columns and beams, shear walls are assigned as rod elements. The weight and mass of the infinite rigid beam are neglected.



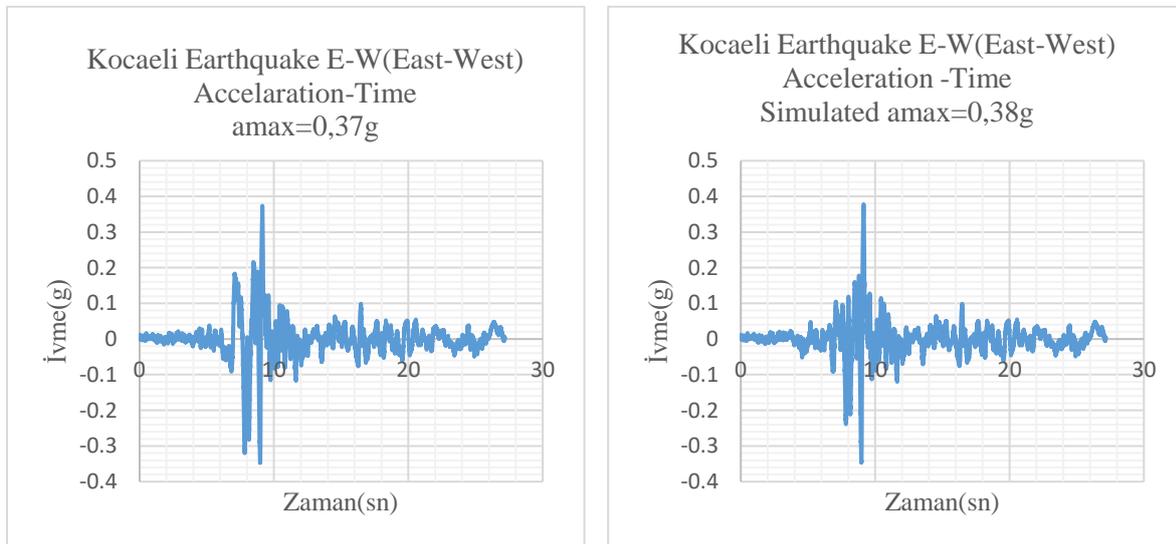
**Figure 2.** Three-dimensional model in three-dimensional(a) and x-y plane(b) view (6-Storey)

### 2.1. Nonlinear Analysis in Time Definition

The earthquake acceleration records that we will use consist of the data of East-West and North-South direction recorded in Düzce Meteorology Station of Kocaeli Earthquake (1999). Turkish earthquake regulation (TBDY-2018), the seismic hazard in a field is defined by the spectrum of design acceleration. It is allowed to use acceleration records compatible with the design acceleration spectrum in linear elastic or nonlinear non-elastic earthquakes calculations in the time domain of structures. Actual earthquake recordings have been chosen to meet the conditions specified in the regulations and simulated to match the design acceleration spectrum. SeismoMatch program was used for this simulation (Figure 3), (Figure 4). Using these records, non-linear analysis was performed in the time domain in the Sap2000 program.



**Figure 3.** Kocaeli(1999) earthquake N-S, N-S (Simulated) directional acceleration-time graphs



**Figure 4.** Kocaeli(1999) earthquake E-W, E-W (Simulated) directional acceleration-time graphs

**2.2. Mechanical Parameters of Seismic Isolators**

Mechanical parameters have been determined by using TBDY-2019 and ASCE-7-10 regulations. Isolator parameters obtained according to the regulations are given in Table 2.1 and Table 2.2 LINK elements have been defined under each column and shear-wall in the curtain-frame system. It is assumed that the seismic-isolation structure shows linear behavior under the lateral and vertical forces . Since the rigidity of the structure is more rigid compared to the isolation system despite the necessity of nonlinear analysis, the structure is solved by linear elastic analyzes to simplify the solution and realistic data is obtained. (Dođru, 2014).

**Table 2.1.** Detection of lead core rubber seismic isolator mechanic parameters (6KHKÇKI)

Parameter	Symbol	Unit	6-Storey Building
Elastic stiffness	$K_1$	KN/m	807000,35
Secondary Stiffness / Elastic Stiffness	$K_2/K_1$	-	0,01
Effective Yield Strength (Characteristic)	$F_y$	KN	395,51

Effective Stiffness	$K_{eff}$	KN/m	9402,81
Total of Effective Stiffness	$\sum K_{eff}$	KN/m	469343,31
Effective Damping of The Systems	$\xi$	-	0,1
Vertical Stiffness	$K_v$	KN/m	3461743,25

**Table 2.2.** Detection of friction pendulum seismic isolator mechanic parameters(6KMHSSI)

Parameter	Symbol	Unit	6-Storey Building
Elastic stiffness	$K_1$	KN/m	66255,1
Secondary Stiffness / Elastic Stiffness	$K_2/K_1$	-	0,10
Effective Yield Strength (Characteristic)	$F_y$	KN	345,70
Effective Stiffness	$K_{eff}$	KN/m	7860,16
Total of Effective Stiffness	$\sum K_{eff}$	KN/m	400868,27
Effective Damping of The Systems	$\xi$	-	0,1
Vertical Stiffness	$K_v$	KN/m	11258027

### 3.RESEARCH FINDINGS

#### 3.1. Comparison of Natural Vibration Periods of the Buildings

The first, second and third mode natural vibration periods obtained in the analysis of fixed based and systems modeled with seismic isolators are given in Table 3.1. When the structure is designed as a seismic isolator, the natural period of vibration increases by 3-4 times compared to the classical (fixed base dual system) method.

**Table 3.** Natural Vibration Periyod of 6-Storey building with Different Types of Isolations and Fixed Base System

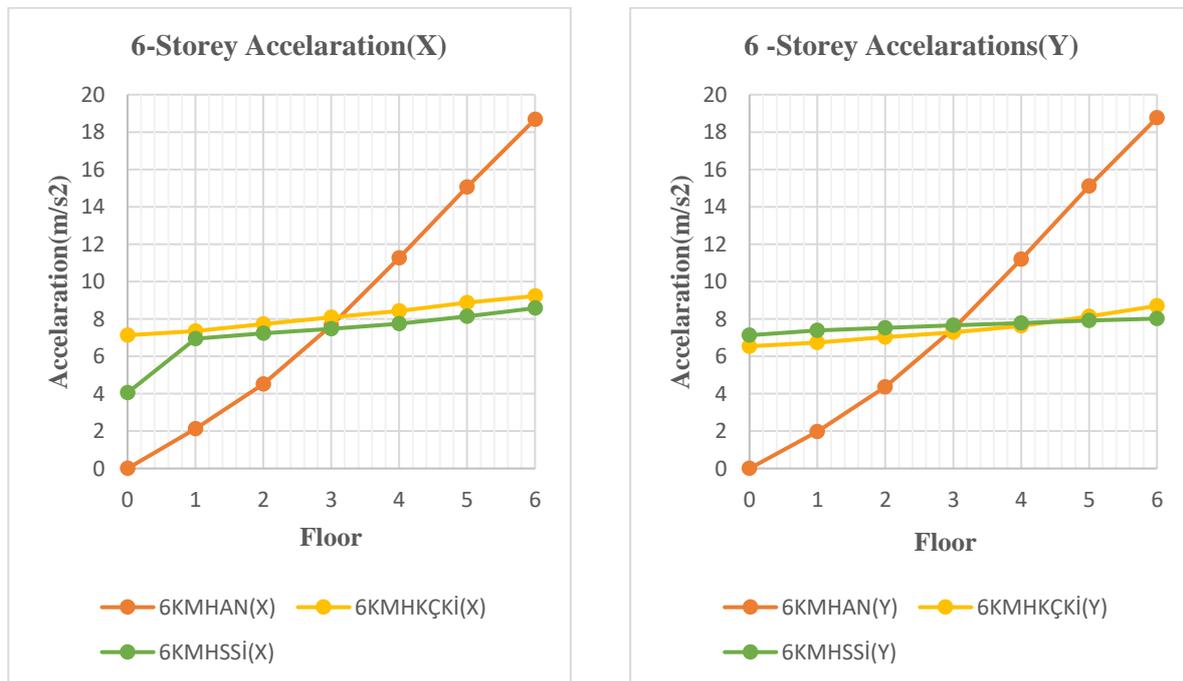
Storey	Mod	Fixed Base Dual System Period(sn)	Lead Core Rubber Bearing Period(sn)	Friction Pendulum İsolation System Period(sn)
6	1	0,32	1,21	1,33
6	2	0,32	1,2	1,33
6	3	0,18	1	1,13

#### 3.2. Comparison of Drift Ratio and Acceleration Values of the Models

After the necessary information and records were entered in the Sap2000 program, dynamic analysis was performed in the time domain according to the EQ (Kocaeli) -1999 earthquake record. The structure gives more realistic results when nonlinear modal analysis is performed in the time domain. The results of the points in the same section and direction were compared with the reference point. The results were compared according to the x-z plane and the reference point determined in the y = 8 m section.



**Figure 5.** Comparison of relative drift ratio(%) of 6-storey hospital buildings in two different directions (X, Y)



**Figure 6.** Comparison of the acceleration values of the 6-storey hospital buildings in two different directions (X, Y)

#### 4. CONCLUSION

- As seen in (Table 3), the natural vibration period of building with friction pendulum isolator (6KMHSSI) is bigger than the building with lead core rubber isolator (6KMHÇKI) and building with fixed base dual. It is seen that natural vibration period values in buildings applied seismic isolator have reached to very big numbers (3.5 times) and become safer against earthquake forces.

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- 6-Storey hospital building compared in terms of acceleration values in horizontal direction (Figure 5), building with friction pendulum isolator (6KMHSSI) and lead core rubber isolator (6KMHKÇI) has smaller acceleration value than fixed dual system
- 6-Storey hospital building compared in terms of relative drift ratio values(%) (Figure 6), building with friction pendulum isolator (6KMHSSI) and lead core rubber isolator (6KMHKÇI) has smaller drift ratio (%) value than fixed dual system.
- In seismic isolation systems; internal forces, relative drift ratio(%) and acceleration of the floor were decreased, but the natural vibration period was increased according to this study

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\*\*This study was produced from the master thesis (The Effect of Different Seismic Isolator Types and Floor Number to Earthquake Behavior on Multi-Storey Reinforced Concrete Structures) while preparing the the first author and advisor of the second author \*\*

**O 105. ASSESSMENT OF PESTICIDES TOXICITY IN TERMS OF ENVIRONMENT AND HUMAN HEALTH**

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**ABSTRACT:** Pesticides are one of the indispensable elements of modern agriculture. Pesticides are mixtures of substances or substances used to prevent, control or reduce harmful organisms. Pesticides may be a chemical agent, a biological agent such as a virus or a bacterium, an antimicrobial, a disinfectant or any other vehicle. However, uncontrolled and excessively used pesticides cause many environmental pollutions. Environmental contamination is also caused by the inaccuracies of the pesticides and the disposal of the increased drugs. Because of these conditions, pesticides have a toxic effect on many living things. Pesticide is harmful to environment and human health has caused to be the subject of research in environmental engineering. In this study, toxic analysis of pesticides was performed and evaluated. The aim of our study is to investigate pesticide toxicity, to examine the environment and human health and to evaluate the results and to present solution suggestions. In the study, the degree of toxicity of pesticides to living things was determined by laboratory studies. *Lepidium sativum* toxicity test was used to determine toxicity. According to the researches, it has been determined that pesticide toxicity has reached values in a way to harm human and environmental health. According to the studies, pesticides such as aldrin have high levels of harm and some pesticides that have been forbidden to use have been restricted. *Lepidium sativum* toxicity tests have shown that toxicity of both insecticides and herbicides is very toxic. In the study, the results of *Lepidium sativum* toxicity test were more toxic than pesticide called pesticide insecticide when it was examined in terms of pesticide types. Pesticides are very toxic hazardous substances. Therefore, pesticide use should be made by people who are conscious and knowledgeable about this pesticides should be preferred less pests to the environment.

*Keywords: Environment, Human, Lepidium sativum, Pesticides, toxicity*

**O 106. WEIGHT ANALYSIS OF PLANE STEEL ROOFS**

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**ABSTARCT:** In this study, the parameters affecting the weight of the plane steel roofs, which will be designed with steel, which is widely used in the world and in our country, are examined. In the light of current knowledge and experience, 6 parameters were determined and 192 different account models were created in order to see the effect of each of these parameters separately. These account models were analyzed by SAP2000 program and the weight values obtained were noted. According to the results, the effect of each parameter on the weight of the steel roofs was determined. In addition, the results obtained by the calculations were tried to be estimated with the help of intelligent systems and the results of these systems were investigated.

*Keywords: Regulation on the Design and Construction Principles of Steel Structures, plane steel roofs, intelligigent systems, design loads for buildings, snow loads, wind loads*

**O 107. RECOVERY OF SOME METAL FROM THE PHOSPHATE SLUDGE; ZINC AND NICKEL**

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**ABSTRACT:** Many products, have an important place in our lives, such as white goods, small household appliances and also cars are made of metals. Oxygen in the air and water causes oxidation of the metal and metals begin to corrosion. The surface treatment chemicals are applied to prevent corrosion of the metals and improve their durability. It is possible to increase the surface holding capacity of dye and the corrosion resistance of the product and the surface by the correct application of the surface process. Therefore, especially in the automotive industry and in many areas of our life, the surface treatment procedure can be said to be as important as the metal finishing process. Therefore, the surface treatment procedure can be said to be as important as the last metal coating process, especially in the automotive industry and equipment used in many areas of our lives. In the surface treatment, the surface to be coated is firstly degreased, activated and phosphated. Phosphating is the oldest and the best surface treatment method to provide protection against corrosion. Phosphating is the process of forming a film layer of zinc phosphate crystals on the surface to be painted as a result of the chemical reaction of metal phosphating. Phosphating is the process of forming a film layer consisting with zinc phosphate crystals on the surface to be painted as a result of the metal phosphating chemical reaction. In the baths where phosphating is performed, according to the General Principles of Waste Management, sludge classified as hazardous waste is produced. This waste is called a phosphate sludge in industry and includes zinc and nickel elements. As it is known these two metals are valuable elements. But the high amounts of them cause toxic effects. The aim of this study is providing the recovery of two valuable elements such as zinc and nickel from the phosphate sludge waste in the industry.

*Keywords: surface treatment technology, zinc, nickel, phosphate sludge, waste management*

**O 108. IMPLEMENTATION OF 480W LLC RESONANT CONVERTER**

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**ABSTRACT:** This study presents the design of an LLC resonant converter as using the leakage inductance of the transformer instead of the inductance in the resonance tank. With serial resonant characteristics, the power MOSFETs are conducted at zero voltage switching and secondary diodes are commutating under soft switching, so the switching power losses on the semiconductor components are decreased. Using the proposed power stage and feedback control loop design considerations, the LLC resonant converter can achieve high power conversion efficiency and stability enhancement. This study provides the working principle of the resonant LLC converter topology by designing the simulation model.

*Keywords: LLC Resonant Converter, Resonant Tank, Soft Switching, Switching Losses, Zero Voltage Switching*

**O 109. CORPORATE STRUCTURE OF THE SOUTHERN ANATOLIA CLEAN AIR CENTER  
AND AIR QUALITY WORKS**

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**ABSTRACT:** Ministry of Environment and Urbanization The Southern Anatolia Clean Air Center Directorate which includes the provinces of Afyonkarahisar, Aksaray, Antalya, Burdur, Isparta, Karaman, Kayseri, Konya, Nevşehir and Niğde was established in Konya with the decision of the Council of Ministers numbered 2015/7754 and published in official gazette dated 10 July 2015 and numbered 29412. In the directorate, produces solutions for the protection of the health of people, the detection of air pollution, and the factors that constitute a risk factor for the ecosystem. Air Quality Index (AQI) is an index used to report air quality on a daily basis. It gives us information on how clean and dirty the air of the region we live is, and what kind of health effects can occur. The air quality index determines the effect on general public health with different air quality, the level of air pollution, and the steps that should be taken when it goes up to the unhealthy level. 37 Air Quality Monitoring stations which can also be seen on the National Air Quality Stations website affiliated to the Ministry of Environment and Urbanization are under the responsibility of The Southern Anatolia Clean Air Center Directorate.

*Keywords: Air Quality, City, Health, Monitoring, Konya*

## **O 110. STOCK PRICE FORECASTING WITH A FINANCIAL RATIO BASED NEURAL NETWORK ALGORITHM**

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**ABSTRACT:** Forecasting stock prices is quite difficult due to uncertainty, chaotic nature and noise in financial markets. The aggregated impact of factors such as political instabilities, financial fragility, international financial integrity, technological developments and change in investor risk preferences make the estimation of stock prices harder. However, the challenge of developing a good estimation model in such an environment, the positive contribution of a successful model to the return of investment make the problem attractive for researchers. It is known that machine learning algorithms are useful in generating predictions in such chaotic environments as stock market, which have multiple sources of data flow. In this study, three stocks traded in Borsa İstanbul are selected according to different criteria and price estimation performances of proposed artificial neural network model together with known support vector machines, logistic regression, random forest and naive bayes classifier machine learning algorithms are compared. 18 financial ratios frequently used in evaluation of company performances with 102 other independent variables are used as inputs and monthly rate of return of stocks in 2009-2018 period are classified and estimated. Analyses on given period have shown that the proposed artificial neural network algorithm is a classifier that can be used as an alternative to other algorithms for stock market forecasting

*Keywords: Artificial neural networks, logistics regression, naive bayes classifier, random forest, stock price forecasting, support vector machines*

### **1. INTRODUCTION**

Stock markets have grown by 320% since 2009 and reached a size of \$ 80 trillion. (Edwards, 2017). However, despite increasing interest, forecasting trends in stock prices for profit is a challenging task due to complexities like rapid changes in economy, the subjective views of investors and political alterations. Stock exchanges are one of the economic environments most open to rapid changes caused by random fluctuations.

Stock market time series are generally dynamic, non-parametric, chaotic and noisy. For this reason, there are researchers who think that stock market price movements are a random process with fluctuations seen more clearly in short-term windows. (Khaidem, 2016) However, some stocks generally tend to develop linear trends over long-term time windows. In any case, there is a need to accurately predict trends in stock prices in order to maximize capital gains and minimize losses.

The importance of valid stock price prediction model applications have increased as a result of developments in financial forecasting modeling and increasing computer capabilities; with these models short term earning expectations increased compared to long-term expectations ("Means, Ends and Dividends", 2012). Nowadays, it is believed that 90% of the daily volume in stock markets is generated by investors using technical analysis, and most of this volume is generated with the help of prediction models developed by computer based algorithms (Cheng, 2017). Therefore, the quality of the forecasting model is directly related to the earnings in the stock market.

The application of machine learning models in stock market behavior is a relatively new phenomenon. This approach differs from traditional prediction and diffusion modeling methods. Pioneer models used in computerized stock forecasting included statistical methods such as time series model and multivariate analysis (Gencay, 1999; Timmermann and Granger, 2004; Bao and Yang, 2008). In these initial models, stock price movement was evaluated as a function of time series and solved as a regression problem and the success of the problem results were determined by comparing the actual value of the stock at that period. However, estimating the exact values of the stock price is quite difficult

due to its chaotic structure and high volatility. As a matter of fact, studies that evaluate stock value estimation as a classification problem instead of a regression problem become more widespread. In this context, the main purpose of the recent studies is to design an intelligent model that predicts future trends in the movement of stock price with the information obtained from market data by using machine learning techniques. As in this study, the predictive outputs in general models aim to support the decision-making processes in stock exchange investments.

Within the scope of this study, an artificial neural network algorithm (ANN) which also uses financial ratio input variables in addition to the studies in the literature is proposed in order to estimate the direction of change for monthly prices of selected stocks traded on Borsa İstanbul (BIST) between March 2009 and December 2018. The results of the proposed algorithm were compared with the prediction results of Support Vector Machines (DVM), Logistic Regression Algorithm (LR), Naive Bayes Classifier Algorithm (NBS) and Random Forest Algorithm (RO) which are frequently used in estimation models and better results are obtained.

## **2. MATERIALS AND METHODS**

### **2.1. Algorithms**

The results of the proposed algorithm were compared with four algorithms frequently used in the literature.

#### **2.1.1. Logistic Regression Algorithm**

Logistic Regression is a multi class classification algorithm. In order to make multiple classifications, one vs all approach is used, by giving each cluster of data once marked as correct to the algorithm all groups are separated. The decision is always made according to the value of the hypothesis function in the range [0,1]. In order to separate decision groups, the data is divided into groups with a polynomial function called decision boundary. The sigmoid (logistic) function can be used to obtain results within the specified range and to assign the results to decision groups, as in ANN. Then a cost function that is convex and can give minimum cost value is sought. As in linear regression, in logistic regression, it is tried to reach the minimum point that makes the derivative value zero from the starting point taken with the parameters determined using gradient descent methods.

#### **2.1.2. Support Vector Machines**

DVM tries to divide data groups into optimal hyperplanes to maximize generalization capability. It identifies the data close to the hyperplane from the data groups as a support vector, and excludes other data, and only works on these training data groups. If data groups cannot be separated linearly, decomposition is achieved by increasing the data size with a generated polynomial.

Since the new N-dimensional space increases the computational load, the kernel function is applied to establish a relationship between the previous space and the new space. Kernel function has varieties as sigmoid kernel, radial kernel and polynomial kernel. Function parameters are found with the help of k-fold cross validation method.

#### **2.1.3. Naive Bayes Classifier**

NBS, which is used in classification problems, is one of the easiest data mining algorithms that can be applied to big data sets as fast as possible. It is a classification technique developed on Bayes' Theorem. NBS, which is called naive because it assumes even closely correlated predictive variables as independent, can yield better results than many sophisticated classification models.

Bayes' Theorem states that the conditional probability of the B event occurring with the occurrence of the A event can be calculated from the inverse conditional probability and the marginal occurrence probability of the A-B events.

$$P(A|B) = \frac{P(A)*P(B|A)}{P(B)} \quad (2.1)$$

### **Bayes Rule for two conditional events**

Assuming that the number of events is more than two and the events are mutually independent, the probability sum of  $k$   $A_j$  events covering the entire event space is 1 and the formula in the following equation applies:

$$P(A_i|B) = \frac{P(A_i)*P(B|A_i)}{\sum_{j=1}^k P(A_j)*P(B|A_j)} \quad (2.2)$$

### **Bayes Rule for multi conditional events**

Therefore, by using a frequency table and probability table, when it is desired to classify a new observation, it can be classified by Bayes' theorem considering the probability values of the training set data (Cichosz, 2015).

#### **2.1.4. Random Forest Algorithm**

Random forest is one of the methods of supervised machine learning. It can be used in a regression environment as well as in a classification environment. It is a tree based method. Tree-based methods essentially group the data set by “if-then” propositions and divide the predicted observation space into zones. In case of regression the sum of square errors; in case of classification the wrong classification rate is being minimized.

One advantage of the decision tree configuration is that it can be determined which prediction variable is more decisive on the dependent variable. As we move up on the decision trees, the effect of the variables on the results increases. These algorithms are preferred because of their simple and easy to understand structure.

General structure of random forest algorithm to be used for comparison is:

For each  $T_b$ ,  $b = 1 \dots b_{max}$ :

Step 1: Control of the number of observations in the end nodes, if the number of observations in all end nodes has reached the specified minimum number of observations go to Step 5.

Step 2: Randomly select  $m$  from the total  $p$  variable,

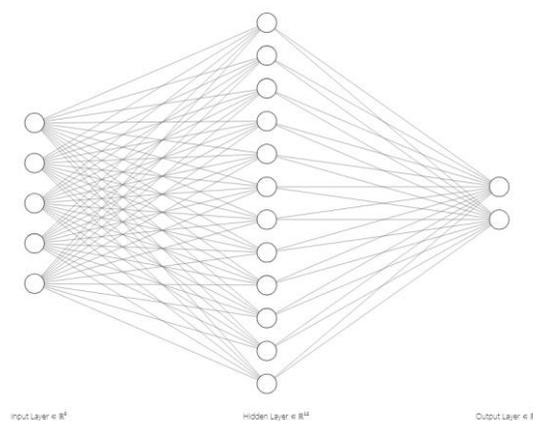
Step 3: Select the variable that makes the best separation in the training set from the selected  $m$  variable,

Step 4: Split end node into two sub-nodes, return to Step 1

Step 5: Save tree as  $T_b$ , stop if the maximum number of branches has been reached, if not return to Step 1. (Amrehn et al., 2018)

#### **2.1.5. Proposed ANN Algorithm**

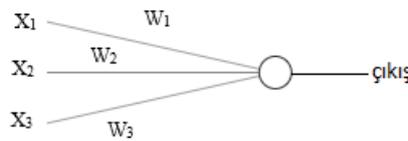
In this study, multilayer perceptron (MLP) which is one of ANN algorithms is used. MLP is the most known and most commonly used type of neural network. In most cases, in the MLP algorithm, signals are transmitted in one direction from the input neuron to the output neuron within the network. This type of ANN architecture is called feedforward architecture. Figure 2.1 shows a feed forward MLP architecture.



**Figure 2.1.** Multilayer Perceptron Architecture

As shown in Figure 2.1, MLP has a layered structure. While the data from the outside world enters the system from the input layer, the output layer shows the result that the algorithm finds for the relevant data. Non-multilayered structures can only separate the solution space linearly (McCulloch and Pitts, 1943). The layer(s) which has no relation with the outside world, processes the data it receives from the input neurons and obtains a result value and transmits this result to the next layers is the hidden layer. Communication between neurons refers to the ignition of the neuron. A neuron processes the weighted values it receives from the precursor neurons bound to it, and transmits it by weighting all of the neurons to which it is linked in the next layer if a threshold is exceeded. Basically, Machine learning means that the algorithm that gives the wrong result can reach the correct result with small changes made in this weight and threshold values.

In order for small changes in weight and threshold values to affect the algorithm results proportionally with the change, neurons should not only take values in binary system (0,1), but also be able to take and ignite intermediate values. In this sense, the most commonly used neuron structure is a sigmoid neuron, a type of neuron that can show slight changes in parameters and always take value in the range [0,1].



**Figure 2.2.** Structure of Sigmoid Neuron

As shown in Figure 3.4 and used in the study, the activation function output value of a single sigmoid neuron that takes  $x_1, x_2, x_3, \dots$  input values by weights  $w_1, w_2, w_3, \dots$  and with a threshold value of  $b$  is:

$$\frac{1}{1 + e^{(-\sum w_j * x_j - b)}} \tag{2.3}$$

**Sigmoid activation function**

In order to evaluate the performance of the algorithm, a cost function is required which will assign zero to the correct estimated observations, assign cost to the wrong estimated observations, and depend on the weight and neuron firing thresholds (bias). If training data set input values are  $x$ , and the desired output value is  $y(x)$  vector (For instance, if output 3 is correct in grouped in a 4 output system,  $y(x)$  must be  $(0,0,1,0)^T$ ) matrix of algorithm weights is  $w$ , ignition thresholds is vector  $b$ , training set total number of observations is  $n$ , algorithm outputs for each observation is vector  $a$  then the cost function is:

$$C(w, b) = \frac{1}{2n} \sum_x \|y(x) - a\|^2 \tag{2.4}$$

**Cost Function**

Thus, the cost function is mean squared error.

The cost reduction process, which is the determination of the most appropriate weight and threshold values for the algorithm, is performed by the gradient reduction method. In this method, cost function is changed step by step in derivative direction for each variable to reach global minimum. Gradient vector in two-variable system is:

$$\nabla C \equiv \left( \frac{\partial C}{\partial v_1}, \frac{\partial C}{\partial v_2} \right)^T \tag{2.5}$$

**Gradient Vector**

Effect of changes in variables on gradient vector is:

$$\Delta v = -\eta \nabla C \tag{2.6}$$

**Gradient-variable relationship**

The value of  $\eta$  -mostly in the range of (0,1)- which determines the speed at which the problem approaches to its minimum point and is called the learning rate. The gradient reduction method aims to minimize the cost function mean square error and the reduction is continued until a certain number of

iterations on the training set called epoch is reached (Egeli ve ark., 2003). Epoch limit of 2000 was used in the study.

## **2.2. Determination of Data Set**

Studies on the estimation of financial data have generally focused on the estimation of stock market index values on a daily or monthly basis (Taran et al., 2015).

In daily forecasting studies, daily input data such as exchange rate, technical analysis indicator values, historical stock data and index values of other stock exchanges are used as input variables. Since macroeconomic indicators and company financial reports are announced in longer periods such as monthly and quarterly, the forecasting models in the studies that use the relevant variables mostly consist of monthly periods. This study was carried out on monthly basis because the financial ratios used from the quarterly financial statements as 66 of the total 120 variables used in the study are being published for monthly or longer periods. Taking into account the presence of historical data, data quality and the structural break created by the 2008 financial crisis in the data time series, 118 monthly data were used between March 2009 and December 2018.

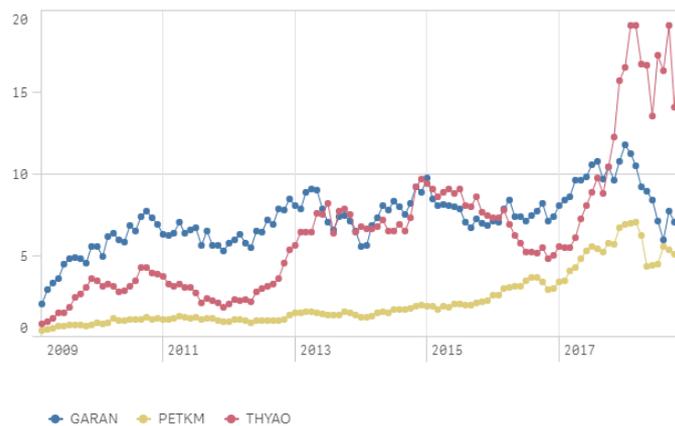
## **2.3. Data Resources**

Interest rates, survey data, money supply information and macro variables gathered from Central Bank of the Republic of Turkey (CBRT) Electronic Data Delivery System; inflation rates from Turkish Statistical Institute (TurkStat); stock market indexes and commodity prices from investing.com website; historical stock values and technical analysis indicator data from yahoo finance website; company financial ratios from Finnet Financial Analysis Program.

## **2.4. Determination of Company Shares**

Within the scope of the study, Garanti Bank Joint Stock Company (JSC) Class A Share (GARAN), Petkim Petrokimya Holding JSC Class A Share (PETKM) and Turkish Airlines JSC Class A Share (THYAO) stock values are used in the estimations.

While determining the shares used in the study, five considerations made: stock liquidity, early stock listing in stock market, sector differences, volatility differences and the behavior (trend) differences. Month-end values of the related shares in the working period are as in Figure 2.3.



**Figure 2.3.** 2009-2018 Stock Month-End Closing Values

## **2.5. Financial Ratios Used**

The financial ratios used as variables are obtained from the ratios used in the sectoral balance sheet evaluation ratios within the scope of the CBRT Sectoral Balance Sheets studies (CBRT, 2017) and from the ratios frequently used by investors using the relevant company balance sheets and income statements. Some financial ratios could not be used for GARAN because of the balance sheet differences between financial companies and real sector firms and they can not be calculated. 18 financial ratios used in the study are given in Table 2.1.

**Table 2.1. Financial Ratios Used**

Current Ratio	Current Assets / Current Liabilities
Acid Test Ratio ?	(Cash + Marketable Securities + Accounts Receivable) / Current Liabilities
Cash Ratio	Cash and Cash Equivalents / Current Liabilities
Inventory Turnover	Sales / Average Inventory
Accounts Receivable Turnover	Net Credit Sales / Average Accounts Receivable
Asset Turnover Ratio	Total Sales / (Beginning Assets + Ending Assets) / 2
Leverage Ratio	Total Liabilities / Total Assets
Short Term Liabilities Ratio	Short Term Liabilities / Total Liabilities
Long Term Liabilities Ratio	Long Term Liabilities / Total Liabilities
Shareholder's Equity Ratio	Shareholder's Equity / Total Assets
Debt to Equity Ratio	Total Liabilities / Total Shareholders' Equity
Asset Return Ratio	EBITDA / Total Assets
Earnings per Share	Net Profit / Common Shares Outstanding
Operating Profit Margin	Operating Income / Sales Revenue
Income Ratio	Net Income / Current Assets
Price Earnings Ratio	Market Value per Share / Earnings per Share
Book to Market Ratio	Common Shareholders' Equity / Market Cap
Price to Sales Ratio	Market Value per Share / Sales per Share

## 2.6. Other Variables Used in Algorithm

Input variables other than financial ratios were used in the study. Table 2.2 summarizes types and numbers of variables are used.

**Table 2.2. Variable Groups**

Variable Type	Explanation	#
Share Variables	Values ??depending on the share, changing with share value	4
Technical Analysis Variables	Moving averages commonly used by investors	5
Index Variables	BIST 100 and some major market index values	24
Currency & Commodity Price Variables	Parity and gold price values	18
BIST Detailed Variables	BIST sub-index value and return values	10
Macro Variables	Money supply, reserve, budget values ??and national survey results	36
Inflation Variables	Overall and narrowed comprehensive inflation indicators	5
<b>TOTAL</b>		<b>102</b>

## 2.7. Data Preparation

1. Monthly - (if not quarterly) data for 120 variables and estimated 3 stock values were obtained from June 2008 to December 2018.
2. Simple moving average (SMA) and Simple Exponential Smoothing (SES) forecasts were calculated over the closing prices for 2-3-6 months.
3. 9 variables based on share value (Opening GAP, volatility, distance to floor, distance to ceiling, 2-3-6 months SMAs and 2-6 months SESs) and 18 variables (6 for GARAN) depending on company financial statements were kept separately for each company and combined with the other 93 variables were common for each company.
4. The missing data of 21 variables (12 for GARAN) whose data are available in quarterly periods were completed by linear interpolation method.
5. The percentage changes of all independent variables and dependent variable end-of-month closing value for the estimated month have been calculated.

$$\text{Changing value at time } t = \frac{\text{Value at time } t - \text{Value at time } (t-1)}{\text{Value at time } (t-1)} \quad (2.7)$$

### Percentage conversion of variable values

6. Since the estimations are made for the next month share values, the independent variable values of period t-1 and the dependent variable value of period t were matched.
7. All the share value closing price change dependent variables were sorted from small to large and the number of observations is divided into two equal groups.

8. 5-fold cross validation (5-fold cross validation) was applied to separate learning and test data and min-max normalization was applied to each of the dependent variables in the learning group and their values were adjusted to [0-1] range.

**2.8. Evaluation Criteria**

Confusion matrix was used as the evaluation criterion within the scope of the study (Kohavi ve Provost, 1998).

**Table 2.3.** 2 - group classification confusion matrix

		<b>Forecasted Value</b>	
		<b>Group 1</b>	<b>Group 2</b>
<b>Real Value</b>	<b>Group 1</b>	$X_{1,1}$	$X_{2,1}$
	<b>Group 2</b>	$X_{1,2}$	$X_{2,2}$

In the confusion matrix given in Table 2.3, the gray areas show that the predicted value is the actual value, in other words the percentage of observations correctly. Therefore accuracy is:

$$Accuracy = \frac{X_{1,1} + X_{2,2}}{\text{Total \# of Observations}} * 100 \tag{2.8}$$

**Group estimated accuracy (%)**

Since the estimation values and actual values were distributed equally to the groups, no detailed evaluation criteria were needed (Kubat et al., 1998).

**2.9. Software and Solution Environment**

Microsoft Excel 2016 was used for creating raw data set and data editing. The solution of the proposed algorithm is made by using deep learning toolbox in MATLAB program (Version 7.1). The compared algorithms were solved in WEKA program (Version 3).

**3. RESEARCH FINDINGS**

The closing price percentage changes for 118 months between March 2009 and December 2018 were classified for each of the three stocks by sorting and grouping according to the number of observations as shown in Table 4.1. For example, PETKM's monthly change was the most negative with -30.96% to -2.39% and its 59-month value was chosen as Group 1 of that stock and the rest as Group 2.

**Table 3.1.** Closing Price Change Data Grouping and Value Ranges

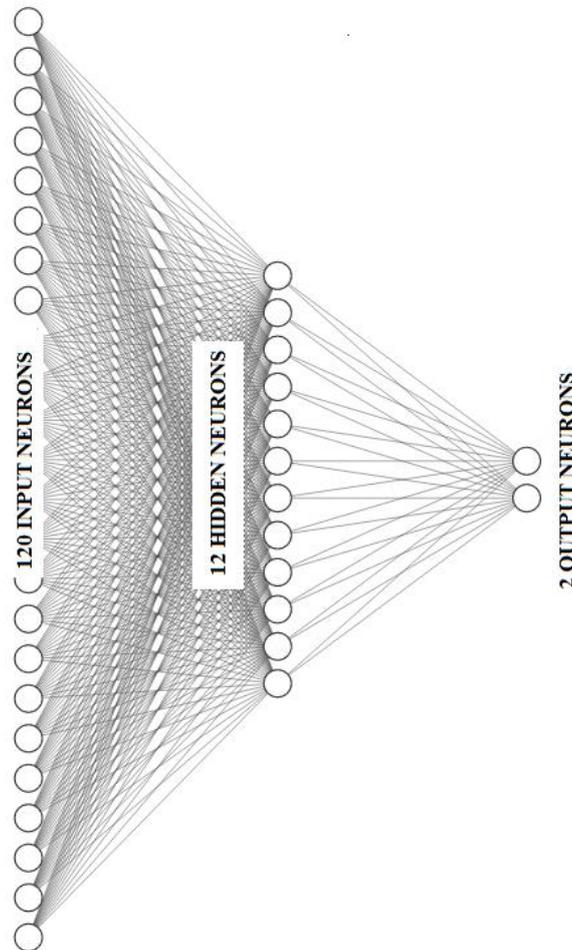
	<b>Group 1</b>		<b>Group 2</b>	
	<b>Min</b>	<b>Max</b>	<b>Min</b>	<b>Max</b>
<b>PETKM</b>	-30,96%	1,65%	1,67%	31,77%
<b>THYAO</b>	-26,40%	1,56%	1,58%	34,02%
<b>GARAN</b>	-16,32%	0,14%	0,18%	42,57%
<b># of Observation</b>	59		59	

The ANN algorithm was tested with different parameter values and data preparation methods without suggesting, and the ANN model which gave the best results in experiments was chosen to be proposed in the study. Parameters and methods were tried in experiment models are given in Table 4.2.

**Table 3.2.** ANN Parameter Values & Methods

Parameter Value & Method	Experimented Value	Proposed Value
# of Hidden Layer	1, 2	1
# of Neuron in Hidden Layer	6, 8, 10, 12, 16	12
Momentum Constant	0.1, 0.2, 0.3	0.2
Learning Rate	0.15, 0.2, 0.3, 0.4	0.3
Activation Function	Sigmoid, RELU	Sigmoid
Normalization Method	Min-Max, Z-Score	Min-Max
Epoch	2000	2000
Cross Validation	5	5
# of Iterations	10	10

The general structure of the proposed ANN is given in Figure 3.1. Other algorithms are calculated with the default parameter values in the WEKA program.



**Figure 3.1.** Recommended Algorithm Architecture

**Table 3.3.** General Results

GARAN		Forecasted Value									
		ANN		NB		LR		RF		SVM	
		Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
Real Value	Group 1	77,97%	25,42%	57,63%	38,98%	66,10%	33,90%	72,88%	20,34%	67,80%	30,51%
	Group 2	22,03%	74,58%	42,37%	61,02%	33,90%	66,10%	27,12%	79,66%	32,20%	69,49%
Accuracy		76,28%		59,33%		66,10%		76,27%		68,65%	
Performance		1		5		4		2		3	
THYAO		Forecasted Value									
		ANN		NB		LR		RF		SVM	
		Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
Real Value	Group 1	74,58%	25,42%	64,41%	37,29%	64,41%	16,95%	67,80%	25,42%	67,80%	30,51%
	Group 2	25,42%	74,58%	35,59%	62,71%	35,59%	83,05%	32,20%	74,58%	32,20%	69,49%
Accuracy		74,58%		63,56%		73,73%		71,19%		68,65%	
Performance		1		5		2		3		4	
PETKM		Forecasted Value									
		ANN		NB		LR		RF		SVM	
		Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
Real Value	Group 1	77,97%	25,42%	59,32%	37,29%	72,88%	25,42%	61,02%	30,51%	66,10%	30,51%
	Group 2	22,03%	74,58%	40,68%	62,71%	27,12%	74,58%	38,98%	69,49%	33,90%	69,49%
Accuracy		76,28%		61,02%		73,73%		65,26%		67,80%	
Performance		1		5		2		4		3	

As a result, in the study conducted on 118 observations in the period of 2009 March - 2018 December; ANN made the best grouping for all three stocks. In 10 iterations, 76.28% of GARAN with the average of 90 observations; 74.58% of THYAO with the average of 88 observations; 76.28% of PETKM with the average of 90 observations were correctly classified.

#### 4. RESULTS AND DISCUSSION

In this study, t time stock value change percentage estimation was made by using t-1 time variable values. The closing price change rates of three different stocks traded in BIST in March 2009 - December 2018 were tested using a model of 120 variables including financial ratios on 5 different machine learning algorithms. ANN has yielded the best results for all three stocks. It is concluded that ANN is a good alternative to the other algorithms in estimation of stock value change.

In the scope of the study, to prevent the possibility of overfitting to keep the number of input variables of the ANN around the number of observations, longer-term lagged variable values were not used (Liu et al., 2017). In future studies, feature selection methods can be used to reduce the number of independent variables and to use variable values such as t-2 and t-3. In addition, studies on stocks in developed markets, stocks of companies in different sectors or stock market index values can be carried out.

Unlike this study, other methods such as hyperbolic tangent and rectified linear units can be tried as activation function when ANN algorithm is established. There was no need to reduce the number of variables because there was no possibility of excessive overfitting, but methods such as Principle Component Analysis or regularization can be used on the variables and studies with different variables can be carried out in future studies.

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## **O 111. THE EFFECT OF CONCENTRATED SOLAR ENERGY ON DRYING OF TREATMENT SLUDGE**

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**ABSTRACT:** Treatment sludge are concentrated wastes including organic or inorganic impurities and resulted from separation process of wastewater treatment plants. Although the sludge is separated by dewatering processes, it contains a large amount of water in its contents. The water content of the non-fluidized sludge cake from the centrifugal dewatering unit varies between 82% and 78% in the Konya wastewater treatment plant. This high-water content in the sludge is a problem that needs to be overcome in the implementation of final disposal or reuse alternatives. It is necessary to increase the solid matter content of the sludge in order to burn, landfilling or to use as fertiliser. Therefore, drying is a mandatory process for these reuse or disposal options. Thermal dryers operated by fossil fuel could be achieve high drying rates, but its cost is disadvantage. Greenhouse type indoor or outdoor drying plants, where the sludge is laid on the floor in a thin layer to benefit from solar energy, have relatively low cost but requires large areas. It is necessary to increase the number of drying options that use the highest level of solar energy. Concentrated solar energy systems are promising alternative to overcome these problems. Parabolic trough types solar collectors where the heat generated at high temperatures is used for industrial application such as production of electricity by steam power. In this study, a mechanism of direct sludge passing through the tube located at the focal point of the parabolic collector was installed to concentrate solar energy on the lower area. The moisture was removed by means of ventilation while the sludge was heated in the metal tube. It was observed that the solid matter content increased from 21% to 64% on a day where the average solar radiation is 1047 W/m<sup>2</sup> and the sludge flow rate of 29 g/min.

*Keywords: Treatment sludge, parabolic trough type solar collector, drying, solar energy*

### **1. INTRODUCTION**

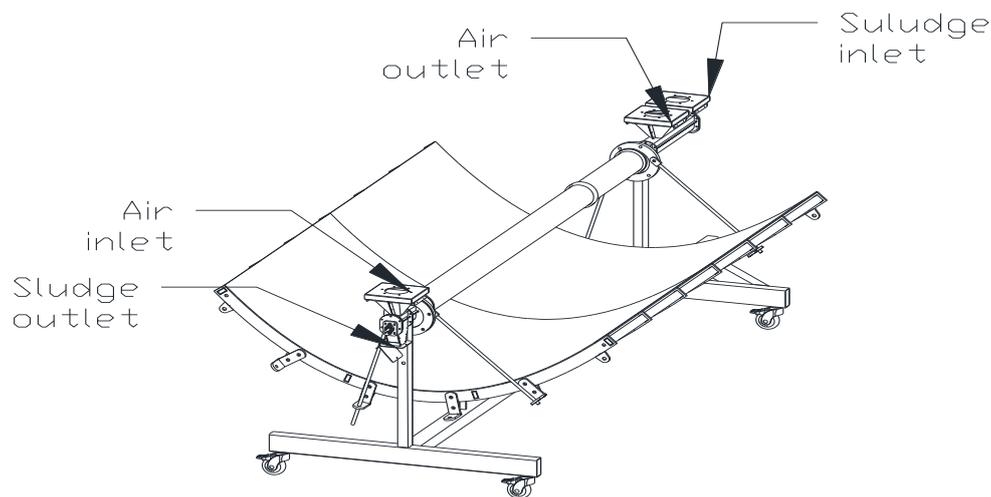
The produced wastewater of Turkey has been increased from 2.3 billion m<sup>3</sup> (%52 treated) in 2001 to 4.5 billion m<sup>3</sup> (%86 treated) in 2016. Municipalities had 126 treatment plant in 2001 and this number increased to 881 in 2016 (Anonim, 2017b; Nas, 2017a). The increase of treated waste water directly increases the amount of sewage sludge. In 2016, about 300000 tons of sludge on dry matter basis was formed in municipalities (Anonim, 2017c). Konya wastewater treatment plant produced 35.000 tons of stabilized sludge cake in 2017. Treatment sludges were applied to 2.7 million m<sup>2</sup> area in Konya for agricultural (Anonim, 2017a). Treatment sludges are often stored on land as regular or irregular in Turkey (İnsel, Arıkan, & Ayol, 2013). Regardless of the disposal method, the sludge cake is reduced in water but the dried product contains at least 70% water. Doubling the sludge dry matter ratio allows the sludge volume decrease to about 50% (Filibeli, 2013). A large reduction in weight and volume of sludge facilitates transport of sludge and increases the possibility of disposal as an additional fuel. Also, the potential for agricultural use increases as the pathogenic activity of dry sludge decreases. Reducing the water content will eliminate the problem of leachate in landfills, thus reducing the impact of disposal on the natural environment (Öztürk, Çallı, Arıkan, & Altınbaş, 2015).

Solar drying in open area or in green house and thermal drying methods have been used in the world as well as Turkey (Öztürk et al., 2015). There are eleven thermal drying and six greenhouse type solar drying plant in Turkey (Nas, 2017b). It is necessary to focus on the low-cost and low-area drying by efficiently using of the solar energy (Hanif et al., 2013). Parabolic trough type solar collectors are mostly used in industrial applications and electricity generation by heating fluids (Kalogirou, 2002). Some applications have been made on the use of heated air for drying the plants by passing air through the

receiving pipe (Kariuki, 2014). However, there is limited study in the literature on the sludge drying with parabolic trough type solar collectors.

## **2. MATERIALS AND METHODS**

The parabolic groove was drawn to the parabola chart that's going to set the reflector to provide heat generation in the desiccant tube (Anonim, 2019). The equation of the parabola focal point is expressed as  $f=x^2/4y$  (Elmas, 2019). The parabola curve was drawn with a computer aided design (CAD) program and this curve was used to form the design of the reflector bed. Polished aluminum sheet (Almeco Vega 95100), which reflects high solar radiation and has low absorption rate, is preferred as reflector. The desiccant tube was designed as conveying and mixing the sludge with spiral, to be possible sludge/air inlet and outlet with chimneys, coating with 0.40 mm solar energy selective surface (Almeco tinnox) on the outer wall and external glass sheath to prevent heat loss (Figure 1). Drying experiments were conducted in October and November 2018 in Konya waste water treatment plant. Avarage air flow of 360 L/min was applied by an air supplier. The open area of parabolic reflector was 4.3 m<sup>2</sup>. Solar radiaton was measured with solar sensor in W/m<sup>2</sup> (Ingenieurbüro Mencke & Tegtmeyer GmbH SiS-01TC-DMM sensor and Victor 86C dijital multimeter). The amount of dry matter of sludge was measured by Ohaus mb45.



**Figure 1.** Parabolic trough type solar collector and desiccant tube

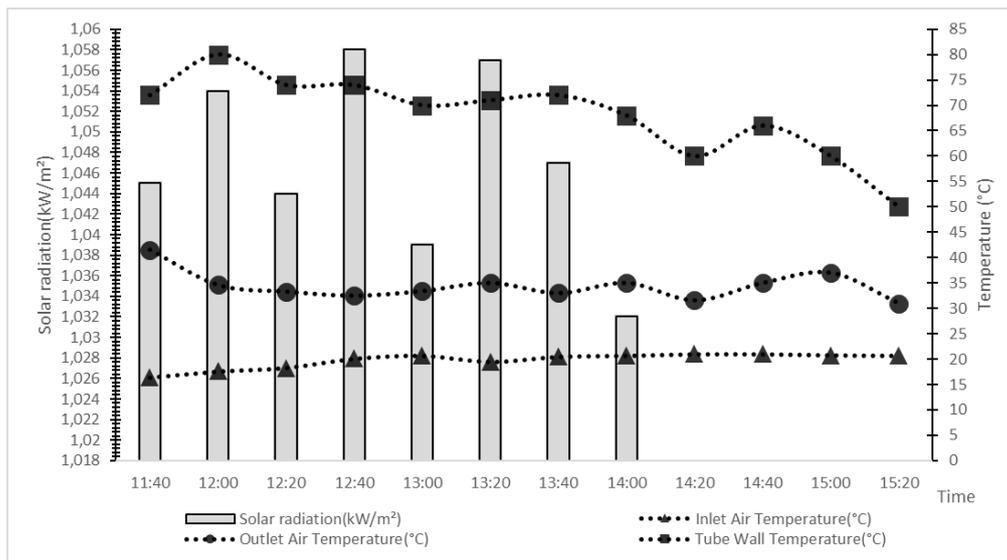
## **3. RESULTS AND DISCUSSION**

In the experiment carried out on October 16, where solar radiation was lower than other days, a dry matter (DM) content of 47% was achieved (Table 1). This shows that ventilation plays an effective role in the drying process even if the heat energy is reduced. On October 9, when the weather was generally cloudy; solar radiation and temperatures were lower. Since the weather became completely cloudy in the last fifty minutes of the study, no sun tracking was performed during the last fifty minutes. However, on such a day when the amount of solar energy is fluctuating, the average KM rate doubles compared to the raw sludge. On 1 November, when solar radiation was high; dry matter rate reached to 60% with 28 g/min sludge feed. The solid matter content increased from 18% to 47% on a day where the average solar radiation is 882 W/m<sup>2</sup> and the sludge flow rate of 33 g/min. On another day when the radiation and the flow rate were 1047 W/m<sup>2</sup> and 28.6 g/min, the solids content increased from 21% to 64%.

In the study carried out on the first day of November (Figure 2), the outlet air temperature started to fall from 41.5°C at 11:40 am, although the solar radiation increased, and was measured as 34.6°C at 12:00. This is due to some heat transfer to the sludge supplied to the system at the start of the work. Sludge feeding and sun tracking were finished at 14:00 and 14:20, respectively. After the end of the solar tracking, an increase in the effluent air temperature was observed. This probably due to decreasing of the heat transfer to the sludge over time after the sludge feeding is finished at 14.00, as the sludges left in the system are thrown out.

**Table 1.** Drying data for trials at different times

		9 October		16 October		1 November	
<b>Sludge amounts (g)</b>		9000		8000		4000	
<b>Flow rate of sludge mass (g/dk)</b>		37,5		33,1		28,6	
<b>Solar radiation (W/m<sup>2</sup>)</b>	<b>Min.</b>	550		469		1032	
	<b>Average</b>	904		882		1047	
	<b>Max.</b>	1086		963		1058	
<b>Influent air temperature (°C) and relative humidity (%)</b>		°C	%	°C	%	°C	%
	<b>Min</b>	23	27	22	37	16	30
	<b>Average</b>	25	31	24	41	20	36
	<b>Max.</b>	26	35	26	47	21	51
<b>Effluent air temperature (°C) and relative humidity (%)</b>	<b>Min.</b>	29	35	30	10	31	31
	<b>Average</b>	33	69	35	62	34	55
	<b>Max.</b>	37	86	60	88	42	75
	<b>Desiccant tube temperature (°C)</b>	<b>Min.</b>	40		40		50
	<b>Average</b>	68		72		68	
	<b>Max.</b>	78		110		80	
<b>Solid matter of raw sludge (%)</b>		19		18		21	
<b>Solid matter of dried sludge (%)</b>		43		47		64	



**Figure 2.** The solar radiation and temperature change on November 1, 2018

#### 4. CONCLUSION

In this study, dry matter of dewatered sludge increased from 21% to 64% in 170 minutes by concentrating of the solar radiation. However, the system can be rapidly affected by changes in solar radiation. It is recommended that the measurements of the solar radiation and air temperature/humidity in desiccant tube may be connected to the automation. Thus, it can be provided that the spiral movement which provides the advancement of the sludge changes depending on the measurements made. It can be dried more amounts of sludge if the drying system would designed using serial collectors or parabolic reflectors having larger area.

#### ACKNOWLEDGMENTS

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**O 112. EVALUATION OF ECO-CITY PLANNING PRINCIPLES IN THE EXISTING LIVING ENVIRONMENTS**

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**ABSTRACT:** One of the sustainable urbanization approaches, eco-urbanization and/or ecological planning which is developed in order to prevent the uncontrolled and rapid development of cities set out several principles to provide a better quality of life for all city inhabitants and make cities coherent and sustainable with green infrastructure. The planned ecosystems with these principles and making the existing cities more ecologic are shaped by four basic elements as structure and relations in urban development (physical and environmental structure relationship), transportation (mobility), energy/material flow and socio-economic dimension, and the goals and principles determined in this direction. This paper aims to investigate how the change of existing urban areas which have been built with the urbanization process in Turkey can be performed in accordance with the eco-urbanization goals and principles. For this purpose, this paper determines strengths and weaknesses for the adoption of the eco-urbanization principles by comparing areas with different typology of housing and city blocks and makes recommendations. Comparisons are mainly covered within the scope of city blocks and adaptation capacities in terms of green infrastructure such as physical and environmental structure relations, green areas, transportation diversity, energy, recycling, location of buildings and sunshine are discussed. As a result, considering the differences in the typologies of housing and buildings in the existing built living environments in the cities, strategies are developed for the applicability of ecological planning approaches.

*Key Words: Natural Resources, Ecology, Eco-City, Konya, Sustainability, Renewable Energy*

**O 113. AN ECO-FRIENDLY MANAGEMENT STRATEGY FOR PLANT PATHOGENIC BACTERIA: BACTERIOPHAGES**

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**ABSTRACT:** Plant pathogenic bacteria affect a wide range of crops worldwide and have negative impacts in agriculture due to their associated economic losses and environmental damages. Control measures including the use of conventional chemicals or antibiotics have lost their efficacy because of the natural development of bacterial resistance against these compounds. Bacteriophages, eco-friendly means of controlling plant bacterial diseases, are a fast expanding subject of plant pathology with considerable potential to replace the chemical control measures now prevalent. Obtained results, different bacteriophages have given promising results on several serious diseases about 30-95% ratios for *Pectobacterium carotovorum* subsp. *carotovorum*, *P. wasabiae*, *Dickeya solani* and *Streptomyces scabies* on potato, *Ralstonia solanacearum*, *Xanthomonas campestris* pv. *vesicatoria* and *Pseudomonas syringae* pv. *tomato* on tomato, *Xylella fastidiosa* on grapevine, *Xanthomonas axonopodis* pv. *allii* on onion, *P. c.* subsp. *carotovorum* on lettuce, *S. scabies* on radish, *X. a.* pv. *citri* on grapefruit, *X. a.* pv. *citrumelo* on orange, *P. s.* pv. *porri* on leek, *Pseudomonas tolaasii* on mushroom, *Erwinia amylovora* on apple and pear. In addition, it has been determined that the efficacy of phages depends greatly on environmental factors as well as on susceptibility of the target organism and the emergence of resistant bacterial strains. In conclusion, bacteriophages can be used effectively as part of integrated disease management strategies as biopesticides.

*Keywords: bacteria, phages, plant disease, biocontrol, eco-friendly plant protection*

## O 114. CRISPR/CAS9 SYSTEM IN COMBATING PLANT PATHOGENIC BACTERIA

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**ABSTRACT:** Editing genes to generate mutations is widely used tool in creating plant varieties resistant to pathogens that otherwise take a lot of time to be developed using conventional breeding methods. Recently developed methods for gene modification includes transcription activator-like effector nucleases (TALENs), zinc finger nucleases (ZFNs), and clustered regularly interspaced short palindrome repeats (CRISPR)/Cas9 (nuclease). Trending amongst scientists today is the Crispr/Cas9 technique due to its simple engineering, cost effectiveness, multiplexing, wide range target sites and ability of cas9 nuclease to induce double stranded breaks. It is basically a defense mechanism found in bacteria and most archea against bacteriophages. Using this method, scientists have successfully targeted the host genome at specific sites obtaining enhanced resistance against pathogenic bacteria such as *Pseudomonas syringae* pv. *tomato* by editing *SIDMR6-1* gene in tomato, *Xanthomonas oryzae* pv. *oryzae* by targeting *OsSWEET13* gene in rice, *Xanthomonas citri* subsp. *citri* by targeting the promoter region of *CsLOB1* (s) genes in Duncan grapefruit and in Wanjincheng orange (*Citrus sinensis* Osbeck) without noticeable difference in growth and development of the plants. Furthermore, to enhance resistance in apple against *Erwinia amylovora*, researchers have done successful molecular analysis of targeting *DIPM-1*, *DIPM-2*, and *DIPM-4* genes in apple protoplasts using Crispr/Cas9 ribonucleoproteins approach instead of plasmid-mediated delivery to overcome off-target mutations. More work is required in this field by focusing different gene editing strategies using Crispr/Cas9 technology such as identify and editing other promoter regions or resistant and susceptible genes keeping in mind of its possible field applications without negative effects on the plant development.

*Keywords: crispr/cas9, resistance, gene editing, plant pathogenic bacteria*

**O 115. THE EFFECT OF VEGETABLE AND FRUIT WASTE ON ANAEROBIC SLUDGE  
DIGESTION PERFORMANCE**

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**ABSTRACT:** Anaerobic sludge digestion process provides energy through stabilization of sewage sludge in municipal wastewater treatment plants. Co-digestion of the sewage sludge fractions with the marketplace wastes (fruit and vegetable) was carried out in semi-continuous laboratory scale bioreactors with three sludge fractions (primary, secondary and mixed) respectively at organic loading rates of 1.65, 0.40 and 1.00 kg VS/m<sup>3</sup>.day, 20 d of hydraulic retention time (HRT) and 35°C. The market wastes were grinded and fed as second substrate to the primary, secondary and mixed sludge receiving anaerobic reactors as vegetable + fruit (50:50%, v: v) and vegetable (100%). When compared to single raw sludge digestion, co-digestion with vegetable + fruit and vegetable, resulted in increased methane production at 60-70% and 35-45%, 55-60% and 40-50% and %for primary, mixed and secondary sludge, respectively. Higher methane increase at vegetable + fruit digestion than the vegetable alone indicated that the fruit waste made a higher contribution as conversion to methane. Co-digestion increased volatile solid removal at 10-11%, 27% and 15% for primary, secondary and mixed sludge, respectively, at vegetable + fruit addition whereas vegetable addition's contribution stayed at 5, 23-24 and 8% of volatile solid removal. Consequently, the addition of feedstock was obtained in descending order for secondary, primary and mixed sludge in terms of its effect on the performance of digestion.

*Keywords: Anaerobic digestion, sewage sludge, energy, organic waste, feedstock, methane production*

**O 116. RECOVERY OF IRON FROM METALLURGIC WASTES**

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**ABSTRACT:** The iron and steel industry, an indicator of development and improvement, has become an integral part of modern society. In this context, the iron-steel sector is of strategic importance for many countries. Its product varieties increase even more in the iron-steel industry with changing consumer needs, developments in technology and competition. The iron, taken from the iron-steel industry, is an indispensable material that is quite hardness and durable. This product is used widely in many industrial areas such as civil, machine and automotive engineering. The amounts of iron ores decrease in the world by the day. Therefore, in the production of iron, scrap materials are used. A slag, a by-product formed during pyrometallurgical processes and deposited on the surface due to the difference in density, is a mixture of metal oxide and silicates. The scrap metal or metal-containing ores, lighter than metal, contain these metal oxides and silicates. Slag, which is very exposed in industry, is a waste. And, it pollutes the environment if not recovered. The amount of metallurgical waste reduces with the recovery of iron slag. By this way, it contributes to the economy. For this reason, this work aim is to recover iron from iron slag in its metallic form.

*Keywords: iron, steel, recovering process, pyrometallurgic waste*

**O 117. INVESTIGATION OF FUEL PRODUCTION FROM PLASTIC WASTES IN PULPER**

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**ABSTRACT:** Industrialization is growing rapidly in both the world and our country. This situation brings accompanying an environmental problem created by industrial wastes. Pollutants formed by industrial wastes constitute non-recyclable permanent environmental damages, if not interfered. Therefore, the recovery planning of these wastes is an important detail for the protection of the environment. In this case, it is significant that the industrial wastes are evaluated by turning into new and different products. Hence, it is possible to get useful products from paper industry. Any paper factory applies the recycling process for the collected wastepaper. The separation of these waste papers is made by using Pulper machine. The waste mixture obtained from the Pulper machine includes plastics contaminants also. Pulper waste is a kind of plastic waste that takes its name from this machine. In this study, pyrolysis of pulper waste and research on the production of liquid fuel with this pyrolysis method were carried out. Pulper's pyrolysis allows the production of gasoline, diesel and heating fuel. With this study, it is aimed to contribute to the national economy by recycling plastic which is one of the most harmful wastes for the environment and gaining new products in this way.

*Keywords: Pyrolysis, pulper, plastic wastes, fuel-oil, environment*

## **O 118. DIMENSIONING AND ECONOMIC ANALYSIS OF A GRID-INDEPENDENT PV SYSTEM FOR A STANDARD HOUSING**

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**ABSTRACT:** With the increasing population and industrialization, the need for electrical energy is increasing day by day. In order to meet the need, the use of renewable energy sources has come to the forefront especially in recent years. Among the renewable energy sources, solar energy technologies are the most appropriate solution to meet the individual energy needs. Photovoltaic (PV) systems that convert solar energy into electrical energy are separated as grid-dependent and grid-independent according to their connection type. Grid-independent PV systems are preferred when there is no network, frequent and long-term disconnection of the network, the transmission lines are not economical.

In this study, economic analysis and dimensioning of the grid-independent photovoltaic system were conducted for a standard housing in the Turgutlu district of Manisa province. The analyses were performed in the Renewable Energy Laboratory supported by the MCBU BAP Unit.

Life cycle cost (LCC), annual life cycle cost (ALCC), electricity cost (UCel) of the components used in this system were calculated. This model can be used to design and assess the economic feasibility of off-grid PV electrification in any geographical location of the world by sorting input data viz. solar insolation, cost of the conventional energy as well as the market prices of the off-grid PV components.

*Keywords: Photovoltaic (PV) systems, grid-independent systems, economic analysis*

### **1. INTRODUCTION**

The main reasons such as the increasing need for energy and the harm to the environment of fossil fuels used in energy production led to the search for alternative sources in production. In recent years, the trend towards the use of renewable energy sources has increased.

Renewable energy is the energy that is assumed to be practically unlimited, which can be used continuously and repeatedly. Solar energy, wind energy, geothermal energy from the earth, biomass produced from plants and hydropower obtained from water are also considered in the renewable energy group (Kıyga, 2013).

Renewable energy technologies enable us to convert energy, which naturally exists in the world without human contribution, into a form of usable energy. The energy carried by the sun's rays, the energy of the wind, the heat of the earth and the nucleus of the earth, the plants' energies, and many other known and unknown forms of energy are transformed into forms of energy that can be used to achieve higher comfort and higher standards of life quality (Baş, 2016).

Solar energy, which is one of the renewable energy sources, is preferred because it is clean and does not harm the environment. Systems that generate electricity from solar energy are called photovoltaic systems. The operation and maintenance and repair costs of these systems are lower than systems that provide the generation of energy from other energy sources (Özgöçmen, 2007).

Photovoltaic systems according to connection types; they can work on the network or independent of the network. Many literature studies have been conducted on network independent systems.

In grid-independent systems, Mandeli et al. (2016) studied the effect of load profile on the design of the photovoltaic system on system sizing. In the sizing of the system; energy needs, daily load profile, photovoltaic and battery system showed that the economic analysis is important. Gallegos et al. (2018)

studied the sizing and placement of the photovoltaic system in diesel generator systems. In their studies, they aimed to reduce environmental pollution and to improve the economy. As a result of the study, they observed that installing the system in remote locations is cost effective and reduces the emissions that cause environmental pollution.

On the energy management of the system, Baurzhan et al. (2016) conducted studies on the African continent. By reviewing the feasibility of network-independent systems, five different main issues have been focused on in terms of falling system costs: cost effectiveness, affordability, financing, environmental impact and poverty reduction. In their study, Goldsworthy and Sethuvenkatraman 2018 used the electricity consumption profiles of the houses consumed from the grid for the analysis of the grid-independent photovoltaic system. Residents who want to leave the grid can make fundamental changes in their consumption patterns to minimize the size of the photovoltaic - battery system. As a result, it has been shown that especially hot water and air conditioning settings can increase the economy significantly, and even device efficiency improvements reduce electricity costs.

In the studies on the batteries used in the system, Bogno et al. (2017) conducted a detailed analysis based on the test results of the battery charge control which ensures the long life and high safety of the storage and production systems. As a result of their experimental work, they charged the 24 V-55 Ah battery with a 175 kW photovoltaic module. Ayengo et al. (2018) compared photovoltaic systems using lithium nickel cobalt aluminum oxide and lead-acid batteries. Models were developed in Matlab / Simulink application and solar radiation, temperature values and electrical charge data of Dodoma city, Tanzania capital were used. The electricity costs for both battery systems were compared and lithium nickel cobalt aluminum oxide batteries were found to be less costly than lead-acid batteries.

In this study, for the design of the grid independent photovoltaic system, the load in a residence in Turgutlu district of Manisa and the solar radiation values of that region were taken into consideration. The system is designed by finding the number of photovoltaic panels, battery and inverter capacities used in the system to be designed. Life cycle cost (LCC), annual life cycle cost (ALCC), electricity cost ( $UC_{el}$ ) of the components used in this system were calculated. The analyses were performed in the Renewable Energy Laboratory supported by the MCBU BAP Unit.

## 2. REQUEST FOR ENERGY FOR HOUSING

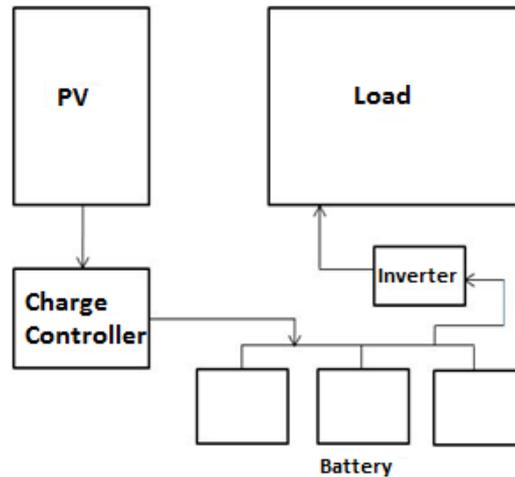
In order to calculate the energy demand, firstly the highest electrical load of this house must find out. The electrical charge requirement ( $L_{el}$ ) in this housing is shown in Table 1. The average daily demand for the selected house was calculated as 5.54 kWh/day.

**Table 1.** Electricity Load Calculation Required for Housing

Load profile					
Equipment in use	No. of equipments	Power of equipment	Total wattage (W)	Daily appliances use (h)	Daily energy required (kWh/d)
Lamps	9	23	207	3	0,62
Refrigerator	1	80	80	24	1,92
Washing machine	1	1000	1000	2	2
TV	1	180	180	4	0,72
Notebook	1	70	70	2	0,14
Total					5,4

## 3. ELEMENTS OF INDEPENDENT PHOTOVOLTAIC SYSTEM FROM THE GRID

In the photovoltaic system independent from the grid, there are panels, charge controller, battery and inverter. The block diagram of the photovoltaic system is shown in Figure 1. In the systems independent from the grid, the sunlight falling on the panels during the day generates electrical energy at the ends of the panels. Electrical energy is stored in the battery group with charge controllers and kept ready for use. In order to be used in devices operating with alternating current, direct current is converted to alternating current (220 V, 50 Hz sine wave) and transferred to the devices.



**Figure 1.** Layout of an off-grid PV system

#### 4. DESIGN OF AN OFF-GRID PV SYSTEM

The design of the PV system starts with the known initial load and available solar energy per unit area. The average daily solar energy input ( $H_{avg}$ ) over the year for Turgutlu is nearly 5.30 kW h/m<sup>2</sup>d.

##### 4.1. Sizing of the PV array

The size of the PV array can be calculated using Eq. (1)

$$A_{PV} = \frac{L_{el}}{H_{avg} * \eta_{PV} * \eta_B * \eta_I * T_{CF}} \quad (1)$$

where;  $A_{PV}$  is the required area of PV array in m<sup>2</sup>,  $L_{el}$  is the required electric load in kWh/d,  $H_{avg}$  is the average irradiation available per day in kWh/m<sup>2</sup>d,  $\eta_{PV}$  is the efficiency of PV panel in %,  $\eta_B$  is the battery efficiency in %,  $\eta_I$  is inverter efficiency in % and  $T_{CF}$  is the temperature correction factor normally taken as 1,23 % per °C for crystalline silicon [48]. The battery and inverter efficiency is generally taken to be 85% and 97%, respectively.

The peak PV power ( $P_{p(PV)}$ ) can be calculated using Eq. (2)

$$P_{P(PV)} = A_{PV} * I_p * \eta_{PV} \quad (2)$$

where;  $I_p$  is the peak solar irradiance taken as 1000 W/m<sup>2</sup>.

##### 4.2. Sizing of the backup battery

The storage capacity of the battery ( $B_{SC}$ ) is calculated based on the continuous number of cloudy days, battery efficiency, depth of discharge of the battery and efficiency of the inverter as shown in Eq. (3)

$$B_{SC} = \frac{N_{CCD} * L_{el}}{\eta_B * D_d * \eta_I} \quad (3)$$

where;  $N_{ccd}$  is the largest number of continuous cloudy days and  $D_d$  is maximum permissible depth of discharge of the battery.

##### 4.3. Sizing of the charge controller

The battery charge controller is employed in PV system to safely charge the batteries and remove the risk of overcharging the batteries. This device also helps in maintaining the long life of the batteries. The charge controller should be selected carefully so that it must be able to carry short circuit current of the PV array.

##### 4.4. Sizing of the inverter

The inverter is selected in such a way that it must be able to handle the maximum expected power of AC loads. Therefore, it must be selected atleast 20% higher than the total rated power of the required AC loads (Table 1).

#### 5. SIZING RESULTS OF AN OFF-GRID PV SYSTEM

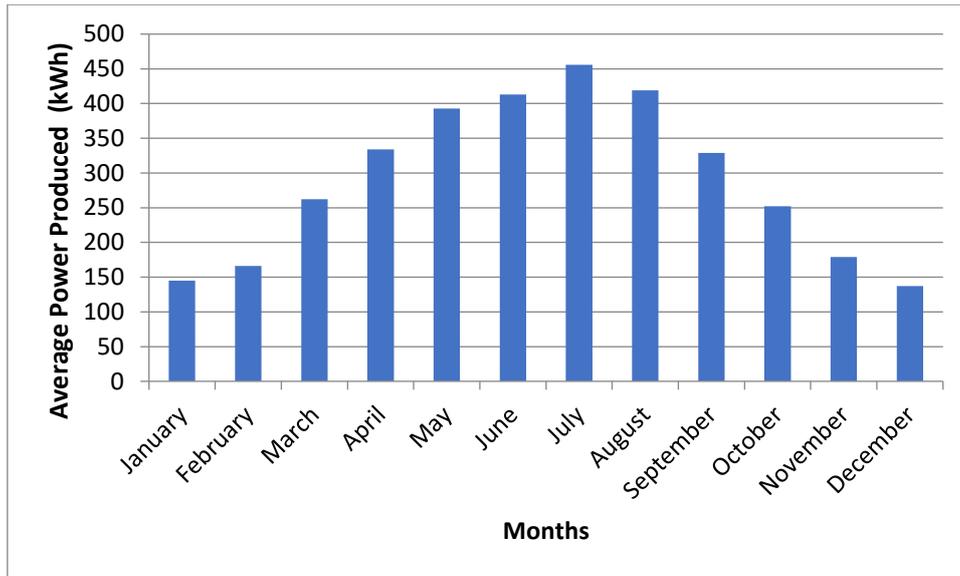
The area of PV for the required load is calculated to be 6,626 m<sup>2</sup> assuming efficiency of PV panels as 15,49%. The peak PV power calculated is 1026,32 Wp. CSUN 300-72M PV module has been selected for stand-alone PV system. The module is made of 72 monocrystalline silican cells connected in series to provide peak power of 300 Wp. The characteristics and specifications of PV module are shown in Table 2.

**Table 2.** Characterisitcs of PV module

<b>Characteristic</b>	<b>Rating</b>	<b>Unit</b>
Maximum power, P <sub>max</sub>	300	W
No. of cells	72	No.
Voltage at P <sub>max</sub> , V <sub>mp</sub>	36,1	V
Current at P <sub>max</sub> , I <sub>mp</sub>	8,32	A
Short circuit current (I <sub>sc</sub> )	8,80	A
Open circuit voltage (V <sub>oc</sub> )	44,8	V
Efficiency	15,49	%

A total number of 8 modules are required with a peak power of single module as 300 Wp, maximum voltage 36,1 V and maximum current as 8,32 A at STC of 1000 W/m<sup>2</sup> and 25 °C. The series and parallel configurations can be adjusted based on required DC bus voltage. The required capacity of the storage battery is calculated to be 1920 W h assuming N<sub>c</sub> as 1 day and DOD as 80%. Based on DC bus voltage of 12 V, the required capacity of the battery is calculated to be 160 Ah.

A graph showing the average of each particular month and corresponding power produced from off-grid PV system is shown in Fig. 2. Fig. 2 depicts the average power produced during different months of the years. It is evident from the Figure that peak average value in July is maximum and in December is minimum. The reason is that the city of Manisa is lying in northern hemisphere having maximum solar insolation in summer than in winter season and the energy range vary from about 137 kWh in peak winter (Dec) to 456 kWh in peak summer (July). The total energy produced per annum from off-grid PV has been found to be 3485 kWh. The results have shown that the annual energy produced using off-grid PV system is much higher than the annual energy demand throughout the year justifying the appropriate size and design of the existing PV system for continuous power generation for household electrification.



**Figure 2.** Average power produced from off-grid PV system

### 6. LIFE CYCLE COST ANALYSIS OF OFF-GRID PV SYSTEM

The life cycle cost analysis of off-grid PV system consists of total fixed and operating costs over its life expressed in today's money. The major cost of PV system includes acquisition costs, operating and maintenance cost. The total life cycle cost of PV system includes the sum of present worth (PW) of PV modules, storage batteries, charge controller, inverter, installation, and operation and maintenance cost. In case of PV system the life of system is considered to be 25 years except for storage batteries that is taken to be ten years. Therefore, each group of batteries needs to be replaced after every five years with effect of inflation ( $i$ ) and discount rate ( $d$ ).

The PWs of all the components can be calculated using the following procedure;

Cost of PV array,

$$C_{PV} = \text{Unit cost of PV} \times \text{No. of modules} \times \text{Peak module power}$$

Initial cost of batteries,

$$C_B = \text{Unit cost of battery} \times \text{battery size}$$

The PW of 1st and 2nd group of batteries after 10 and 20 years can be calculated using Eq. (4).

$$C_{B1} = C_B * \left(\frac{1+i}{1+d}\right)^N \tag{4}$$

The cost of charge controller is calculated using unit cost of charge controller multiplied by size of the charge controller and inverter cost as unit cost of the inverter multiplied by size of the inverter. The installation cost is considered to be 10% of initial cost of PV modules.

The PW of maintenance cost ( $C_m$ ) can be calculated using annual maintenance ( $M$ ) cost and lifetime of the system using Eq. (5).

$$C_M = M * \left(\frac{1+i}{1+d}\right) * \left(\frac{1 - \left(\frac{1+i}{1+d}\right)^N}{1 - \left(\frac{1+i}{1+d}\right)}\right) \tag{5}$$

Finally, the LCC of the system can be calculated using Eq. (6).

$$LCC = C_{PV} + C_B + C_{B1} + C_{B2} + C_C + C_I + C_{inst} + C_M \tag{6}$$

The annualized LCC (ALCC) of off-grid PV system in terms of its present value can be calculated using Eq. (7).

$$ALCC = LCC * \left(\frac{1 - \left(\frac{1+i}{1+d}\right)}{1 - \left(\frac{1+i}{1+d}\right)^N}\right) \tag{7}$$

The unit electrical cost can be calculated using Eq. (8).

$$UC_{el} = \frac{ALCC}{365 * L_{el}} \quad (8)$$

To calculate the cost of the suggested off-grid PV system, the following data of the system components have been taken into account using current market prices as shown in Table 3. The inflation and discount rate is taken to be 9% and 8%, respectively.

**Table 3.** Unit Costs Of PV System Components

Item	Unit cost	Unit
Cost of PV	0,48	\$/W
Cost of battery	1,66	\$/Ah
Cost of charge controller	1,319	\$/A
Cost of inverter	0,413	\$/W
Installation cost	10% of PV	\$
Operation and maintenance cost	2% of PV cost	\$

Using the above methodology and equations, the PW's of all the items have been calculated. The cost of PV array is calculated to be 1152 \$. The PW's of initial set of batteries was calculated to be 266.323 \$. The PWs of group of batteries for first after 10 years and second after 20 years were calculated to be 292,035 \$ and 320,231 \$ respectively. The total cost of charge controller and inverter was calculated to be 26,38 \$ and 1733.935 \$ respectively. The installation of PV system is taken as 10% of initial cost of PV system and was calculated to be 115,2 \$. The PW's of maintenance cost (2% of initial PV cost) was calculated to be 650,754 \$.

Finally, the total LCC of the system is the summation of all PW's of the system components including installation and maintenance cost and was calculated to be 4556,859 \$. The Annualized Life Cycle Cost (ALCC) of the system was calculated to be 162, 83 \$ per year. The unit electrical cost of the system was calculated to be 0,0806 \$/kWh.

## 7. CONCLUSIONS

With the increasing population and industrialization as well as with the depleting resources of fossil fuels, the utilization of solar energy is gaining popularity worldwide for household electrification. It is imperative to enhance the acceptance rate of this technology, it is worth full to determine the proper design, feasibility, viability, financing indicators, and risk factors involved in the implementation of off-grid PV electrification system.

The present study focuses on the design aspects and economics analysis of an off-grid PV system to fulfil the required load for a residential house in Turgutlu. This paper covers the algorithm for sizing of the complete PV system to determine the required capacity of peak PV array, battery storage capacity, size of charge controller and inverter to meet the energy demand. As a result of mathematical modeling, the peak power and area of PV modules, capacity of battery backup, size of charge controller and inverter were determined to be 1026,32 Wp and 6,626 m<sup>2</sup>, 1920 W h, 20 A and 4200 W, respectively. In order to assess the economic feasibility of this system to the end-users, life cycle cost analysis of off-grid PV system under consideration has been carried out and was found to be 4556,859 \$. Annualized life cycle cost and unit electricity cost have also been calculated to be 162,80 \$ per year and 0,0806 \$/kWh, respectively.

This model can be used to design and assess the economic feasibility of off-grid PV electrification in any geographical location of the world by sorting input data viz. solar insolation, cost of the conventional energy as well as the market prices of the off-grid PV components.

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## O 119. A SNEAKY GAS ALL OVER OUR LIVES; RADON

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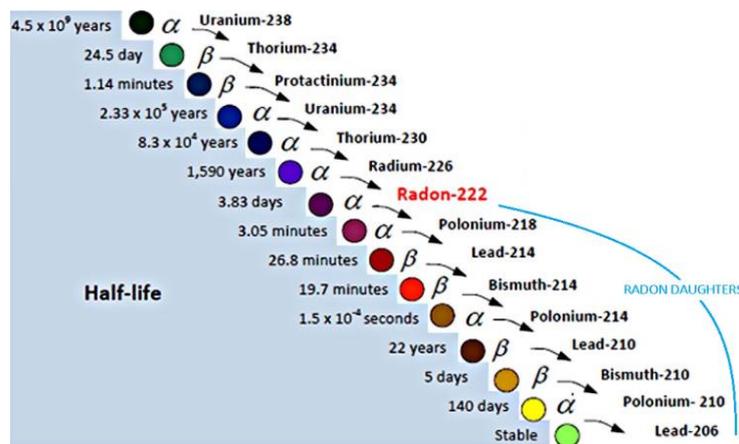
**ABSTRACT:** Radon gas, a radioactive substance, can be found almost anywhere in nature due to uranium. Because radon is released in the radioactive decay chain of uranium, it is not caused by human activities. It is the second most common cause of lung cancer after smoking. Radon, which does not appear to be dangerous in open areas, poses a high risk in closed areas and houses. The radon level in soil, air and water should be in accordance with international safety standards. It is important that the ground surveys of the buildings to be constructed be performed well and that the radon levels are determined correctly. When necessary, it is important for the human health to isolate the connection of the building with the soil floor. All building materials used in the construction and insulation of the building are suitable to be preferred by low-radiation ones. The smell, color and taste of radon cannot be felt; it is a dangerous inert gas that triggers the risk of lung cancer. For this reason, the greatest measure to be taken by the governments is to raise awareness and educate the public about the health problems that may be caused by this gas and the damages caused by the radon gas.

*Keywords: Radioactive elements, inert gases, radon gas, human health, lung cancer*

### 1. INTRODUCTION

Radon was first discovered by F. E. Dorn in 1900 and was isolated in 1908 by William Ramsay and Robert Whytlaw-Gray (Wilkening, 1990; Mc Laughlin, 2012; Parsons, 2003). Colorless, odorless and tasteless, Radon is the last member of the noble gases in the VIIIA group of the periodic table (Erees and Yener, 1999). Radon is a gas with an atomic weight of 222 atoms and defined by the symbol Rn, which is radioactive in nature. The boiling point is  $-62\text{ }^{\circ}\text{C}$  and the melting point is  $-71\text{ }^{\circ}\text{C}$  (Ferreira and Lobo, 2007; Smits et al. 2018; Tufaner, 2018).

Radon has 27 isotopes; the most important of these are radioactive gases known as radon ( $\text{Rn}^{222}$ ), thoron ( $\text{Rn}^{220}$ ) and actinon ( $\text{Rn}^{219}$ ) (Szabó et al., 2014; Appleton, 2007). Especially,  $\text{Rn}^{222}$  is considered in the measurements because of their very short half-lives and very small quantities. It is known that the amount of radon in nature is 20 times higher than the amount of thoron.



**Figure 1.** Radioactive elements and their half-lives in the radioactive decay chain of uranium

Radium ( $\text{Ra}^{226}$ ) is formed as a result of the radioactive decay of natural uranium ( $\text{U}^{238}$ ) on earth. Radioactive decay of radium ( $\text{Ra}^{226}$ ) with a half-life of 1600 years results in unstable radon gas ( $\text{Rn}^{222}$ ) (Pérez-Moreno et al., 2019). This gas is subjected to radioactive degradation by emitting alpha particles

( ${}^4_2\alpha$ ; helium nuclei) and beta particles ( ${}_{-1}^0\beta$ ) until it stabilizes. This decomposition results in short half-life and solid radioactive decay products. These are known as radon strains or radon daughters (figure 1). The last of many radioactive elements formed in the radioactive decay cycle is the stable  $\text{Pb}^{206}$ . Together with radon; all radioactive elements in the uranium decay chain can be found in rock, soil and water and can be released from all natural surfaces. The increase in the amount of radon in the gas content released from the bottom of the earth towards the surface can be considered as an important predictor of earthquake. Although the half-life of the radon is very short (3.8 days), 50% of the radiation in the natural environment is due to this element (figure 2) (Smits et al. 2018; Field, 1999; Ivanova et al., 2019).

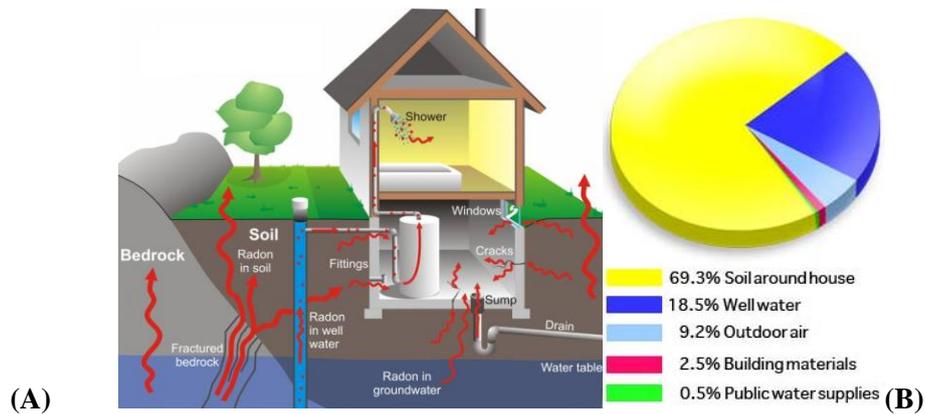


Figure 2. Radon oscillation paths (A); Radon resources (B)

## 2. REGIONS WHERE RADON GAS IS PRESENT IN THE WORLD

Variations in the amount of radon gas may be seen depending on the seasons and various factors (Prasad et al., 2016). Radon and its daughters can be found hanging in the air in high amounts in caves and rocks where uranium is present, the amount of which can vary from year to year and even from day to day. Especially in places where there are some geological structures such as granite and volcanic rocks, the high amount of radon can sometimes be detected even in drinking water (Poortinga et al., 2008; Baixeras et al., 2001). Radon and its daughters are invisible derivatives that are found in large quantities in tunnels, caves, mines, subway lines, shopping centers, factories, schools and offices, parking areas, spas and hot springs and structures in the earthquake zone (figure 3) (Swakon' et al., 2005; Doi and Kobayashi, 1996). It has been reported that the amount of radon is lower in places with sedimentary rocks. The fact that the amount of radon in the earth is infiltrating into buildings, which are the living spaces of people, presents serious dangers.

The majority of the radon source in the buildings is the soil and rocks at the base of the building. Radon and other gases rise along the ground and are trapped under the building. These trapped gases create great pressure. In our homes that are our living spaces, the air pressure is generally lower than that in the soil. Due to this high pressure at the bottom of the building, gases leak from the floor and walls of the building into the houses through the cracks and cavities. Radon gas can also leak into the houses through the wall cavities of the plumbing pipes in the building. Especially, it is seen that the amount of radon is higher in the basement and ground floors of the houses due to its being a heavy gas. In addition, radon gas can also be transported to houses with building materials used in the construction of the building (Al-Jarallah, 2001).

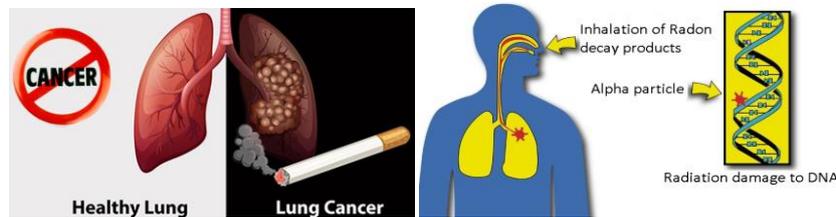




**Figure 3.** Different regions in terms of excess radon gas

### 3. NEGATIVE EFFECTS OF RADON GAS ON HUMAN HEALTH

Short-lived radon and radioactive decay products that cannot be detected without special devices are present as suspended particles in the air. They penetrate the human body through breathing but do not chemically bind to tissues. Since the solubility in tissues is very low. However, they may be trapped in the lungs in the form of radioactive aerosols and adversely affect human health by increasing radiation dose in the bronchial epithelium. When the alpha particles emitted during radioactive decay hit a surface, their energy is absorbed by the surface. Human skin is thick enough not to be affected, but alpha particles can strongly affect lung cells. This may result in cell damage and, in the future, lung cancer (Erees and Yener, 1999). Radon-induced lung cancer is estimated to be approximately 10-15% of all lung cancer cases (figure 4). This does not mean that anyone exposed to radon gas will develop lung cancer. Already the risk of lung cancer is higher in smokers (Poortinga et al., 2008). Radon and cigarette have a “synergistic” effect; that is, the damage caused by exposure to both is greater than the damage caused by the two separately. It can be said that the workers in the mines are in the highest risk group due to the high amount of radon they are exposed to (Lubin and Boice, 1997). Similarly, many people who use spas and caves for health often face the same risk. However, since the amount of radon in open areas is very low, no adverse effects on health are observed. Thus, except for the high level of radon, the cancer-causing effect of it is directly related to how much time a person spends in confined spaces and, of course, whether he smokes or not.



**Figure 4.** Lung cancer effects of radon

### 4. RADON LEVELS ALLOWED BY SOME HEALTH ORGANIZATIONS

It is the fundamental duty of all humanity to protect and raise public awareness against radiation. Therefore, national and international radiation protection institutions have been established in many regions of the world. The International Commission on Radiological Protection (ICRP), which was established in Stockholm in 1928, is the first to carry out studies. In radiation protection, there are many international organizations like; the United Nations Effects of Atomic Radiation Scientific Committee (UNSCEAR), the International Atomic Energy Agency (IAEA), the European Atomic Energy Community (EURATOM), Turkey Atomic Energy Agency (TAEK), the International Radiation Units Commission (ICRU), the World Health Organization (WHO), International Standards Organization (ISO) (Costa, 2014; Calmet, 2014; Ivanova et al., 2019). The permissible radon level in homes and workplaces is determined by these organizations. According to the IAEA Basic Safety Standards, the recommended levels for radon are determined in the range of 200 to 600 Bq/m<sup>3</sup>, while the amount of radon according to ICRP should be <300 Bq/m<sup>3</sup> in homes and <1000 Bq/m<sup>3</sup> in workplaces. The amount of radon in the same habitats was reported by TAEK to be <400 Bq/m<sup>3</sup> in houses and <1000 Bq/m<sup>3</sup> in workplaces respectively (Kürkçüoğlu and Tozun, 2015; Tufaner, 2011). As can be understood, there are limits to the amount of radon determined by each country as well as international standards and there are differences between these values even though they are close to each other. In case the said radon limit values are exceeded, warnings are made by the national and international organizations to take

measures to reduce the amount of radon and the necessary recommendations are forwarded to the relevant units.

## **5. PRECAUTIONS FOR RADON**

The construction areas should be analyzed thoroughly, and it should be determined whether the surface is suitable for radon levels and whether the new buildings will be isolated from radon should be taken into account (Darby, et al., 2001). The houses used should be ventilated frequently and the cracks in the basement and ground floors should be repaired. In particular, the floors below the third floor of the buildings should be investigated in terms of radon gas and necessary precautions should be taken. In addition, the control and supervision of the functioning of the ventilation systems of the buildings should be done periodically. Care should be taken not to establish residential areas in locations where international radon gas levels are exceeded. Construction of buildings should be allowed particularly in areas away from earthquake risk areas. Or the floor area where the building will be built must be isolated from radon gas.

## **6. CONCLUSION AND SUGGESTIONS**

Since Radon is colorless, odorless and cannot be detected without special devices, it is necessary to be protected from this gas by taking necessary precautions in living areas. In particular, ground surveys of long-term homes and workplaces should be carried mandatorily out with care. The preparation of a report by the relevant management units on whether the ground is suitable for constructing a building in terms of radon gas is the basic element in protecting human health. Radon, which is a radiation hazard, is a harmful gas that can adversely affect human health and trigger the risk of lung cancer. Therefore, it is helpful for countries to keep their radon levels within the standards set by the World Health Organization. In fact, it is necessary to bring in the expert units in order to determine the radon level and maintain the amount of this gas at a constant level. Personnel trained as specialists in the field of radon gas should be on duty and the construction of buildings should only be allowed with proper ventilation systems.

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- Figure 2; (B)- <https://www.radontestinginma.com/other-radon-sources-in-the-home.html> (18.06.2019)
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- <https://eurasia.uitp.org/metro-train-heart-russia-launched-london-underground> (18.06.2019)
- <http://absalarm.com.tr/en/?p=677> (18.06.2019)
- <https://www.bigstockphoto.com/tr/image-96310/stock-photo-otopark> (18.06.2019)
- [http://www.yapi.com.tr/haberler/maden-ocaklari-icin-hazir-tahkimat-sistemi-alinacak\\_125774.html](http://www.yapi.com.tr/haberler/maden-ocaklari-icin-hazir-tahkimat-sistemi-alinacak_125774.html) (18.06.2019)
- Figure 4; [https://www.google.com/search?biw=1600&bih=757&tbm=isch&sa=1&ei=eOIIxcq-BMbEwALPqJWIBg&q=lung+cancer&oq=lung+cancer&gs\\_l=img.3..35i39j0i4j0i30i5.673644.675759..676159..0.0.0.139.1481.0j11.....0....1..gws-wiz-img.....0i67.VQm8NRrjOzE#imgsrc=MIRjWahpaAySuM](https://www.google.com/search?biw=1600&bih=757&tbm=isch&sa=1&ei=eOIIxcq-BMbEwALPqJWIBg&q=lung+cancer&oq=lung+cancer&gs_l=img.3..35i39j0i4j0i30i5.673644.675759..676159..0.0.0.139.1481.0j11.....0....1..gws-wiz-img.....0i67.VQm8NRrjOzE#imgsrc=MIRjWahpaAySuM) (18.06.2019)
- <http://www.testexpert.ca/radon-test/> (18.06.2019)

**O 120. THE EFFECTS OF OVERSIZED/ OVERLOADED VEHICLES ON HIGHWAY  
FLEXIBLE PAVEMENTS AND SELF-PROPELLED MODULAR TRANSPORTER  
(SPMT) EXAMPLE**

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**ABSTRACT:** Highway flexible pavement design; is based on the determination of the thickness of the layers according to the characteristics of the material to be used in the current traffic loads and environmental conditions in a way to resist the stresses that will occur during the design life. An exemplary study on the transfer of an important building with SPMT (Self-Propelled Modular Transporter) carried out. Converting the axle load of the SPMT to the Equivalent Standard Single Axle Load Repetition Number; AASHTO 1993 design method, which is still the most used pavement design method in our country and in the world, has been calculated by using the damage formulas and the layer thickness calculation has been made. As the Mechanistic-Empirical Design Method has become an increasingly powerful method in the design of pavement according to empirical methods (AASHTO 1993), the mechanistic-empirical design method was used to compare the damage. For this, using the Kenpave software which is accepted as a reference in the mechanistic-empirical pavement analysis, the maximum stresses that will occur under the asphalt layer were calculated while passing SPMT's. The maximum horizontal tensile stress under the surface layer due to axle loads and the vertical pressure force are used to determine the number of load repetitions that will cause cracking and rutting damage, which is defined as the fatigue life of the pavement.

*Keywords: Equivalent Standard Single Axle Load Repetition Number, Kenpave, Overweight/Oversized Vehicle, Project Logistics, Self-Propelled Modular Transporter*

## **O 121. STEROIDS AND THEIR EFFECTS ON HUMAN HEALTH**

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**ABSTRACT:** Steroids, which have important functions in the living body, are natural hormones that are naturally released into the blood from gonads and adrenal glands. However, these hormones can also be synthesized artificially. Synthetic steroids are chemical molecules that work just like natural hormones. Synthetic steroids are widely used in medicine for the treatment of various diseases. It is known that immunosuppressive steroids are used to suppress the immune system and anti-inflammatory steroids are used as anti-inflammatory agents. The main purpose of the initial synthesis studies of steroids was to be able to treat the hormonal disorders in the human body. Today, however, many people and especially athletes, are using steroids to accelerate fat burning in their bodies and increase muscle development and body resistance. Irresponsible use of steroids can lead to a deterioration of the natural hormone balance and several side effects in the human body. These side effects occur in overdose and long-term use, even if not in all people. Side effects associated with steroid use include acne, blurred vision, cataract, glaucoma, insomnia, high blood pressure, weight gain with appetite, hair growth, bad temper, restlessness, sudden mood swings, swollen face, edema, worsening diabetes and liver damage. The use of steroids should always be checked by experts to minimize the side effects on human health.

*Keywords: Synthetic steroids, corticosteroids, anabolic steroids, natural hormones*

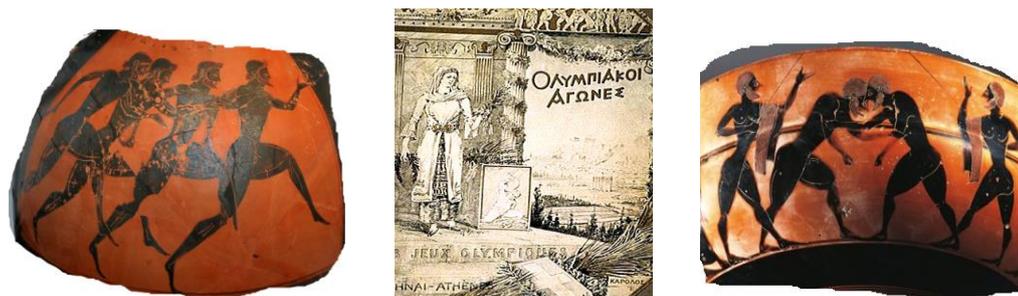
### **1. STEROIDS AND THEIR TYPES**

Steroids are divided into two main groups as natural and synthetic (Aufartová et al. 2011). Natural steroid hormones are natural hormones produced from cholesterol in gonads and adrenal glands and released into the blood (Rone et al. 2009; Soldin and Soldin, 2009). They are produced at the levels required by the body. Cholesterol, which takes part in natural synthesis, is the precursor of five major steroid hormones secreted in the body. These hormones are progesterone, cortisol, aldosterone, estrogen and testosterone. These 5 hormones are important hormones that assume various functions in our body. Synthetic steroid hormones, on the other hand, are natural steroids that can be synthesized under laboratory conditions. In other words, important steroids in our body are also produced by synthesis and used for various purposes. Artificial steroids are used both by patients in terms of medical requirements and by athletes to provide muscle and performance gains (Hoffman and Ratamess, 2006).

### **2. HISTORY OF STEROIDS**

It is thought that the efforts to improve the performance of athletes with steroid use started in the 1940s. In fact, the basis of these studies dates back to the 1700s. Indeed, the preparation of athletes competing in the Greek Olympics by consuming sheep and bull testicles and the serious improvements in their performance due to this consumption was written in the historical records as also showing in figure 1 (Yesalis and Bahrke, 2002).

In fact, the presence of hormones in the testicles was first recognized by religious leaders and medical professionals of the late 15th century. Actually, the testicles of young men assigned to sing at the opera were removed to prevent puberty from changing their voices. Thus, these people were enabled to sing in soprano tones. These young children were boys of that time and called Castrati (Peschel and Peschel, 1987).



**Figure 1.** Historical records of sports in ancient time

Synthetic testosterone hormones were first used during World War II. During the war, these hormones were used to eliminate the malnutrition of the soldiers and to increase their body weight to make them stronger during the war (Yesalis and Bahrke, 2005).

In the same years, the use of anabolic steroids was very common in the Soviet Union. The success of the Soviet Union in international sporting events has been the biggest proof of this. In 1952, the wrestling team of the Soviet Union increased their performance with these compounds and attracted attention. In 1953, 19-nortestosterone (nandrolone) was the first synthesized anabolic steroid. This derivative performs 5 times better than testosterone in terms of muscle building. Dr. John Ziegler learned that a Soviet coach used steroids at the weight lifting championship in Vienna in 1954 and decided to work in this field and in 1958 he synthesized methandrostenolone (dianabol) (Todd, 1987).

During the 1988 Olympic Games in Seoul, Ben Johnson used Stanazolol, an anabolic steroid, and set a record by completing the 100-meter marathon in 9.79 seconds. However, these substances were detected in his urine samples and his gold medal was withdrawn (Yoshida et al., 1994). In 1998, at the Tour de France, Russell, coach of the Festina cycling team, admitted that his team was using steroids called erythropoietin (EPO) (Savulescu et al., 2004). There are many similar examples around the world. For this reason, it has been made compulsory to perform a doping test in all sports activities.

### **3. MEDICAL USE OF STEROIDS AND THEIR EFFECTS ON HUMAN HEALTH**

Doctors often use steroids to treat muscle loss, anemia, developmental disability and delayed puberty in patients. Corticosteroids, which are similar to the hormones secreted by the adrenal glands and also happen to be their synthetic forms, are steroids commonly found in medicine. They are prescribed by doctors in almost every area from calcification to the treatment of respiratory diseases (Tabakoğlu, 2014; Akdoğan and Özen, 2006).

Androgenic steroids, the synthetic form of hormones secreted from gonads, play an active role in prostate, seminiferous vesicles, gland growth, increased body mass, skeletal development and closure of the pineal plaque (Carson and Manolagas, 2015). In addition, in the treatment of premenopausal breast cancer, trauma, surgical intervention, prolonged inactivity and after severe diseases, the use of androgens and anabolic steroids in combination with appropriate diet and exercise is useful.

Anabolic Androgenic Steroids (AAS) are synthetic derivatives of testosterone (Rogol and Yesalis, 1992). They are often used to promote the growth of muscles and bones due to their ability to increase cell growth and division. However, they can also increase the growth of other body tissues. There are many different types of anabolic steroids and each of them has different anabolic and androgenic properties. These are called AAS or Anabolic-Androgenic Steroids. Bone growth, appetite, puberty and muscle growth can be stimulated by using anabolic steroids. Anabolic steroids are being used by athletes because they increase protein synthesis, muscle mass and strength (McBride et al., 2016). Even when the great benefits of using anabolic steroids for medical purposes are controversial, their use by athletes for training purposes is a contradiction. Due to the potential health effects of anabolic steroids, the use of these substances is controlled in the United States and other countries.

#### **3.1. Side effects of steroids**

Not everyone who uses steroids may experience side effects and harm. There are those who have been using steroids for a long time but have not suffered any side effects or harm, there are, by contrast, those who have been exposed to permanent damage even after using them for a very short time. Everyone's

body structure, functioning and genetics are different. Therefore, irresponsible and excessive use of steroids can cause significant health problems (Bordin et al., 2017). Excessive doses of both oral and injectable steroids have serious side effects. Side effects of overdose may include acne, blurred vision, cataract, glaucoma, easy bruising of the skin, difficulty in sleeping, high blood pressure, increased appetite, weight gain, body hair growth, less resistance to infection, muscle weakness, bad temper, uneasiness, osteoporosis, sudden mood swings, swollen face, edema, worsening diabetes, high blood pressure, high total cholesterol, increased acne and pimple, hair loss and baldness, prostate cancer (Vardar et al., 2002; Talas and Pınarcı, 2010).

#### **4. CONCLUSION**

Natural and artificial steroids have important functions for human health. The body produces a certain number of steroid hormones in its own balance. However, in case of insufficient steroid production or medical necessity in the body, a specialist doctor can give artificial steroids to his patients for treatment. In addition, athletes can use synthetic steroids to improve their body and muscles and to increase their performance in competitions. Irresponsible use of these drugs can cause negative side effects in the human body. For this reason, in case of medical needs where steroid use is necessary, it should be done under doctor's supervision. Of course, the profit and loss relationship for the patient and/or athlete who will use steroids should be considered by experts.

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**O 122. EVALUATION OF THE USE OF BIOMIMESIS IN BUILDING SHELL DESIGN  
THROUGH EXAMPLES**

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**ABSTRACT:** Mankind has tended to constantly regulate its environment in order to meet its needs and desires since its existence. For this, he benefited from the order of nature. The operation and sustainability of the cycle in nature has been an inspiration in the design, and sustainable/ ecological designs have begun to be made. In parallel with the development observed in ecological architecture, especially thanks to the recently developed technology, studies have started in terms of materials, processes and formations by going beyond formal and structural concerns. At this point, the science of biomimesis has come to the fore. Biomimesis is a new science that brings sustainable solutions in design by observing the formations, textures and strategies found in nature to the problems of humanity. Within the scope of the study, it was aimed to determine the use of biomimesis in shell design by associating it with nature in terms of sustainability. In this context, it has been evaluated through sample designs in accordance with determined biomimesis principles. As a result, example structures with biomimetic solutions show that a biomimetic approach based on nature is a very important source in designing structural shells for architects, producing versatile innovative ideas, and providing sustainable solutions to problems that may arise today and in the future.

*Keywords: biomimesis, sustainability, ecological design, building shell design*

**O 123. DETERMINATION OF ENVIRONMENTAL MICROORGANISMS BY IMAGE  
PROCESSING**

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**ABSTRACT:** Environmental microorganisms are microscopic organisms found in natural (lake, river, sea, air, soil, etc) and artificial (suspended and attached biological reactor, oxidation ponds, constructed wetlands etc) environments that cannot be seen with the naked eye. The classification of environmental microorganisms is very important in monitoring environmental quality and operating biological reactors. However, microbiological analyzes are quite time consuming, laborious and expensive by conventional methods. In recent years, rapid advances in optical and software technology have allowed conceptualization and rapid recognition of small organisms such as bacteria and protozoa (0.1-100 µm) by means of microscopes. In this new classification technology, which is known as digital image processing, the microorganisms are preferably stained with a suitable dyestuff with taking the images by microscope, after this image is processed morphologically and then taken into the computer's memory. Identification of the microorganism is performed by comparing with the processed images. In this study, the method of image processing which is very advantageous compared to the laborious classical methods and the expensive molecular microorganism determination methods, are explained conceptually and information about the limited studies are given.

*Keywords: Environmental microorganisms, Identification, Image, Microscopy, Processing*

**O 124. WHICH IS GREENER: PLASTIC BOTTLES OR ALUMINUM CANS?**

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**ABSTRACT:** Bottled and canned drinks are big business in the world. For soft drinks, the same product comes packaged in a variety of different containers. So, what is the best environmental option – plastic bottle or aluminium can? This study aims to compare the life cycle environmental sustainability of plastic and aluminium packaging. Life cycle assessment (LCA) study has been carried out in compliance with the ISO 14040 and 14044 standards. The scope of the study is from cradle to grave starting with the extraction of natural resources to final disposal of the product. LCA study is conducted on the packaging of 1000 litres soft drink in 330 ml Al-cans and 200 ml PET bottles produced. LCA software tool CCaLC2 has been used for calculating carbon footprint. The comparative LCA study reveals that the Aluminium cans are found to have the higher environmental impact than PET bottles. In addition, the resulted environmental impacts could be significantly reduced via increasing the respective recycling rates of the two investigated packaging materials.

*Keywords: Life cycle analysis, sustainability, packaging, carbon footprint and environmental impact*

**O 125. GREENHOUSE GAS EMISSIONS FROM CEMENT INDUSTRIES IN TURKEY**

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**ABSTRACT:** Cement production is the most important source of process-related CO<sub>2</sub> emissions, which taking up nearly half of all process-related CO<sub>2</sub> emissions. There are fossil fuel combustion and process related emissions in the cement industry. It is responsible for the most important part of human source CO<sub>2</sub> emissions in the cement sector. In this study, CO<sub>2</sub> emissions from the cement industries in the different regions of the turkey were detected as fossil fuel combustion and process related emissions.

*Keywords: Air pollution, cement industry, greenhouse gas emissions, Turkey.*

## **O 126. ENGINEERING PROPERTIES OF HYBRID FIBER REINFORCED CEMENTITIOUS COMPOSITES FOR SUSTAINABLE STRUCTURES**

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**ABSTRACT:** An experimental investigation was carried out on hybrid fiber reinforced cement mortars through the use of polymeric (1% by volume) and steel fibers (1% by volume). In order to compare results specimens were also produced with single fiber incorporation together with plain specimens as reference. The incorporation of single fibers was totally kept at 2% by volume of each mixture. A total of 4 mixtures were produced and specimens were tested to assess their compressive strength and flexural strength. Improvement of basic engineering properties was further elaborated via microstructural characterization including scanning electron microscopy and video microscope recorder. Results suggest steel fiber incorporated cement mortars by volume of 2% were promising to exhibit increased bending resistance while hybrid and single polymeric fiber reinforced specimens were comparable.

*Keywords: Sustainability, polymeric fibers, steel fibers, mechanical properties.*

### **1. INTRODUCTION**

Different types of fibers are widely used to improve the flexural strength of cement-based composites (Balaguru et al. 1992; Nawy, 2001). The role of fibers is generally ascribed to bridging cracks to delay the propagation so that additional force is necessary to break the bond strength between fibers and matrix (Johnston, 2001). Also, fibers provide controlling shrinkage, improving fracture toughness and impact resistance for plain concrete mixtures (Sorelli et al., 2006). However, fiber inclusion may cause air-entrapped voids in cement paste and interface that worsen the mechanical properties. Delaying of crack growth can be possible when several processes take place in the concrete due to fiber pull-out, rupture or yielding of fibers. At the final stage, an increased number of cracks tend to link each other to create wider cracks that result in a fracture. Several studies suggest that the performance of the fibers in concrete mixtures is mainly related to their dispersion (Mobasber et al., 1990) and ratio (Betterman et al., 1995). So far, different types, sizes and ratios of fibers have been investigated to precisely understand their reinforcement contribution in concrete (Lawler et al., 2003; Sahmaran et al., 2005). Micro or/and macro fibers reinforcements sustain a random of crack arresting in cement-based materials composites, nevertheless, the fibers act solely at their specific properties. To date, studies have proved that utilization of at least two different types of fibers, i.e. hybrid fibers, can improve the engineering properties of cementitious composites. (Sahmaran et al., 2007). Hybrid reinforcement system in cementitious composites possesses a behavior of a higher chance of defect mitigation compared to specimens that do not contain fibers or contain single fiber type. In addition to that, not all fibers provide higher ductility due to their characteristic mechanical properties and brittleness (Lawler et al., 2003).

In this study, fiber hybridization system of cement-based materials has been developed by the incorporation of different fibers into the cementitious system. The compressive and flexural strength of cement mortars reinforced by microscale (steel and polymeric) fibers have been investigated. Furthermore, microstructural analysis has been performed to confirm the findings of abovementioned properties by SEM and microscope analysis. The contribution of fibers in the crack development mechanism was aimed to be outlined throughout the study.

### **2. EXPERIMENTAL DETAILS**

#### **2.1. Materials**

Portland cement (PC) Type I CEM-42.5/R, similar to ASTM Type I, was used as a hydraulic binder in the production of mixtures. Specific gravity and Blaine fineness of Portland cement were 3.1 and 325 m<sup>2</sup>/kg, respectively. Physical properties and chemical composition of PC was given in Table 1. Standard

silica sand (max. aggregate size of 2 mm) was used in mixtures with the conformity of CEN (CEN 196-1, 2009). The particle size distribution of the silica sand was presented in Table 2. For each mixture, polycarboxylic ether-based high-range water reducing admixture (HRWRA) was added to obtain similar flow.

**Table 1.** Physical and chemical properties of PC

Chemical composition, %	PC
CaO	61.12
SiO <sub>2</sub>	21.63
Al <sub>2</sub> O <sub>3</sub>	5.12
Fe <sub>2</sub> O <sub>3</sub>	3.45
MgO	2.41
SO <sub>3</sub>	2.39
K <sub>2</sub> O	0.69
Na <sub>2</sub> O	0.22
SiO <sub>2</sub> +Al <sub>2</sub> O <sub>3</sub> +Fe <sub>2</sub> O <sub>3</sub>	30.2
Specific gravity	3.10
Blaine fineness (cm <sup>2</sup> g <sup>-1</sup> )	3250

**Table 2.** Particle size distribution of the silica sand in mortars

Particle size (mm)	Cumulative retained sand (%)
2.00	0
1.60	7 ± 5
1.00	33 ± 5
0.50	67 ± 5
0.16	87 ± 5
0.08	99 ± 1

Hooked-end steel fibers with lengths of 30 mm, diameters of 0.56 mm, specific gravity of 7.85, and tensile strength of 1500 MPa were used in the mixtures. Polymer type synthetic fibers with lengths of 6 mm, diameters of 27 μ, specific gravity 1.14, and tensile strength of 962 MPa was used to the reinforce cementitious system. Polymeric fibers (PF) and steel fibers (SF) used in the study were given in Figure 1.



**Figure 1.** Polymeric and steel fibers

## 2.2. Preparation of Mixtures

A standard cement mortar fabrication was followed in conformity with the Turkish Standard (TS EN 197-1, 2009). Apart from standard mortar preparation, different amount of fibers were used for both

steel and polymeric fiber reinforced cement mortars. To start with, water was put into mortar mixer together with the cement and mixing started for 30 seconds in 62 round per minute (rpm). Then, silica sand was gradually added into the mixer in 30 seconds and mixing continued for another 90 seconds in 125 rpm. SFs or/and PFs were gradually added into the mixer tank during 60 seconds for relevant mixtures. Together with fiber addition, chemical admixture was used to provide similar consistency (flow diameter  $20\pm 1$ ) for each mixture. Specimens were molded to prismatic specimens with the dimension of  $40*40*160$  cm. Three specimens were fabricated for each type of mixture (Figure 2).



**Figure 2.** Specimens produced from four mixtures

After 24 hours, mortars were taken from molds and kept in thermostat controlled curing tank for 27 days in lime-saturated water at  $20\pm 2$  C.



**Figure 3.** Thermostat controlled curing of specimens at  $20\pm 2$  C

Ingredients of the total 12 specimens and their mixture identities were given in Table 3 in order to be easily followed in the study

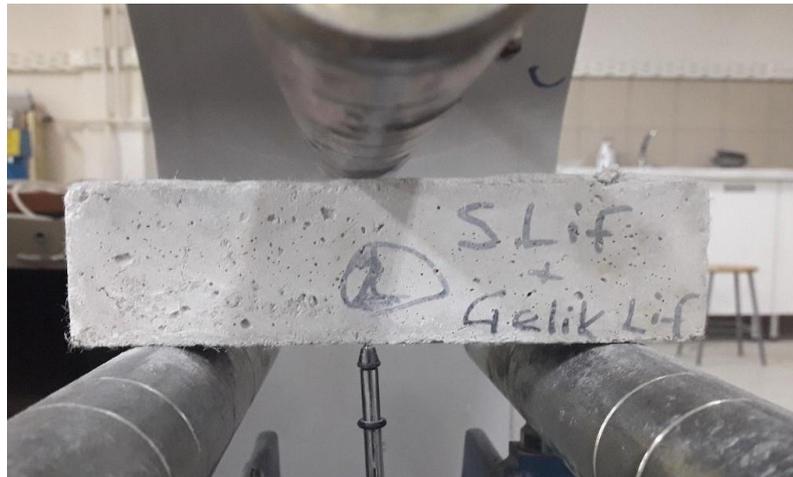
**Table 3.** Ingredients of the mixtures by weight (gr)

Mix ID	Cement	Fly ash	Water	w/b ratio	Sand	PFs (by volume of total mixture)	SFs (by volume of total mixture)
1. M/Ref.	450	-	225	0.5	1350	-	-
3. M/PF	450	-	225	0.5	1350	1%	-
4. M/SF	450	-	225	0.5	1350	-	1%
6. M/SF-PF	450	-	225	0.5	1350	0.5%	0.5%

## 2.3. Experiments

### 2.3.1. Mechanical Properties

Flexural and compressive strength of each mixture was evaluated in accordance with TS-EN 1015-11 (TS-EN 1015-11, 2000). Compressive strength was determined on each half of 160 x 40 x 40 mm prism specimen by uniaxial loading at 2400 N/second. The flexural strength of mortars was determined by three-point loading of a 160 x 40 x 40 mm prism specimen (Figure 4). The loading rate was applied at 50 N/second. Specimens were placed on supports of the testing machine as details were given in Figure 4. Both mechanical tests were carried out for 28 days-old specimens.



**Figure 4.** 3-point bending tests of hybrid fiber reinforced cement mortars

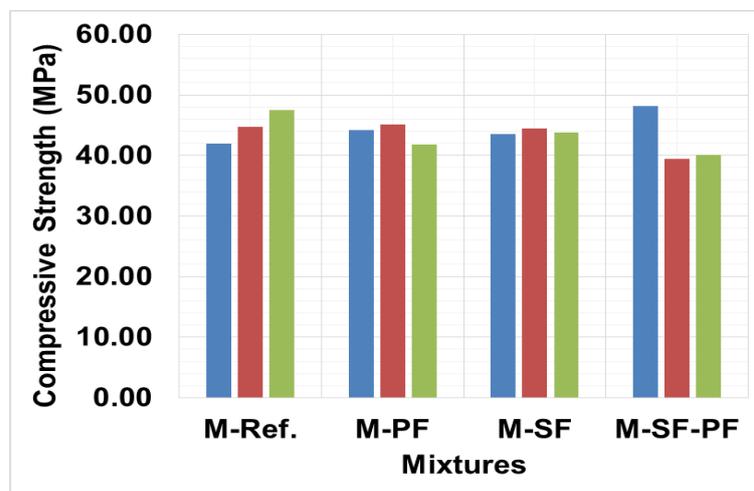
### 2.3.1. Microstructural analysis

Microstructural analysis was performed to confirm the physical structure of cement mortars at 28 days as a validation of mechanical results. To this end, microstructural properties of cement mortars were assessed with the use of SEM images. The surface of fibers and fiber-matrix interfaces were investigated under a scanning electron microscope. To that end, samples were sliced into 1\*1\*1 cm pieces for each mixture

## 3. RESULTS and DISCUSSIONS

### 3.1. Compression Tests

Mechanical properties of four different cement mortars were determined. The results of the experimental in compressive strength were given in Figure 5.

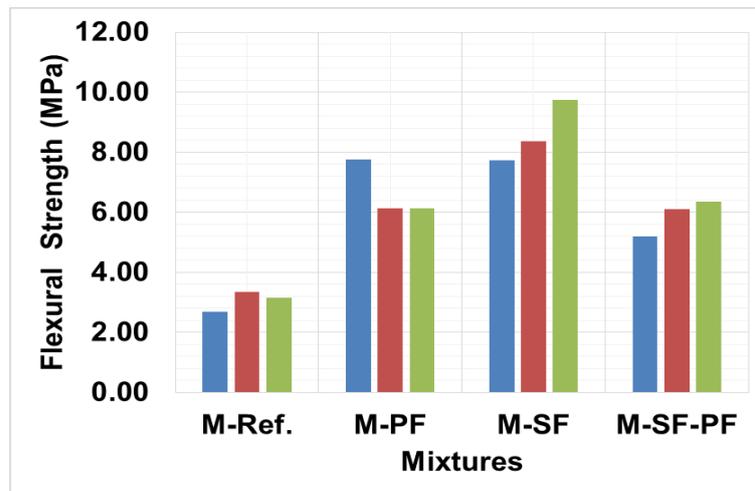


**Figure 5.** Compressive strength of different mixtures at 28 days

As given in Figure 5, the average compressive strength of mixtures were 44.8 MPa, 43.7 MPa, 43.9 MPa and 42.6 MPa for M-Ref, M-PF, M-SF and M-SF-PF specimens, respectively. The negligible reduction in the average compressive strength of M-SF-PF mixture compared to the reference mixture can be attributed to entrapped air due to the inclusion of fibers into mixtures. Also, it can be stated that variation in compressive strength of hybrid fiber reinforced mortars was higher than the other three mixtures. However, the average compressive strength of mixtures at 28 days was comparable and no significant reduction was obtained. Although fibers may have led to entrapping of air into the cement matrix, the capability of flaw-bridging effects of fibers at the microscale could have mitigated this detrimental effect.

### 3.1. Flexural Tests

Flexural strength of different mixtures under 3-point bending experiments was presented in Figure 6.



**Figure 5.** Flexural strength of different mixtures at 28 days

As can be clearly inferred from Figure 6, the average flexural strength of all fiber reinforced cement mortars was higher than control specimens. For example, the average flexural strength of PF based mixtures was 118% higher than the reference mixture. These increment rates were recorded at 182.6% and 92.7% for M-SF and M-SF-PF mixtures, respectively. Compared to compressive strength, the inclusion of fibers enhanced the properties of M-PF under flexural loadings, as expected. However, the dispersion of steel fibers into cement-based materials was more promising in terms of flexural strength. This result can be ascribed to higher rigidity of steel fibers contributing to higher resistance under flexural loadings. Since the tensile strength of steel fibers (1500 MPa) is higher than polymeric fibers (962 MPa), the increment of flexural strength in M-SF was more pronounced compared to M-PF. The average of flexural strength of M-PF specimens was 6.68 MPa while it was 8.62 MPa and 5.88 MPa for M-SF and M-SF-PF specimens, respectively. Although higher rigidity of steel fibers contributed higher flexural strength, it was observed that the crack width of M-SF specimens was larger than M-PF and M-SF-PF specimens. This suggests that fracture toughness is higher in M-SF specimens and it may indicate that lesser energy absorption capacity can be possible although this requires further study. Figure 6 presents the larger crack width of M-SF specimens and tight crack width of specimens.



Steel fiber reinforced cement mortars after flexural tests



Hybrid fiber reinforced cement mortars after flexural tests

**Figure 6.** Different cracks widths of specimens after tests

### **3.1. Microstructural Tests**

Microstructural analysis confirms that larger crack widths of M-SF specimens are due to pull out of steel fibers under a high level of flexural loadings. Lesser ductile behavior of M-SF specimens compared to polymeric fiber incorporated specimens (M-PF and M-SF-PF) is due to sudden failure of M-SF specimens. On the other hand, tight crack width of polymeric fiber incorporated specimens can be related to reduced toughness of specimens so that higher chance of increased strain under bending loadings is possible. Figure 7 illustrates the dense hydration products and crack width of M-SF specimen.

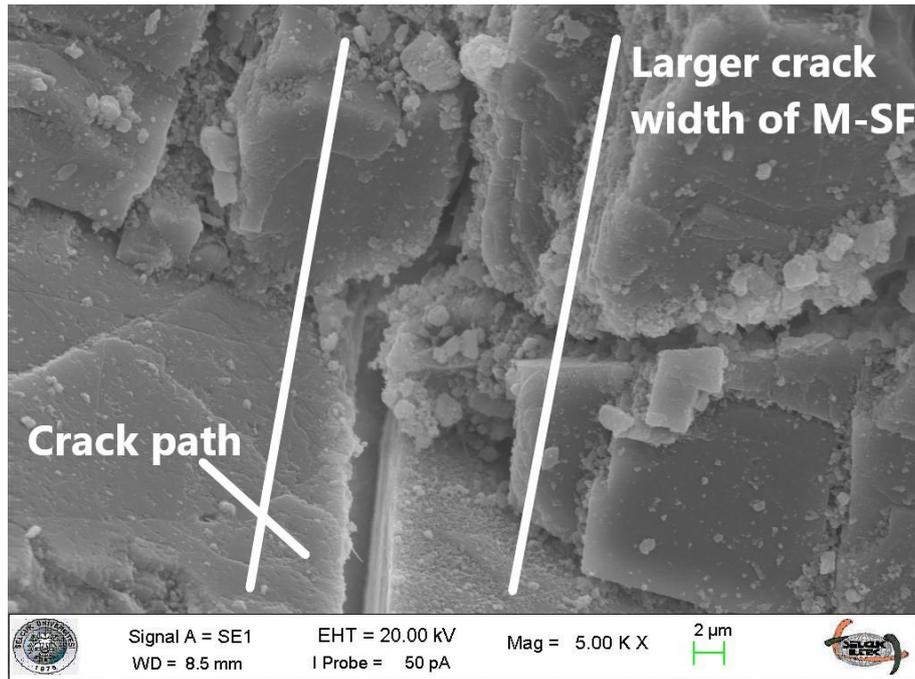


Figure 7. SEM image of steel fiber reinforced cement mortars

#### 4. CONCLUSIONS

An experimental investigation was performed to determine the mechanical properties of single and hybrid fiber reinforced cement mortars. After evaluating the basic engineering properties, the microstructural analysis was performed on mortars. The following conclusions can be made below;

- The addition of polymeric fibers or/and steel fiber did not cause a considerable reduction in compressive strength although the variation of compressive strength values was higher in M-SF-PF mortars. These results suggest that more experimental investigation should be made on hybrid cementitious mortars. Possibly, the inclusion of fibers may have led to entrapped air whereas fibers may have also played a significant role in delaying of cracks under compressive loadings.
- Steel fiber based mortars were promising in flexural strength compared to M-SF-PF, M-PF, and M-Ref. specimens. The reason can be related to higher tensile strength and rigidity of steel fibers that triggers resistance at a higher level of flexural loadings at fracture stage.
- Microstructural analysis supports the abovementioned findings that steel fibers increased the flexural strength however larger crack width was obtained after experiments compared to polymeric fiber incorporated specimens. These results also support that steel fiber incorporated specimens were more fragile than other specimens although this finding necessitates further investigation.

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## **O 127. COMPARISON OF FIBER REINFORCED AND CARBON NANOTUBE MODIFIED CEMENT MORTARS**

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**ABSTRACT:** Brittleness of concrete has been tailored to higher bending attribute thanks to reinforcement elements which mostly include steel bars and several types of fibers. Inclusion of fibers into cementitious matrix has become a well-known practice in terms of improving engineering properties. Recent developments in nanotechnology products have led to the utilization of nano-scale materials in cementitious composites for different purposes. Among nanomaterials, carbon nanotubes (CNT) possess superior properties for the benefit of the mechanical properties compared to conventional additives. Taking into consideration the fact that there is an likeness between the micro-scale and bulk structure of the material, uniting both scales in an engineering manner is significant especially in the use of nanomaterials. In this paper, researchers performed an experimental study on the reinforcing of cement-based materials. To do this, CNTs were incorporated homogeneously in cement mortars. Also, conventional fiber reinforced cement mortars were produced by using polymeric fibers together with specimens that do not contain any reinforcing elements as reference. Produced specimens were tested under compression and flexural loadings. Results of each mixture were discussed in terms of basic engineering properties taking into account of microstructural investigations.

*Keywords: Nanomaterials, sustainability, fibers, cement mortars, mechanical properties*

### **1. INTRODUCTION**

Cementitious materials are brittle due to low strength at tension zone and inadequate in strain capacity. Homogeneously distributed fibers serve the purpose of eliminating the brittleness of concrete and its weak resistance to crack initiation and progress. Improved tensile strength, ductility and toughness can be obtained owing to fiber inclusion into cement-based materials. (Vandewalle, 2007; Jamshidi and Karimi; 2010; Yao et al. 2003; Öztürk et al. 2018). Favorable mechanical properties can be gained by hindering or controlling the different crack patterns by means of metallic or polymeric fibers in concrete mixture design. Many studies can be found in the literature with the intent of improving the ductility and toughness of cementitious composites by utilizing different fibers (Brandt 2009). Since fiber reinforced concrete comprises different stages of crack formation from micro-crack occurrence to propagation of a macro-crack (Banthia and Nandakumar 2009; Ahmed et al. 2003), cementitious composites can be tailored to advanced properties approximately in the given production cost by combination of different fibers (considering type, ratio and amount) as reinforcement.

Beside conventional reinforcing elements such as polymeric fibers, limited attempts to date have been presented in incorporating nanoscale reinforcement agents in cementitious material systems. Carbon-based nanomaterials have proved to significantly increase the mechanical performance of cement-based materials due to their unique ability to fill pores, physically supporting the hydration process and effectively bridging micro / nano-cracks under loadings (Öztürk et al. 2018; Öztürk, 2015).

In this study, different fiber reinforced cement-based materials have been developed by the incorporation of polymeric fibers and nanoscale materials into cement mortars. The compressive and flexural strengths of cement mortars reinforced by the carbon nanotubes (CNTs) and microscale (polymeric) fibers have been investigated at 28 days. Furthermore, microstructural analysis has been conducted to ensure the findings of abovementioned properties.

## 2. EXPERIMENTAL DETAILS

### 2.1. Materials

In the preparation of specimens, Portland cement (PC) Type I CEM-42.5/R, similar to ASTM Type I, was used as a hydraulic binder. Specific gravity and Blaine fineness were 3.1 and 325 m<sup>2</sup>/kg, respectively. Physical properties and chemical composition of PC was presented in Table 1. Standard silica sand with a maximum aggregate size of 2 mm was used in conformity with CEN (CEN 196-1, 2009). The particle size distribution of the sand was within limits of Table 2. Polycarboxylic ether-based high-range water reducing admixture (HRWRA) was used to obtain similar flow for each mixture.

**Table 1.** Physical and chemical properties of PC

<b>Chemical composition, %</b>	<b>PC</b>
CaO	61.12
SiO <sub>2</sub>	21.63
Al <sub>2</sub> O <sub>3</sub>	5.12
Fe <sub>2</sub> O <sub>3</sub>	3.45
MgO	2.41
SO <sub>3</sub>	2.39
K <sub>2</sub> O	0.69
Na <sub>2</sub> O	0.22
SiO <sub>2</sub> +Al <sub>2</sub> O <sub>3</sub> +Fe <sub>2</sub> O <sub>3</sub>	30.2
Specific gravity	3.10
Blaine fineness (cm <sup>2</sup> g <sup>-1</sup> )	3250

**Table 2.** Particle size distribution of the silica sand in mortars

<b>Particle size (mm)</b>	<b>Cumulative retained sand (%)</b>
2.00	0
1.60	7 ± 5
1.00	33 ± 5
0.50	67 ± 5
0.16	87 ± 5
0.08	99 ± 1

Polymer type synthetic fibers with lengths of 6 mm, diameters of 27 μ, specific gravity 1.14, and tensile strength of 962 MPa was used to the reinforce cementitious system. The other reinforcing element was carbon nanotubes, 20-30 nm in diameter, 10-30 μm in length and had a surface area of more than 200 m<sup>2</sup>/g with purity greater than 90%. Polymeric fibers (PF) and carbon nanotubes (CNTs) were given in Figure 1.



**Figure 1.** Synthetic fibers in a bundle and randomly distributed form (at left) SEM micrograph image of CNT (at right)

## 2.2. Preparation of Mixtures

A standard cement mortar fabrication was applied in accordance with the relevant Turkish Standard (TS EN 196-1, 2009). Apart from standard mortar preparation, and polymeric fibers (PF) were added in cement mortars. To start with, water was put into mortar mixer together with the cement. Mixing started for 30 seconds in 62 round per minute (rpm). Then, silica sand was gradually added into the mixer in 30 seconds and mixing continued for another 90 seconds in 125 rpm. PFs were gradually added into the mixer tank during 60 seconds for relevant mixtures. Together with fiber addition, HRWRA was used to provide similar consistency (flow diameter  $20\pm 1$ ) for each mixture.

A different mixing procedure was applied for CNT bearing cement mortars. Since CNTs tend to agglomerate due to very high surface area ( $200 \text{ m}^2/\text{g}$ ) it requires a special distribution process to achieve uniformly dispersed CNTs in cement mortars (Öztürk, 2015). To address this issue, a separate production process for CNT modified cement mortars was followed. CNTs were first mixed with an entire amount of mixing water and HRWRA with another blender for 15 minutes at 3000 rpm. After that dry materials were mixed in a similar way with the former procedure. The separately prepared solution was then gradually to raw materials and additional mixing continued for 10 minutes at 300 rpm. Detailed mixing method of CNTs into cement-based materials can be found in the former study of corresponding author (Öztürk, 2015). The preparation of specimens can be seen in Figure 2. A total of 3 mixtures were molded to prismatic specimens with the dimension of  $40*40*160 \text{ cm}$ . Three specimens were fabricated for each type of mixture. After 24 hours, mortars were taken from molds and kept in thermostat controlled curing tank for 27 days in lime-saturated water at  $20\pm 2 \text{ C}$ . Ingredients of the total 3 mixtures were given in Table 3 to be easily followed throughout the study.



**Figure 2.** Preparing CNT solution (at left) and CNT incorporated cement mortars (at right)

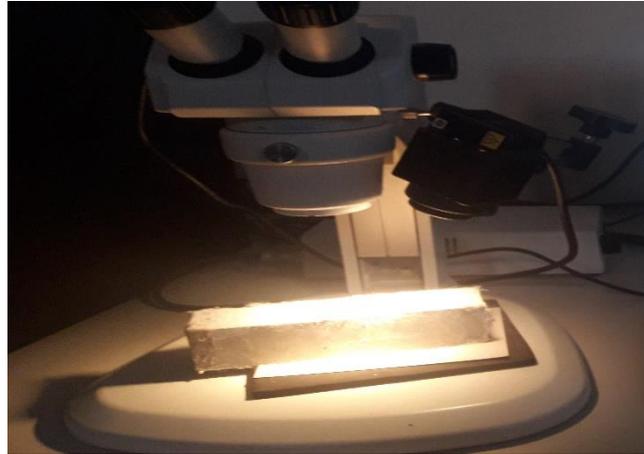
**Table 3.** Ingredients of the mixtures by weight (gr)

Mix ID	Cement	Fly ash	Water	w/b ratio	Sand	PFs	CNTs
M-Ref.	450	-	225	0.5	1350	-	-
M-PF	450	-	225	0.5	1350	1%	-
M-CNT	450	-	225	0.5	1350	-	0.5%

## 2.3. Experiments

### 2.3.1. Microstructural analysis

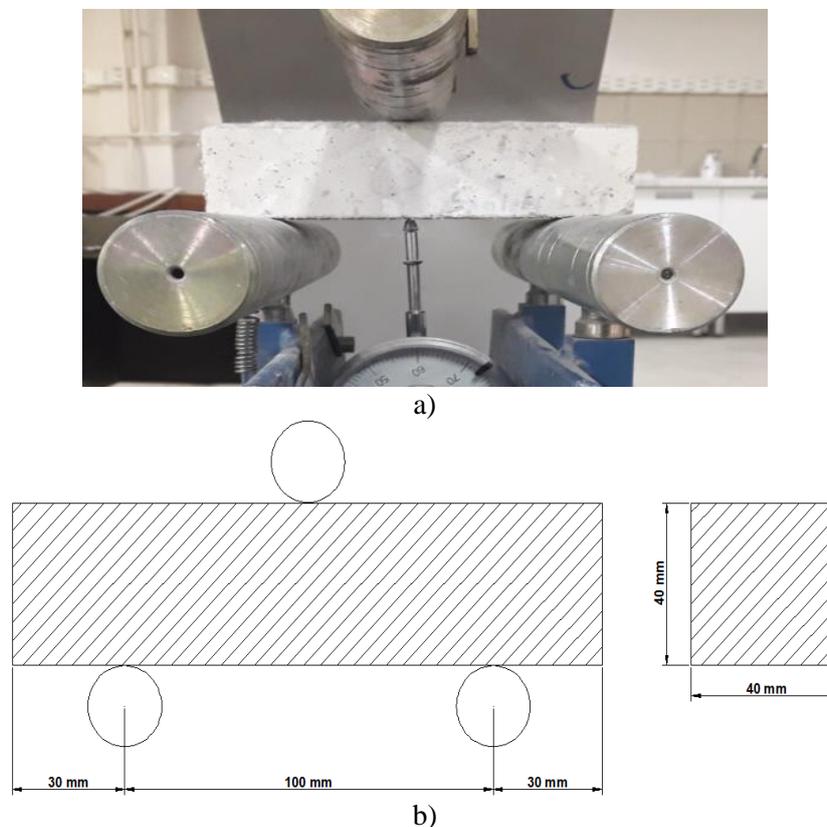
Microstructural analysis was performed to confirm the physical structure of cement mortars at 28 days as a validation of mechanical results. To this end, microscope analysis was used as given in Figure 3.



**Figure 3.** Microstructural investigations of specimens

### 2.3.2. Mechanical Properties

Flexural and compressive strength of each mixture was evaluated in accordance with TS-EN 1015-11 (TS-EN 1015-11, 2000). Compressive strength was determined on each half of 160 x 40 x 40 mm prism specimen by uniaxial loading at 2400 N/second. The flexural strength of mortars was determined by three-point loading of a 160 x 40 x 40 mm prism specimen (Figure 4-a). The loading rate was applied at 50 N/second. Specimens were placed on supports of the testing machine as details were given in Figure 4-b. Both mechanical tests were carried out for 28 days-old specimens.

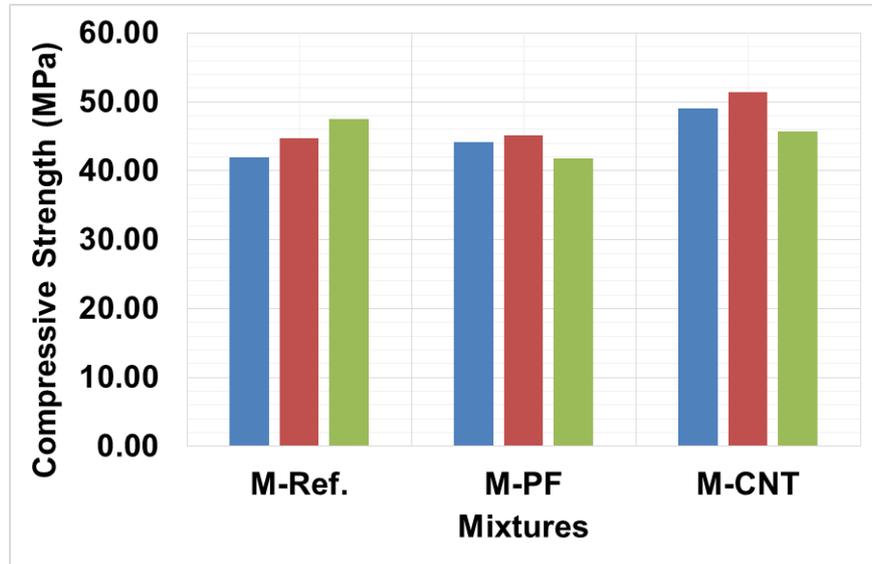


**Figure 4.** Flexural tests (a) schematic details for flexural tests (b)

### 3. RESULTS and DISCUSSIONS

#### 3.1. Compression Tests

Mechanical properties of 3 different cement mortars were determined. Experimental results of basic mechanical properties made with evaluating compression strength were given in Figure 5.

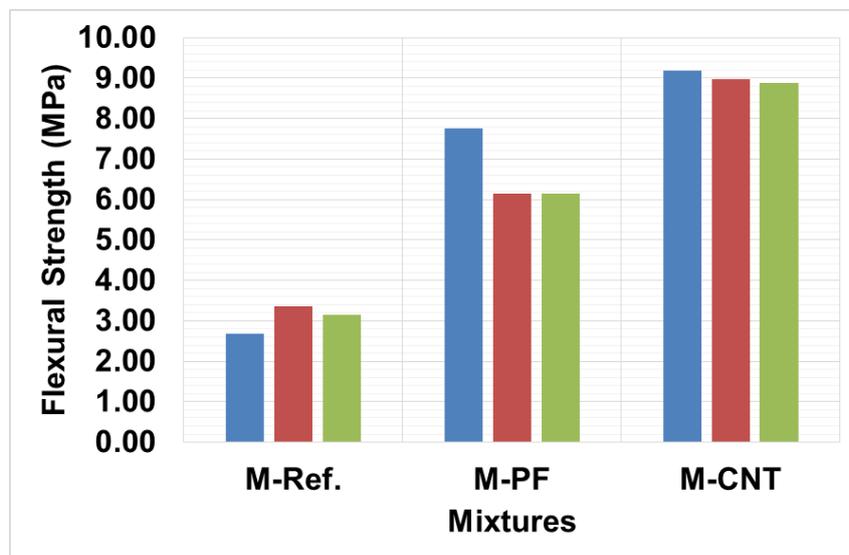


**Figure 5.** Compressive strength of specimens at 28 days

As given in Figure 5, the average compressive strengths of M-PF mixture (43.7 MPa) were comparable with the M-Ref mixture (44.8 MPa). The negligible reduction in the average compressive strength of M-PF mixture compared to the reference mixture can be attributed to entrapped air due to the inclusion of polymeric fibers into mixtures. CNT incorporated mixtures exhibited 8.8% higher compressive strength than M-Ref specimens. The higher compressive strength of M-CNT specimens can be related to higher specific surface areas of CNT particles, which may have provided more nucleation sites with filler effects and flaw-bridging effect at nano/scale.

#### 3.2. Flexural Tests

Flexural strength results of different mixtures under 3-point bending tests were illustrated in Figure 6.



**Figure 6.** Flexural strength of specimens at 28 days

As can be clearly inferred from Figure 6, the average flexural strength of M-PF specimens was higher (119%) than control specimens. Also, the average flexural strength of CNT based mixtures was 195.4% higher than reference mixture. Compared to compressive strength, the inclusion of fibers enhanced the properties of M-PF under flexural loadings. However, the homogeneous dispersion of CNT into cement-based materials was more promising in terms of flexural strength. This result can be ascribed to the capability of CNT in the arresting of crack growth. CNTs were probably likely to act as internal pore and/or microcrack bridging reinforcing elements. Superior characteristic properties of CNTs may have played a significant role in modifying pre- and post-microcracking behavior thus higher bending strengths were obtained. Both in compressive and flexural behavior of CNT based mortars were stronger in packing through densification of matrices so that improved particle size distribution was achieved.

### **3.3 Microstructural Tests**

Microstructural tests were conducted on  $1 \times 1 \times 1$  cm sliced specimens by using a microscope. Microstructural analysis confirms that reduction of compressive strength in M-PF mixture compared to reference specimens is due to flocculation of polymeric fibers (Figure 7). Although the reduction in compressive strength is negligible, different dispersion methods for polymeric fibers can be further investigated to increase the mechanical properties.



**Figure 7.** Flocculation of polymeric fibers in mortars

Another microstructural finding suggests that incorporation of polymeric fibers led to entrapped air voids as can be clearly seen in Figure 8. The air voids on the surface of the sliced specimen by  $1 \times 1 \times 1$  cm (Figure 8) support that entrapped air was responsible for the reduction in compressive strength due to decreased cross-sectional area.



**Figure 8.** Entrapped air voids due to the inclusion of polymeric fibers

#### 4. CONCLUSIONS

An experimental study was undertaken to evaluate the mechanical properties of polymeric fibers and CNT incorporated specimens. After determining the compressive and flexural strength, the microstructural analysis was performed on mortars. The following conclusions were reached.

- The addition of polymeric fibers caused a negligible reduction in compressive strength although polymeric fibers triggered higher flexural strength thanks to the bridging of cracks thereby retarding post-cracking. Dispersion method of polymeric fibers can be improved to obtain higher compressive strength. However, the average compressive strength of M-PF specimens was comparable with the reference specimens.
- CNT based mortars were promising in compressive strength compared to M-PF and M-Ref. specimens. The reason can be related to the seeding effect of CNTs so that dense microstructure assisted to increment of compressive strength. Also, CNT based mortars were clearly better in flexural strength compared to the other two mixtures. It can be said that CNTs are highly preferable to improve mechanical properties provided that homogeneous dispersion is conducted.
- Microstructural analysis supports the abovementioned findings that polymeric fibers slightly reduced the compressive strength due to non-uniform orientation in mixtures. However, this behavior can be accepted as tolerable since the results are comparable. Also, despite delaying crack growth, polymeric fibers may lead to entrapping air in mortars as microstructural analysis suggests.

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TS EN 197-1 Cement-Part 1: Compositions and conformity criteria for common cements.

**O 128. SOME DURUM WHEAT (*Triticum durum* L.) GENOTYPES DETERMINATION OF  
COMBINATION OF SKILLS IN THE DIFFERENT NITROGEN ENVIRONMENT**

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**ABSTRACT:** Nitrogen has an important place in the plant nutrients, which is essential for plants, because of its location in plant metabolism and its specific situation in the soil. Nitrogen is used as a basic building block in plant nutrients, so it is important to have enough nitrogen in the soil to get optimum yield. However, in order to achieve this situation, it is obvious that the use of excess nitrogen fertilizers has negative effects on both plants and the environment and human health. In order to minimize the negative effects of nitrogen in recent years, scientists have needed to research the nitrogen sources that can provide the necessary nitrogen at the time they need plants and eliminate or minimize the losses. One of the most important factors to be taken into consideration in these studies is the method of investigating the varieties with high nitrogen utilization efficiency, low growth rates and high yield and quality. In this research; 30 durum wheat hybrid combinations, which were formed by crossing 10 main lines and 3-line lines as line-testers, were planted with 3 replications separately in nitrogen sufficient and insufficient environments in central location of Konya. Combination capabilities have been determined from the materials identified to give high efficiency in inadequate environments.

*Keywords: Durum wheat, Nitrogen utilization efficiency, Yield*

## **O 129. THE WIND EROSION SEEN IN KARAPINAR**

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**ABSTRACT:** Karapınar which is located in Konya Closed Basin is area to prone to erosion with a cause such as being salty, calcareous and dune of soil structure, lack of rainfall, having sparse vegetation due to failure to comply the rules of pasture management in their rangelands which previously had good a pasture. 23% of farmland in town is a matter of wind erosion with different reasons. In Karapınar, fighting wind erosion was started hat 1962 for the first time. In the first step, the prevent erosion studies got off the ground by hedging round 160,000 decares of in this area. The reed curtain was established on dune hill in this land on the purpose of firstly decreasing wind speed and then preventing sand movement. Then, the between reed curtains was made a place green with plants like crested wheatgrass, tall wheatgrass, etc. Planting works to decrease soil movement was used plants which belong to the region and being drought-tolerant species such as silverberry, false acacia, Fraxinus, black pine, etc. In this review, information about the wind erosion occurring in Karapınar.

*Keywords: Karapınar, Rangeland, Wind Erosion*

### **1. INTRODUCTION**

Erosion is one of the significant environmental problems in terms of polluting in water and ecosystem; moreover, erosion reduces in yield and quality by causing limited of production on agriculture. In Turkey, 89% of the soil having problems is seen the erosion, and the wind erosion occurred in Turkey is about 465.900 ha. This wind erosion seen in our country comes up to 1.5% of total agricultural land (Acar and Dursun 2010, Kirtiş 2014, Çarkacı 2019).

69.2 % of all wind erosion area in Turkey occurs in Konya (Table 1). Karapınar, Sarayönü, Kadınhanı, Çumra, Cihanbeyli, and Ereğli are mostly affected by wind erosion in Konya. On 103.000 ha areas of Karapınar occurred wind erosion composed of 22.1% all wind erosion in Turkey (Anonymous 1986, Kirtiş 2014).

**Table 1.**The Wind Erosion Severity in Turkey and Konya (Anonymous 1986, Kirtiş 2014).

Erosion Severity	Wind Erosion Area in Turkey (ha)	%	Wind Erosion Area in Konya (ha)	%
Slight	165,664	35,6	124,521	26,7
Moderate	231,041	49,6	138,794	29,8
Severe	64,385	13,8	56,678	12,2
Very severe	4,823	1,0	2,481	0,5
Total	465,913	100,0	322,474	69,2

The underside soil layer on the wind erosion area in Karapınar have sandy structure while the surface layer has a loamy structure (Anonymous 1986). The soil in this area abounds with lime and potash, and organic matter and phosphorus in this soil are scarce. Total area in the town has about 296.900 (i.e., agricultural land of 150.000 ha, rangeland about 130.444 ha), and 23% of these areas in Karapınar have occurred to wind erosion (Anonymous 2014).

In our country, wind erosion has occurred commonly arid and semi-arid regions. The climate of the region can be defined as semi-arid continental. The summers are dry and warm, and the winters are usually cold. Average annual precipitation in the area is about 270 to 280 mm, about 40% falls in winter.

The average temperature is 11 C. The nights are cold in winter. In time the temperature drops below - 20 C or lower. In summer the heat is often between 30 and 35 C and is occasionally above 35 C. The dominant winds are commonly from the south-western corner, mainly from the south, south-west, and rise to dust storms that are disagreeable and destructive. Stormy days are standard, and wind attains speeds of 20 to 25 m/sec or more. The average relative humidity is between about 40 % in summer and is 80 % in winter (Anonymous 1986, Anonymous 2019).

The Reasons for Wind Erosion severely seen in Karapınar (Anonymous 1986):

- 1- Karapınar was lake bed in the past
- 2- Having hot and dry continental climate
- 3- Overgrazing by sheep in the region
- 4- Locals ripped off the soil –protecting plant such as *Astragalus microcephalus*, *Marrubium parviflorum*, *Alhagi cemalorum*, etc. from pastureland.
- 5- Using extremely soil working machinery and equipment
- 6- Be located on an intense wind course

## 2. THE COMBATTING EROSION SEARCHES IN KARAPINAR

Problem broke out in 1960 in Karapınar. In the first step, the prevent erosion studies got off the ground by hedging round 160,000 decares of in this area. In these areas were surveyed at hydrologic, geologic, soil and topographic surveys. After, the improvement studies were continued on 130.000 da. In that research, regions were divided into quarters and were carried out improvement studies regarding the situation of areas. The research conducted for improvement between 1962 and 1973 and being a model at today are summarized in Table 2. The improvement studies were gone on during decades, and after the protection, control, research, and production studies were stated in these areas (Anonymous 1986).

**Table 2.** The research conducted for improvement between 1962 and 1973 and the areas of the situation at that time (Derived Anonymous 1986, Anonymous 2019)

Area of Name	Area (da)	The case in the 1960s	The Research Conducted for Improvement (Between 1962 and 1973)
<b>Sand Extruders Field (Kum Bars)</b>	43.000	View a desert; there wasn't a vegetation cover	a- Physical Precautions: Firstly, it was decreased wind speed by using a reed screen (Figure 3-6) b- Cultural Precautions: 1- Covering with grass: It was used weed seed collected from locale pasture and drought tolerant plant such as sand ryegrass, crested wheatgrass, tall wheatgrass (Figure 7-8) 2- Forestation: The drought-tolerant trees belonging region such as <i>Elaeagnus sp.</i> , <i>Fraxinus sp.</i> , <i>Robinia pseudeaccucia</i> , <i>Ulmus sp.</i> , <i>Acer sp.</i> , <i>Amygdalus sp.</i> , <i>Prunus mahalep</i> , black pine, cedar trees, were planted, and nursery garden established in the field (Figure 9-10)
<b>Moving Sand Dune</b>	40.000	Overgrazing, Damaged varying reasons like ripped of some shrubs, etc.	Firstly it wired to the field, and in these areas were supplied covered with vegetation of square by using the natural seed of plants belongs in the regions.

<b>Sensitive to Erosion, flat and soil field</b>	32.000	There weren't vegetation cover, in the beginning, dry agriculture was done, be left owing to erosion	Fallow –Cereal Crop rotations were applied in 10.000 da fields. In 2.000 da was grown horticultural crops. The production facility of pasture and rangeland crops were established in the remainder area. Band seeding method was applied in these areas.
<b>Ketir Hill</b>	15.000	The area covered with trees before erosion. In the 1960s there weren't any tree	These areas were done forestation study with pine, cedar, blackthorn, wild almond and blackberry when stopped moving sand, and planted 7 million almond.

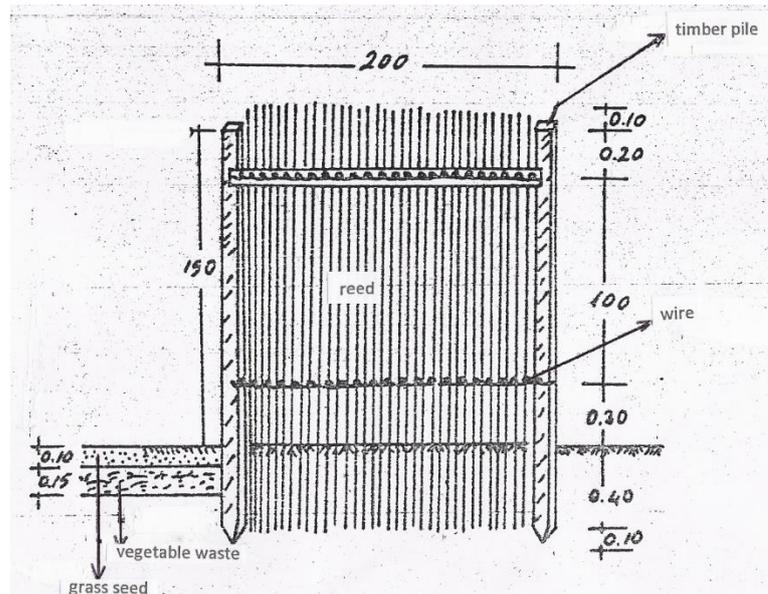
In combating erosion is essential continuity for being sensitive erosion region due to having climate and soil structure in Karapınar. Nowadays, combating erosion in these areas are used forage shrubs such as *Atriplex canescens*, *Kochia prostrata*, *Haloxylon aphyllum*, etc. (Acar and Dursun 2010), and in the research, the institute is grown the lavender which is medicinal plant and nectar source plant (Çarkacı 2019) (Figure 1-3).



**Figure 1.** *Atriplex canescens* in Karapınar in 2018 (Org.)



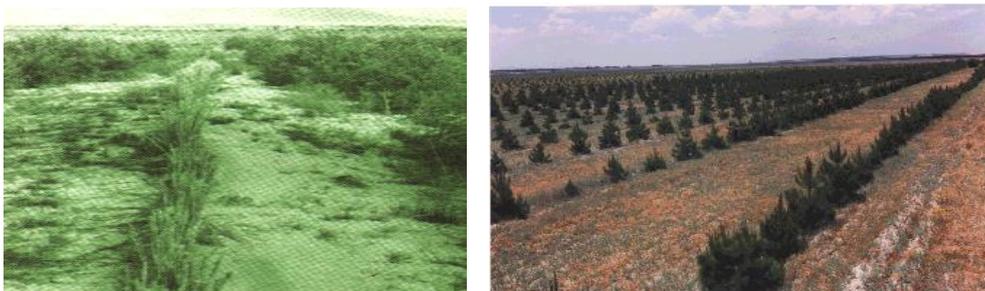
**Figure 2.** *Kochia prostrata* in Karapınar in 2018 (Org.)



**Figure 6** Physical Precautions: Structure and shape of the reed screen in Karapınar (Acar and Dursun 2010)



**Figure 7-8.** The first step in Cultural precaution: covering with grass in Karapınar in the 1960s (Acar and Dursun 2010)



**Figure 9-10.** The second step in Cultural precaution: Forestation studies in Karapınar in the 1960s (Acar and Dursun 2010)

### **3. CONCLUSION**

The rangeland areas about 130.444 ha located in Karapınar are sensitive to erosion due to overgrazing. For this reason, plant composition of rangeland in Karapınar should be determined with vegetation etude studies, and to start the rangeland improvement researches is a necessity with improvement methods such as natural seeding, overseeding by using shrub species according to meadow situation to increasing pasture yield.

Agricultural land in the region is recommended to strip farming method decreased to the speed of wind erosion. We believe to decline in the effect of wind erosion to include plants which are used the water economically instead of fallow, spud plants in rotation system in the region.

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**O 130. CFD SOLUTION OF DAM SPILLWAYS**

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**ABSTRACT:** Since the design of each dam in hydraulic engineering is special by its shape, purpose, basin characteristics and topography of the dam and so it cannot be made any unque standard project. It is very important for security to test the spillways of the dams which are safety structures of the dams by physical and / or mathematical modeling methods before the construction. In physical modeling, although the effect of scale, time and laboratory conditions, assumptions made in mathematical modeling and initial investment cost are restrictive, it is very useful in prediction of the problems encountered during modeling and construction phase. During physical model studies, a series of experimental studies were conducted; speed profiles, key curve, water surface profiles and pressures at various conditions, working conditions of the energy breaking pool are measured. The development of computer technologies and recent advances in numerical solutions lead engineers to do numerical modeling. In the scope of this study, the hydraulic properties of Alpaslan 2 Hydroelectric Power Plant (HEPP) Project were investigated experimentally with 1/70 scale physical model in the laboratory. Flow depth, flow discharge and pressure readings were measured under the different current conditions. Computational Fluid Dynamics (CFD) simulation was also tested to see if there is a suitable solution for the modeling of numerical modeling in spillway flow. In mathematical modeling, FLOW-3D program was used to solve the Reynolds-averaged Navier-Stokes (RANS) equations. The FLOW-3D program defines the cells in the calculation area by defining partially or completely filled cells. At the end of the study, the results of the project and the results of both models were compared. For the comparison of physical modeling and numerical modeling, the rating curve, flow profiles in the discharge channel, cavitation number, velocity and pressure measurements and energy dissipation structure flow conditions were used. The results obtained from physical and numerical modeling were found to be overlapping each other.

**Key words:** Spillway design, physical modelling, CFD solutions, spillway modelling, Flow 3D

**O 131. COMPARATIVE INVESTIGATION OF TRAFFIC EMISSION RATES IN KONYA**

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**ABSTRACT:** The increase in the population of the world brings the significant challenges of protection our environment and atmosphere from being polluted. As the economic growth and urban development of any city depends on transportation it's necessary to understand their negative impacts and their changing rates as well in order to optimize our traffic network planning. This study aims to investigate the air pollutants including NO<sub>x</sub>, PM and CO caused by motor vehicles in Konya province. The annual average daily traffic of the motor vehicles on Turkish state highways inside Konya borders considering their types and fuel were used for calculation the annual emission rates of the pollutants between 2010 and 2017. The emission values of each year comparatively evaluated and the effects of personal cars in total were identified. As a result, we found that the total taken pathways length increased by 67.8 % in 2017 according to 2010. Therefore, the increase in the amount of NO<sub>x</sub>, CO and PM found as 18.2 %, 66.7% and 32.1% respectively in 2017 according to 2010. Lastly the length of the pathways traveled by personal cars was made %64.18 of the total in 2010 and increases to 68.14% in 2017. We understood from study that most significant vehicles with respect to the contribution in air pollutions are ranked as personal cars and then motor vehicles using diesel fuels. While the vehicles using LPG has a lower effect.

*Keywords: Air Pollution, Traffic Emissions, Pollutant Emissions, Konya*

**O 132. PUMPED-HYDRO ENERGY STORAGE: A CASE STUDY IN TURKEY**

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**ABSTRACT:** Due to the limitations in the sources of fossil fuels as well as their environmental adverse effects, the implementation of renewable energy sources and the more efficient use of existing systems became critical to fulfill the increasing demands of our global for energy consumption. Most renewable energy systems like wind and solar cannot adjust their output to match cities fluctuating power demands. Therefore, various energy storage systems have been developed and many of them are under the investigation. Among various energy storage methods pumped-hydro storage systems has been developed rapidly over the last decades because of their capability of the large-scale energy time shift and the ability of being integrated with renewable energy. The component of system is an upper and lower reservoir connected with a pump/turbine. The technique works as pumping water from down to up during low demands on electricity and releasing back through the turbine to produce electricity during the pick hours. The aim of this study is to investigate the principles and factors affecting the alternatives for site selection. The locations and topography of dams and lakes of Turkey have been explored using Google Earth to search for suitable locations, and the locations listed and ranked by factors that affect the applicability, efficiency, sustainability, and environmental friendliness of the projects.

*Keywords: Pumped Hydro Storage, Dam, lake, Energy Storage, energy, electricity*

**O 133. INVESTIGATION OF URBAN FLOOD PROTECTION STRUCTURES AND THEIR PROBLEMS: A CASE STUDY OF KONYA FLOOD PROTECTION STRUCTURES**

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**ABSTRACT:** Floods events occur frequently in Turkey. Therefore, like earthquake and other natural disasters, floods also should be taken in to measure in advance as well. Therefore, with all other operations, constructing flood protection structures with a good planning and project, their proper using and their protection is important for ensuring that floods do not become a disaster. With lack of precaution listed above sometimes flood put huge effects on areas where are not identified as risky areas on flood risk assessment maps. In this study, primarily, the concept of flood, the effects, causes, types and the principles of protection from flood are discussed. Secondly, the problems in the flood protection structures located in Konya province, Turkey, were exemplified by photographs and evaluated. Lastly the sources of the problems, their effects on infrastructures, farmlands and domestics identified and some suggestion are made.

*Keywords: Floods, flood protections, flood risks, open channels, culverts*

**O 134. CFD ANALYSIS OF FLOODING AND ASSESMENT OF FLOOD DAMAGES**

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**ABSTRACT:** Floods are the main cause of natural disaster damage in the world after earthquakes. It is a fact that the topographic structure and precipitation regime in different geographic regions have caused flood disaster in many streams during different precipitation periods. Increasing in population growth and as a result of this increasing in the number of residential areas, improper city planning and urbanization, uncontrolled construction of water structures and increasing the number of settlements in the riverbed increase the loss of life and property of the flood event. In order to reduce the damages caused by floods, riverbed improvement and structures need to be regulated. For these reclamation studies, it is necessary to know the natural topography, the cross-sectional changes formed by the hydraulic structures on the stream (bridge, regulator, etc.) and the flood water level. Numerical computation methods can be used to make such calculations. In this study, the HEC-RAS numerical model was used in order to analyze of the flood occurred on 11.06.2018 in KONYA Köyceğiz Region. As a result of flood, residential areas on the stream bed, schools, the Köyceğiz Campus area was under the water flow. At the beginning of the study, the topographic map of the region was obtained, and a digital elevation model was created with ARC-GIS program and terrain cross sections were obtained by HEC-GEORAS. The obtained sections were transferred to the HEC-RAS program and the hydraulic characteristics of the floodplain were determined. The results obtained were compared with the images of flooding, which were obtained by taking photos during the flood time.

*Keywords: Flooding, Flood analysis, HEC-RAS, Flood risk maps*

**O 135. COST ANALYSIS OF WASTE COLLECTION AND TRANSPORT**

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**ABSTRACT:** Garbage is an end of product that is inevitable to emerge as a result of our vital activities. The ways of collecting, transporting and disposing of these products also affect the environmental health and the country's economy, significantly. In the solid waste management system, the collection and transport of waste is the part that has the highest financial value, so the garbage collection and transportation systems must be designed in the best and economical way. It is of great importance to collect and transport the garbage by the authorities, which is formed as a result of human and human activities in the use areas such as home, school, workplace, park, industry. In this study, the methods and cost of waste collection and transportation of the waste to the disposal which were investigated. At the same time, garbage collection and transportation costs were analyzed in Selcuklu district of Konya province.

*Keywords: Waste, solid waste, cost, economy, garbage*

## **O 136. FORAGE CROPS IN ACID SOILS OF INDONESIA**

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**ABSTRACT:** Indonesia is a country located on the equator, between two continents and two oceans. For this reason, Indonesia has a tropical sea climate. The amount of precipitation and humidity in Indonesia is very high. Due to the high amount of precipitation, water availability and groundwater with a shallow water table of the land are also very high in Indonesia. However, wet climatic conditions and high precipitation amount intensively cause alkaline washing in the soil. Consequently, it causes most of the lands in Indonesia to become acidic. Approximately 70% of the total land in Indonesia is acid soils with a pH less than 5. As a tropical country, Indonesia has a very high biodiversity of plants. There are many plant species that can be used as fodder. These plants originate from various families. This paper tries to give general information about some plants grown in acid soils (low pH levels) used as the most common animal feed in Indonesia.

*Keywords: Animal Feed, Fodder Plants, Pasture and Rangeland, Tropical Forage Crops, Water Tabel Depth*

### **1. INTRODUCTION**

Indonesia has unique and rich natural resources and biodiversity, as it is located between two continents (Asia and Australia) and two oceans (Indian and Pacific) (KLH, 2011). The world's second largest biodiversity is found in Indonesia (Brown, 1997) and Indonesia is the world's richest submarine biodiversity country (Tamindael, 2011). Indonesia is also located on the equatorial line that causes Indonesia has a tropical climate (KLH, 2011) and causes Indonesia has a very high biodiversity of plants. However, because of wet climatic conditions and high precipitation intensively cause alkaline washing in the soil and consequently cause around 70% of the soils in Indonesia to become acidic (Mulyani et al. 2010). There are many plant species that can be used as fodder in Indonesia. These plants originate from various families. This paper tries to give general information about some forage crops. These crops are mostly from grasses and legumes (and two plants from other families). The crops presented in this paper are the most common forage crops in Indonesia and most of these crops grow on acid soils (at low pH levels).

### **2. GENERAL INFORMATION ABOUT THE NATURE OF INDONESIA**

#### **2.1.**

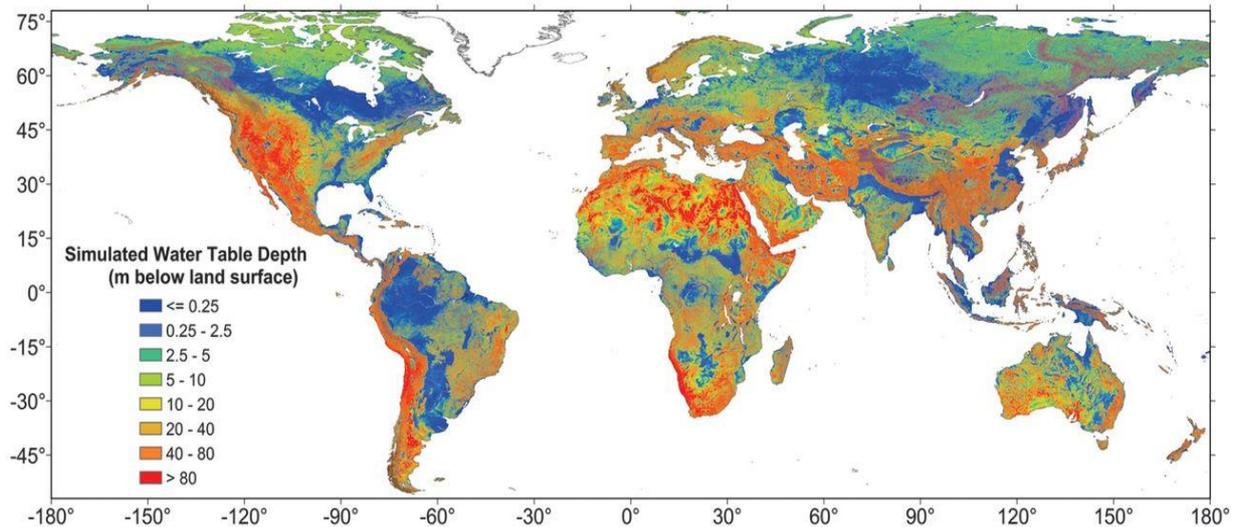
#### **2.2. Geography of Indonesia**

Indonesia, an archipelago country of 17 504 islands, is the world's largest archipelago country with a land area of 1.91 million km<sup>2</sup> (BPS, 2015), and as the 14th largest country in the world. Geographically, Indonesia is located on the equatorial line between 06° 08' North and 11° 15' South Latitudes, and between 94° 45' and 141° 05' East Longitude (KLH, 2011). Latitude position causes Indonesia has a tropical climate. While the long longitude position causes Indonesia has three time zones, namely West Indonesia Time (UTC +7), Central Indonesia Time (UTC +8) and Eastern Indonesia Time (UTC +9) (KEPPRES RI No. 41/1987).

#### **2.3. Climate and Water Table of Indonesia**

Indonesia is located on the equator, between two continents, and between two oceans. For this reason, Indonesia has a tropical sea climate. Indonesia has two seasons, the dry season (May-September) and the rainy season (October-April). The air temperature of Indonesia is between 20-30 °C. The precipitation amount is very high and the average annual rainfall is 2000-3000 mm (Hidayat, 2008). As

it is surrounded by oceans and seas, humidity is also very high ranging from 85-100% (BPS, 2018). Water availability is very high in Indonesia (BMKG, 2016). Due to the very high amount of rainfall, water availability is generally very high (BMKG, 2016), which two-thirds of Indonesia's area is a water territory and makes Indonesia is included in the world's 10 countries that are rich in water (BPS, 2018). In most of Indonesia's land, water table is very shallow. The water table is deeper only in areas around volcanoes and in areas close to Australia (Fan et al. 2013) as shown in Figure 1.



**Figure 1.** The map of the simulated world's water table depth (Fan et al. 2013)

#### **2.4. Acid Soils of Indonesia**

There are 10 soil orders found in Indonesia, they are Histosols, Entisols, Inceptisols, Alfisols, Mollisols, Vertisols, Ultisols, Oxisols, Andisols and Spodosols (Figure 2). Wet climatic conditions and high precipitation of Indonesia intensively cause alkaline washing in the soil. Consequently, it causes most of the soils in Indonesia to become acidic. Approximately 70% of the total land in Indonesia is acid soils with a pH less than 5. These acid soils are originated from Histosols, Entisols, Inceptisols, Oxisols, Ultisols and Spodosols soil orders (Mulyani et al. 2010).



**Figure 2.** The map of soils of Indonesia (Sarwani et al. 2012)

### 3. FORAGE CROPS IN ACID SOILS OF INDONESIA

There are many plant species that can be used as fodder in Indonesia. In this section, general information about most common forage crops in acid soils (at low pH levels) of Indonesia. These crops are mostly from grasses and legumes families (and two plants from other families).

#### 3.1. Grasses Forage Crops

##### 3.1.1. *Pennisetum purpureum* Shumach.

*Pennisetum purpureum* originates from sub-Saharan tropical Africa (Govaerts, 2013). It has been introduced as a forage crop to most tropical and subtropical regions of the world. *Pennisetum purpureum* is usually found between 10° N and 20° S (Rojas-Sandoval and Acevedo Rodriguez, 2013). This plant grows in areas up to 2000 m above sea with annual precipitation above 1500 mm. It gives good yields at temperatures ranging from 25-40°C (Francis, 2004). *Pennisetum purpureum* is a robust perennial grass with a strong root system (Duke, 1983). The plant is resistant to drought and it grows in areas where rainfall is 200-4000 mm (Göhl, 1982). It grows better in rich and deep soils, but it can grow in poorly dried with poorly drained clays or in extremely dry sandy soils with pH between 4.5-8.2 (Duke, 1983). *Pennisetum purpureum* is a full sunlight plant species, but can grow under partial shade (Francis, 2004). It requires a high rate of fertilizer and regular water supply (Mannetje, 1992). The yield varies between 20-80 tons dry matter (DM) ha<sup>-1</sup> year<sup>-1</sup> with high fertilizer application (Francis, 2004). And the yield without fertilizer is in the range of 2.4-5.3 tons DM ha<sup>-1</sup> year<sup>-1</sup>. Grass cut can be done at 45-90 day intervals depending on location (Duke, 1983).

##### 3.1.2. *Brachiaria decumbens* (Stapf.)

*Brachiaria decumbens*, originates from the African continent (FAO, 2016). It is now common in tropical and subtropical regions (Pizzaro et al. 1996; FAO, 2016). It has been extensively naturalized in Southeast Asia and the Pacific (Schultze-Kraft et al. 1992a). *Brachiaria decumbens* are naturally found in open grasslands or partially shaded areas, from 27° N to 27° S, up to 1750 m above sea level. Grows at temperatures above 19 °C. Optimum growth occurs between 30-35 °C and where the average rainfall is above 1500 mm (FAO, 2016). *Brachiaria decumbens* is a perennial (5 years) grass (Husson et al. 2008). It has a deep root system that effectively removes P and N from the soil. It can grow on a wide variety of soils including poor soils with low pH (up to 3.5) and high Al concentration. It is moderately tolerant of Mn and is sensitive to salinity (Deifel et al. 2006). It does not develop well in waterlogged heavy clays, but resistant to 4 or 5-month dry season. The average yield is generally about 10 tons DM ha<sup>-1</sup> (FAO, 2016).

##### 3.1.3. *Brachiaria humidicola* (Rendle) Schweick

*Brachiaria humidicola* is a tropical perennial grass from East and South-East Africa and has been introduced to Australia, the Pacific Islands and South America (Cook et al., 2005; FAO, 2016). It is an important pasture plant in humid tropical areas. In the natural environment, it can be found in areas up to 2400 m above sea level. Optimal growth conditions; The annual rainfall varies between 600-4000 mm and the average daily temperatures of 32-35 °C. Grows in a wide variety of soils including low acidic (pH 3.5) and infertile soils with low P levels, high Al saturated soil, heavy cracking clays and high pH coral sands (Cook et al. 2005). *Brachiaria humidicola* is poor drainage tolerant and can withstand short flood pressure at the bottom of the valley. It also can withstand drought periods (3-4 months) but it is not resistant to freezing (Tergas, 1981). The dry matter yield is in the range of 7-34 tons ha<sup>-1</sup> year<sup>-1</sup> and is greatly affected by soil fertility. The most suitable harvest stage is 35 to 65 days after the last cut (Bereau, 1990).

##### 3.1.4. *Paspalum dilatatum* Poir.

*Paspalum dilatatum* is native to South America (Brazil, Argentina, Bolivia, Chile, Paraguay, Uruguay). Nowadays, it is common in tropical, subtropical and warm climate areas (Cook et al. 2005). It can be found in humid areas between 28 °N - 35 °S (FAO, 2016). It grows in areas up to 2300 m above sea level. Optimal growth conditions; heavy, humid, alluvial and basaltic clay soils or red loams, average daily temperatures ranging from 23-30 °C, annual rainfall of 900-1300 mm or with good irrigation. This plant can grow at an annual rainfall of less than 750 mm and a pH range of 4.5-8. It is very resistant to

drought and has a slight tolerance to frost (Cook et al., 2005). *Paspalum dilatatum* is a valuable feed and is one of the first species used for permanent sown meadows (Cook et al. 2005; FAO, 2016). It is a very tasseled, leafy perennial grass. *Paspalum dilatatum* yields a medium yield (3-15 tons DM ha<sup>-1</sup>) and a short grazing season in rain-fed pastures (Cook et al., 2005).

### **3.1.5. *Imperata cylindrica* (L.) P. Beauv.**

*Imperata cylindrica* grows and becomes widespread in tropical regions of the world. It is naturalized in Australia, New Zealand, Central and South America, West Indies, Cape Verde Islands, Madagascar, Melanesia and Polynesia (USDA, 2015). It grows well in humid or semi humid pastures or in open forested areas up to 2000 m above sea level in the Himalayas. Its optimal growth conditions are 25-35 °C daytime temperatures, 250-6250 mm annual precipitation, full sun or slightly shaded, light sandy soils with a pH between 4-7.5. It is tolerant of long drought periods. It cannot withstand flood and low temperature (FAO, 2016). *Imperata cylindrica* is a perennial grass. It is used as feed when young in height of 15-25 cm. The annual average dry matter yield is 11.5 tons ha<sup>-1</sup> (FAO, 2016).

### **3.1.6. Sorghum (*Sorghum bicolor* (L.) Moench)**

Sorghum is a grass native to eastern Africa, probably from Ethiopia. Nowadays it is found in areas between 50 °N - 40 °S and up to 1000 m above sea level (Cook et al. 2005). Optimal growth conditions for sorghum are the day temperatures during seedlings are 25-30 °C and during the growth is 30 °C, the annual rainfall is 400-750 mm. Grows best in deep, well-drained loam clay with a pH of 5.5-7.5. Sorghum shows tolerance to drought and slightly tolerance to waterlogging (for short periods). However, it is sensitive to freezing and continued flood conditions. (FAO, 2016). Sweet sorghum is tolerant of salinity (Cook et al. 2005). Sorghum plant is a tall (height up to 5 m) and perpendicular annual grass. Sorghum is used as grain and feed. The forage sorghum produces about 20 tons of fresh matter ha<sup>-1</sup> year<sup>-1</sup> (Balole and Legwaila, 2006), but can reach 75 tons ha<sup>-1</sup> under optimum growth conditions (FAO, 2016).

### **3.1.7. Corn (*Zea mays* L.)**

Corn is native to Central America and later spread to Central America, the Caribbean, South America and North America. It is now growing worldwide including from 58 °N in Canada and Russia to 40 °S in Chile and Argentina, and up to 3800 m above sea level in Andean mountains (Cook et al., 2005). Its optimal growth conditions are average daytime temperature between 18-21 °C, annual rainfall higher than 750 mm, well-drained rich soils. Corn can withstand annual rainfall of 230-4100 mm, a pH of 4.3-8.7 and a wide variety of soils. There is no tolerance for freezing and flooding of corn (Heuze et al. 2016a). Corn is an annual grass (OGTR, 2008). The green matter yield of corn varies between 10-50 tons ha<sup>-1</sup> (FAO, 2016). The yields obtained from small corn plants ranged between 31-46 tons ha<sup>-1</sup> (21-25 tons DM ha<sup>-1</sup>) (Chaudhary et al. 2012).

### **3.1.8. Rice straw (*Oryza sativa* L.)**

Rice straw is the vegetative part of the rice plant (*Oryza sativa* L.), which is cut in or after the grain harvest. Rice straw can be burned and left in the field after harvesting, it can be spread for soil improvement or it can be used as a feed for livestock (Kadam et al. 2000). Rice straw is an important feed in rice production areas. Rice originated from Asia, which has been cultivated since 6500 BC and is now naturalized in most tropical and subtropical regions. Rice grows from 53 °N in China to 35 °S in Australia. Its optimum growing conditions: average daily temperatures of 20-30 °C, night temperature above 15 °C; productive and heavy soils; pH 6.5-7. Most types ("swamp rice", "plain rice") should be planted in stagnant water and require an equivalent amount of 200 mm precipitation or equal amount of irrigation per month, while others ("mountain rice" or "upland rice") require a lesser irrigation and a rainfall of 750 mm for 3-4 months without dry period (Heuze and Tran, 2015a). Its annual yield ranges from 12 to 15 tons ha<sup>-1</sup> (FFTC, 2005).

### **3.2. Legumes Forage Crops**

#### **3.2.1. *Sesbania sesban* (L.) Merr.**

*Sesbania sesban* is a fast growing, long-lasting legume tree that reaches a height of up to 8 meters. It is widely distributed and produced in semi-arid and humid tropics. It grows in riversides and swamp sides with altitude up to 2300 m above sea level (Cook et al. 2005). Optimal growth conditions for *Sesbania sesban* are annual rainfall of 500-2000 mm and average annual temperature of 17-20 °C. It is tolerant of saline, alkaline and acid soils and soils with low P levels (Heering and Gutteridge, 1992a; Cook et al. 2005; FAO, 2016). *Sesban* yields up to 20 ton DM ha<sup>-1</sup> year<sup>-1</sup> under optimum conditions. The average yield worldwide is 4-12 tons DM ha<sup>-1</sup> year<sup>-1</sup> and it is cut 3-5 times a year (Heering and Gutteridge, 1992a).

#### **3.2.2. *Pueraria phaseoloides* (Roxb.) Benth.**

*Pueraria phaseoloides* is a legume species grown in tropical countries as a cover crop, green manure and forage crop. *Pueraria phaseoloides* is thought to be native to East and Southeast Asia. It has been introduced to be grown in most tropical areas and has now become naturalized and widespread in all humid tropics (Halim, 1997). It grows in an altitude of 1000-1500 m above sea level (Cook et al. 2005). It can grow in areas with annual rainfall ranging from 850 mm to 2000 mm, but gives better results when the annual rainfall is above 1500 mm and day/night temperatures are 32/24 °C. *Pueraria phaseoloides* can withstand dry, short term water logging and flood conditions (Halim, 1997). It is very tolerant to shadows and highly preferred in tropical tree plantation (Halim, 1997; Cook et al., 2005; FAO, 2016). It is resistant to acidic conditions (pH varies between 3.5-6) and tolerant to Al. However, it cannot withstand saline soils (Halim, 1997). This plant is a strongly curled and climbing perennial legume. It can be grazed or used as straw or silage. Dry matter yield is up to 20 tons ha<sup>-1</sup> (Ezenwa et al., 1996).

#### **3.2.3. *Calliandra calothyrsus* Meisn.**

*Calliandra calothyrsus* is a valuable small tropical legume tree as a multipurpose tree. It is native to the humid regions of Central America and Mexico. In 1936 it was brought to Indonesia for green manure and shadow production. It has been introduced to many tropical countries, particularly to Southeast Asia and Africa, as well as to Australia, Brazil, Bolivia, Colombia and Hawaii (Hess et al., 2006). It grows up to 1800-2200 m above sea level but gives better results up to 1300 m. The plant develops optimally with annual precipitation between 700-3000 (-4000) mm (rainy tropical) and annual temperatures 22-28 °C. *Calliandra calothyrsus* does not rely on freezing but tolerates dry conditions lasting 1-7 months (Wambugu et al., 2006). This plant grows in very light-textured and low-productive soils from acid sandy soils to deep volcanic soils. *Calliandra calothyrsus* does not rely on compressed, poorly drained and alkaline soils, but can survive on acid soils (Orwa et al., 2009). *Calliandra* is a small perennial legume tree with about 5-6 m tall and can reach 12 cm tall, and almost evergreen. It has a flat body with a diameter of up to 30 cm and has many branches (Orwa et al., 2009). The annual feed productivity is 7-10 tons DM ha<sup>-1</sup> (Kabi and Bareeba, 2008).

#### **3.2.4. *Desmanthus virgatus* (L.) Willd.**

*Desmanthus virgatus* is mainly used as feed. It can be highly edible and grazed to ruminants or freshly fed in cutting-handling systems. This legume originated from the tropical and subtropical Americas (Cook et al. 2005). It is naturalized to African dry soil (Senegal, Zambia, South Africa), Pacific Islands (New Caledonia, Hawaii), Indonesia, India and Australia (FAO, 2016). It can be found in areas with an altitude up to 2000 m above sea level but mostly found in coastal bushes, roadside and overly degraded areas with altitude below 500 m above sea level. *Desmanthus virgatus* is very compatible and grows in a wide temperature range (including frost conditions) and in wide precipitation conditions (between 250-2000 mm) (Cook et al., 2005). It prefers alkaline clay or clayey-loam soils, can also grow well in acid and unproductive soils (Gutteridge and Shelton, 1994). It is a drought-resistant legume. But it does not rely on shaded conditions (Cook et al. 2005). *Desmanthus virgatus* is a perennial legume. The yield of *Desmanthus virgatus* is 7.6 ton DM ha<sup>-1</sup> in humid tropical regions (2000 mm rainfall), and 2-2.4 ton DM ha<sup>-1</sup> in low rainfall areas (600-750 mm). *Desmanthus virgatus* is based on regular cuts and can be cut 4-6 times per year for feed (Cook et al., 2005).

### **3.2.5. *Leucaena leucocephala* (Lam.) de Wit.**

*Leucaena* is one of the finest and most palatable forage trees of the tropics. *Leucaena* is native to Guatemala and Mexico. It was introduced to the Philippines and Southeast Asia in the 16th century, spread to the Asia Pacific region and reached Australia in the late 19th century. It is commonly found between 30 °N - 30 °S and grows well in regions where the annual precipitation is between 650-3000 mm and the day temperatures are at 25-30 °C. It prefers neutral to slightly acidic and well-drained soils. This plant is resistant to dry climates (300 mm) and drought periods (up to 6-7 months). It can withstand mild frost, moderate salinity and short-term waterlogging (less than three weeks) (Cook et al. 2005).

*Leucaena leucocephala* grows fast, evergreen, steep and grows up to a length of 5-20 m (FAO, 2016). It is a long-lasting perennial legume (up to about 23 years in Australian conditions). *Leucaena* can be lightly grazed in the first year after the seedling is finished and graze heavily after the second year. The average yield is 3-30 ton DM ha<sup>-1</sup> year<sup>-1</sup> depending on soil, temperature and humidity conditions. For optimum yield, the harvesting interval can be made between 6-8 weeks in very productive areas and 12 weeks in lower productive areas (Cook et al. 2005).

### **3.2.6. *Sesbania grandiflora* (L.) Pers.**

*Sesbania grandiflora* is a legume tree used for animal feeding in humid tropical regions. *Sesbania grandiflora* is native to Asia and is now widespread in the most humid tropical regions around the world (Göhl, 1981). Its optimal growth conditions are an altitude of 800-1000 m above sea level, an average annual temperature of 22-30 °C, and an annual rainfall of 2000-4000 mm (Cook et al. 2005). This plant is adapted to a wide range of precipitation zones and soil types. It can be grown in heavy clay, alkaline and saline soils as well as poorly drained and low fertile soils (FAO, 2016). This plant is also resistant to drought periods of 6-7 months in acid soils and can live with 800 mm annual precipitation. It is tolerant to waterlogging and flooding (Cook et al., 2005). It does not develop at temperatures below 10 °C (FAO, 2016). *Sesbania grandiflora* is a perennial, evergreen, fast-growing leguminous tree that can reach a 10-15 m tall (Cook et al., 2005). The life span is about 20 years (Heering and Gutteridge, 1992b). In Java, an annual yield of 27 kg (up to 50 tons ha<sup>-1</sup>) of green leaves is obtained and can be cut every 3-4 months (Cook et al. 2005).

### **3.2.7. *Calopogonium mucunoides* Desv.**

*Calopogonium mucunoides* originated from tropical America and Western India. It is now found in the most humid tropical regions (Africa, Asia, Australia). *Calopogonium mucunoides* are introduced and naturalized in Indonesia and Malaysia as a cover crop and are found at an altitude of up to 2000 m above sea level (Peng and Aminah, 1997). Its optimal growth conditions are daily temperature is between 24-36 °C (Cook et al. 2005) and annual rainfall is 1000-1500 mm (Peng and Aminah, 1997). *Calopogonium mucunoides* can withstand the flood conditions. It can grow on a wide variety of soils, but it gives better results in acid clay soils (pH 4.5-5). It is also tolerant to high Al saturation but does not rely on saline soils. *Calopogonium mucunoides* is not freezing and drought resistant. It is tolerant to moderate shading and can grow in plantations where light transmission is between 60-100% (Cook et al. 2005). *Calopogonium mucunoides* is a strong, pubescent, perennial or short-lived perennial legume. It can reach a few meters in length, its roots are 30-50 cm in depth, with dense leaves (Cook et al. 2005; FAO, 2016). It can be grazed or cut and fed fresh. If the crusts are harvested in a single cut, they can yield up to 14 tons DM ha<sup>-1</sup>. However, if it is cut every 9-12 weeks, the DM yield is about 4-6 tons ha<sup>-1</sup>. It is recommended to be grazed with a rest period of 8-12 weeks (Peng and Aminah, 1997).

### **3.2.8. *Gliricidia sepium* (Jacq.) Kunth ex Walp.**

*Gliricidia sepium* is native to the Pacific coast of Central America, which is seasonally dry and is now widespread in tropical regions between 6 °S and 19 °N of the equator. It grows in the areas with an altitude up to 1600 m above sea level with the average temperature varies between 20-29 °C and annual precipitation is between 650-3500 mm and has a dry period of five months. It can adapt to a wide range of well-drained soils with pH in the range of 4.5-6.2. It does not withstand night temperatures below 15 °C. It is tolerant of waterlogging and non-fertile soils (Cook et al. 2005). It is one of the important tropical feed trees due to its protein-rich feed and high nutritional value. It is also possible to make silage from chopped feed which can be mixed with grass or corn. *Gliricidia sepium* produces 9-16 tons DM

ha<sup>-1</sup> in forage areas. The cutting can be done about 7 months after previous cutting and 14 months after the establishment of the plants that grow from the seedlings. Then, the cluster can be done every 2-3 months during the rainy season and every 3-4 months during the dry season (Wiersum and Nitis, 1992).

### **3.3. Forage Crops from Other Families**

#### **3.3.1. Cassava leaves (*Manihot esculenta* Crantz.)**

Cassava (*Manihot esculenta* Crantz) is mainly grown for tubers used as basic food or starch, but cassava leaves can be a valuable feed (Phengvilaysouk and Wanapat, 2008). Cassava is native to South America and is common in tropical and subtropical regions including Sub-Saharan Africa and Southeast Asia. The main production areas are at 30 °N - 30 °S. It grows in areas up to 2000 m above sea level. Its optimal growth conditions are the annual average daytime temperature is above 18-20 °C, the annual rainfall ranges from 500 mm to 3500 mm, high solar radiation and light, well-drained and acid soils. It is very tolerant to bad soil conditions, drought and insects, but does not grow well in heavy, rocky and gravelly soils. It is sensitive to water-saturated, saline or alkaline soils. Very low P levels are considered to be good while zinc deficiency should be avoided (Vongsamphanh and Wanapat, 2004). Cassava is mostly grown in marginal environments, acid and fertile soil (Man and Wiktorsson, 2001). Cassava is a perennial plant which is mostly grown as an annual (Dominguez, 1983). The leaves of cassava can be fed freshly, but it is generally preferred to be dried or silted because the leaves contain hydrogen cyanide which may be toxic to livestock (Wanapat, 2002). The annual dry matter yield varies between 7.5-9 tons ha<sup>-1</sup> (Ravindran, 2018).

#### **3.3.2. Sweet potato (*Ipomoea batatas* (L.) Lam.)**

Sweet potato is thought to come from the mouth of the Orinoco River in Mexico and the Yucatan Peninsula. It grows between 40 °N and 32 °S at an altitude up to 2000 m above sea level (and 2800 m in equatorial regions) (Ramirez, 1992). Sweet potatoes are grown in more than 100 countries, sometimes as basic food, but often as an alternative food. Great sweet potato producers are China, Indonesia, Vietnam, India, Philippines and Japan in Asia, Brazil and the US in America, And Nigeria, Uganda, Tanzania, Rwanda, Burundi, Madagascar, Angola and Mozambique in Africa (FAO, 2016).

Sweet potato is a perennial plant but mostly grown as an annual. Roots are adventurous, mostly found in 25 cm of the top soil (Duke, 1983). Sweet potatoes can be grown everywhere with enough water to support their growth and the annual rainfall for optimal growth should be between 750-2000 mm. Sweet potato requires full sunlight with an average temperature of 20-25 °C for optimal development. Sweet potatoes grow in soils that have a high humus content and well-drained which provide a warm and moist environment for the growth of good roots. The optimal soil pH is between 5-7. Sweet potato is slightly drought resistant (Ramirez, 1992). Although sweet potato tubers are the main agricultural product, vegetative parts are a very valuable feed for animals. The vegetative parts of sweet potato can be used as fresh, dry or silage. For the best leaf and root production, it is recommended that 50% of the total leaves should be cut by an interval of 20 days, as excess leaves can reduce the production of tuber roots. Vegetative parts of sweet potatoes can be harvested three or four times during a growing season (Scott, 1992). The dry matter yield varies between 5.4-9.1 ton ha<sup>-1</sup> (Lam, 2016).

## **4. CONCLUSION**

As a tropical country, Indonesia has rich natural resources and biodiversity including very high biodiversity of plants. However, because of wet climatic conditions and high precipitation intensively cause alkaline washing in the soil and consequently cause around 70% of the soils in Indonesia to become acidic. There are many plant species that can be used as fodder in Indonesia. This paper presents 8 species of grasses forage crops, 8 species legume forage crops and 2 species forage crops from other families. These crops are only some of the most common crops used for animal feeding in Indonesia especially grow in acid soils, however there are so many plants that are used as forage crops in Indonesia which cannot be presented in this paper.



**Figure 3.** *Pennisetum purpureum* Shumach.  
(Heuze et al. 2016b)



**Figure 4.** *Brachiaria decumbens*  
(Heuze et al. 2016c)



**Figure 5.** *Brachiaria humidicola*  
([www.germipasto.agr.br](http://www.germipasto.agr.br))



**Figure 6.** *Paspalum dilatatum*  
(<http://flowers.la.coocan.jp/>)



**Figure 7.** *Imperata cylindrica*  
(<https://facultystaff.richmond.edu>)



**Figure 8.** *Sorghum bicolor* (L.) Moench.  
([www.botany.wisc.edu](http://www.botany.wisc.edu))



**Figure 9.** *Zea mays* L.  
([www.aphotoflora.com](http://www.aphotoflora.com))



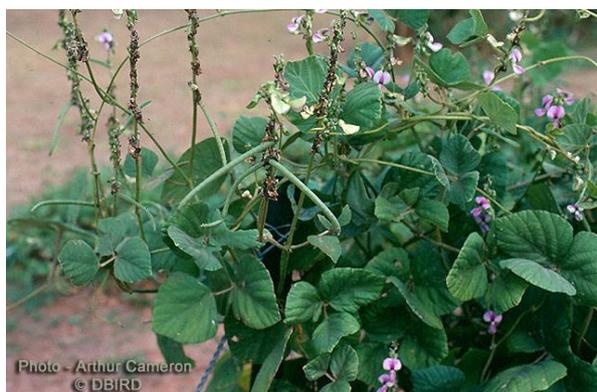
**Figure 10.** *Oryza sativa* L.  
([www.skrmindia.com](http://www.skrmindia.com))



**Figure 11.** *Sesbania sesban*  
([www.westafricanplants.senckenberg.de](http://www.westafricanplants.senckenberg.de))



**Figure 12.** *Calliandra calothyrsus*  
([www.tropicalforages.info](http://www.tropicalforages.info))



**Figure 13.** *Pueraria phaseoloides*  
([www.tropicalforages.info](http://www.tropicalforages.info))



**Figure 14.** *Desmanthus virgatus*  
([www.tropicalforages.info](http://www.tropicalforages.info))



**Figure 15.** *Leucaena leucocephala*  
(<http://keyserver.lucidcentral.org/>)



**Figure 16.** *Sesbania grandiflora*  
([www.flickr.com](http://www.flickr.com))



**Figure 17.** *Calopogonium mucunoides*  
([www.medicinalplantsinnigeria.com](http://www.medicinalplantsinnigeria.com))



**Figure 18.** *Gliricidia sepium*  
([toptropical.com](http://toptropical.com))



**Figure 19.** *Manihot esculenta*  
([www.livestrong.com](http://www.livestrong.com))



**Figure 20.** *Ipomoea batatas*  
([www.legom.info](http://www.legom.info))

Table 1. Main chemical components and ruminant nutritional values of forage crops (fresh) (modified from <http://www.feedipedia.org/>)

Forage Crop	Dry Matter (%)	Crude Protein (% DM)	Crude Fiber (% DM)	Neutral Detergent Cellulose (% DM)	Acid Detergent Cellulose (% DM)	Lignin (% DM)	Ash (% DM)	Brute Energy (MJ kg <sup>-1</sup> DM)	Digestible Organic Matter (%)	Digestible Energy (%)
<b>Grasses Forage Crops</b>										
<i>Pennisetum purpureum</i>	17.9	9.7	36.1	71.5	42.5	5.7	13.8	17.4	61.4	58.7
<i>Brachiaria decumbens</i>	26.8	8.9	31.4	68.1	37.2	5.7	8.6	18.1	55.2	52.7
<i>Brachiaria humidicola</i>	26.0	9.0	34.8	67.7	40.8	6.0	6.7	18.7	55.6	53.2
<i>Paspalum dilatatum</i>	23.8	10.3	35.1	68.5	41.0	5.6	9.4	18.3	62.4	59.7
<i>Imperata cylindrica</i>	31.9	6.5	39.4	74.3	45.7	6.6	7.0	18.6	57.2	54.7
<i>Sorghum bicolor</i>	28.1	8.2	33.6	57.9	35.0	3.3	9.1	18.1	63.1	60.3
<i>Zea mays</i>	36.6	11.4	29.0	63.6	31.5	4.3	12.2	17.6	68.4	65.8
<i>Oryza sativa</i>	92.8	4.2	35.1	69.1	42.4	4.8	18.1	15.5	49.8	46.5
<b>Legumes Forage Crops</b>										
<i>Sesbania sesban</i>	26.0	24.4	12.9	27.1	18.8	4.5	9.7	18.3	85.2	78.9
<i>Pueraria phaseoloides</i>	19.0	19.3	33.0	49.4	38.0	7.1	8.7	18.9	62.2	59.4
<i>Calliandra calothyrsus</i>	34.9	20.8	25.2	55.6	37.1	14.0	6.3	19.1	70.0	68.3
<i>Desmanthus virgatus</i>	35.2	15.8	34.0	46.7	37.0	13.1	6.4	19.3	61.2	58.5
<i>Arachis pintoi</i>	21.2	21.4	27.3	53.3	32.8	8.1	6.6	19.0	64.6	61.8
<i>Leucaena leucocephala</i>	29.9	23.3	19.9	40.9	25.4	10.8	8.5	19.0	75.4	73.3
<i>Sesbania grandiflora</i>	17.3	25.5	16.2	25.5	19.5	5.8	8.5	19.2	79.2	75.5
<i>Calopogonium mucunoides</i>	33.1	12.8	34.8	54.4	41.5	9.7	8.8	18.7	60.4	57.7
<i>Gliciridia sepium</i>	25.3	22.3	19.7	49.7	34.8	13.0	10.0	19.7	75.6	73.3
<b>Forage Crops from Other Families</b>										
<i>Manihot esculenta</i>	22.5	24.9	17.7	42.3	27.2	9.4	7.4	19.9	63.9	62.6
<i>Ipomoea batatas</i>	13.0	16.5	21.1	42.7	31.7	8.3	11.2	18.3	66.0	61.8

Table 2. Mineral and secondary metabolite contents of forage crops (fresh) (modified from <http://www.feedipedia.org/>)

Forage Crop	Calcium (g kg <sup>-1</sup> )	Phosphorus (g kg <sup>-1</sup> )	Potassium (g kg <sup>-1</sup> )	Sodium (g kg <sup>-1</sup> )	Magnesium (g kg <sup>-1</sup> )	Manganese (g kg <sup>-1</sup> )	Zinc (g kg <sup>-1</sup> )	Copper (g kg <sup>-1</sup> )	Iron (g kg <sup>-1</sup> )	Tannic Acid (g kg <sup>-1</sup> )	Catechin (g kg <sup>-1</sup> )
<b>Grasses Forage Crops</b>											
<i>Pennisetum purpureum</i>	3.6	2.9	29.0	0.3	3.0	91.0	45.0	11.0	413.0	22.2	12.4
<i>Brachiaria decumbens</i>	3.6	2.3	18.4	0.5	2.2	132.0	30.0	4.0	389.0	-	-
<i>Brachiaria humidicola</i>	2.3	2.1	13.7	3.5	2.8	2.8	21.0	8.0	-	-	-
<i>Paspalum dilatatum</i>	3.4	2.3	25.7	2.6	1.8	259.0	21.0	8.0	-	-	-
<i>Imperata cylindrica</i>	3.3	1.4	11.7	0.2	2.1	89.0	13.0	3.0	-	-	-
<i>Sorghum bicolor</i>	4.1	2.0	19.3	2.5	2.2	82.0	45.0	13.0	919.0	-	-
<i>Zea mays</i>	6.3	1.5	16.6	1.0	3.5	256.0	69.0	11.0	-	12.3	-
<i>Oryza sativa</i>	2.9	0.9	18.0	2.7	1.9	454.0	34.0	6.0	335.0	0.1	-
<b>Legumes Forage Crops</b>											
<i>Sesbania sesban</i>	15.9	3.3	11.6	0.3	3.5	-	-	-	-	-	2.0
<i>Pueraria phaseoloides</i>	9.6	2.7	23.6	0.1	3.0	98.0	40.0	12.0	206.0	-	-
<i>Calliandra calothyrsus</i>	7.1	2.8	6.0	0.1	3.6	-	84.0	14.0	351.0	10.5	55.1
<i>Desmanthus virgatus</i>	7.1	2.8	6.0	0.1	3.6	-	-	-	-	73.5	-
<i>Arachis pintoi</i>	15.4	4.1	-	-	-	-	-	-	-	36.9	-
<i>Leucaena leucocephala</i>	10.7	2.1	18.9	0.2	3.9	-	65.0	30.0	13.0	23.8	27.6
<i>Sesbania grandiflora</i>	14.1	4.6	20.4	2.4	3.8	-	179.0	18.0	881.0	43.2	28.6
<i>Calopogonium mucunoides</i>	11.1	2.0	9.3	0.6	3.7	44.0	33.0	9.0	557.0	-	1.0
<i>Gliciridia sepium</i>	11.9	2.3	27.1	0.4	4.5	79.0	35.0	12.0	153.0	11.0	10.9
<b>Forage Crops from Other Families</b>											
<i>Manihot esculenta</i>	11.9	3.7	12.5	0.6	7.3	-	25.0	29.0	-	65.9	26.3
<i>Ipomoea batatas</i>	9.5	2.9	24.9	0.8	4.0	141.0	70.0	2.0	1690.0	6.2	-

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**O 137. RESPONSE OF BORON GENOTYPES TO BORON DEFICIENCY AND TOXICITY**

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**ABSTRACT:** Boron element can cause toxicity in plants while It's deficient in some region for the benefit of plants in our contry. Boron uptake capacity of plants shows differ for each plant variety, and also differs between the same plant species. Boron is one of the important elements that plants need as a micro-nutrient element. Significant deformities occur in cell walls of plants that do not contain enough boron. Deficiency of boron can cause growth irregularities in STEM and body meristem cells. In our study, it is aimed to investigate the changes that occur in the development of radish plant by boron application at inadequate or toxic levels in the growing environments of radish plant which has an important place in agriculture of our country. Four different radish genotypes that White, Hazelnut, Black ve Çukurova (Rolex F1) were used in the study in water culture environment. 0mM B,0,5mM B,1mM B, 2mM B,4mM B ve 8mM B doses were applied to radish seedlings when plants come to the first three-leaf phase. They have been identified as Sensitive and durable genotypes, hazelnut, Rolex F1 genotypes. There has been a decrease in plant growth in hazelnut radish genotypes against increasing boron applications, Which according to its own group. The resulting differences have been seen becosue of the character of varieties against applications. And It has been determined that the Rolex F1 Genotype has shown a more healthy development than the other genotypes against high boron doses.

*Keywords: Boron, Radish, Genotypes, Deficiency, Toxicity*

**O 138. SOIL EROSION IN INDONESIA AND ITS CONTROL**

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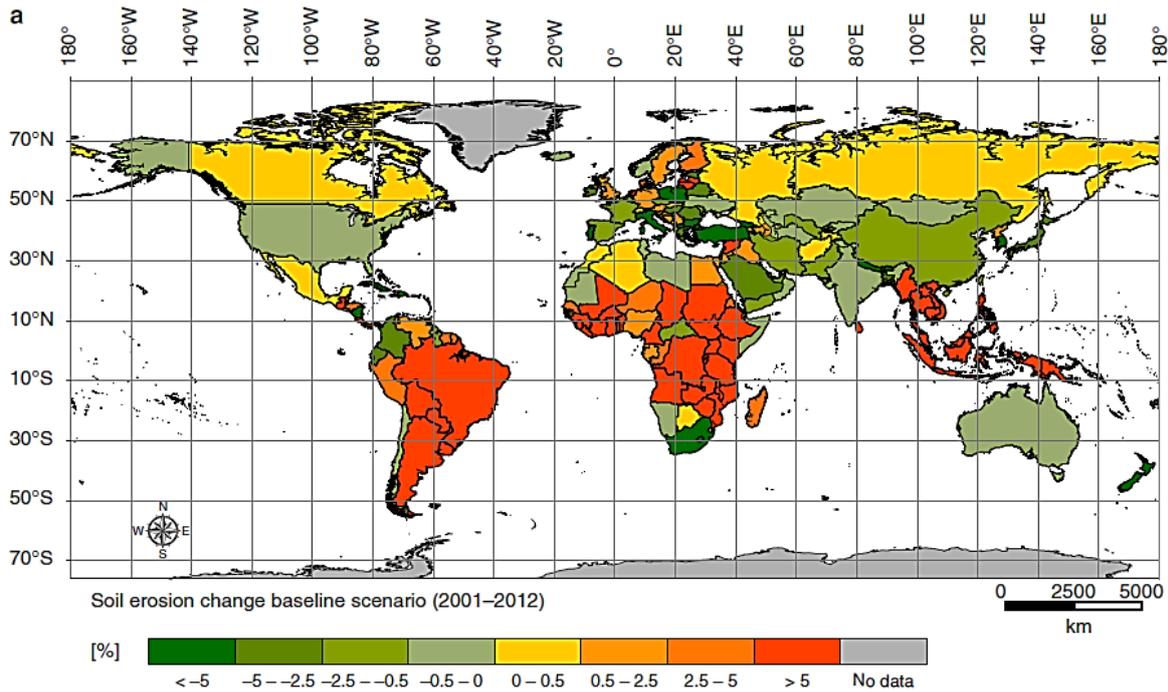
**ABSTRACT:** Erosion is a major cause of soil damage, soil loss, and soil degradation. Soil erosion can threaten agricultural productivity, food security, environmental sustainability, lead to the damage or even destruction of infrastructures and also lead to other disasters such as flood, landslide and lost of people's life. Indonesia is a tropical country with high intensity of rainfall and mountainous, hilly and wavy topography. The climate and topography conditions of Indonesia alongside with the inappropriate soil exploitation activities cause a high risk of soil erosion. Agricultural land is a major area with the highest soil erosion rate in Indonesia. Some soil erosion controls must be done to reduce soil erosion rate, especially on agricultural sloping lands. This paper tries to give brief information about soil erosion in Indonesia and some management and control efforts against soil erosion.

*Keywords: Agricultural Lands, Deforestation, Environmental Sustainability, Erosion Control*

## **1. INTRODUCTION**

Soil is one of the major natural life-supporting resources which has an important role in the natural ecosystem (Yang et al., 2003). Although its essential role for the ecosystem, the exploitation of soils for any purposes can also result in some damages (Nortcliff et al. 2006) such as soil erosion. Soil erosion threatens agricultural productivity, food security and environmental sustainability (Pimentel, 2006; IAEA, 2015), lead to the damage or even destruction of infrastructures (IAEA, 2015) and also lead other disasters such as sedimentation, pollution, flood (Morgan, 2005), landslide and loss of people's life. Soil erosion is affected by many factors, such as topography of the land, soil type and structure, the intensity and duration of rainfall (Morgan, 2005; Turner et al. 2017), the slope of the land (Morgan, 2005; Sheikh et al. 2017), land use (Yang et al. 2003; Turner et al. 2018), vegetation cover (Rehman et al. 2015; Eshghizadeh et al. 2016) and tillage (Ritter and Eng, 2012).

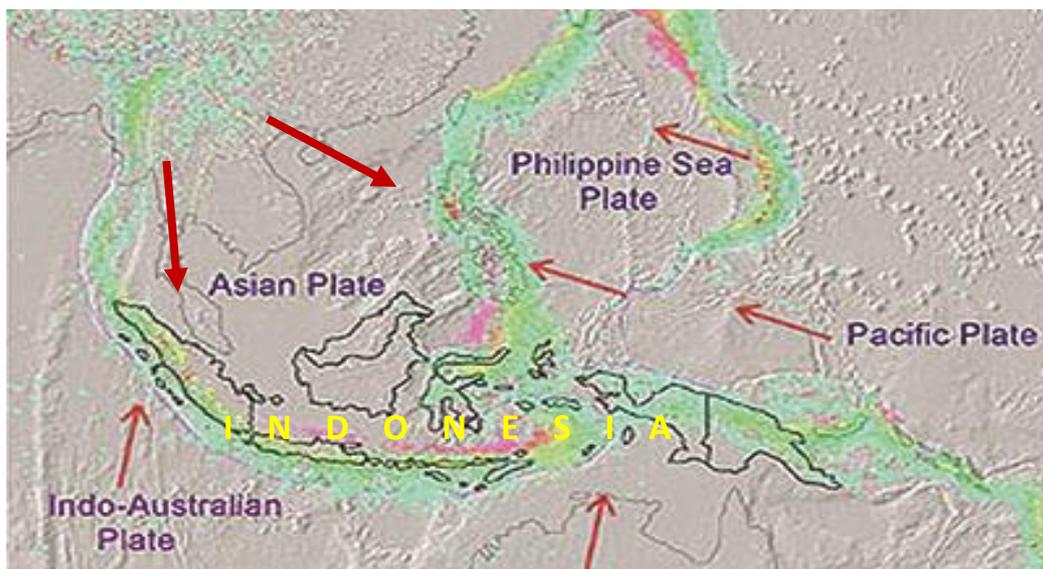
Soil erosion caused by water is a global major cause of soil damage, soil loss, and soil degradation. In the tropic, due to the large amount and high intensity of rainfall, the risk of soil erosion potentially greater than other regions (Labriere et al. 2015). Figure 1 shows that Southeast Asia, Sub-saharan Africa, and South America which are mostly tropical regions are the most regions that have higher estimated soil erosion rates. Indonesia is a tropical country in Southeast Asia which has mostly wavy, hilly and mountainous topography and high amount and intensity of rainfall potentially has a high risk of soil erosion. The inappropriate agricultural practices and deforestation including the conversion of forest lands and forest fire also become supporting factors to soil erosion in Indonesia. Some measures must be taken in order to control soil erosion. This paper is trying to give some brief information about soil erosion in Indonesia and its most used control.



**Figure 1.** The estimated changes of global soil erosion rates in 2001-2012 (Borelli et al. 2013)

## 2. GEOPHYSICS AND CLIMATE OF INDONESIA

Indonesia is located in the junction point of four tectonic plates with the Indo-Australian plate in the south, the Eurasian or Asian plate in the north, and the Philippine Sea plate and Pacific plate in the east. These four tectonic plates move to different directions and create a three-way collision (Figure 2). The movement of these plates is buffered by the nearly continuous release of tectonic strain energy in the form of large earthquakes, explosive volcanic eruptions, and associated tsunami and landslides that claim lives and cause societal and economic disaster (Harris and Prasetyadi, 2002). The junction point of these tectonic plates also created a series of volcanoes and frequent earthquakes and land movements. There are more than 500 volcanoes in Indonesia and 129 of them are active (BNPB, 2010). These tectonic activities may cause an average of three times ground vibrations and one earthquake in a day and at least one volcanic eruption in a year (KLH, 2011).



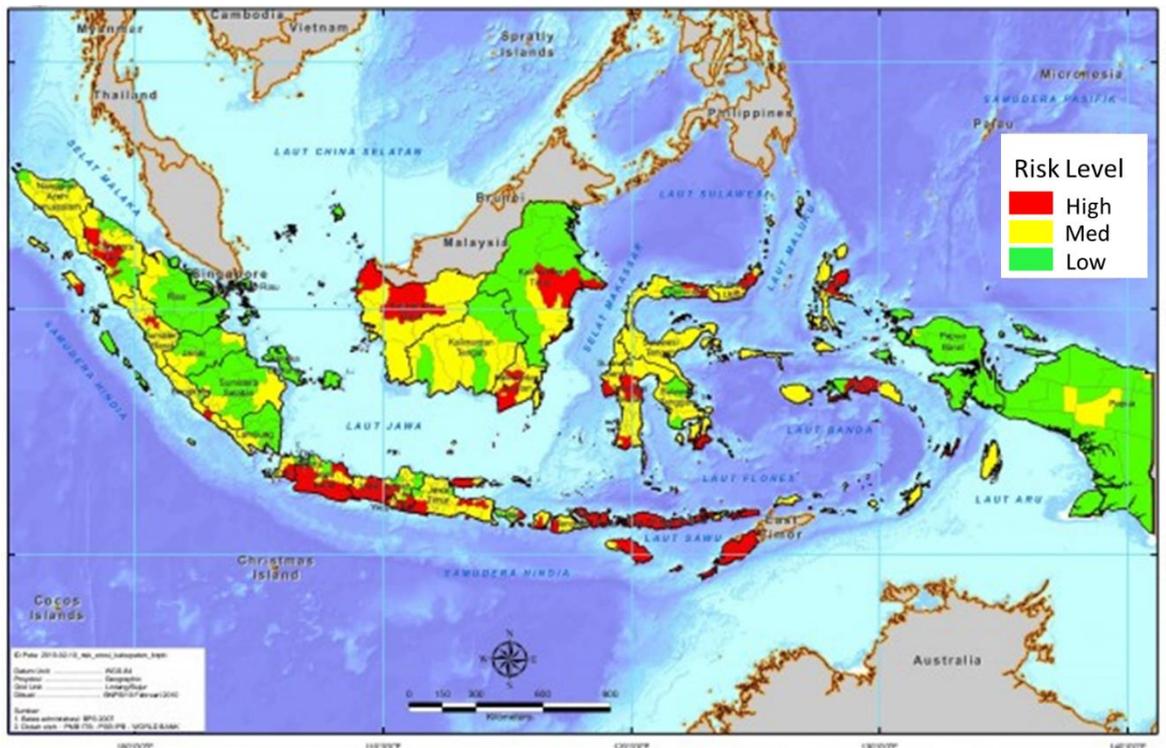
**Figure 2.** The map of tectonic plates and their motion of Indonesia region (Harris and Prasetyadi, 2002)

Due to its more than 500 mountains, the soil surface of Indonesia is mostly sloped. 77.4% of Indonesia's lands are sloped more than 3%, while 22.6% of them are flat (Dariah et al., 2004a; Juarsah et al., 2008). Its topography is wavy, hilly and mountainous. Generally, the sloping land of each island is larger than the flat land. For example, the sloping land of Sumatra Island is approximately 33.7 million ha, while the flat land is approximately 13.5 million ha. The sloping land of Java Island is approximately 10.8 million ha and the flat land is approximately 2.4 million ha (Juarsah et al., 2008).

Indonesia is also located on the equator line and between two continents (Asia and Australia) and two oceans (Indian and Pacific). These conditions made Indonesia has a tropical sea climate. There are two seasons in Indonesia, namely the rainy season (October-April) and the dry season (May-September). The air temperature is between 20-30°C. Indonesia has very high rainfall, with an average annual rainfall of 2000-3000 mm. However, rainfall is different according to the months and geographical location. In general, the western part of Indonesia has more rain than the eastern part. Baturaden is a city in Java Island with the highest rainfall in Indonesia, located at mountainside of Mount Slamet with an annual rainfall of 7 069 mm. The lowest amount of precipitation is located in Palu City of Sulawesi Island, which has an annual rainfall of 547 mm (Hidayat, 2008). As a tropic archipelago country surrounded by oceans and seas, Indonesia has a very high humidity ranging from 85-100% (BPS, 2018).

### **3. SOIL EROSION IN INDONESIA**

The erosion in Indonesia is generally caused by rainwater. The main reasons for this are the high amount and intensity of rainfall, the slope of the land topography (Dariah et al., 2004a) and agricultural activities on the sloping land. Erosion in sloping soils between 3-15% is very high. This amount varies between 97.5-423.6 tons ha<sup>-1</sup> year<sup>-1</sup>. In general, the amount of soil erosion in Indonesia is 35-220 tons ha<sup>-1</sup> year<sup>-1</sup>, and the annual rate of increase is 7-14% or 3-28 tons ha<sup>-1</sup> (Adimihardja, 2008). The soil erosion risk of Indonesia is presented in Figure 3.



**Figure 3.** The map of soil erosion risk in Indonesia (BNPB, 2010)

#### **3.1. Soil Erosion Types**

According to erosive agents, erosion in Indonesia is generally water erosion. There are two ways in which the soil particles are transported by the water, they are surface erosion and landslide (Figure 4).

### 3.1.1. Surface erosion

As the soil is bare without cover, the soil particles are detached from the soil surface with the impact of raindrops and carried in the slope direction by runoff. This erosion occurs as sediment transport. The amount of surface erosion in Indonesia is 35-220 tons ha<sup>-1</sup> year<sup>-1</sup> (Adimihardja, 2008).

### 3.1.2. Landslide

Landslides occur when moving and loose slopes become saturated with water and increase its weight. The slippery bottom of soil surface layer causes the saturated soil sliding down to the direction of the slope. In 2014, there were 413 landslides in Indonesia (KEMENLHK, 2015).



**Figure 4:** a. Sediment transport in River Lumut in Bangka Island (Riyadi, 2016); b. Landslide event in Banjarnegara, Central Java in December 14, 2014 (Koesuma, 2015)

## 3.2. General Causes of Soil Erosion in Plant Production Areas

In general, the most important causes of soil erosion in plant production areas of Indonesia are as follows:

### 3.2.1. Inappropriate agricultural practices

- Agriculture practices on very steep slopes (more than 15%),
- The cultivation in sloping areas without any protective measures,
- The soil surfaces around agricultural lands are left bare (Adimihardja, 2008),
- Conducting the soil operation in a parallel direction to the slope (Balittanah, 2016).

### 3.2.2. Illegal logging and deforestation

Deforestation is a conversion of forest land to other land uses or the decrease of tree canopy in such a long term (KEMENLHK, 2018). In 2015, the deforestation rate in Indonesia is 1 092 181,6 ha (BPS, 2018). Illegal logging is an important cause of deforestation. According to WWF, the number of illegal logging in Indonesia is very high (70-80%) as shown in Figure 5.



**Figure 5.** The estimation of world’s illegal logging (www.wwf.org.au)

### 3.2.3. Conversion of forest land to other sectors

The conversion of forest land to other sectors is one of the major causes of deforestation in Indonesia. The Indonesian Ministry of Environment and Forestry of the Republic of Indonesia reported that until 2014, approximately 7.9 million ha of Indonesian forests were converted into agricultural land, settlement, mining and industrial sectors (Table 1).

**Table 1.** The conversion of forest land to other sectors (KEMENLHK, 2015)

Sector	Conversion rate (ha)
Agriculture	6 531 591.83
Settlement	890 560.07
Mine	449 887.06
Industry	45 737.43
<b>Total</b>	<b>7 917 776.39</b>

### 3.2.4. Forest fire

Fires also become one of the major causes of deforestation in Indonesia. Fires cause not only the destruction of vegetation cover but also cause the loss of biodiversity and air pollution. Forest fires are generally seen in large islands in Indonesia, which have very large forests. Most of the large islands in Indonesia are forests with organic peat soils with a depth of 12 meters. This makes the blaze is difficult to be extinguished when fires happen. Fires usually occur during the long dry season and occur by burning agricultural land around the forest or by burning the forests for opening the new agricultural lands (KLH, 2011). Fires occurred in 32 761.26 ha forest areas in Indonesia in 2014 (KEMENLHK, 2015).

## 4. THE CONTROL OF SOIL EROSION IN INDONESIA

### 4.1. Reforestation or Forest Rehabilitation

Forest rehabilitation is defined as an activity that is intentionally aimed at regenerating trees, both naturally and/or artificially, on grasslands, shrubs, or barren areas that used to be forests, with the aim of increasing productivity, community livelihoods, or benefits of environmental services (Nawir and Murniati, 2008). According to the report from Ministry of Environment and Forestry of the Republic of Indonesia, 105 656 ha reforestation have been done in 2013 (KEMENLHK, 2015) while 200 447, 198

346 and 200 990 ha forest and land rehabilitation have been done in 2015, 2016 and 2017 respectively (KEMENLHK, 2018).

#### 4.2. Agroforestry

International Council for Research in Agroforestry (ICRAF) defines agroforestry as a land management system based on sustainability in improving the overall yield of the land, combining the production of crops (including tree crops) and forest trees and/or livestock simultaneously or sequentially on the same land unit, and applying management methods that are in accordance with local culture. Agroforestry is intended to maximize the use of solar energy, minimize nutrient losses, optimize water use efficiency and minimize runoff and erosion (Suryani and Dariyah, 2012). The coverage of agricultural crops and forest trees reduce the runoff and prevent erosion of soil surface (Santoso et al. 2004; Suryani and Dariyah, 2012).



**Figure 6:** a. Agroforestry of upland rice and teak trees in Ngawi, East Java (Marwati, 2014); b. Agroforestry of pineapple and sengon trees in Pemalang, East Java (Wiguna, 2013)

#### 4.3. Mulch

Mulch is a material that is deliberately laid on the soil surface in order to cover the soil and not to leave the soil bare (William et al. 1993; Santoso et al. 2004). In Indonesia, three mulch types are usually used:

- Plastic mulch or inorganic mulch (Figure 7a),
- Organic mulch; organic materials such as leaves, branches, straws, wood shavings and similar plant residues are generally used (Figure 7b).
- Cover crop (biological mulch or biomulch); Cover crops are planted on the surface of the bare soil between the main crops. Cover crops from the family of legumes are usually used (Figure 7c). Most commonly used cover crops are *Mucuna bracteata*, *Calopogonium mucunoides*, *Centrosoma pubescens*, *Pueraria javanica* and *Arachis pintoi* (Santoso et al., 2004; Erfandi, 2013; Sumiahadi, 2014; Sumiahadi et al. 2016; 2018).



**Figure 7:** a. The use of plastic mulch (Hidayat, 2019); b. Rice straw mulch (Sakti, 2017); c. *Arachis pintoi* biomulch (original documentation)

#### **4.4. Appropriate Soil Tillage and Management**

Soil tillage and bed formation must be carried out perpendicular to the slope of the land or parallel to the contour level (Figure 8). This application can both reduce runoff and erosion, and protect the water (Dariah et al. 2004b).



**Figure 8.** Soil tillage and bed formation parallel to the contour level (Anton, 2015)

#### **4.5. Rorak or Sediment Trap**

Rorak or sediment trap is a hole made to catch the eroded soil and runoff. Rorak becomes a reservoir for the eroded soil and water where the eroded soil will be trapped and accumulated and water will be infiltrated into the soil (Figure 9). Sediment traps are made in infiltration channels between crop rows of cultivation areas (Dariah et al. 2004b; Erfandi, 2013).



**Figure 9.** Sediment trap (Agus, 2008)

#### **4.6. Terrace**

The terrace is a conservation method that is intended to reduce the length of the slope, hold water that reduces the speed and amount of runoff, and increases the chance of water infiltration into the soil. The terrace is the most applied soil erosion control method in Indonesia. Most applied terrace types in Indonesia are bench terrace and ridge terrace.

- Inward and outward sloping bench terraces: Usually for growing vegetable and annual crops,
- Irrigation bench terrace: Usually for growing rice,
- Flat with ditch or level bench terrace: Usually for growing vegetable and annual crops,
- Ridge terrace: Usually for growing tea and perennial crops (Dariah et al. 2004b).



**Figure 10.** a. Vegetable field terrace in Majalengka, West Java ([www.explorermajalengka.web.id](http://www.explorermajalengka.web.id)); b. Rice field terrace in Ubud, Bali ([www.grandbalitour.com](http://www.grandbalitour.com))

## 5. CONCLUSION

Indonesia is a tropical country in Southeast Asia which has mostly wavy, hilly and mountainous topography and high amount and intensity of rainfall. With this conditions, Indonesia potentially has a high risk of soil erosion. In general, the most important causes of soil erosion in plant production areas in Indonesia are inappropriate agricultural practices, deforestation, conversion of forest land to other sectors and forest fires. Some measures have been applied in order to control soil erosion in Indonesia. They are reforestation or forest rehabilitation, agroforestry, the use of mulch, appropriate soil management, sediment trap, and terrace system application. These are only some of the most used erosion control measures that have been applied in Indonesia. There are more erosion control measures that cannot be presented in this paper.

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**O 139. PHYSICAL MODELING FOR DEVELOPMENT OF ENERGY DISSIPATING  
STRUCTURES**

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**ABSTRACT:** Energy dissipating structures are constructions that transfer the water from upstream to downstream safely by reducing the energy of the flow. They are generally used in irrigation channels, discharging from a dam bottom outlet, at the foot of the spillway structures and in dissipating the energy of water in a similar situations. The main principle of energy dissipating pools is to keep the hydraulic jump in the channel while flow regime is changing from super critical to sub critical. In this study, the channel was set up to investigate the energy dissipating blocks which were placed at the downstream of the ogee spillway in the energy diispating pool. In this study, trapeze section energy dissipator blocks test setup was used to increase the energy dissipating rate. During the experimental studies, Froude similarities were used for modelling flow rate, flow depth and rating curve. Finally, the effect of the shape of the blocks on energy dissipating along the channel was figured out.

*Keywords: Energy dissipating pool, energy dissipating blocks, spillway design, ogee design, open channels*

**O 140. CHLORIDE ADSORPTION BY THE ADSORBENT SYNTHESIZED FROM WASTE PAPER**

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**ABSTRACT:** In the production of recycled paper, two main problems of recycled product are whiteness and strength. For this reason, the most common approach is producing cartoon and cardboard. However, some waste papers are no longer convenient for recycled paper or cardboard production. Available environmentally friendly second- or third- generation solutions are needed for those types of waste papers. In this case the most common approach is incineration for energy production, which is the unfeasible one-time benefit, that does not allow keeping the material remain in the system. Chloride (Cl<sup>-</sup>) is an anion that result in salty taste, salinity and abrasion in water and when excessive in soil, that cause reduced productivity of culture plants. In order to protect drinking water resources, the system should be prevented from excess Cl<sup>-</sup> entry. One of the Cl<sup>-</sup> removal methods from aqueous media is adsorption/ion exchange. Therefore, in this study an adsorbent was synthesized from wastepaper, and effectiveness of this adsorbent in Cl<sup>-</sup> adsorption was investigated. Firstly, slurry was obtained from shredded wastepaper, then citric acid activation was applied, rinsed, dried and ground to obtain fibrous adsorbent. NaCl solution was used in Cl<sup>-</sup> adsorption. In batch adsorption studies, first, optimum pH was determined as 7.8 at which the highest Cl<sup>-</sup> adsorption was achieved. Then, varying dosages of adsorbent were added to the reactors containing Cl<sup>-</sup> solution of the same initial Cl<sup>-</sup> concentration. The reactors were operated in a shaker at 220 rpm and at room temperature. Samples were withdrawn from the batch reactors at different time intervals and Cl<sup>-</sup> concentration of the samples was analyzed via Mohr titrimetric method. The sampling was performed until remaining Cl<sup>-</sup> concentration become constant, which was recorded as equilibrium time. The results indicated that at 2 g/L adsorbent dosage, in 120 minutes about 70% Cl<sup>-</sup> removal can be achieved. Isotherm analysis indicated that, the system fits Freundlich isotherm with the model of  $q=0.016 \cdot C_e^{1.74}$  this indicates that the adsorbent surface is heterogeneous, and adsorption is multilayer through physical forces. The maximum Cl<sup>-</sup> adsorption capacity was found as 500±16 mg/g. This study resulted in two benefits: one is the recovery of a new generation material from a waste, and the second one is the suggested new alternative solution for Cl<sup>-</sup> removal from aqueous solution. As the paper adsorbent is in fibrous form, it is recommended that the effectiveness of this material, when mixed with soil, in reducing its salinity should be studied.

*Keywords: Adsorption, chloride (Cl<sup>-</sup>) removal, wastepaper*

**O 141. CHALLENGES OF COMBATING WITH AIR POLLUTION IN NORTH MACEDONIA**

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**ABSTRACT:** Ambient air quality has an important impact on the environment. It is a global, regional and local environmental problem. Air pollution affects human health and quality of life of the citizens. Threats from air pollution have been growing permanently. In North Macedonia in the last ten years the problems with air quality has become the biggest environmental problem. This has particularly dramatic range in the urban areas in the capital city Skopje, Tetovo, Bitola and other bigger cities. According to the data from World Health Organization more than three thousand people per year have premature death caused from air pollution. The most critical situation is with pollution from suspended particles PM<sub>10</sub> and PM<sub>2.5</sub> but also the degradation of air quality is caused by others harmful substances such as, CO<sub>2</sub>, SO<sub>2</sub>, NO and other harmful substances. The air pollution in the country is measured by 17 fixed measuring stations and 40 mobile stations. This provides the information to the citizens and rising of its public awareness, and also contributes for intensification of activities in combating with air pollution. Undertaking measures and activities for combating the air pollution is a -big challenge for mitigation the damages from air pollution for central and local government, but also for the business sector, experts, nongovernmental sector and all involved stake holders. There are many factors which cause air pollution such as: traffic and transport, industry, energy, heating and particularly low quality of heating wood, unsustainable construction, destruction of greenery and other factors. North Macedonia as a candidate state, expects beginning of negotiations with the European Union. In 2005 the country started with transposing the EU air quality regulation into the national regulation, especially the Directive 2080/50 EC. In 2005 was adopted Law on ambient air quality which is detailed in several sub law acts. The national regulation transposes the main principles and standards from EU regulation, but the problems appear with its practical implementation. There is a need of undertaking urgent measures for mitigation the negative effects of air pollution, not only for the fulfillment the obligations toward to the EU accession, it is a necessity for the improvement of human health and quality of life. The main aim of this paper is to analyze the conditions in the area of air pollution and to compare with the situations in the EU and to give some recommendations for the urgent improvement of the ambient air quality in North Macedonia.

*Keywords: air, combating, quality, regulation, European Union*

## **O 142. NEW CONSIDERATION FOR BIODIESEL SMALL SCALE PRODUCTION USING MODELING AND SIMULATION TECHNICIS**

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**ABSTRACT:** Biodiesel is a material serving as a promising energy alternative to cover the demand of clean sustainable energy sources. Conventional biodiesel production is done by transesterification method using stirred tank reactor and homogeneous base or acid catalyst then followed by purification process. However, there are some disadvantages related with this method. They include soap formation, sensitivity to free fatty acid (FFA) content and purification difficulties. Transesterification process depends upon a number of process parameters which are required to be optimized in order to maximize the biodiesel yield.

In this paper we have worked for flow sheet constructions of Biodiesel small plant using computer simulating software. All the conclusion results will be shown in simulation part of paper. The core objective of this paper would to design and develop a profitable biodiesel production plant by examining all models.

*Keywords: Biodiesel, Modeling, Simulation, Small Scale*

### **1. INTRODUCTION**

The high-speed growth of the global population leads to drastically increasing demand for a sustainable energy supply also turning the attention to waste treatment. Demand for energy is progressively increasing and current energy sources are limited, researchers are always looking for alternative energy sources. (Wolfram, C., Shelef, O. & Gertler, P. J. (2012))

Another reason, even today, is the drastic increase in oil prices as a result of finite energy sources for fossil fuels and environmental concerns have led researchers to seek alternative energy sources, and in particular biodiesel sources.

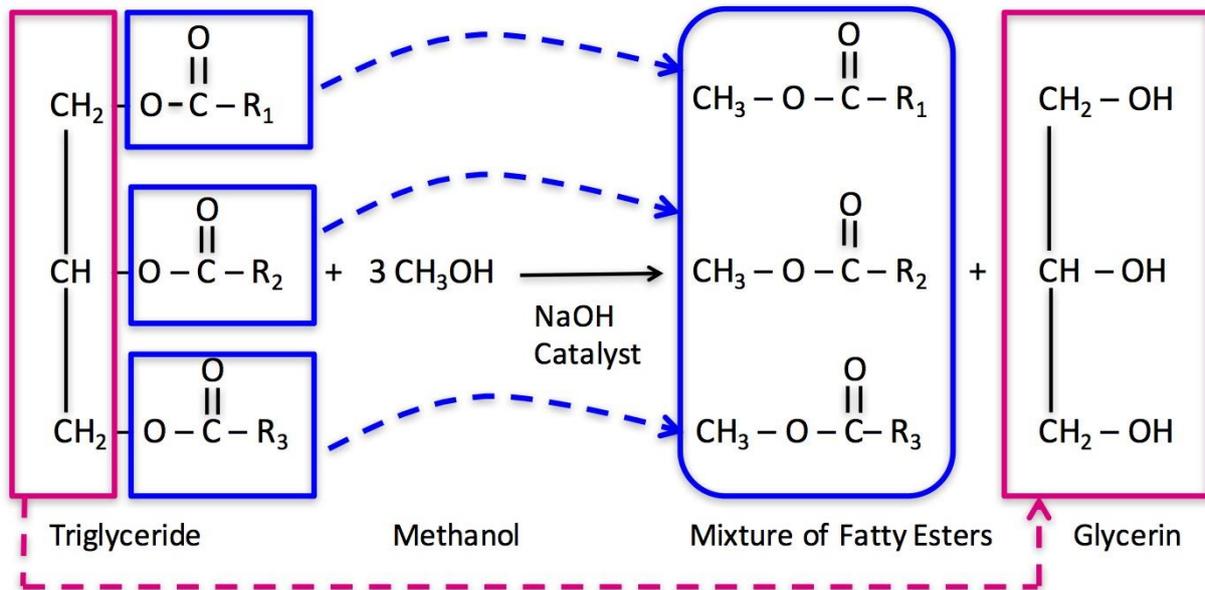
Biodiesel promises to be one of the most potential and most potent energies it is also a source of clean fuel as it emits less toxic pollutants and greenhouse gases than diesel fossil. Biodiesel can be used as a single fuel or mixed with conventional diesel. It is also proven in previous works that Biodiesel is suitable for diesel engines without the need for any particular modification and has not resulted any negative impact on engine performance.

Biodiesel presents many advantages over fossil diesel such as renewability, sustainability and biodegradability. (Zhang, Y. 2003 )

Without eliminating the need for sustainable energy, the issue of global pollution is also important to be discussed. One of the most trendy and key ways to reduce pollution is waste recycling, turning them into important products. (M. Zabeti, 2009)

Referring to a large number of studies we see that they are focused on biodiesel production with ante of transesterification of vegetable oils with alcohol under different reaction conditions. The transesterification reaction is carried out in the presence of acidic or basic catalysts. It has been found that there are disadvantages when using acid / base catalysts. Firstly, alkali catalyzed processes are very sensitive to the presence of free fatty acids (FFAs) and water. In this case, the reaction causes us to form soap, reducing the rate of biodiesel production and resulting in cleaning difficulties. The second reason is that acid catalyst processes refer to a long reaction time. (Demirbas, A. (2009))

Esterification and transesterification processes are the most popular processes for biodiesel production. The general reaction is referred to in **Figure 1**.



**Figure1:** Transesterification reaction of triglyceride by methanol with alkaline catalyst

The required product of this reaction is methyl ester (biodiesel), while the main sub-product is glycerol. Methanol is one that is mainly used as a low cost reason. The residues produced by the biodiesel production process are mainly water from the purification process, and the residues of the catalysts and the alcohol that they often return to the recycling process.

### 1.1. Simulation by Aspen

Aspen Hysys's and Plus application uses the basic concepts and their connection among them, for example, mass and energy compensation, to evaluate how to perform a complex procedure. The Aspen principle gives engineers the ability to describe and test a synthetic process in a short time. Furthermore, it can be used to explore the impacts of diverse configuration parameters of the synthetic process and give comes about that are hard to acquire in research center.

By utilizing thermodynamic testing information and practical working conditions, the actual behavior of the process can be re-implemented.

Also, the reenactment transformation empowers the architects' methodology to grow the best methodologies using the device, for example, affectability probe, adding the machine square, expanding parts, benefit analysis, and special outline. Aspen methodology application can be utilized by the following steps ( Aspen technology (2009)):

Step 1: Identify the unit operations and the procedure streams that stream to and from them in the process flow sheet. Name all streams and associate them to the unit operation models.

Step 2: Identify the substance columns from the Aspen Hysys database or define them .

Step 3: Identify thermodynamic models incorporated with Aspen Hysys to meter the physical properties of the parts and mixtures simultaneously.

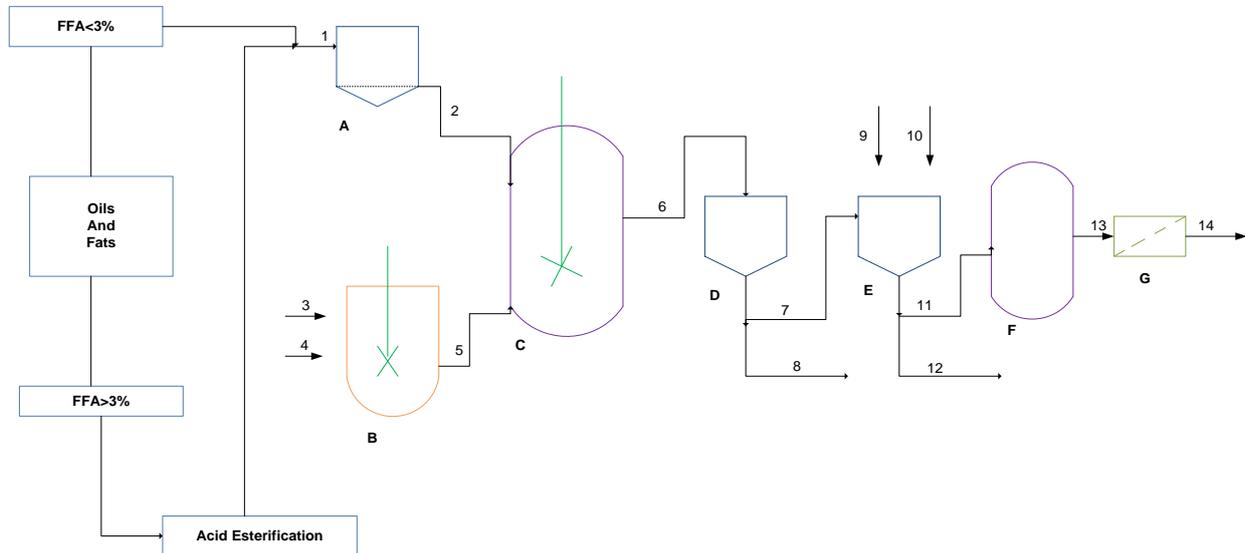
Step 4: Identify the thermodynamic conditions and the part stream rates of the info streams.

Step 5: Identify the working conditions for the unit operation models.

We can change most of the above information details to distribute options forms. Additionally, Aspen Plus can be used to customize plant information with reproduction models to predict and restore physical properties, generate even deliver results, and interface results in spreadsheets. In this enterprise, different models are in contrast to biodiesel production and the parameters have improved so the greater transformation and the least warmth obligation is taken. Now, for the trans-esterification reaction, let's look at different models for studying.

## RESULTS AND DISCUSSION

The program used for simulation is Aspen plus v10. Also block schemes are built according to the vision 2017 program. In the following schemes are given some alternatives that we have worked with to reach the optimum scheme for Biodiesel production.



**A:** Filtering and heating tank reactor for Oil and fats

**B:** Blender

**C:** Transesterification stirring tank reactor

**D:** Settler 1

**E:** Settler 2 (Biodiesel washing process)

**F:** Tank reactor for biodiesel drying

**G:** Filtration Unit

**1:** Untreated oil and fats

**2:** Treated oil and fats

**3:** Methanol

**4:** Sodium hydroxide

**5:** Methoxide solution

**6:** Reaction products

**7:** Biodiesel+methanol+impurities

**8:** Glycerin

**9:** Hot Water

**10:** Citric acid 0.4%

**11:** Biodiesel+Water

**12:** Washing Water

**13:** Biodiesel

**14:** Final Biodiesel

**Figure 2.** block simplified scheme of alkali-catalyzed biodiesel production

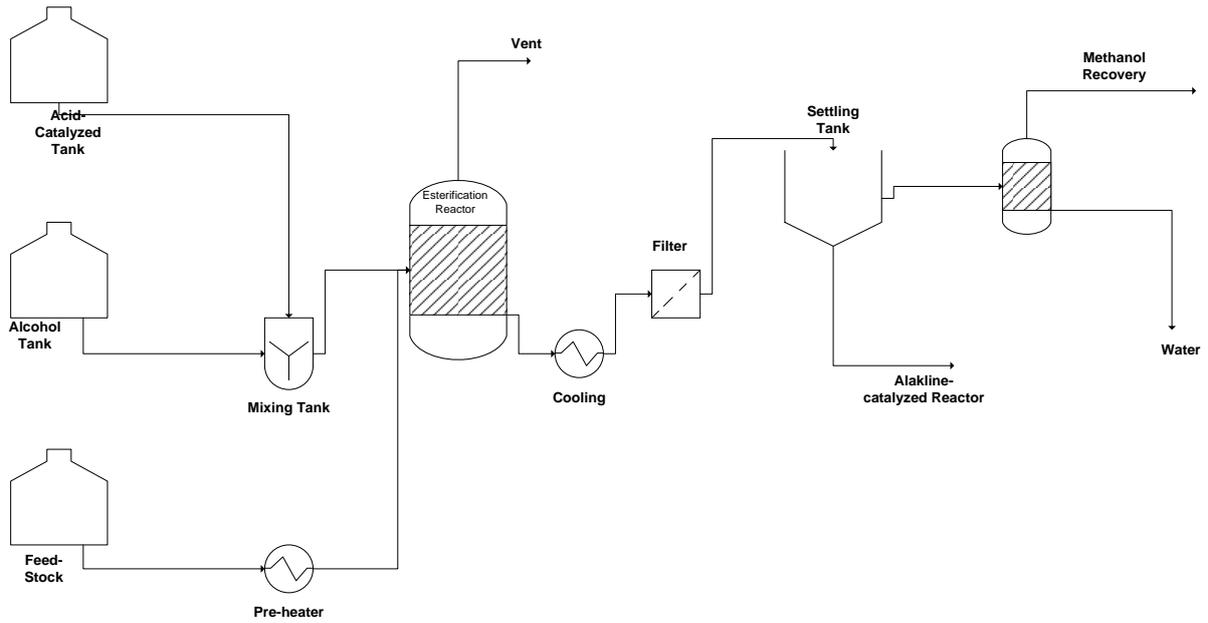


Figure 3. Pretreatment of high free fatty acid feed-stock with acid-catalyzed reactor—process

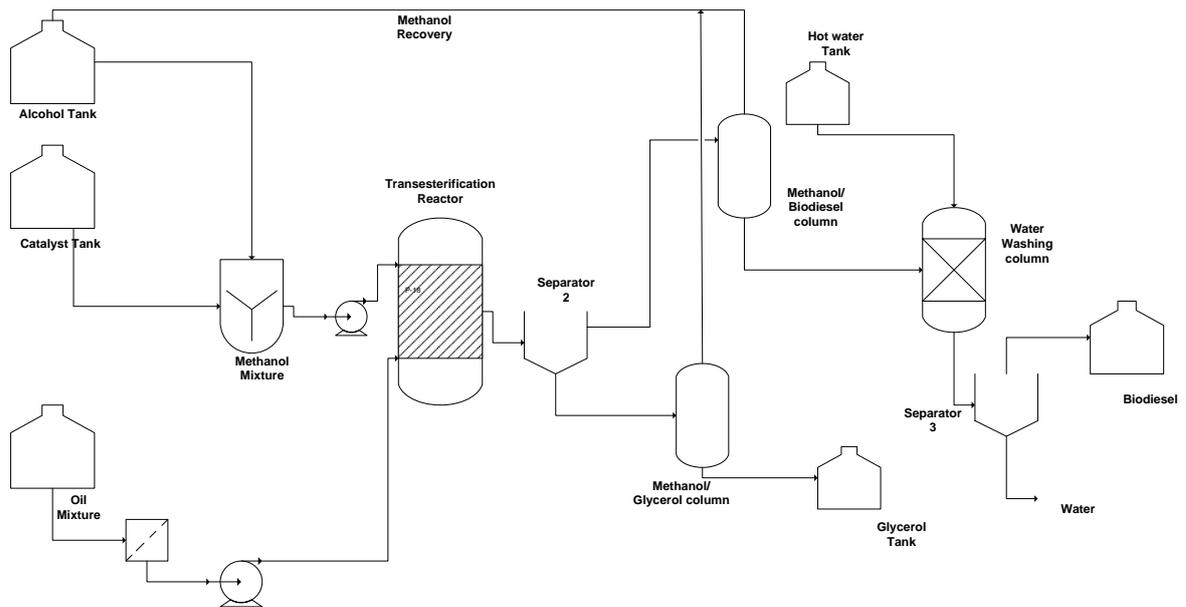
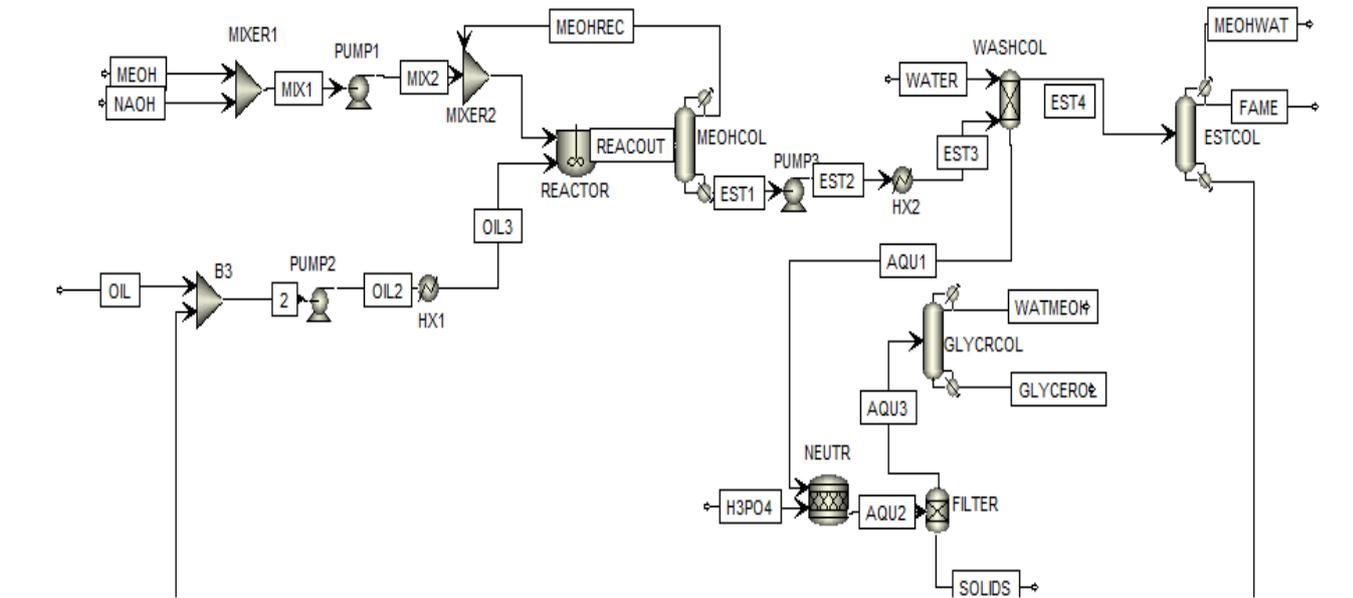


Figure 4. Alkali-catalyzed treatment of pretreated waste cooking oil—process



**Figure 5.** Process Flow diagram for Biodiesel plant in Aspen plus simulator.

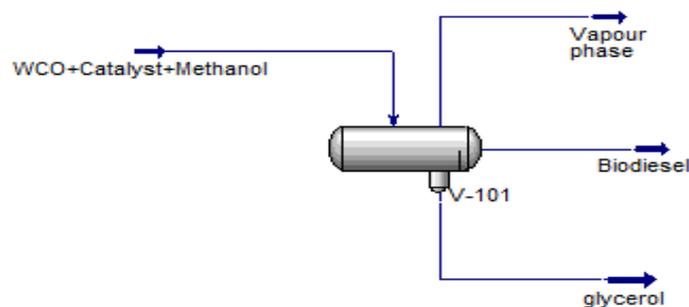
The simulated continuous process flow sheet is presented below in Figure 5 . The process scheme can be described commencing with biodiesel synthesis and followed by the downstream processing steps to obtain pure biodiesel and glycerol products

From the general simulation scheme in the Aspen plus V10 program, we developed the separator tank V-101.

In the incoming stream we have WCO, catalyst and alcohol that have come from the Reactor where the transesterification reaction occurred.

We used experimental data developed at laboratory scale where the reaction took place under the following conditions: at a temperature of 150 F (65°C) at 1atm pressure.

Initially this operation was performed in an isothermal way using a decanter and an initial water sensitivity analysis out to ascertain the amount of water that can affect separation as well as allowing recycling. For this way of operation, an increase in water supplied to the led process to a reduction in the separating effect due to the existence of a homogeneous region, biodiesel, glycerine and water went out into a single stream. However in carrying out adiabatically, the division effect was discovered regardless of the amount of water used and glycerol was effectively derived from the ester phase.



**Figure 6.** Separation of Biodiesel and Glycerol

**Table 1.** Main Stream results of the simulated process and fraction compositions of Biodiesel production plant especially Separator Tank

Streams					
		WCO+Catalyst+Methanol	Vapour phase	Biodiesel	glycerol
Vapour Fraction		0.0000	1.0000	0.0000	0.0000
Temperature	F	150.0	150.0	150.0	150.0
Pressure	psia	15.50	15.50	15.50	15.50
Molar Flow	lbmole/hr	5.338	0.0000	1.931	3.407
Mass Flow	lb/hr	700.0	0.0000	590.3	109.7
Std Ideal Liq Vol Flow	barrel/day	52.77	0.0000	46.00	6.771
Heat Flow	Btu/hr	-1.116e+006	-0.0000	-6.019e+005	-5.145e+005
Molar Enthalpy	Btu/lbmole	-2.091e+005	-9.769e+004	-3.117e+005	-1.510e+005

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## **O 143. THE IMPORTANCE OF RENEWABLE ENERGY SOURCES FOR THE ENVIRONMENT**

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**ABSTRACT:** All energy sources have positive and negative effects on the environment. These effects occur in different ways at every stage from the acquisition of energy resources to the consumption. It is possible to solve the energy need which has become the world's biggest problem without harming the environment with renewable energy sources and clean energy sources. In this article, positive environmental effects of renewable energy sources and negative effects of fossil fuels are discussed.

*Keywords: Renewable energy, environment, fossil fuels*

### **1. INTRODUCTION**

In the first stages of energy production, the environment was thought to be human-centered and the “anthropocentric” approach based on the idea that the environment should be in the service of humanity was exhibited (Özerkmen, 2002).

18. Economic growth starting after the century and about 2 centuries in the process of economic growth and environmental conflict, which is considered as priority, in natural life and with environmental degradation approaching the irreversible point, economic growth policies will also take care of Environment and natural life in the perspective of sustainable development. (Vina, Hoff and Derose, 2002)

Increasing energy demand causes rapid population growth, traffic intensity, urbanization and industrialization to increase the environmental problems. Most of the pollutants and greenhouse gases in the atmosphere are due to the energy sector. (Çukurçayır and Sağır, 2018).

Energy savings are required for a strong economy and a reduced pollution level. Considering that it is limited to environmental problems arising from the use of fossil resources, we can say that renewable energy sources are more environmentally friendly and economical. Renewable energy will be at the forefront of the use of fossil resources for the environment and the damage it has caused to this time will be reduced.

### **2. RENEWABLE ENERGY SOURCES**

It is defined by the ability to renew itself at the same rate as the energy from the source, or faster than the rate of depletion of the source. Renewable energy sources and fossil fuels are the characteristics that distinguish between fossil fuels once they are used and can not be converted again. Renewable energy sources can be converted to energy at an unlimited level, and can be thought of as free fuel. It is a clean type of energy, although it leads to reasonable levels of damage during manufacturing and installation phases, it exhibits an environmentally sensitive, non-polluting structure in the energy production phase. Most of the greenhouse gases in the world are due to energy production and consumption. To reduce greenhouse gases, investments in renewable energy technologies need to be increased. Renewable energy sources security of energy supply is important in terms of reducing dependence on foreign energy, reducing carbon emissions and creating jobs (Çoban and Kılınç, 2016). It is important to reduce emissions in the fight against greenhouse effect reduction. (Yakıncı and Kök, 2017). Acid rain and global warming are among the most worrying environmental problems lately.

Renewable energy refers to the “energy source within the evolution of nature, which can be the same as the next day” (Yılmaz and Kösem, 2011). In addition, renewable energy sources such as hydraulic, wind, current energy and tides, hydrogen, which are present in nature, which are mostly supplied on Earth and nature without needing any production process, which is not fossil-source (coal, oil and carbon-

derivative), which occurs at a low level while generating electrical energy, which has a much lower impact on (Seydoğulları, 2013).

Renewable energy sources (hydraulic, geothermal, solar, wind, biomass, wave, etc.), the countries' domestic resources within energy policies, contributing to energy supply security, being clean, contributing to the elimination of environmental concerns and the economic value-carrying characteristics within the framework of the Kyoto Protocol 5 are of great importance. Investing in renewable and clean technologies in developing countries has been facilitated even more because of the funding source created by the financial flexibility mechanisms of the Kyoto Protocol (Bayraç, 2011).

With 79% of the world's final energy production, fossil fuels rank first. This is followed by renewable energy sources with 18% share and nuclear energy with 3% share. While most of the share of renewable energy is traditional biomass, it is followed by large hydraulic, hot water/heating, power generation and biofuels respectively. Renewable energy sources such as electricity generation, water heating, greenhouse heating, drying, lighting, heating, chemical processes are used in many areas. The use of these resources in electricity generation is very important. The share of renewable resources in the world's electricity production is 18%. While the largest share of electricity produced from these sources is 16%, it is biomass and wind, solar, geothermal and so on. sources are monitoring. (GEKA, 2011). The "edible" energy source is only the "multiplier" energy source as much as it is consumed.

### **3. ENERGY, ENVIRONMENT AND SUSTAINABLE DEVELOPMENT**

The concept of "sustainable" was first used in the Brundtland report in the 1980s and refers to "the use of our existing resources enough for future generations" (Seydoğulları, 2013). Meaning, today, live without blocking tomorrow (Tıraş, 2011). The main characteristic of the concept used in different areas is that it takes the subject of the human future and contains the protection of the resources of the area it is used for. (Tıraş, 2011) According to Gilman (1992), sustainability continues to function until an uncertain future without depleting the main resources of society, the ecosystem or any ongoing system (Özmehmet, 2010) With these explanations, the economy, society and the environment, which are the three main components of sustainability, are emerging (Seydoğulları, 2013).

There are four conditions for sustainable energy production:

1. "Ensuring that the supply of energy is sufficient to meet human needs (i.e., to ensure that per capita income growth is at least 3%);
2. To implement energy efficiency and conservation measures and to minimize loss of energy resources;
3. Protection of Public Health by knowing the security hazards and consequences of energy sources
4. Protecting the biosafety, preventing more local pollution." (Gürsoy, 2004)

Today, energy, which plays an important role in economic growth in all countries of the world, is an indispensable element of development programs and development. Energy policies, especially in developing countries, are an integral part of development plans. Energy is the most strategic sector, so Turkey should use the energy effectively. Furthermore, it is a fundamental obligation to meet all kinds of energy needs at safe, adequate, continuous, Reasonable Prices and environment friendly conditions. (Kılıç, 2013).

For Example ;

#### **a. Energy Production in WORLD**

Today, where the destruction of nature and environmental costs have reached enormous levels, the state is the main actor of a very delicate balance between nature and economic development. (Keles et al. 2009) point out, the state is obliged to facilitate the inclusion of natural resources in the economic cycle and to prevent the misuse of these resources as a requirement of its position. The most important means of the state to ensure that a social welfare loss does not occur are fiscal policies, which will be elaborated later. The fact that the energy sector has a much higher share in the formation of environmental problems with 70 percent of all other sectors makes it essential that the measures to be taken and implemented within the framework of solving these problems are realized in this sector. From this point of view, the article focuses on environmental problems caused by traditional energy sources and how these problems can be solved.

**b. Environmental-economic benefits that can be obtained from the use of clean energy resources in literature of fossil fuels**

Fossil fuels are consumable resources such as oil, natural gas and coal that cannot be regenerated in a short period of time. Fossil fuels, which are not renewable and have limited reserves, create a continuous risk for the environment and they cause global environmental disasters such as toxic gases, global warming, climate change and acid rain during the use of these fuels (Özey, 2001). In addition to the damages caused by these resources to the environment, it has been shown in detail in many studies that it imposes significant costs on societies in the economic sense.<sup>3</sup> Energy is an indispensable importance for economic growth and being dependent on the outside constitutes a serious risk for growth. Therefore, reducing dependence on foreign energy is a strategic priority. For this reason, many countries are conducting important researches and making big investments in energy production in order to ensure sufficient, continuous, reliable, economic and environmental impacts of the energy they need (Karaca, 2011). The availability of heavily used fossil fuels in a limited number of countries raises questions about the sustainability and safety of energy. However, the renewable energy resources of almost every country are not subject to any price increase and are not affected by political and political instability. According to the relationship accepted in the literature, the increase in the production and use of renewable energy can directly reduce the import costs arising from oil and natural gas, prevent instability problems that may arise as a result of energy dependence, and additional added value can be obtained from domestic energy production.<sup>4</sup> It is frequently discussed in the literature that the production volume in this field will expand with the support given to the Turkish market and that with this expansion a significant amount of income can be obtained in the export.<sup>5</sup> Therefore, the factors such as its contribution to the national economy, the fact that it is a domestic resource and the capital remain within the country are of great importance. bears. Some of the important benefits of using renewable energies instead of fossil fuels for a country's economy are discussed below (Karaca and Erdoğan, 2005)

**c. Energy Efficient Building**

Today, as environmental problems gain momentum and increase in the amount of energy we consume as a technology society, construction activities it is the important emergence of these global problems, which concern the future generations as well as today. The search for solutions that enable buildings to have less environmental impact leads the architectural design towards ecological and energy efficient approaches. Energy efficient design is the most economical way to prevent air pollution both indoors and outdoors and to meet our future energy needs. Energy efficient buildings are designed in a way that will not harm the ecosystem during the design phase, construction phase, usage phase, post-use and demolition phases. In energy efficient building design; location, structure, building intervals, climatic data, water and material conservation, building shell parameters are taken into consideration. In addition to the combination of these design parameters with appropriate values, the integration of the use of 15 renewable energy sources defines the energy efficient building. The tendency towards energy efficient buildings is a natural and contemporary result of solving environmental problems. With this approach, architecture plays an important role in conveying sustainable environmental awareness to the society. (Uslusoy, 2004)

**e. The use of renewable energy resources in accommodation industry and its economical effects towards tourism in terms of sustainability**

It is necessary to enable renewable energy resources in order to obtain the required energy to provide sustainability to the services at accommodation businesses in a less costly way. There is no need for raw materials in order to get renewable energy resources, the only cost is the first installation costs. Since it is redeemed in a short amount of time, it reveals that these kind of energy resources are budgetfriendly and necessary. In this direction, it is more advantageous for the businesses that operate in tourism industry, to invest in renewable energy resources so that they can actualize their activities in a more economical way. Because it will be possible to provide an economical environment by decreasing the service costs in tourism industry in terms of providing sustainability in energy by the use of renewable energy resources. The importance and necessity to increase and popularize the use of renewable energy resources, especially solar energy, were mentioned in this study. In this respect, it was aimed to evaluate the topic in an economical aspect by doing a situation assessment. Therefore the economical

contributions of solar energy investments amongst renewable energy resources to the sustainability of tourism were revealed in order to actualize one of the main goals of sustainable tourism that is providing efficient and low cost energy use. In this direction, a set of suggestions were made in terms of the economical contributions of solar energy if it is used in an effective way by the accommodation businesses (Gümüş and Örgev, 2013).

#### **4. DISCUSSION AND CONCLUSION**

It is possible to solve the energy need which has become the world's biggest problem without harming the environment with renewable energy sources and clean energy sources. (Convergence and Root, 2017). Energy use and environmental impacts are evaluated in terms of sustainable development when it is clear that there is a strong relationship between them. Energy production and consumption during the environmental problems that minimize the optimal planning of resources should be made economically and reliably (Selici, et al. 2007).

In the field of renewable energy resources Ar-Ge activities should be developed and supported. Energy consumption savings, energy use programs should be developed, public awareness and encouraged. Region plans, environmental layout planning and development plans, air pollution to residential areas and other areas requiring protection should be made to ensure that the negative impact is as little as possible. In the first nuclear power plant protocol, which is planned to be established due to insufficient industrial support and lack of experience in nuclear project management in our country, it should be stated that construction, operation and necessary technical personnel, supply of fuel to be used, transport, where wastes will be stored and with which technology. Coal used to be high calorific value and sulfur, humidity, volatile and ash rates should be low should be provided. The heater boilers used in heating and the stove should be provided full combustion and their burning devices should be trained and appropriate to the technique to be burned. On the other hand, heat insulation in buildings should be done to prevent heat losses (Kadioğlu and Telliöğlu, 1996).

Appropriate environmental technologies work should be focused on energy production and environmental pollution reduction should be targeted. However, in order to benefit from renewable energy resources, more research and development activities can be done, for this purpose, the creation of the 'renewable energy resources master plan', private sector investments to be made in this area subsidies, low interest credit, tax refund and exemption can also be useful to bring applications such as. However, investment, generation and consumption costs are barriers to greater consumption of renewable energy sources. For example, as long as there is not a high penalty for carbon dioxide emissions that occur when coal is burned, it will continue to be an important source of energy, especially given the abundance of developing countries. On the other hand, natural gas will it is important energy planning of many developing and heavily populated countries in the coming years. In spite of all these developments, it is a pleasure to take further steps in this direction with international cooperation in order to overcome the severe environmental problems we have experienced on a global scale, even if the renewable energy sources are not at the desired level to date.

The use of renewable energy is important in preventing environmental pollution. Therefore, in the name of sustainable development, renewable energy resources are the energy resources that should be used (Tuğrul, 2003). There are a number of disadvantages of alternative energy sources. Dams built to generate hydraulic energy damage biodiversity. Solar panels create image pollution. Wind energy is used to generate electricity from wind. High capital investments required during the installation of alternative energy sources are the most important obstacles to these energy sources. Renewable energy sources are more expensive than other sources, but are profitable for the national economy in the long run. The first step can be reduced costs with government support (Cukurcayır and Sağır, 2007).

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**O 144. AN ANALYSIS OF LOGISTICS VILLAGES IN TURKEY BY USING GEOGRAPHIC INFORMATION SYSTEMS (GIS): KONYA SAMPLE**

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**ABSTRACT:** In the world of evolution and speed, the logistics services considered the essential necessity for all sectors. Also, the fundamental factor affected the firm's performance. Then, the logistic villages are the most important elements of the logistics and it contributes to the Turkish economy significantly. In this study, the definition, characteristics and advantages of the logistics villages were mentioned. Thematic map created with GIS, the qualifications and quantities of the logistic villages in it was specified. Then, the logistic village (kayacık) in Konya was analyzed. weaknesses and strengths points were discussed.

*Keywords: Geographic Information Systems (GIS), Logistics Villages.*

## **1. INTRO**

Logistics is the art and science of the managing the flow of goods, energy, information and other resources such as: products and services and even though the people, from the production area to market. It's totally hard or impossible to accomplish any global trade or the movement of export and import process . Or the transportation of raw materials or products and manufacturers without the support of the professional logistics.

## **2. LOGISTIC VILLAGE AND LOGISTIC VILLAGES IN TURKEY**

Many definitions have been put to the logistic village. For example, logistical village: modes of transport for short and far distance (air, railways and Sea). The Services which are provided in the logistics villages are: (transport, distribution ,classification and compilation of goods and storage). Then, The logistics villages achieved environmental benefits in terms of : ( cost, speed, efficiency, improvement and sustainability through all the logistics activities).

Moreover, The logistics villages are built in large and important production centres (industrial areas, business centres, towns, railways, road lines ). As if it's possible in the ports, but in such points isn't affected directly at the traffic of the city.

Some of the main features that should be: an area of at least 250 hectares.

Although the creation of a logistic village , it's an attractive logistical activity because of these advantages, choosing an unsuccessful site can eliminate all these benefits. The selection of the site is the most strategic step to start up the logistic village. On the other hand , the Choice of the wrong location reduces the efficiency and efficiency of the logistics village.

Turkey distinguished by the geographical advantages such as : being surrounded by seas and the combination of the continents. Also, in China and the development of the East Asian market, today increases the strategic importance of Turkey as a transit country.

The logistics village started work in 2006, Also 21 logistics village projects have been included in the agenda eight of them (Balıkesir, Denizli, Eskişehir, İstanbul/Halkalı, İzmit, Samsun, Uşak, Türkoğlu/Kahramanmaraş) started working and Six other logistic villages are expected to be operational (Bilecik, Erzurum, Mardin, Kahramanmaraş, Mersin, İzmir/Kemalpaşa).

Moreover, The process of expropriation is carried out in 7 centers (Konya, İstanbul/Yeşilbayır, Kars, Kayseri, Sivas, Bitlis/Tatvan, Habur)

In addition, The aim of the centres is for Turkey to become a regional logistic base as it's coordinating with many institutions and organizations. With the introduction of planned logistics villages, it planned

to provide 40 billion dolar in contribution to the logistics sector, 27 million tons of additional transportation and 9 million square metres of container holdings.

Logistics centers spread across Turkey and also provide more jobs for more than 10,000 people.

Finally, the logistic villages were added that Turkey according to the vision of 2023 aims to export 500 billion dolar in order to become the largest logistic force in Asia, Europe and Africa.

The village of Izmir (Kemalpaşa) is the largest logistic village under construction, while the smallest logistic village is Denizli (Kaklık) is a Logistics village.

See Appendix, the thematic map for logistics villages in Turkey and the areas covered.



**Figure 1.** Logistic Villages in Turkey, Source: <http://www.tcdd.gov.tr/lojistik-merkezler+m129>

### **3. KONYA LOGISTICS VILLAGE PROJECT**

#### **3.1. The spatial and qualitative description**

Konya is the largest province in Turkey, with an area of 41.001 km<sup>2</sup>. It has the sixth in terms of population density of 2.205.609 according to data for the year 2018 and it has located in Central Anatolia in the international transport corridors. Also, Konya is a vibrant business centre and it has many huge investments, it is an important city for logistics and global trade.

Konya Province is highly efficient in industrial and agricultural terms. There are many advanced business and financial institutions, and they have experience in foreign trade, relations and railway connection to ports. Then, it contains a large and organized industrial city. For those reasons Konya contributes significantly to the Turkish economy.

The logistic village in Konya is the one of 6 logistic villages which is still under construction with regard to the construction of the logistics village.

In addition, the work is carried out in the coordination between the State Railways and the municipality of Konya. When the logistic village is activated, which is planned to be built on an area of 300,000 square meters, the cargo will be transported 1, 679, 000 T/Y.

Moreover, Logistics services, coal, cement, marble, various foods, fertilizers, sugar, agricultural machinery, agricultural products, containers and military materials will be transported.

As a result, one of the most important services that will be offered in Konya Logistics Village is the transit traffic between transport modes, providing loading, storage and unloading services, as well as Terminal Services such as: (security, maintenance, showrooms, meeting conference rooms, catering facilities, banks, post office etc.).

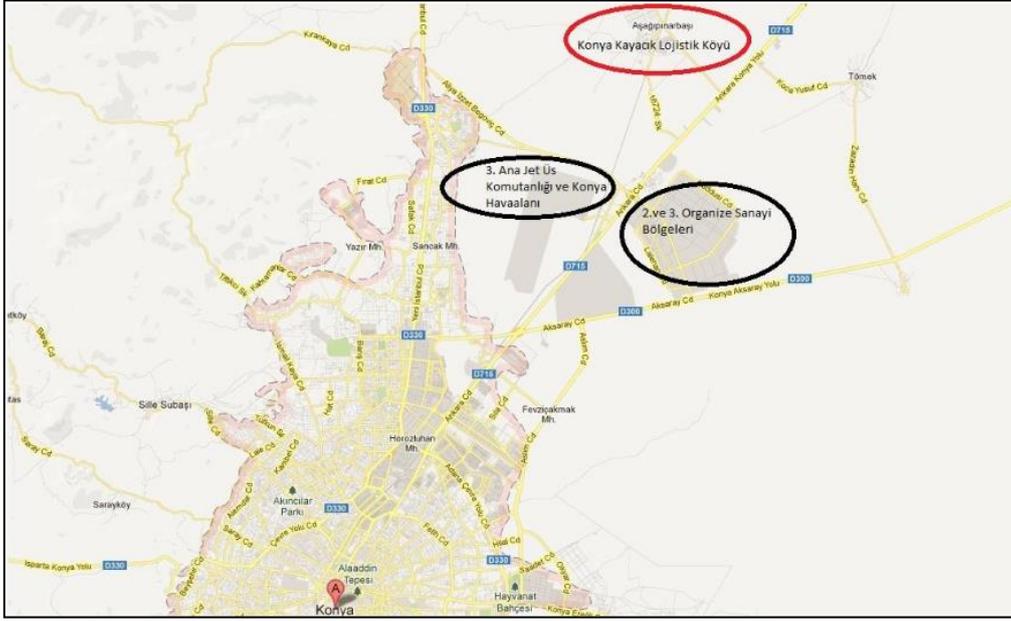


Figure 2. Konya Kayacik Logistics Village, Source: google.maps

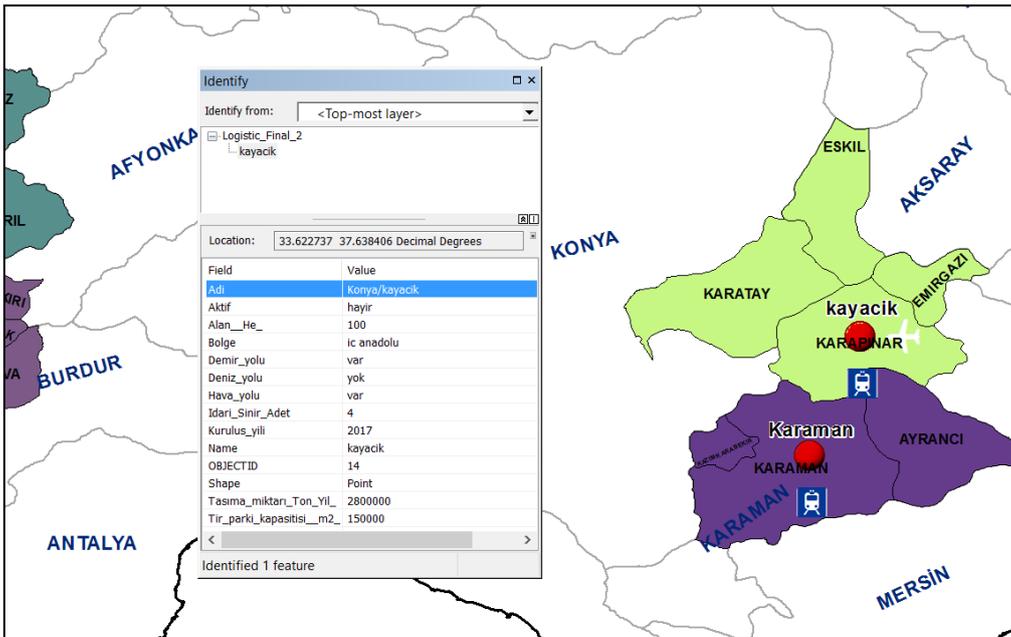


Figure 3. Konya Kayacik Logistics Village by GIS (Self-source).

### 3.1.1. Rapid transport

The columns of the trucks which are passed through Konya that occupies the most important place in Turkey. The total length of transport corridors in Turkey is 19.066 Km, while the length of the 869 km is according to General Directorate of Highways.



Figure 4. Konya Province Highway Infrastructure, Source: KGM.

### 3.1.2. Rail transport

There's a rail line from Istanbul to Konya across to Adana. there are train lines between Konya and Kerman. The journeys by a high speed rail available for (Konya - Istanbul, Konya - Ankara and Konya - Eskişehir). It also provides a line linked with Konya to Afyon, and another line connected between Konya and Tasucu and the last one between Konya to Mersin.



Figure 5. Turkey Railway Infrastructure, Source: TCDD

### 3.1.3 Air transport

Konya airport is located in a distance of 18 kilometres from the central city. The building was completed in 2014 . Also, the totals are 23.640 square kilometres. so, It's one of the most important shipping airports.

### 3.2. The Strengths of the logistics village (Kayacık) in Konya

Geographical location: it's near of centre of city and airport also it leads to the lower cost. Multiple Transport: where it passes many rail lines. The number of vehicles, awards and and it's attachment to technology and high rate of daily transport. The growth of the national economy in accordance to the goals of the state of 2023. The Low labour costs and the large number of employees, ongoing contacts with clients, effective management processes and the use of the newest techniques.

### 3.3. The Weaknesses of the logistics village (Kayacık) in Konya

Wars in the Middle East, global economic crises, Lack of current infrastructure, Lack of publicity, Inappropriate for shipping, Insufficient the use of information technology in the village.

## 4. RESULTS AND RECOMMENDATIONS

Logistical villages : it's used roads, airways, railways and sea transport as multimedia transport facilities integrated with advanced facilities. with these areas all activities logistics are conducted at low, interest and high speed cost. As a result of that Turkey became one of the 20 largest economies in the world. Also, it'll be increase in logistical activities, there is a need for further investment, and should be increase the logistical villages of Turkey with the participation of the private sector in the meantime. When establishing logistical village unnecessary investments must be avoided. It should be managed by the logistics villages in Turkey by one authority.

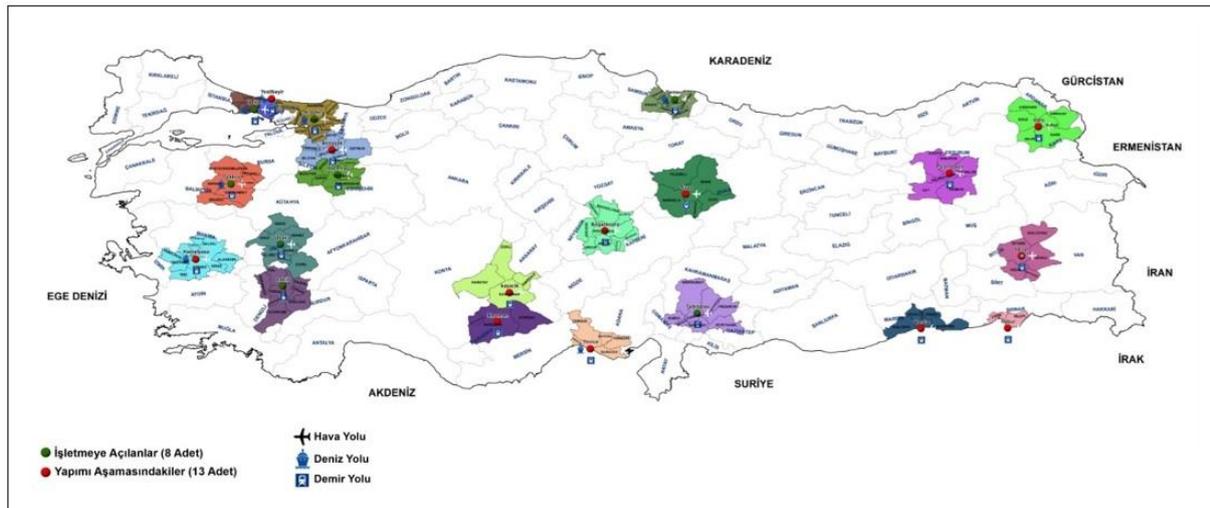
Finally, the operating of the logistical villages and the establishment of the logistics villages are also important. then, it'll contribute to the proper management of logistics services in the national economy and the logistics services sector.

The high potential for the return of the logistics and logistics sector in Turkey and expansion of the logistical villages will be beneficial for both the logistics and economy sectors.

In recent years, Konya has become one of the most important industrial centres in Turkey. The movement of exports to 189 countries have become in many different sectors.

Moreover, The number of factories was 105 in two years, and the number of companies in the industrial area in conjunction was 600. So, with other investments in the city, Konya will get a new production step. In addition, now we've subsidiary structure of industry preferred by international investors. Then we expect the volume of international investment in the city, which contains more than 300 euro million of international investment in the last three years, to 700 million euro.

## APPENDIX



App 1. Logistic Villages in Turkey by GIS (Self-source)

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**O 145. UNDERPASS DESIGN WITH TOP-DOWN CONSTRUCTION TECHNIQUE ON  
RAILWAY AND HIGHWAY INTERSECTION LINES**

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**ABSTRACT:** In this study, the definition, construction stages, advantages and disadvantages of top-down construction technique were mentioned. Within the scope of Karaman - Ulukışla high-speed train project infrastructure works, the solution of the problem encountered in the railway - highway intersection route between 201 + 900 km and 202 + 000 km was discussed with the top - down method and the numerical analysis related to this problem was performed in PLAXIS 2D computer program. Material parameters to be used in the analysis were selected according to the literature and obtained data in the field. As a result of the analysis carried out in PLAXIS 2D computer program, deformations and cross-sectional effects of the structural system were obtained. The static and dynamic safety factor of the designed system have been obtained and controlled according to permissible limits.

*Keywords: Top-down, Karaman-Ulukışla high-speed train project, excavation method, top-down construction, underpass construction*

## **1. INTRODUCTION**

Top-down construction method is a method used in our country for the last 30 years. It is preferred especially in deep and very basement buildings with limited working area. This method is the opposite of the traditional excavation methods and constructions are completed from top to down. In this way, both the basements and the upper floors of the structure can be constructed in the same time. In addition, if there is not enough slope distance for the excavation and the construction of the superstructure should be continued, the top-down method becomes reasonable. This method is preferred especially in underground subways, underpasses, car parks and hotel constructions. Top-down construction technique can be applied on all soil condition.

Top-down method was constructed in 1993 at Kızılay station of the Ankara metro line. Being quite intense pedestrian and vehicle traffic in Kızılay and due to excavation in order to minimize the environmental negative effects primarily, it is decided to construct the station and construction methods as a top-down, one of the first practices in Turkey that has been preferred construction method from top to bottom. In the period of the excavations, urban transportation and vehicle traffic, which will be very difficult during the construction period, is needed to ensure that the traffic flow should be provided in the shortest time in order to prevent the encounter of bigger problems.

In previous studies on the subject, top-down construction method was preferred to support excavation in places where anchorage support system could not be applied. In the designed anchor shoring system, depending on the environmental conditions and ground conditions, anchors in some levels could not be constructed. Moreover, it is determined that the manufactured anchors do not carry enough load as a result of performance tests. Due to the large size of the construction area, the excavation surfaces with steel struts could not be supported. As a result of this situation, half-top-down construction method was used in the fronts. In the study, the deformations that would occur in the excavation pit of 25,00 m depth and in the case of semi-top-down were determined and compared with the PLAXIS 8.2 computer program. [5]

Excavation should be done from the ground to the foundation bottom level within the scope of underpass construction. Excavations are usually carried out as slope excavation depends on soil and working conditions. Considering that the planned underpasses will be built in the city, the slope distances of the deep excavations are not enough and may correspond to the structures or the road - railways where the traffic should work. Hence, deep excavations may be required by means of shoring systems. With top-down method, the underpass reinforced walls can be constructed with secant piles, soldier piles or

diaphragm walls. It is aimed that the railway beams are connected to the pile heads and the railways can operate continuously and to limit the deformations.

## **2. TOP-DOWN CONSTRUCTION TECHNIQUE**

During excavation of the foundation made with classical excavation techniques, the excavation process is continued until the final excavation level. After the excavation is completed, the foundation plate is constructed and the construction of the structure is continued to the upper floors. In other words, the construction of structure is done from bottom to top. [5]

In the top-down construction method, the building's curtain and carrier columns are constructed. Shoring curtain and concrete slabs connected to the carrier columns are constructed, then a space is left in the floor and excavation is done for the production of plaques in the lower levels. Following the completion of each excavation stage, the building floors are constructed from the top to the bottom level respectively. In this process, upper floors can be continued to construct.

In the top-down method, the lateral supports of the retaining walls consist of basement floors or steel beams. In other words, the use of horizontal elements such as anchoring and pipe support, which are used in conventional methods, undertakes slab and beams.

In the dimensioning of the slabs and beams, the structural loads and lateral loads that occur during the excavation are taken into consideration. [3]

It is planned to add four basement floors to the project within the scope of the restoration works of two Ottoman mansions, Hatice and Fehime Sultan built in the late 19th century on the shores of the Bosphorus. Due to the lack of sufficient distance for the excavation and its proximity to the surrounding structures, it was found appropriate to build the basements with the top down method. The curtain wall of the building was formed with 5,00m socketed diaphragm walls and the carrier columns with bored piles. Considering the challenging ground and environmental conditions, it was determined that the top-down construction method is a safe, economical solution and can save time for the project. [1]

### **2.1. Elements Used in Top-Down Systems**

The top-down construction method utilizes secant piles, intermittent piles, diaphragm wall, steel profiled piles for the surroundings of the excavation area, and structural slabs to provide lateral support to them. In the selection of the vertical elements used in top-down method, the determinants can be listed as geological unit of the ground, ground water condition, cost status, vertical and horizontal forces acting on the shoring system.

In case the ground water level is high, the diaphragm walls are more favorable than the intersecting walls as the retaining wall. Because the diaphragm wall width is larger than the piles, labor defects will be less. Diaphragm walls have a more rigid geometry than piles, so they are safer than piles in terms of stability. However, in addition to all these advantages, it is a more expensive solution compared to piled shoring systems.

In case the ground water level is high, the diaphragm walls are more favorable than the intersecting walls as the retaining wall. Because the diaphragm wall width is larger than the piles, labor defects will be less. Diaphragm walls have a more rigid geometry than piles, so they are safer than piles in terms of stability. But it is a more expensive solution compared to piled shoring systems.

The top-down construction method stages are given below;

- The shoring wall surrounding the boundary of the area to be excavated is constructed,
- Carrier columns of the structure are constructed as a barette piles or bored piles,
- The ground floor slab is attached to carrier columns and shoring wall. In addition, the slab plate for excavation of the lower stages of machinery and excavation is provided with sufficient space to exit and entrance.
- After the construction of the ground floor, the excavation equipment excavates from the space left in the floor to the floor bottom level to be made at the lower level and the excavation from the excavation is taken out from the left space.
- The first basement floor slab is the constructed after the excavation
- The operations listed above are followed up to the lowest level of the building and finally the structure of the building at the lowest level is constructed.

## **2.2. Top-Down Application in Underpass Construction**

Considering that the underpasses will be built in the city, the slope distances required for the excavations are generally not enough. In this case, pedestrian, vehicle and railway traffic disruptions occur. As a result, it is necessary to carry out the top down construction technique in excavations for the completion of the construction. The construction of the structures to be constructed by the top - down construction method is important in terms of minimizing the negative effects that traffic and environmental structures will be exposed to during the construction period. Underpass walls are designed with bored piles. It is the primary goal that the railway beams can be connected to the constructed pile heads and that the railway can operate continuously during the underpass production.

During the construction phase, the land is leveled up to the upper elevation and then piles are produced with sufficient reinforcement and length. After the piles have reached sufficient strength, the railway beams are construction in the with sufficient moment, shear and axial load capacity to ensure that the system works as a whole. The rail beam is an important factor in reducing the lateral deformations because it will serve as the pile cap between the piles.

Examples of the top-down method of excavation method preferred for the construction of Ankara Metro are given in Figure 1.



**Figure 1.** Kızılay station constructed by top-down construction method [2]

## **3. CASE STUDY**

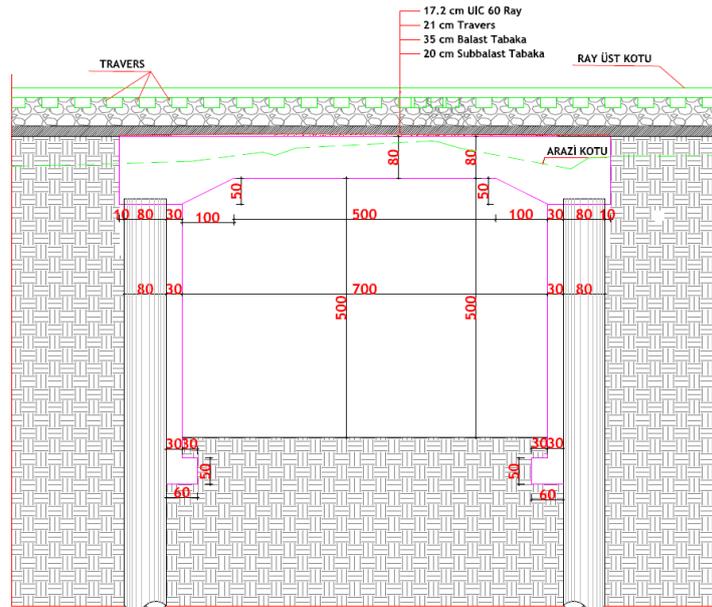
### **3.1. The Solution of Problem encountered in Karaman - Ulukışla Railway Line Structures by Top-Down Construction Technique**

In this study, the solution of the problem encountered in the railway - highway intersection route between the railway line 201 + 900 km - 202 + 000 km within the scope of Karaman - Ulukışla high speed train project infrastructure project was discussed.

It is aimed that the railway and highway transportation will continue uninterruptedly by constructing underpasses, overpasses, bridges at railway and highway intersections.

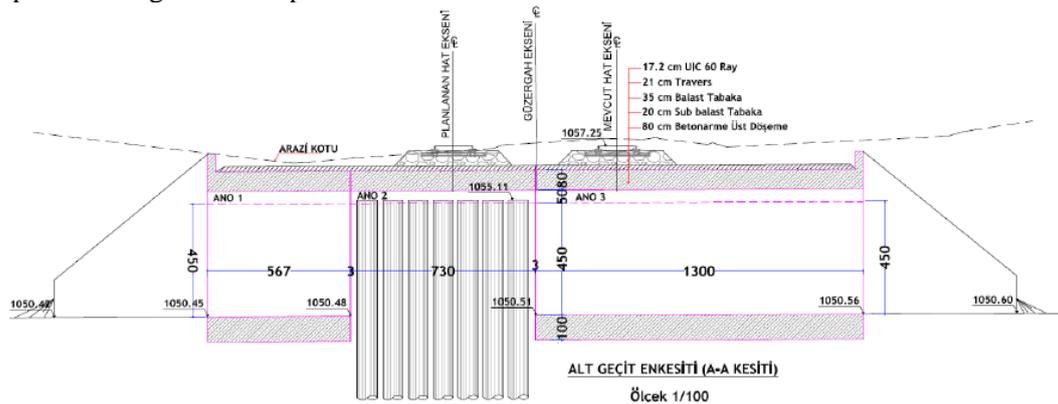
Underpasses that are planned to be built generally correspond to the city. Considering the thickness of the gabarite and reinforced concrete structures at the underpasses, excavations should be carried out at depths ranging from about 6-8 m. Excavations cannot be carried out in slope excavation and endangers the safety of environmental structures. In addition, the train running on the current line during construction must continue to serve. For this purpose, it was considered appropriate to apply the underpass construction with top down method.

Karaman - Ulukışla 135 km 2. Line Infrastructure and Superstructure Construction work at the intersection of railway and highway underpass is planned to be constructed with the Top-down method. The underpass is projected as shown in Figure 2 and Figure 3.



**Figure 2.** Underpass design with top-down method

In Figure 2 given the longitudinal section of 5m x 7m, there are 80cm diameter bored piles, 80cm high pile cap connecting the bored piles and rail fill on the header beam.



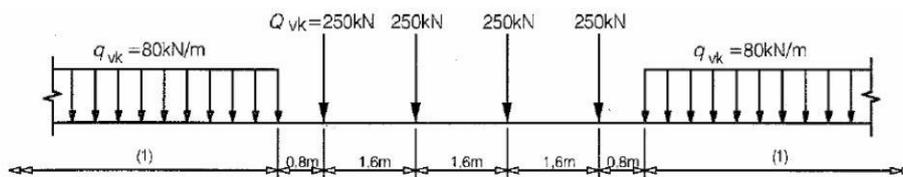
**Figure 3.** Underpass top-down longitudinal section

The analysis of top-down construction was done in PLAXIS 2D computer program, deformations of the structure and forces on the bearing elements were determined.

### 3.1.1. Underpass Load Acceptance and Determination of Stress

The load model Eurocode LM 71, which represents the static effect of the vertical load under normal railway traffic, is shown in Figure 4.

The following figure shows the loads transferred from the train axles. In the analysis, the rail load was taken as 80 kN / m. Rail transport structures should be designed to carry the vertical static load given in Figure 4.



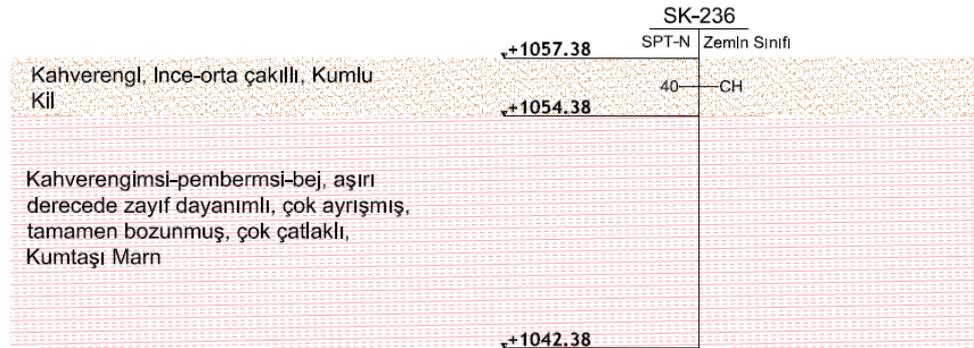
**Figure 4.** Characteristic values for load model LM 71 and vertical loads [4]

### 3.1.2. Field and Laboratory Studies

In order to obtain geological and geotechnical data related to the project, drilling wells with depth of 15.00 meters were opened in the region.

In the borehole drilled from 0.00 to 3.00m, brown colored, coarse-medium gravel, high plasticity, sandy clay (CH), between 3.00 and 15.00 m brownish-pinkish-beige, extremely weak strength, decomposed, completely degraded, very cracked sandstone-Marn was passed. Groundwater levels were not found in the soundings.

The soil profile formed in accordance with the ground units determined as a result of the drillings is given in Figure 5.



**Figure 5.** Ground profile determined in the borehole

Pressuremeter test was performed in the borehole. The results of the pressuremeter test are given in Table 1.

**Table 1.** Results of the pressure test of the drilling well

Depth (m)	Net Limit Pressure $P_{LN}$ (kg/cm <sup>2</sup> )	Menard Modul $E_M$ (kg/cm <sup>2</sup> )
2,00	13,90	167,00
4,00	14,80	180,00

There are various correlations between  $P_{LN}$  value and undrained shear strength ( $c_u$ ) in the literature and between the Menard module and Elasticity module. Net limit pressure and Menard module values given in Table 1 were used to determine the engineering parameters of the clay unit determined in the drillings.

### 3.1.3. Determination of soil parameters and idealized soil profile

SPT-N values, Atterberg limits and pressuremeter test result were used to determine the soil parameters and profile. While determining the modulus of elasticity for the clay units, the safe side remained within the limits specified in the literature.

The idealized soil profile and parameters used in the analysis were determined by using the field and laboratory tests and also within the limits specified in the literature,  $c_u$  (undrained shear strength),  $c$  (cohesion),  $\phi$  (internal friction angle) and  $E_s$  (Elasticity module) parameters of the soil units are shown in Table 2.

**Table 2.** Idealized soil profile and parameters

Depth (m)	Geological Unit	$c_u$ (kPa)	$c$ (kPa)	$\phi$	$E_s$ (kN/m <sup>2</sup> )
0,00 – 3,00	Sandy Clay	100,00	5	26	40.000
3,00 – 25,00	Weathered Sandstone-Marn	150,00	10	28	60.000

### 3.1.4. Engineering Analysis and Evaluations

Ø80cm bored piles are designed with 100cm spacing. All details of the top-down system are given in Figure 2 and Figure 3. 80cm header on the pile made of the pile to work together. After the construction of the beam, excavation was done at both side. While determining the load of the current route; the rail surcharge load is taken as 80,00 kN/m.

#### 3.1.4.1. Cross Section Details

Details of the planned underpass construction, top-down system to be constructed in 201- 934 km are given in Table 3.

**Table 3.** Km: 201 + 934 underpass retaining system details

Diameter of pile (cm)	Pile Length (m)	Pile Spacing (cm)	Excavation Depth (m)
80,00	13,80	100,00	≅6,00

#### 3.1.4.2. PLAXIS 2D Analysis

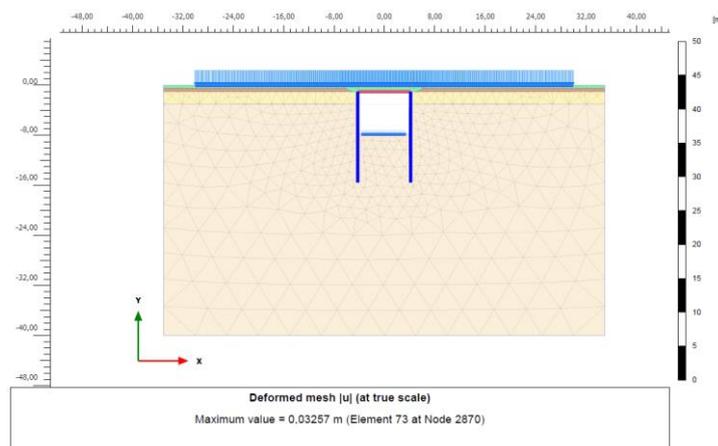
The underpass planned to be constructed within the scope of the project was analysis in PLAXIS 2D computer program and deformations and forces on piles were observed in the system under top-down construction method.

In PLAXIS 2D program, all stages, from the beginning of the underpass construction to the opening of the train services, are modeled respectively. The stages of construction are given below.

- Stage 1: Slope excavation up to the upper of the pile elevation in the existing land.
- Stage 2: Construction of the designed size and diameter bored piles.
- Stage 3: Construction the railway beams on the cap of the piles and ensuring that the piles work together.
- Stage 4: Filling up to the upper elevation of the rail after the production of the head beam.
- Stage 5: Opening of the railway line to transportation.
- Stage 6: Excavation up to the road level.
- Stage 7: Determination of cross-section effects by applying earthquake forces to the system.
- Stage 8: Determination of safety factors for static and dynamic analysis.

Progressive solutions of the top-down excavation method in PLAXIS 2D computer program and the results are given below.

Figure 6 shows the PLAXIS 2D model in case of underpass excavation under railway traffic. According to the results of the analysis, the maximum deformation that will occur under railway approach fillings is determined as 3.25 cm.



**Figure 6.** Total deformations in the static state in PLAXIS 2D analysis

Figure 7 shows the vertical deformations in the system in case of underpass excavation under railway traffic. According to the results of the analysis, the vertical deformation will be 3.25 cm.

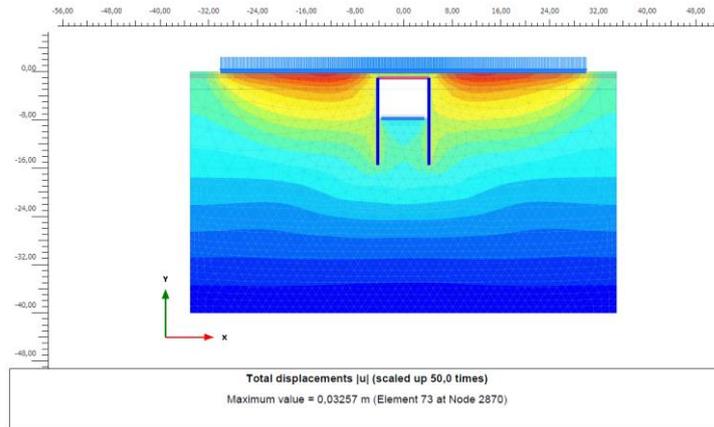


Figure 7. Vertical deformations in the static state in PLAXIS 2D analysis

Figure 8 shows the horizontal deformations in the system in case of underpass excavation under railway traffic. According to the results of the analysis, the resulting horizontal deformation will be 0.47 cm.

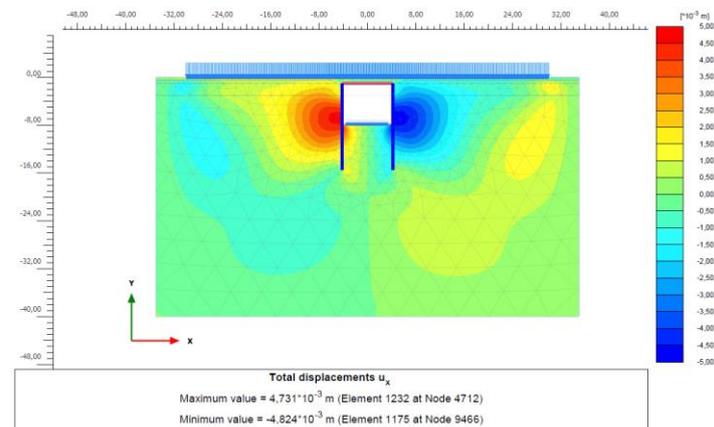


Figure 8. Horizontal deformations in the static state in PLAXIS 2D analysis

Figure 9 shows the horizontal deformations in the bored piles in case of underpass excavation under railway traffic. Maximum horizontal deformation in the bored piles designed according to the results of the analysis is 0.47 cm.

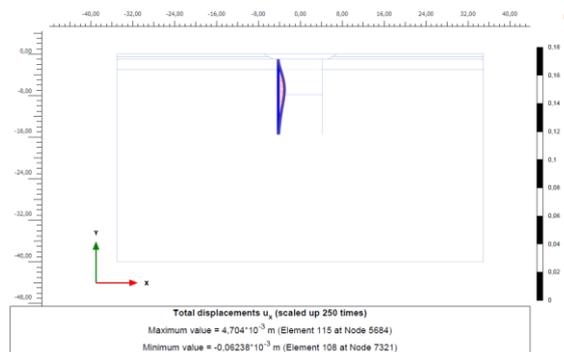


Figure 9. Horizontal deformations in piles in static state

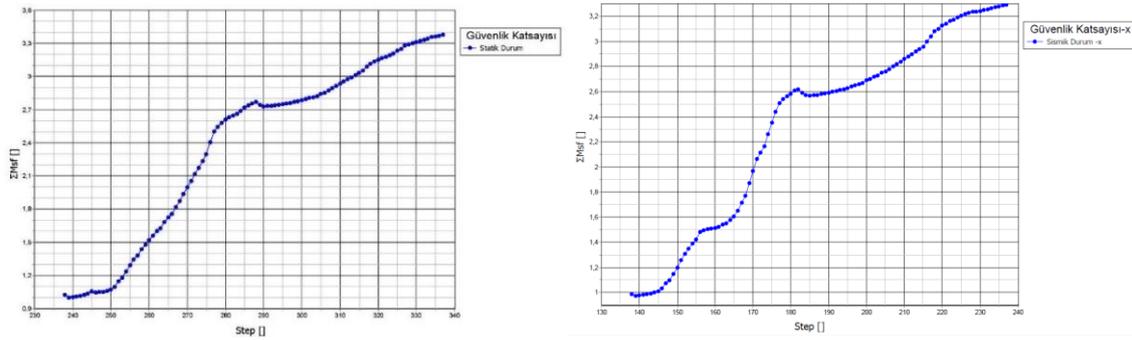


Figure 10. Static and dynamic factor of safety in PLAXIS 2D analysis

In the analysis, 0,47cm horizontal deformation was measured in the static situation. The system was designed in a static condition and exposed to a seismic effect by subjecting to a 0.05 g earthquake acceleration and the safety coefficients were measured. The static and dynamic safety parameters of the designed system were determined as 3.33 and 3.23, respectively (Figure 10). Deformations and safety coefficients determined as a result of the analysis remain within the allowable limits. The section effects to be formed in the piles are given in Figure 11.

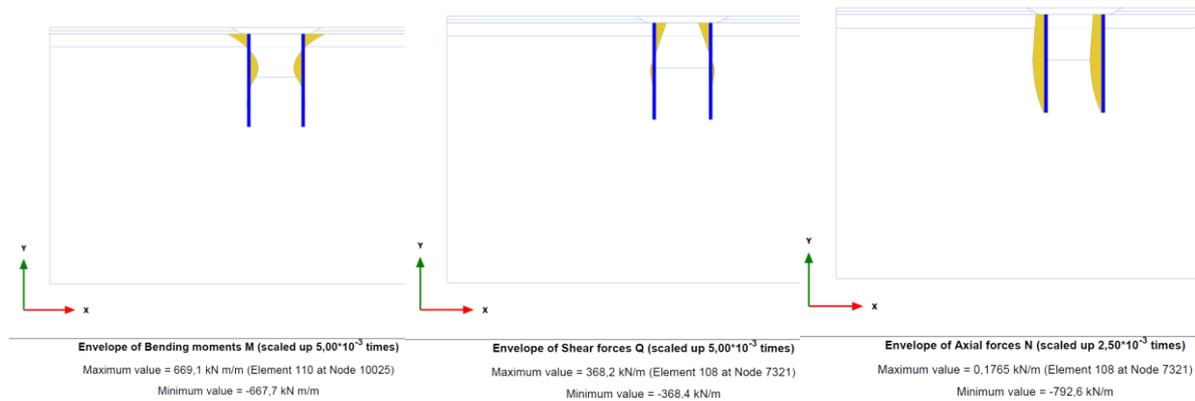


Figure 11. Sectional effects on piles in static state

#### 4. CONCLUSION AND DISCUSSION

In this study, the solution of the problem encountered in the railway - highway intersection route between the railway line 201 + 900 km - 202 + 000 km within the scope of Karaman - Ulukışla high speed train project infrastructure project was discussed. It is aimed to continue the railway and highway transportation uninterruptedly by under passing the railway and highway intersection points.

In the determination of the soil parameters used in the analysis, drillings, laboratory test results and pressuremeter test results were used.

Top-down construction method, designed for underpass construction was modeled and analysis in PLAXIS 2D computer program. Retaining system Ø80cm L = 13,80m bored piles are designed at interval 100cm. 80cm height header beams on the top of the piles were provided to work together.

As a result of the analysis, the horizontal deformation occurred in the system in static condition was 0.47cm and vertical deformation was measured as 3.25cm. Figure 7 shows that when investigated carefully, vertical deformation of 3.25cm is found in underpass approach fillings. The vertical deformation of the constructed beam will be less. The static and dynamic safety coefficients of the designed system were determined as 3.33 and 3.23, respectively. The calculated factors of safety are above the permissible limits in the literature.

As a result of the analysis, the determined cross section effects are multiplied by the pile interval of 1,00m. As a result of this process, the moment force of the stakes was 669.1 kNm, the shear force was 368.4 kN and the axial force was 792.6 kN.

In case the structure is constructed with the designed system, the underpass excavation can be performed safely while the railway line is working.

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## O 146. CONTROL OF PERMANENT MAGNET SYNCHRONOUS MOTOR

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**ABSTRACT:** The use of PMSM (permanent magnet synchronous motor) in the industry increased strongly because of the advantages such as: high efficiency and torque intensity. The ordinary speed control of these motors use encoders which has the effect of increasing the noise, complexity and price of the system. To solve this problem, sensorless speed control have come to industry. There are a lot of sensorless algorithms but the most efficient methods are MRAS and SMO where EEMF (extended electromotive force) should be determined to specify the position or speed. There are two ways to implement these algorithms, either DSP or FPGA. In sensorless speed control, a model is built for the motor, this motor should work in parallel with the real motor. Real states such as currents of the motor are measured, and estimated states of the model are calculated simultaneously. This process is concurrent, and since the parallel processing is one of the best features of the FPGA, then the FPGA is more preferable than DSP in this application. So if parallel process is exist then FPGA is more preferable otherthan DSP. This work gives a simple review about control strategies of PMSM.

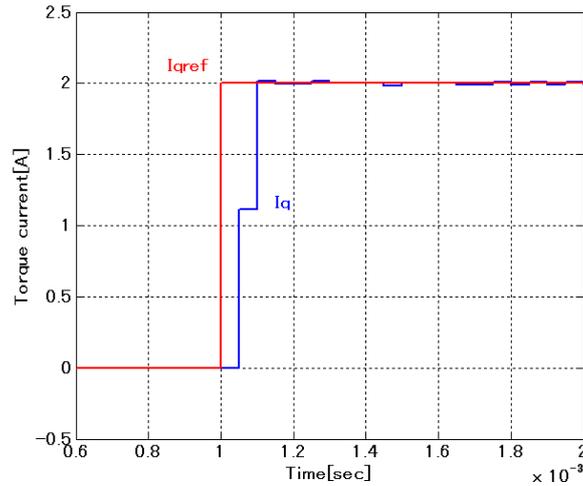
*Keywords: FPGA, MRAS, PMSM, SVPWM*

### 1. INTRODUCTION

Today, the Interior Permanent Magnet Synchronous Motor (IPMSM) has become more and more valuable in many industrial applications because of many features such as high-power density, high torque to inertia ratio, high efficiency. In space vector control, the addition of three phase motor stator currents will create a current vector with certain magnitude and angle. By orienting this stator current vector MMF to be at 90° with respect to rotor flux, a maximum amount of torque for a given amount of stator current can be obtained. Hence it is necessary to know the rotor position information to be able to control the speed and torque of this motor. Measurement devices such as resolvers or encoders can be used to obtain rotor angle information but these devices have high prices, increase the wiring, complexity and add noise to the system. To solve these problems, sensorless algorithms can be applied. There are a lot of sensorless algorithms, the most famous are SMO, MRAS, EKF, Fuzzy which can be applied in medium and high-speed range. These algorithms cannot be applied for low speed range because they are depend on the EMF or EEMF which are have very small or zero values in zero and low speed range and hence have a small signal to noise ratio. As a result, only one algorithm exists for low speed range which depend on the saliency of the rotor that is injecting high frequency carrier method. To implement these sensorless algorithms, there are two methods. Either using DSP or FPGA, which one is the best depends on many factors: In sensorless speed control, a model is built for the motor, this motor should work in parallel with the real motor. Real states such as currents of the motor are measured, and estimated states of the model are calculated simultaneously. This process is concurrent, and since the parallel processing is one of the best features of the FPGA, then the FPGA is more preferable than DSP in this application. Another criterion is that in DSPs are instruction based while FPGAs are clock based so to implement any simple mathematic process in DSP three or four initiating instruction have to be processed, as a result an additional time will be lost because of these initiating instructions. All of these reasons make FPGAs are more suitable.

### 2. FPGA IN PMSM CONTROL

In (Tomoki and Asahi, 2013) a deadbeat control (Takao et al, 1990; Alireza, 2015) is used with sensor speed control of IPMSM using FPGA, but inspecting Figure 1 shows that the  $I_q$  requires about 50  $\mu$ s to follow  $I_{qref}$ . In electric vehicle applications, the switching frequency is limited to not more than 10 kHz (switching period is 100  $\mu$ s).



**Figure 2.** Simulation result for step response (Tomoki and Asahi, 2013)

An interesting module is proposed in (Ying-Shieh et al, 2005), in this work, the module consists of a fuzzy controller, a reference model for the PMSM and an adjusting mechanism (to minimize the error between the rotor speed and the output of the reference model). The adaptive fuzzy control in speed control loop is realized by software method under the Nios embedded processor and a current vector control is implemented using PLD. The dead time for the inverter is 1  $\mu$ s, so the control loop should be finished in this time and the author didn't show the how much time the control loop has taken to track the real speed, however Figure 2 shows that the system tracks the real speed.

One of the basic mathematical tasks is to find the inverse Clarke i.e. converting  $\alpha$ - $\beta$  voltages and currents to a-b-c voltages and currents as shown in (1-3):

$$i_a = i_\alpha \tag{1}$$

$$i_b = -\frac{1}{2}i_\alpha + \frac{\sqrt{3}}{2}i_\beta \tag{2}$$

$$i_c = -\frac{1}{2}i_\alpha - \frac{\sqrt{3}}{2}i_\beta \tag{3}$$

(Ying-Shieh et al, 2005) used the following way to find  $\frac{\sqrt{3}}{2}$ :

$$\frac{\sqrt{3}}{2} = \frac{1}{2} + \frac{1}{4} + \frac{1}{16} + \frac{1}{32} + \frac{1}{64} + \frac{1}{256} + \frac{1}{512} + \frac{1}{2048} \tag{4}$$

Equation (4) is representing in FPGA as shown in Figure 3.

It is easier to represent  $\frac{\sqrt{3}}{2}$  by equation (5):

$$\frac{\sqrt{3}}{2} = \left( \frac{1}{2} - \frac{1}{16} - \frac{1}{256} + \frac{1}{2048} \right) \tag{5}$$

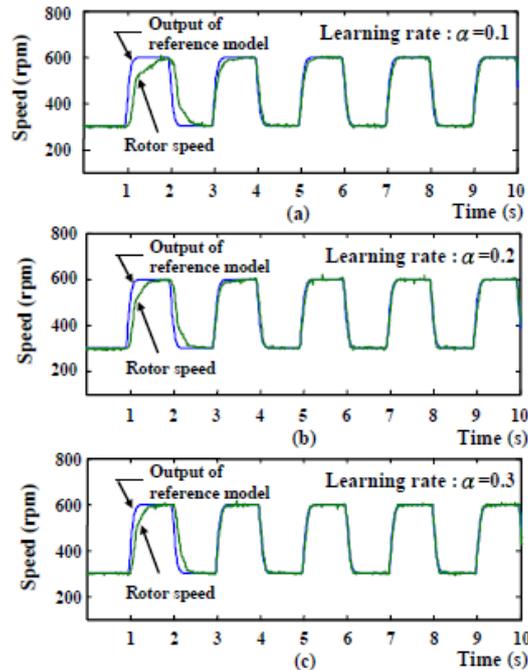
Equation (5) can be represented in VHDL code as shown below:

```

i $\beta$ 1 <='0' & i $\beta$  (17 downto 1);
i $\beta$ 2 <="0000" & i $\beta$  (17 downto 4);
i $\beta$ 3 <="00000000" & i $\beta$  (17 downto 8);
i $\beta$ 4 <="000000000000" & i $\beta$  (17 downto 11);
 $\frac{\sqrt{3}}{4}$  i $\beta$  <= i $\beta$ 1 - i $\beta$ 2 - i $\beta$ 3 - i $\beta$ 4;
 $\frac{\sqrt{3}}{2}$  i $\beta$  <=  $\frac{\sqrt{3}}{4}$  i $\beta$  (16 downto 0) & '0';

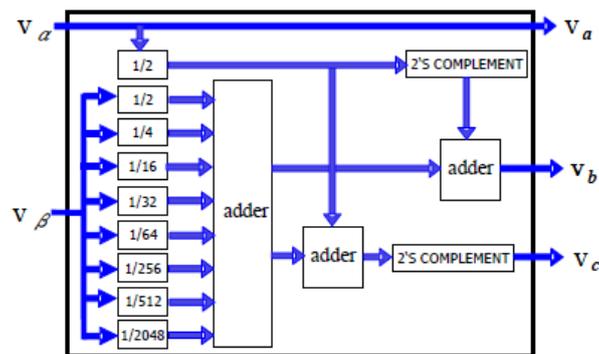
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The last code if implemented will decrease the number of elements in Figure 3.



**Figure 2.** Tracking results between the output of reference model and the actual rotor speed under 1.0 Nm load torque but different learning rate (a)  $\alpha=0.1$  (b)  $\alpha=0.2$  (c)  $\alpha=0.3$  (Ying-Shieh et al, 2005).

For the low speed region, the back EMF of the motor is nearly zero and has a lot of noise, the algorithm used in this case is injecting a high frequency voltage in stator winding. The rotor saliency will affect the magnitude of the high frequency stator current and from which the rotor position can be determined. The work in (Maragliano et al, 2010) have designed a novel FPGA based algorithm aimed for the low speed range by injecting a high frequency signal in stator winding and shows a good results as shown in Figure (4-5) where the estimated speed track the measured speed in spite of that the reference speed is square wave which subject the system to hard conditions.



**Figure 3.** Inverse Clark Formulation (Ying-Shieh et al, 2005)

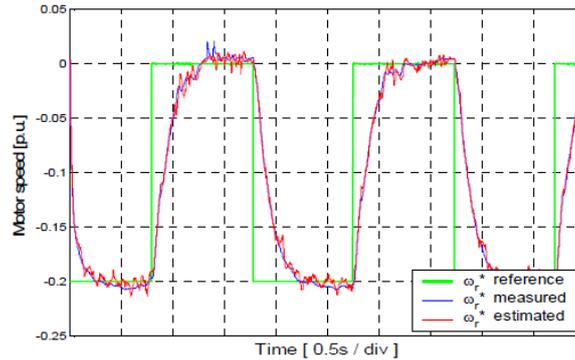


Figure 4. Reference, measured and estimated speed (Maragliano et al, 2010)

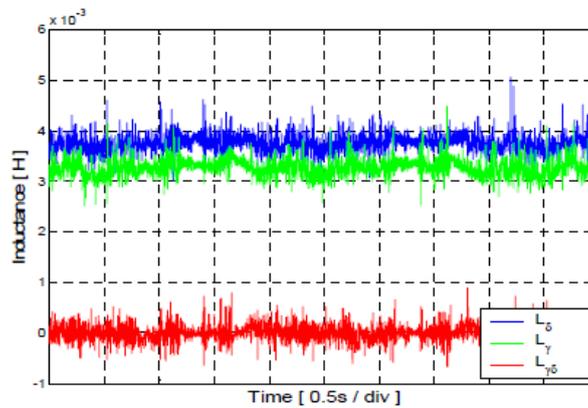


Figure 5. Estimated inductances (Maragliano et al, 2010)

Extended Kalman Filter (EKF), is one of the effective algorithms in speed estimation of PMSM but the problem of this algorithm is the high order state equation which lead to high calculation time. The work in (Nguyen et al, 2012) propose use two reduced order EKF work in parallel on FPGA platform as shown in Figure 6 and shows good tracking result as shown in Figure 7.

Two types of direct torque controller (DTC) for PMSM shown in Figure 8 have been controlled in (Yoshiharu et al, 2006). Both of them used single chip FPGA, One of the controllers was constructed by programming a soft-core CPU and hardware logic circuits written in VHDL, while the other was constructed of only hardware. This work proved that the controller constructed of only hardware logic circuits was able to shorten the control period and it was able to suppress the low torque ripple. So constructing all control function by only hardware will decrease the processing time but at the expense on increasing of logic element which is not a problem in large scale IC. So in this work processing time is decreased from 50μs to 20.34μs. On the other hand, the rate of total logic elements increased from 35% to 53%.

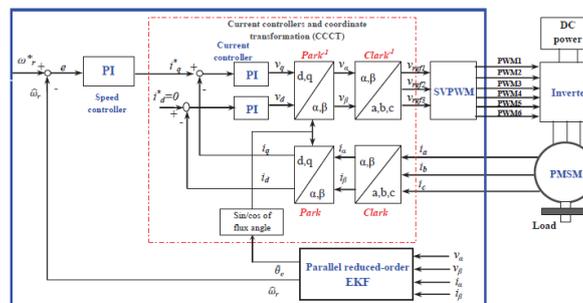


Figure 6. The proposed speed control system in (Nguyen et al, 2012)



**O 147. THE CHARACTERISTICS OF THE DAIRY FARMS WITH FREESTALL HOUSES  
SUPPORTED BY IPARD IN KONYA REGION AND THE THEIR EFFECTS ON  
ENVIRONMENTAL POLLUTION<sup>#</sup>**

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**ABSTRACT:** International Phonetic Alphabet Rural Development (IPARD) was established by the European Union (EU) in order to improve the performance of agricultural farms in the candidate and potential candidate countries, to protect the environment and to comply with the relevant EU standards on animal welfare issues. Konya region ranks first in our country in terms of production quantity and number of animals in dairy cattle breeding. Particular, Konya region the dairy farms with freestall housing are constructed by the support of IPARD. The aim of this study is to investigate the characteristics of the dairy farms with freestall housing supported by IPARD in Konya region and to determine their effects on environmental pollution. It was investigated representative twenty dairy farms with different animal capacities by using purposeful sampling method in this region. Examined dairy farms were evaluated at 5 different groups according to their animal capacities with <50 head, 50-99 head, 100-149 head, 150-199 head and 200 head and over. In this study, the number of dairy cows 35-225, the total animal capacities 71-453, 48-332 BBHB and 62.5-398.8 LU, the production of feed 327-2509 ton, the annual total milk production 235000-1750000 L and daily milk production 18.26-22.86 L per cow and year were determined. In addition, a large number of units such as the milking shed, the milk cooling and storage tank, the pressure washer system for cleaning milking parlours and the monitoring systems as well as manure conveyors, manure mixer research, fertilizer pump and fertilizer warehouses are available in all the farms investigated. As a result, it can be said that IPARD supported projects are environmentally friendly projects which take environmental pollution into consideration and try to solve the waste pollution.

*Keywords: Dairy farm, environmental pollution, freestall houses, IPARD*

## **1. INTRODUCTION**

Milk has an indispensable importance for human health. Consumption of drinking milk per person is estimated in Turkey 40 kg, 100 kg on the countries of Northern Europe, the European Union average of 60 kg, 71 kg in Canada, the United States 69 kg (National Milk Council, 2019).

Increasing the quantity and quality of milk will be possible by raising the dairy cattle in farms built for the welfare of the dairy cattle.

Animal farms are structures designed to protect animals from adverse climatic conditions and provide a comfortable farm and production area for animals (Uzal, 2008). Stress factors should be eliminated in farm designs to provide a comfortable environment for animals. Sources of these stress factors in animals; climatic, structural, social and other factors (Uğurlu and Uzal, 2004).

The aim of livestock raising is to obtain the highest economic and yield. The selection of the facilities in livestock raising is of various sizes and types according to the production type and purpose. Planned farm type; settlement and orientation, regulation of environmental conditions, sizing, selection of building materials, use of equipment and internal details are important for animal production economics. In addition, the characteristics and needs of animals are important in farm planning. Animal farms should be planned suitable for purpose, economical, convenient, effective, practical useful and according to animal behavior characteristics (Olgun and Çelik, 1997).

Freestall housing system and loose housing system dairy farms are widely used in dairy cattle breeding in the European Union and America (Bravo-Ureta ve ark. 1990; de Boer, 2003; Haskell ve ark. 2006). These farm systems have been applied intensively in milk production in Konya region since the beginning of 2000 and an important part of the milk production in Konya was realized in the farm with this farm system. The reason for this is the planning of freestall housing system and loose housing system

dairy farms by considering issues such as animal welfare, production quantity and quality and environmental pollution (Uzal, 2013).

The purpose of the freestall housing is to create clean soft mini-resting areas where cow can be used to lay and rest without harming themselves and other cow. In freestall designs; sufficient and appropriate space should be provided for easy entry-exit and recumbent-up actions without causing injury to dairy cattle (Nordlund ve Cook, 2003).

IPARD (International Phonetic Alphabet Rural Development), was established by the European Union (EU) to improve the performance of agricultural enterprise in candidate and potential candidate countries, to protect the environment and to comply with relevant EU standards on animal welfare. IPARD supports are implemented by the Agriculture and Rural Development Support Institution (TKDK). The purpose of supporting dairy farms under the IPARD program is to improve the performance of dairy farms, protect the environment and ensure animal welfare.

IPARD program is implemented in 42 provinces across Turkey (Afyon, Ağrı, Aksaray, Amasya, Ankara, Ardahan, Aydın, Balıkesir, Burdur, Bursa, Çanakkale, Çankırı, Çorum, Denizli, Diyarbakır, Elazığ, Erzincan, Erzurum, Giresun, Hatay, Isparta, Kahramanmaraş, Karaman, Kars, Kastamonu, Konya, Kütahya, Malatya, Manisa, Mardin, Mersin, Muş, Nevşehir, Ordu, Samsun, Şanlıurfa, Sivas, Tokat, Trabzon, Uşak, Van, Yozgat). It contributes to the establishment of agricultural enterprises producing 1107 milk, 382 red meat and 731 poultry meat in accordance with European Union standards with grant support up to 70% (Anonymous, 2019). The majority of IPARD support consists of the purchase of agricultural structures and machinery equipment.

Efekan (2013) compared the current status of animal farms in the central districts of Erzurum with the EU standards. With the IPARD program, it will be more effective in terms of time and cost by rebuilding existing animal farms instead of modernizing them.

Turkmen (2018) examined the compulsory farm criteria and their effects in two freestall dairy cattle farms supported by IPARD in Şahinköy, Bursa.

Şerefoğlu (2008) refers in his work in the IPARD program in order to represent the heavily applied in Turkey, select a province from each of the measures to be taken regarding feedlots and agricultural building design significance.

Bilici (2010) states that monitoring and evaluations during and after the implementation of the IPARD program and during the implementation of the project are inadequate and unsuccessful.

In a study by Çukur et al. (2009) the changes in the last 20 years in Turkey's dairy cattle were evaluated taking into account the EU harmonization process.

In recent years, the number of research on (Şerefoğlu, 2008; Çukur vd. 2009; Bilici, 2010; Efekan, 2013; Türkmen, 2018) cow farm supported by IPARD has increased. Research conducted so far is usually in the form of economic analysis and examination of the structural features of farms in compliance with EU standards. However, animal welfare and environmental protection is another issue supported by IPARD and animal farms need to be examined in this respect.

The aim of this study is to investigate the properties of dairy cow farms with freestall houses supported by IPARD in Konya Region and to determine the effects of animal welfare and environment.

## **2. MATERIAL METHOD**

Konya is geographically located between 36 ° 41' and 39 ° 16' north latitudes and 30 ° 14' and 34 ° 26' east longitudes in the south of Central Anatolia. The average height of the sea is 1016 m. The province is adjacent to Ankara in the north, Niğde and Aksaray in the east, İçel, Karaman and Antalya in the south and Isparta, Afyonkarahisar and Eskişehir in the west. In addition, the province consists of 31 districts, including 3 centers and 28 connected districts. The region has a typical continental climate (Anonymous, 2019).

Konya is in the first place in our country in terms of production quantity and number of animals in dairy cattle breeding. Large pasture and crop production areas contribute to the development of animal farm in Konya. Konya, with approximately 14% of dairy cattle has part of Turkey (Table 1). With this ratio, it is also ahead of the leading cities of Erzurum and Izmir.

**Tablo 1.** Dairy Cattle Stock in Turkey and Konya (head)

	<b>TÜRKİYE</b>	<b>KONYA</b>	<b>%</b>
<b>2014</b>	5.664.131	255.891	11,98%
<b>2015</b>	5.598.773	264.653	12,36%
<b>2016</b>	5.495.044	274.248	12,86%
<b>2017</b>	6.038.545	331.964	13,46%
<b>2018</b>	6.413.789	352.051	13,90%

Milk production amounts of the last 5 years are shown in Table 2.

**Table 2.** Türkiye and Konya Milk Production Amount (ton)

	<b>TÜRKİYE</b>			<b>KONYA</b>		
	<b>CATTLE</b>	<b>SHEEP</b>	<b>GOAT</b>	<b>CATTLE</b>	<b>SHEEP</b>	<b>GOAT</b>
<b>2014</b>	17.053.653	1.113.937	463.270	898.662	75.902	9.561
<b>2015</b>	16.996.281	1.177.228	481.174	930.703	77.852	10.362
<b>2016</b>	16.849.348	1.160.413	479.401	971.569	76.859	11.069
<b>2017</b>	18.831.720	1.344.779	523.395	1.200.488	79.320	10.395
<b>2018</b>	20.112.619	1.446.271	561.826	1.280.196	86.095	11.196

In Turkey, according to TÜİK statistics animal production cattle in 2018 (20.112.619 tons), sheep (1.446.271 tons), goats (561.826 tons) of the total amount of milk production is 22.120.716 tons. In Konya, the total production amount of cattle (1280196 tons), sheep (86095 tons) and goats (11196 tons) is 1377487 tons.

Changes according to the year of the existence of animals in Turkey and Konya are given in Table 3. There is an increase in cattle assets compared to 2014. Turkey appears to be a decline in sheep and goats in existence in 2017. In Konya, there is a decrease in the presence of sheep in 2015 and 2016, goats in 2017.

**Table 3.** Turkey and Konya Animal Stocks (head)

	<b>TÜRKİYE</b>			<b>KONYA</b>		
	<b>CATTLE</b>	<b>SHEEP</b>	<b>GOAT</b>	<b>CATTLE</b>	<b>SHEEP</b>	<b>GOAT</b>
<b>2014</b>	14.415.257	29.284.247	9.225.548	727.560	1.895.986	231.451
<b>2015</b>	14.223.109	31.140.244	10.344.936	740.148	1.862.022	255.168
<b>2016</b>	13.994.071	31.507.934	10.416.166	752.533	1.826.773	261.681
<b>2017</b>	14.080.155	30.983.933	10.345.299	868.551	1.894.530	240.367
<b>2018</b>	17.220.903	35.194.972	10.922.427	921.572	2.001.010	251.451

In the Konya Region, especially dairy cattle farms with freestall housing are planned in order to increase the production quality and quantity together with animal welfare and the important part is being built with the support of IPARD. It was conducted in 2017-2018 in order to examine the characteristics of the dairy cattle farms with freestall housing supported by IPARD in the region and to determine their environmental impact It was investigated representative twenty dairy farms with different animal capacities by using purposeful sampling method in this region. In terms of production type and animal

capacity in which the breeding is carried out continuously and commercially, the enterprises that are suitable for the purpose of research and representing the region have been selected as material. The data obtained from the surveyed farms were obtained by conducting a face-to-face survey with the owner. In addition, measurements, sketches, observations and photographs were taken in order to better define the structures within the farm. Examined dairy farms were evaluated at 5 different groups according to their animal capacities with <50 head, 50-99 head, 100-149 head, 150-199 head and 200 head and over. Purposeful sampling method was used in determining the farm.

Yüksek (2003) and Armağan (2004) reported the presence of animals in the grouping of farms according to their size as bovine unit (BBHB). In the calculation of BBHB value, 1 constant coefficients are used for cows, 0.6 for calves and heifers and 1.2 for bulls.

Costanheira et al. (2010) reported in their study that in the LU (Livestock Unit) calculation, they use 0.6 coefficient for animals less than 9 months and 1.0 coefficient for animals older than 9 months, ignoring calves less than 1 month.

### 3. RESEARCH RESULTS AND DISCUSSION

The farms examined in the study and their characteristics are given in Table 4. In this research, 20 units with different capacities were examined under 5 different groups as <50 heads, 50-99 heads, 100-149 heads, 150-199 heads and 200 heads and above.

The investigated farms are located of 10 in Sarayönü, 3 in Meram, 2 in Kadınhanı, 2 in Karatay, 2 in Karapınar and 1 in İçeri Çumra. Group capacities were determined based on the number of dairy cattle.

**Table 4.** Distribution Investigated Farms According to Dairy Cow Capacity

GROUP NUMBER	FARM NUMBER	DAIRY FARMS	LOCATION	DAIRY COW (HEAD)	TOTAL ANIMAL (HEAD)
1. GROUP	1	Senanmuz Süt Üretim Çiftliği	Sarayönü	30	62
	2	İnovaya Süt Üretim Çiftliği	Kadınhanı	30	70
	3	Eren Süt Hayvancılık Tarım	Karatay	41	78
	4	Elit Süt Düve ve Süt Üretimi	İçeriçumra	40	73
2. GROUP	5	Kuter Süt Üretim Çiftliği	Sarayönü	50	122
	6	Öcal Süt Üretim Çiftliği	Sarayönü	50	94
	7	Burak Atay Süt Çiftliği	Sarayönü	80	192
	8	Guycuoğlu Süt Çiftliği	Meram	80	198
3. GROUP	9	Ulusoy Süt Üretim Çiftliği	Sarayönü	100	230
	10	Lordlar Süt Üretim Çiftliği	Meram	100	270
	11	Agrobey Süt Üretim Çiftliği	Kadınhanı	120	270
	12	Erdoğan Süt Üretim Çiftliği	Sarayönü	120	275
4. GROUP	13	Durmuş Karabıyık Süt İşletmesi	Meram	150	329
	14	Ocakbey Tarım ve Hayvancılık	Sarayönü	150	328
	15	Erdem Süt Hayvancılık Tarım	Sarayönü	180	399
	16	Bilgi Süt Çiftliği	Karapınar	180	370
5. GROUP	17	Kefe Süt A.Ş.	Sarayönü	200	349
	18	CHS Süt Çiftliği	Karatay	200	363
	19	Projinal Tarım ve Hayvancılık	Sarayönü	250	547
	20	Karadağ Süt Üretimi	Karapınar	250	553

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The average number of dairy cow, total number of animals, BBHB, LU, feed production, annual total milk production and daily milk production values are given in Table 5. The difference between farm characteristics and groups was found to be significant ( $P < 0,01$ ).

**Table 5.** Properties of Enterprises

	I. Grup (<50 baş)	II. Grup (50-99 baş)	III. Grup (100-149 baş)	IV. Grup (150-199)	V. Grup (200< baş)	F	P
Number of Dairy Cow	35,25 ± 3,04 <sup>d</sup>	65,00 ± 8,66 <sup>d</sup>	110,00 ± 5,77 <sup>e</sup>	165,00 ± 8,66 <sup>b</sup>	225,00 ± 14,4 <sup>a</sup>	72,8	0
Total Number of Animal	70,75 ± 3,35 <sup>d</sup>	151,5 ± 25,8 <sup>cd</sup>	261,3 ± 10,5 <sup>bc</sup>	356,5 ± 17,2 <sup>ab</sup>	453,0 ± 56,1 <sup>a</sup>	27,8	0
BBHB	48,25 ± 2,75 <sup>d</sup>	97,3 ± 15,0 <sup>d</sup>	170,5 ± 8,54 <sup>e</sup>	252,3 ± 12,7 <sup>b</sup>	332,0 ± 29,5 <sup>a</sup>	49,3	0
LU	62,5 ± 2,90 <sup>d</sup>	133,3 ± 22,6 <sup>cd</sup>	230,0 ± 9,38 <sup>bc</sup>	314,0 ± 15,0 <sup>ab</sup>	398,8 ± 49,3 <sup>a</sup>	27,9	0
Feed Production	327 ± 116 <sup>e</sup>	1010 ± 134 <sup>bc</sup>	1173 ± 436 <sup>bc</sup>	2003 ± 121 <sup>ab</sup>	2509 ± 294 <sup>a</sup>	12,9	0
L/dairy cow.year	18,415 ± 0,931 <sup>b</sup>	22,035 ± 0,388 <sup>a</sup>	22,855 ± 0,133 <sup>a</sup>	18,260 ± 0,723 <sup>b</sup>	21,335 ± 0,455 <sup>a</sup>	12,7	0
Total Milk Production(L)	235000 ± 15679 <sup>e</sup>	521250 ± 66156 <sup>e</sup>	918250 ± 51118 <sup>b</sup>	1100000 ± 73598 <sup>b</sup>	1750000 ± 106066 <sup>a</sup>	70,52	0

a, b, c, d, Differences between data with different letters on the same line are statistically significant.

The difference between the groups in terms of total number of animals, BBHB and LU, feed production, annual total milk production and daily milk production (L / milking cow.year) was found to be significant ( $P < 0,01$ ).

Daily milk production is the highest III. group (100-149 head) with 22,855±0,133 L per cow, II. group (50-99 head) with 22,035±0,388 L per cow and V. group (200<head) with 21,335±0,455 L per cow. Daily milk production is the lowest IV. group (150-199 head) with 18,260±0,723 L per cow and I. group (<50 head) with 18,415±0,931 L per cow. This difference in daily milk production is due to the difference in farm management.

The highest milk production was in V. group (200<head) with 1750000±106066 L and the lowest was in I. group (<50 head) with 235000±15679 L and II. group (50-99 head) with 521250±66156 L. Milk production increases in proportion to the number of animals.

The highest feed production is 2509 ± 294 tons with the highest animal capacity is in V. group (200 <head). I. group (<50 heads) with the lowest animal capacity with the lowest feed production is 327 ± 116 tons. Feed production increases in proportion to the number of animals.

Türkmen (2018) stated in his study that dairy cattle farms in terms of economic and sustainability of their own forage crops to be added to the IPARD program, and that the fertilizer produced in these areas can contribute to both the environment and feed production.

Since dairy cattle farms are supported by the IPARD program, the conditions in the investments are compulsory. Therefore, there is no significant difference between the structural features of enterprises ( $P > 0,01$ ). Within the scope of IPARD support, under the laws of TKDK, min. structural features are described as follows.

- For cattle from 6 months to 12 months; stall widths should be at least 0.7-0.8 m and total stall lengths should be at least 1,2-1,3 m. At stall, a total area of at least 4-5 m<sup>2</sup> including the fertilizer path, should be provided. Outside the barn, at least 4-5 m<sup>2</sup> of courtyard areas should be provided.
- For cattle from 12 months to 12 months; stall widths should be at least 0.9-1.0 m and total stall lengths should be at least 1,4-1,5 m. At stall, a total area of at least 6-7 m<sup>2</sup> including the fertilizer path, should be provided. Outside the barn, at least 6-7 m<sup>2</sup> of courtyard areas should be provided.
- For cattle over 18 months; stall widths must be at least 1.1-1.2 m, stall lengths should be at least 1.8-1.9 m. At stall, a total area of at least 7-8 m<sup>2</sup> including the fertilizer path, should be provided. Outside the barn, at least 7-8 m<sup>2</sup> of courtyard areas should be provided.
- At least 1.8 m<sup>2</sup> of space should be provided for group calves (2-6 months) both for the barn (as a housing area) and outside the barn (as a navigation area) per calf.
- Shelter height of minimum 3 m and maximum 5 m shall be provided.
- A window area etc. of at least 1/20 of the floor area should be planned.
- At least 1/100 of the barn floor area, ventilation chimneys, cavities, etc. It should be planned.
- The birth compartment should be planned so that at least 15.75 m<sup>2</sup> area will fall per 25 dairy cattle in farm.
- An infirmary should be planned with a minimum area of 15.75 m<sup>2</sup> per 50 animals.

Fertilizer management is important in terms of environment, animal health and health of farm workers. Lack of fertilizer storage structure in traditional agriculture causes great harm to the environment and the farm. With fertilizer management, laws and standard criteria are introduced to ensure that the productivity of enterprises is not negatively affected, that environmental problems do not occur and that there is no unhealthy life (Süslü ve Uzal Seyfi, 2016).

IPARD attaches importance to fertilizer management which is the biggest environmental problem in the farms. IPARD has introduced criteria for storage and management of fertilizers within the scope of the support. If the farm is carried out with cattle for milk production, there should be a fertilizer store according to weekly fertilizer quantity (m<sup>3</sup>) and operation capacity. The fertilizer tank must be sealed. With the fertilizer scrapers, fertilizer mixer, fertilizer pump and fertilizer depots, IPARD is one of the most environmentally friendly projects that take into consideration the environmental pollution and tries to solve the waste pollution.

Örs (2018) reported that the regulations in the EU legislation on animal welfare, environmental protection, general hygiene, milk quantity and quality are compulsory in the farms.

As stated in the literature, it was determined that dairy farms with freestall houses in Konya region benefited from IPARD program successfully in terms of animal welfare and fertilizer management.

Considering that an important part (78%) of greenhouse gases originating from agricultural production originates from animal production, it is an important issue that must be studied meticulously on fertilizer management and environmental impacts of fertilizer.

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**O 149. ZERO WASTE AND SUSTAINABLE DEVELOPMENT**

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**ABSTRACT:** Zero Waste Project which was launched actual by the Environment and Urbanization Ministry of Turkish Republic in 2017. Prevention of wastefulness and more efficient use of resources have been targeted and in this context works has been carried out. A total of 1544 people have been trained in schools, public institutions and organized industrial zones and visited to public institutions / organizations, non-governmental organizations and associations within the scope of the project. Participation was provided for the activities of universities about zero waste in Konya Province. Competitions were organized to increase the awareness among children and teenagers. The registration of 2437 institutions and 40 municipalities were done to the Zero Waste Information System Implementation Module. 18,875 tons of paper and cardboard was recovered, 12,797 tons of plastic, 3850 tons of glass and 7 tons of metal waste were recycled. 1.989 tons of waste batteries were collected. 35,529 tons of non-hazardous waste was utilized

Disposal of wastes without utilizing within the recycling and recovering process causes serious loss of resources both as material and energy. There is an unavoidable increase in consumption while population and living standards in the world are increasing, and this situation increases the pressure on natural resources and disrupts the balance of the World so limited resources cannot meet the increasing needs. Considering this situation, the importance of efficient use of natural resources becomes even more apparent. For this reason, in recent years, zero waste application studies in all over the world are spreading in both the individual, institutional and municipal areas.

*Keywords: Zero Waste, Sustainable Development*

## **1. INTRODUCTION**

Zero Waste Project was launched actual in 2017 by Ministry of Environment and Urbanization, which is the implementing agency of the legislation in order to protect the environment, is a common existence of all living things, in line with the principles of sustainable environment and sustainable development. In this context aimed to prevent waste, to make more efficient use of resources, to inhibit or to minimize waste formation by considering the causes of waste formation, to ensure separate collection and recovery of the waste in case of formation of waste.

## **2. METHOD**

As part of the zero waste projects, works has been carried out for increase awareness and try to create more conscious individuals. In this direction target group has been reached with prepared information presentation and short films. Also in order to reach a wider group, Konya Provincial Directorate of Environment and Urbanization prepares activities such as public spots, theater and folklore shows, activity truck, award-winning competitions and award ceremonies.

In the studies completed until this time;

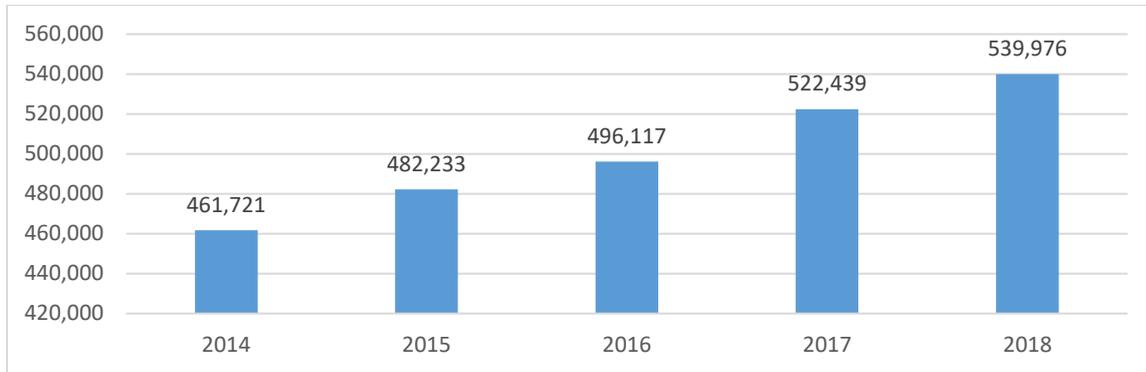
- A total of 1544 people have been trained in schools, public institutions and organized industrial zones.
- Participation was provided for the activities (panels, career days, symposiums) of universities about zero waste in Konya Province.
- Visits were made to public institutions / organizations, non-governmental organizations and associations, problems encountered in project implementation were consulted.
- Two different competitions were organized to increase the awareness of zero waste projects among children and young people, by Environment and Urbanization Ministry and Konya Provincial Directorate of Environment and Urbanization.

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- The registration of 2437 institutions and 40 municipalities were done to the Zero Waste Information System Implementation Module.

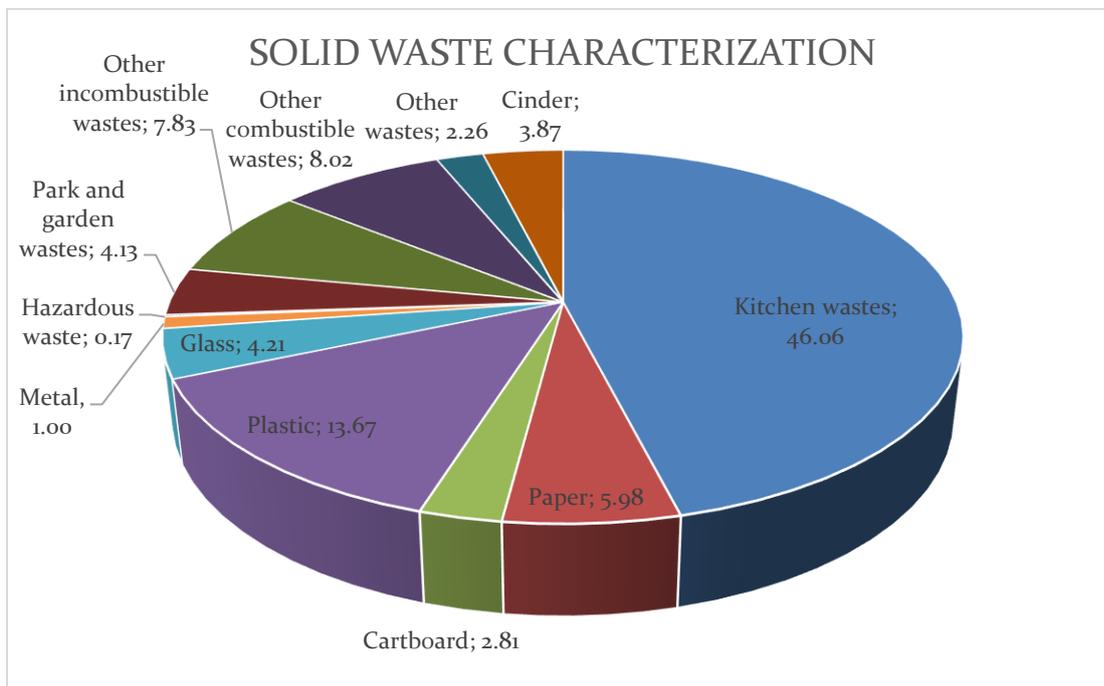
**3. RESULTSTS**

The amount of solid waste disposed by the Metropolitan Municipality in our city is shown in Graphic 1. In parallel with the increasing population and consumption, the amount of annual solid waste increased.



**Graphic 1.** Amount of solid wastes disposed according to years in Konya province (ton) (Konya Province Environmental Status Report data, 2018 )

Solid waste characterization studies carried out by Konya Metropolitan Municipality in 2018 are given below. As seen in the graph, a large amount of recoverable waste found inside solid wastes.



**Graphic 2.** Waste composition of Konya province in 2018 (Konya Province Environmental Status Report data, 2018 )

For this reason, the studies carried out within the scope of the zero waste projects will make contribution to the reduction of waste formation, separation in source and recovery.

#### **4. CONCLUSION AND RECOMMENDATIONS**

Province-wide within the context of project in 2018;

- The cutting of approximately 254,000 adult trees was prevented with recovering of 18.875 tons of paper-cardboard.
- The use of 91,000 lt of oil has been saved with recycling of 12.797 tons of plastic waste.
- 324 tons of raw materials were saved with 3.850 tons of glass waste.
- 9 tons of raw materials were saved with recycling of 7 tons of metal waste.
- 1.989 tons of waste batteries were collected under the project.
- Total of 35,529 tons of non-hazardous waste was utilized within the scope of the Zero Waste Project.

Furthermore; it is thought that there will be an increase in the number of licensed facilities in which the wastes are treated by ensuring the spread of the project.

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Konya Province Environmental Status Report, 2018

**O 150. A RESEARCH OF PARTICLE MATTER LEVEL FROM QUARRIES INDUSTRY IN  
KONYA “ANKARA ROAD” DISTRICT**

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**ABSTRACT:** Air quality is affected by many types of pollutants that are emitted from various sources, including stationary and mobile. These sources release both criteria and hazardous air pollutants, which cause health effects, ecological harm, and material damage. They are generally categorized as either particulates or gas-phase pollutants. Air pollution increases the risk of respiratory and heart disease in the population. Both short- and long-term exposure to air pollutants have been associated to health impacts. One of the air pollutants is Particulate Matter (PM) that can be found in the air as primary or secondary, by their formation's type. Particles smaller than 10 microns in diameter with air we breathe easily enter our respiratory tracts and cause various damages. In Konya, the points to sample the stone quarries and the crusher facilities determined for “Ankara Road” and the "Tecora" device had measured PM<sub>10</sub> and PM<sub>2.5</sub> for six months. Measurements was done with "Tecora" brand dust meter, PM<sub>2.5</sub> and PM<sub>10</sub> particulate matter suspended in the atmospheric environment has the feature of continuous measurement and recording.

*Keywords: Air Pollution, Particulate Matter (PM), Modelling, Quarries Industry, Health*

**P 1. DETERMINATION OF FATTY ACID PROFILE OF SOME EXTRA VIRGIN OLIVE OIL BY GC-FID**

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**ABSTRACT:** Olive oil, differently from most vegetable oils, is a natural product obtained from olive fruits. It is a natural juice and can be consumed without further treatments, so it has been produced by mechanical extraction without chemicals and any treatment (Boskou, 2006). Environmental and seasonal effects, as well as the olive oil processing methods (Di Vaio et al., 2013), has been reported to affect olive oil composition and to create different categories of olive oil that has been established by the international organizations. Among the different types of olive oil, extra virgin olive oil which is the most valuable olive oil category. In this study, an automated gas chromatography system for determination of fatty acid profile of some extra virgin olive oils was used. It was seen that olive oil species analysed have high amounts of oleic acid mostly. The biggest oleic acid ratio was %72,25 in extra virgin olive oils analysed. With this study, the olive oils to be obtained from different regions of our country have been examined by chromatographic method and their results have been compared. With the results obtained, it is aimed to draw attention to the changes in the olive oil profile of our country and make important contributions to the literature.

*Keywords: Extra virgin olive oil, fatty acid profile, gas chromatography*

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**P 2. APPLICATION OF GEOGRAPHICAL INFORMATION SYSTEM FOR LANDSLIDE  
SUSCEPTIBILITY MODELING IN THE TORTUM LAKE AND ITS NEAR VICINITY (NE  
TURKEY) USING INFORMATION VALUE METHOD**

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**ABSTRACT:** Landslides are natural hazards. In many countries, landslide is a major issue to threaten the lives and property of people. In this paper, Tortum Lake and its near vicinity is chosen as a study area. Tortum Lake is located in the northern part of the Uzundere District, Erzurum, NE Turkey. The main objective of this research work was to model the landslide susceptibility in study area using geographical information system (GIS) and data-driven bivariate statistical approach involving information value model. Landslide locations within the study area were identified using literature search of historical landslide records, aerial photographs and a field survey. Nine landslide-conditioning factors, including slope degree, slope aspect, altitude, lithology, vegetation coverage, soil type, geomorphology, curvature and topographic wetness index (TWI), were considered in the generation of landslide susceptibility model (LSM). The all data layers were extracted from digital elevation model (DEM), geological and topographical maps and Landsat satellite images, then were integrated on GIS software to produce the LSM of the study area. The generated LSM was validated and the results of validation show that the success rate and the prediction rate of the model are 68.1% and 71.4% respectively.

*Keywords: Geographical Information System (GIS), Remote Sensing (RS), Landslide Susceptibility Modeling (LSM), Landslide Conditioning Factors (LCFs), Information Value Method (IVM), Tortum Lake*

**P 3. ENERGY EFFICIENCY AND CARBON EMISSION POTENTIAL COMPARISON OF HEATING SYSTEMS**

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**ABSTRACT:** The aim of this study is to create a decision-making methodology for fuel performances and greenhouse gas emissions of heating systems by considering combination of financial and non-financial criteria, which are dependent on the region and the people, and to show logical choices numerically. For this purpose, a specific building with its architectural drawings was specified and heat loss equations were observed by using MS Excel according to TS 825- Thermal Insulation Requirements for Buildings .Calculations of heat loss were performed separately for four different types of heating zones in our country by selecting different cities in these zones. Bu using heat losses that were calculated based on placing the building in different zones, different types of heating strategies were determined. Moreover, fuel costs, installation cost and greenhouse gas emissions were determined based on different fuel usage ratios. These calculations and observed criteria were investigated and tried to explain. The results of the comparison of these selections was given in this present study.

*Keywords: Heating systems, Fuel calculation, Greenhouse gas emissions, TS-825 Thermal Insulation Requirements for Buildings*

**P 4. IMPROVEMENT OF DRUG PRODUCTION PROCESSES: EFFECT OF ACTIVE SUBSTANCE PARTICLE SIZE DISTRIBUTION ON THE PRODUCT DISSOLUTION RATE**

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**ABSTRACT:** One of the most prominent features of our age is the effects of strong changes that affect almost everything. So, the companies should adapt to their environment and obtain competitive advantages by renewing at the required levels, improving their processes and offering the products with high quality level at the optimum cost [1]. When the critical parameters in the processes are taken under control, it is known that the inefficient processes are reduced by rejection of inappropriate products and limitation of waste in the companies [2]. When the factors affecting the solubility and dissolution rate of molecules are listed, it has been reported that organic molecules with higher molecular size have less solubility in water than small molecules. And also, the solubility of the molecules generally reduces with increasing molecular weight [3]. In this study, a nonsterile solid form finished product including active substance named “moxifloxacin” was used and tested. The effects of particle size of the active substance on the quality of a film tablet form product including moxifloxacin were investigated. The data as shown in Table 1 were statistically analyzed and supported by case studies. As a result, optimum particle size distribution for product dissolution rate in the drug production process was determined.

**Table 1.** Optimum particle size distribution for moxifloxacin

Sieve analysis (Process optimization)	100 g	Sieve size ( $\mu\text{m}$ )	Amount remaining on the sieve (%)
		710 $\mu\text{m}$	0.3 – 4.0
		250 $\mu\text{m}$	20.0 – 40.0
		106 $\mu\text{m}$	30.0 – 55.0
		25 $\mu\text{m}$	20.0 – 30.0
		<25 $\mu\text{m}$	0

*Keywords: Particle size distribution, high quality production in the pharmaceutical industry, continuous improvement, critical process control parameters*

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**P 5. DETERMINATION OF LINEAR AND NONLINEAR OPTICAL BEHAVIOUR OF  
NOVEL TETRAAZAMACROCYCLE DERIVATIVES**

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**ABSTRACT:** In this study; the electric dipole moments, static first and hyperpolarizabilities, dynamic linear polarizabilities, first and second hyperpolarizabilities of the title tetraazamacrocycle compounds, (6E,8E,15E,17E)-7,16-bis(3,3-dimethyl-3H-indol-2-yl)-2,3,11,12-tetrakis(octyloxy)-5,14-dihydrodibenzo[b,i][1,4,8,11]tetraazacyclotetradecine (**1**) and (6E,8E,15E,17E)-7,16-bis(3,3-dimethyl-3H-pyrrolo[3,2-h]quinolin-2-yl)-2,3,11,12-tetrakis(octyloxy)-5,14-dihydrodibenzo[b,i][1,4,8,11]tetraazacyclotetradecine (**2**), have been calculated using ab-initio and density functional theory (DFT) methods. The measured one-photon absorption wavelengths for **1** and **2** are consistence with the theoretically obtained values using time-dependent Hartree-Fock (TDHF) technique. The nonlinear optical results computed here have been compared with the experimental data previously reported in the literature.

*Keywords: Electric Dipole Moment, First Hyperpolarizability, Second Hyperpolarizability, Ab-Initio, Time-Dependent Hartree-Fock*

**P 6. STRENGTHENING OF RC BEAMS SUBJECTED TO CORROSION UNDER THE  
EFFECT OF FLEXURAL**

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**ABSTRACT:** As a result of the failure of the reinforcement to resist corrosion, it is known to have a negative effect on the structural performance and structural safety under the influence of the earthquake. During the seismic evaluation of existing buildings, it is recommended to consider the corrosion effects in a multidimensional manner. Reduction of reinforcement diameter, loss of adherence, change of concrete cracks and mechanical properties of reinforcement are the main results of corrosion. As a result of corrosion, mass-section loss occurs in the reinforcement, concrete is cracked without any load, loss of adherence occurs, mechanical properties of reinforcement are adversely changed. There are different repair / reinforcement methods to solve these negative consequences in reinforced concrete structures. Fiber Reinforced Polymer is one of the most important methods that need to be investigated. In the scope of the project, an experimental study was carried out by considering the bending effect in structural analysis. In this study, 6 x 25x40x250 cm beam samples were produced. As a result of rusting, the behavior of the test specimens under bending, ductility, load-displacement relationship, moment-curvature relationship, adherence-slip relationship, crack width and distribution were investigated. Secondly, reinforced concrete beams rusted with 6%, 10% and 18% strengthened by FRP were investigated and the effect of FRP on corrosion and bending was investigated. The results obtained have helped to better evaluate the seismic performance levels of the building due to the comparison of the bending strength of reinforced concrete beams with different rust ratios before / after reinforcement.

*Keywords: Corrosion, FRP, Strengthening, Flexural Effect*

**P 7. DIATOM COMMUNITY FROM EPIPHYTIC ALGAE IN DIFFERENT DEPTH  
SAMPLES FROM “GUR I KUQ” STATION IN OHRID LAKE**

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**ABSTRACT:** This paper aims to present data regarding diatom community, at “Gur i Kuq” sampling site, in Lake Ohrid. Samples are collected like epiphyte in macrophyte on July 2011, in different depth from the shoreline (0.5m, 1.3m, 5m, 7m, 8.5m, 10m, 13m, 17m, 19m, 20m). There is no comprehensive and systematic review of the distribution of the endemic species in Lake Ohrid and its watershed, but probably a high number of endemic diatom species are distributed throughout the lake. From the microscopy examination, the most dominant species belong to pennates genera. The most abundant diatom species were: *Cyclotella ocellata* (Pantocsek), *Achnanthes minutissima* (Kützing agg.), *Amphora pediculus* (Kützing) Grunow, *Cymbella amphicephala* Naegeli, *Cocconeis placentula* var. *placentula*, *Cymbella microcephala* Grunow gr., *Cocconeis pediculus* Ehrenberg, etc., which are characterized by a specific distribution, morphological variability and ecology. Some of diatoms species were found rarely which included: *Nitzschia palea* var. *palea* (Kützing) W. Smith, *Nitzschia dissipata* (Kützing) Grunow, *Navicula cari* Ehrenberg, *Gomphonema olivaceum* var. *olivaceum*, *Diatoma vulgare* Bory, etc. Individual species of diatoms have specific preference to habitat and requirement for water chemistry. In this sampling sites, Lake Ohrid, shows metal pollution, because more years ago, in this station has been active the mines of chromium, nickel and iron. The values of heavy metals are higher in the shoreline if we compare with different depth, which is reflected in the number of different species.

*Keywords: Diatom community, epiphytic, Ohrid Lake, mines zone*

**P 8. AN OVERVIEW OF SOIL REMEDIATION TECHNOLOGIES**

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**ABSTRACT:** Soil pollution is one of the most important environmental problems the world is facing nowadays. The impacts of soil pollution are definitely very important because the pollutants pass through the food chain, the ground water is polluted by these contaminants, humans may be subjected to adverse health effects, and the remediation of a contaminated land generally has a high cost and this process is mostly time consuming. In fact, pollutants directly and indirectly affect the three environments, namely air, water and soil. Soils can be contaminated as a result of air pollution and contaminated surface water used as irrigation water. Improper waste disposal, the excessive use of chemical fertilizers and pesticides in agriculture are among the other reasons for soil pollution. Contaminated soils can be remediated and there are various methods for the remediation of contaminated soils. However, it should be kept in mind that the priority is to protect the soils from contamination and to take the necessary precautions to prevent soil pollution. The technologies used for soil remediation can be divided into three categories as physical/chemical, biological and thermal methods. This review includes an assessment of soil remediation technologies considering geotechnical aspects. In this review, the recent studies on soil remediation are also overviewed.

*Keywords: Soil, Pollution, Remediation, Geotechnical engineering*

**P 9. ASSESSMENT OF WATER QUALITY IN THE DIFFERENT DEPTH OF OHRID LAKE  
(ALBANIAN PART) BASED ON DIATOM INDICES**

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**ABSTRACT:** Since many years, the siliceous algae (diatoms - *Bacillariophyta*) are used to evaluate the ecological state of surface fresh water. Lake Ohrid is the deepest lake of the Balkan, with a maximum depth of 288 m and a mean depth of 155 m. The data about water quality in Ohrid Lake, which are presented in this paper, are based in diatom composition in different depth. The diatoms communities were collected like epiphyte in macrophytes, in different depth of three sampling sites (Hudënisht, Gur i Kuq and Mëmëlisht) during yrs. 2011. Most of the species in Ohrid Lake are oligotraphent, growing up only in clean waters with low nutrients, like: *Achnanthes minutissima*, *Navicula cryptotenella*, *Cymbella microcephala*, *Nitzschia denticula*, *Fragilaria capucina*, etc. Other species of highest vitality in stronger mesotrophic to eutrophic waters were observed, like: *Amphora pediculus*, *Cocconeis pediculus*, *Gomphonema pumilum*, *Gomphonema olivaceum*, *Cymbella minuta*, *Diatoma vulgare var. vulgare*, etc. The ecological preference groups of diatoms reflect the chemical character of different streams. Such changes in diatom community structures suggest a change in environmental conditions such as, for example the deterioration of trophic status observed in Ohrid lakes. From a rough estimation of diatom species based on two standards: EN 13946:2003 and EN 14407:2004, we have calculate the Shannon Index, which gave evidence of biodiversity variations over the seasons and some differences between sampling sites. The Saprobic Index oscillated within a small band, indicative for oligo-β-mesosaprob to β-mesosaprob conditions. The Trophic Diatom Index (TI<sub>DIA</sub>) and the Saprobic Index (SI) follow similar trends. The structures of the diatom communities reflect real environmental changes. These states are confirmed also by relative activities, such as: from mine and from agriculture land in to the watershed area.

*Key words: Ohrid Lake, diatoms indices, epiphyte in macrophyte, ecological assessment*

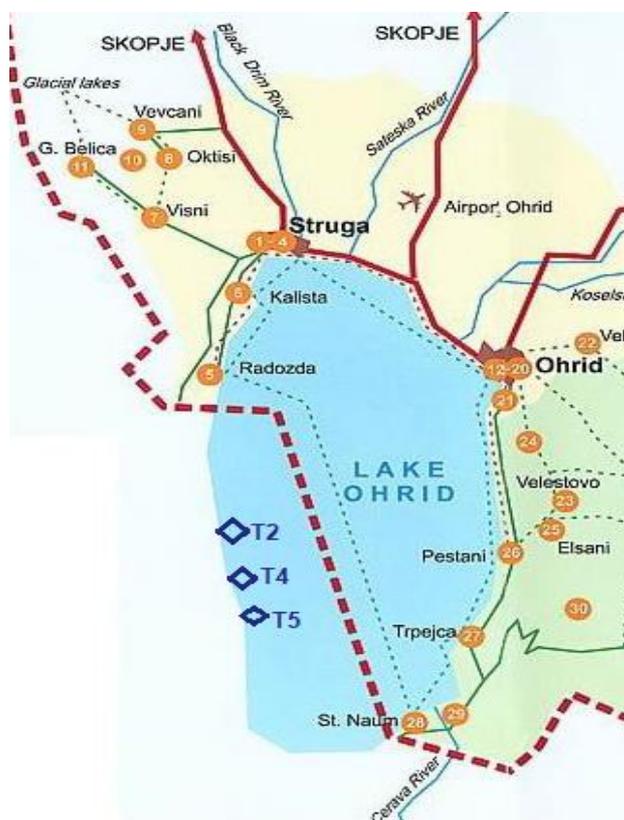
## **1. INTRODUCTION**

Lake Ohrid has 87.5 km of shoreline and covers an area of 358.2 km<sup>2</sup>. The average depth of the lake is 164 m; it has a maximum depth of 289 m. The watershed of Lake Ohrid includes steep mountains, as well as both Macro and Micro Prespa Lakes. The total area of the watershed is about 3,921 km<sup>2</sup>. A little less than half of the water in Lake Ohrid comes from its tributaries. On the Albanian side, river flow is substantially less, but the Pogradeci and Verdova Rivers are the largest contributors. The remaining inflow comes from the springs that flow into the southern part of the lake, at St. Naum, Drilon and Tushemisht. These springs are fed by water flowing out of the porous karst mountains (Mali i Thate). Over thousands of years, holes and channels have formed within the mountain rock. These channels carry water that originates in the Prespa watershed to Lake Ohrid. The farmland in the basin is likely a significant source of pollution to Lake Ohrid as fertilizers, soil particles, and pesticides wash into rivers and streams and eventually to the lakes. Much of the farmland in the watershed is irrigated, which increases the load to the lake. In Albania, human waste and wastewater is currently not treated in the watershed. In Pogradec, the waste generated by about 30% of the town is collected but it is simply discharged into Lake Ohrid near Tushemisht. In addition to eutrophication, Lake Ohrid also shows metal pollution near the sites of the old chromium, iron, nickel and coal mines outside Pogradec (in Gur i Kuq and Memelisht). Long-term exposure to elevated levels of chromium, copper, cobalt, nickel, and other metals have been shown to have harmful effects on human health. The shoreline around Pogradec is also the prime area for tourism on the Albanian side of the lake, so the water pollution from sewerage has significant economic, as well as ecological impacts. Evidence of the ecological impacts of human

activities is apparent in both the aquatic plant community and the phytoplankton in the near shore waters. In the region of Pogradec, phytoplankton densities are much higher than elsewhere along the shoreline, and the submerged plant community has high densities of pollution tolerant taxa. In the mining area of Memelisht and Guri i Kuq, these plants show evidence of metal contamination and stunted growth. The population in the Pogradeci areas has been growing rapidly, and as this growth continues, the pressures on the lake will continue to increase. To accommodate this growth, and the economic development necessary to improve the quality of life in the region, aggressive management actions will be needed. A coordinated approach that manages urban growth, agricultural impacts, and industry must be developed. Diatoms are the main primary producers and chemical modulators in freshwater aquatic ecosystems (Kupe L. et al., 2008, Wu et al., 2012; Bere et al., 2014; Mangadze et al., 2015, Dalu T. et al., 2016). The diatoms are very sensitive to environmental change. Moreover diatoms have distinct ecological tolerances and short generation time (Zalack et al., 2010, making them suitable indicator organisms for water quality changes over short time scales. Diatoms have been used as water quality indicators in Europe (Kelly et al. 1998; Prygiel et al., 1999, Sládeček V., 1986, Willén E., 2000). Most of the indices employed are based on Zelinka and Marvan's (1961) approach, which considers weighted averages of taxa's sensitivity to nutrients and organic degradation, as well as pH and salinity (Dalu T. et al., 2016). We evaluated that changes in water quality resulting from different depth would be reflected in diatom community structure.

## **2. MATERIAL AND METHODS**

Lake Ohrid is a tectonic and the deepest lake of the Balkans, with a maximum depth of 289 m and a mean depth of 164 m. It covers an area of 358.2 km<sup>2</sup>, containing an estimated 55.4 km<sup>3</sup> of water. Lake Ohrid is special as such; by far the most spectacular quality is its impressive endemism. He has more endemic species covering the whole food-chain, from phytoplankton to fish. Sampling and monitoring of the diatoms were performed on July 2011. The samples are collected in three sampling sites and for each sampling sites we have collected samples in different depth from shoreline: Memelisht (5.6m, 7.5m, 8.8m, 12m, 13m, 15m); Hudenisht (1.5m, 3.5m, 4.5m, 5.8m, 7m, 9m) and Gur i Kuq (4m, 5m, 7m).



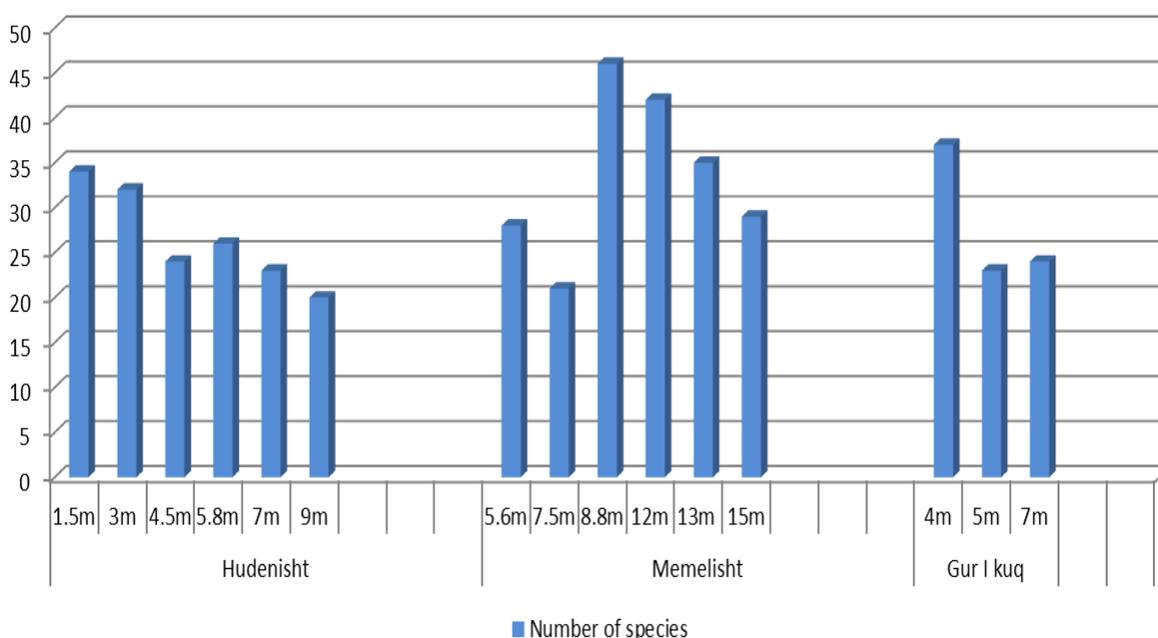
**Figure 1.** Sampling sites in Ohrid Lake in different depth

In this paper in total we will present 15 samples, in which sample we have calculate the Diversity Index ( $H'$ ), trophic Diatoma Index ( $TI_{DIA}$ ) and Saprobic Index (SI). The diatom community are collected like epiphyte in different macrophytes in different depth from shoreline; the resulting suspensions collected in small bottles and preserved in 4% formaldehyde (Kelly et.al., 1998; Prygiel et. al., 2002; Kupe L., 2006; Kupe et. al., 2013). The cleaning of diatom frustules was done boiling the material, first with  $HCl_{cc}$  and then, after washing, boiling them again with  $H_2SO_4_{cc}$ , adding during the last procedure some crystals of  $KNO_3$ , as described by Krammer & Lange-Bertalot 2001 (standards of EN 13946: 2003). About 500 valves per slide were counted using 100 oil immersions, yielding a 95% confidence for the data on species composition (Lund et al., 1958; Kelly et al., 1998; Prygel et al., 2002). Diatoms were identified using standard literature (Cleve – Euler 1955; Pascher 1976; Krammer & Bertalot 1996-2001), (EN 14 407: 2004). Several studies have clearly demonstrated that diatom community's change with increasing concentrations of both organic and inorganic load of substances, making them the preferred organism group for in situ biomonitoring studies in Europe, the USA and Asia (Cox 1991; Kovacs et. al., 2006; Kupe et al., 2012).

### 3. RESULTS AND DISCUSSION

In 15 samples of 3 sampling sites we have determine in total 88 species in Hudenisht; 94 species in Memlisht and about 60 species in Gur i Kuq. The dominant species in our samples are presented by: *Cyclotella ocellata*, *C. fottii*, *Aulacoseira ambigua*, *Cocconeis placentula*, *C. robusta*, *Denticula tenuis*, *Epithemia ohridana*, *Gomphnema olivaceum*, *Navicula cryptotenella* etc. Each species is characterized by an ecological value, which have indication in trophy level of water. The Ohrid Lake is also very rich with endemic species. For them didn't determined the ecological value but their presence though high in some cases is not taken into account in calculating the trophic and saprobic index due to lack of that their ecological values. Among the endemic species we determination: *Placoneis macedonica* Levkov, *Amphora ohridana* Levkov, *Encyonema macedonicum* Levkov, *Encyonema ochridanum* Krammer, *Placoneis juriljii* Miho, *Planothidium lanceolatum* Lange- Bertalotti, *Hippodonta costuliformis* Lange-Bertalot (Miho & Tase 2004; Miho Witkovskii 2005).

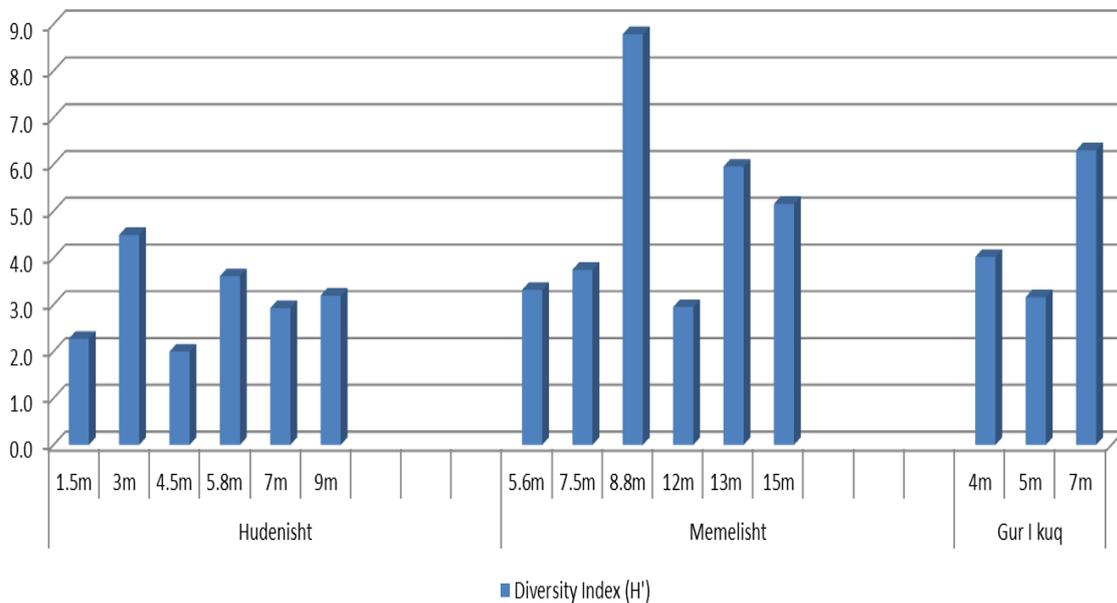
The high number of species was found in Memelishti station, in 8.8m depth. The low number of species was found in Memelisht (7.5m) and Hudenisht 9m. If we compare three sampling sites, the average number of species belong Memelisht station, especially in 8.8m and 12 m, which show the high value of nutrient and organic matter.



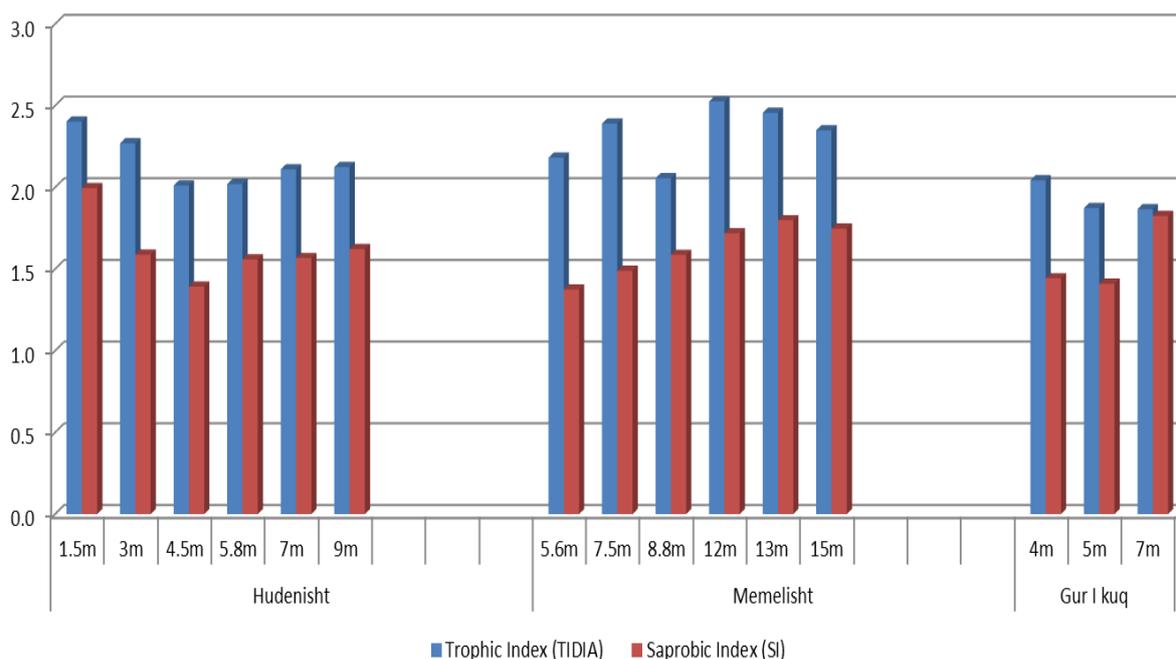
We have identify tolerant species that are dominant and grow in a wide range ranging from oligotrophic to eutrophic waters, such as: *Neidium dubium*, *Nitifolia amphibia*, *Nitzschia angustata* etc. Some others species like as: *Achnanthes lanceolata*, *Amphora pediculus*, *Cocconesi pediculus*, *Cymbella minuta*,

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*Diatoma vulgare* var. *vulgare*, *Epithemia adnata*, *E. sorex*, *Fragilaria capucina* var. *mesolepta*, *Gomphonema minutum*, *Gomphonema pumilum*, *G. olivaceum*, *Gyrosigma accuminatum*, *Meridion circulaire*, *Naviculadicta atomus*, *N. saprophila*, *Navicula cryptocephala*, *N. menisculus* var. *grunowii*, *N. reinhardtii*, *Nitzschia dissipata*, *N. linearis*, *N. palea*, *Rhoicosphaenia abbreviata*, *Surirella angusta*, etc. The polytrophic and polyhypertrophic species of diatoms species such as: (*Amphora lybica*, *Cymatolpeura solea*, *Fragilaria ulna*, *Navicula cuspidate*, *Gomphonema olivaceum*, *Navicula cryptotenella*) are not very dominant in Lake Ohrid. Most of species in Ohrid Lake belong to endemic species. The highest values of the variability indicator are found in the Memelisht (depth 8.8m) which indicates a variety present, is related to the various trophic levels, which determine the quality of the waters. Diatom indices have been used extensively for water pollution and trophic status assessment. These indices like as: trophic indices (TI<sub>DIA</sub>) were significantly correlated to (nutrient) ammonium, nitrate and phosphate concentrations. But saprobic indices (SI) were significantly correlated to organic matter.



TI<sub>DIA</sub> oscillated from 1.9 Gur i Kuq to 2.5 in Memlisht, show a moderate level of inorganic mater in water. They come from domestic matters and agricultural land. SI oscillated from 1.4 (oligosapro) to 2 (β – mesosaprob). In general, the value of saprobic index shows low level of organic matter.



In all sampling sites and in all depth, trophic values are very high if we compare with saprobic index. The high values of trophic index are the results of high level of inorganic matter (nitrogen and phosphorous) have a strongly influence to growth the macrophytes. The trophy levels in Ohrid Lake oscillated from mesotroph in Gur i Kuq to eutroph in Hudenisht and Memelisht. The caused by the impact of the inhabited of villages like as: Hudenishti and Memelisht.

#### 4. CONCLUSION

The Pennat diatoms are the most dominant species in the waters of Lake Ohrid because samples were accumulated as epiphyte in macrophytes dominated by: *Cocconeis placentula* var. *lineata* (show a moderate pollution of water), *Cocconeis robusta* (endemic species), *Gomphonema pumilum* (show a good quality of water), *Navicula cryptotenella* (from moderate to high pollution which is low presence), *Gomphonema minutum* (modearte pollution, high presence in all depth and in all sampling station), *Cymbella ohridana* (endemic species of Ohrid Lake). However, in Ohrid Lake, we have identify tolerant species that are dominant and grow in a wide range ranging from oligotrophic to eutrophic waters, such as: *Neidium dubium*, *Nitifolia amphibia*, *Nitzschia angustata* etc. Some others species like as: *Achnanthes lanceolata*, *Amphora pediculus*, *Cocconesi pediculus*, *Cymbella minuta*, *Diatoma vulgare* var. *vulgare*, *Epithemia adnata*, *E. sorex*, *Fragilaria capucina* var. *mesolepta*, *Gomphonema minutum*, *Gomphonema pumilum*, *G. olivaceum*, *Gyrosigma acuminatum*, *Meridion circulaire*, *Naviculadicta atomus*, *N saprophila*, *Navicula cryptocephala*, *N. menisculus* var. *grunowii*, *N. reinhardtii*, *Nitzschia dissipata*, *N. linearis*, *N. palea*, *Rhoicosphaenia abbreviata*, *Surirella angusta*, etc. However, in littoral habitats, there have been observed tolerant species as dominant that grow up to a wide range, from oligotrophic to eutrophic waters, like: *A. biasoletiana*, *N. minima*, *Neidium dubium*, *Nitzschia amphibia*, *Nitzschia angustata*, *Gomphonema truncatum*, *G. parvulum*, *Fragilaria brevistriata*, etc. Other species of highest vitality in stronger mesotrophic to eutrophic waters were observed. High presence of *Cyanophytes* has been observed in planktonic samples near Pogradeci. Some more considerations about trophy state of Albanian habitats were reported in a previous publication (Miho et al., 2006)

The poliotrophic and polyhypertrophic species of diatoms species such as: (*Amphora lybica*, *Cymatolpeura solea*, *Fragilaria ulna*, *Navicula cuspidate*, *Gomphonema olivaceum*, *Navicula cryptotenella*) are not very dominant in Lake Ohrid. The composition of the diatoms in Ohrid Lake oscillated from oligosaprobic to oligo-  $\beta$ -mesosaprobic state, ie a medium to moderate contamination with organic matter and a little more contaminated with inorganic matter from mesotroph to eutrophic.

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**P 10. THE IMPORTANCE OF FORAGE KOCHIA (*Kochia prostrata* (L) Schrad) IN  
RANGELAND IMPROVEMENT AND THE RESEARCHES CARRIED OUT IN KONYA  
CONDITIONS RELATED TO FORAGE KOCHIA**

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**ABSTRACT:** Forage kochia (*Kochia prostrata* (L) Schrad Syn. *Bassia prostrata*) belonging *Chenopodiaceae* family is a perennial semi-evergreen sub-shrub species. This species which grows naturally in Turkey's rangelands is tolerance to drought, cold and salinity. Moreover, forage kochia remains green during dry fodder period, and cattle, sheep and goat graze gladly on the forage. While this species green fodder has got 13-18% crude protein, the crude protein ratio in dry matter in hay is between 9% and 11%. In a research carried out in Konya was determined as crude protein 17% DM, NDF 43% and ADF 32%. Immigrant and Snowstorm forage kochia varieties have 1500-2500 kg ha<sup>-1</sup> hay yield. However; in the search carried out, Konya was stated that the populations belong the Konya province had got 1070- 2580 kg ha<sup>-1</sup> hay yield. Forage kochia is used in drought and salty rangelands improvement in the world. In our country, forage kochia have a high potential for economic yield obtain from rangelands having salinity and drought problems in KOP region. For this reason, the practices to rangeland improvement with forage kochia are started, especially in Konya. This review's target is awareness arising from the importance of forage kochia by stating researches carried out and work in progress in Konya Selcuk University related to forage kochia.

*Keywords: Bassia prostrata, Forage Kochia, Hay Yield, Rangeland Improvement*

**1. THE IMPORTANCE OF FORAGE KOCHIA (*Kochia prostrata* (L) Schrad)**

The perennial semi-evergreen shrub forage kochia (*Kochia prostrata* (L.) Schrad Syn. *Bassia prostrata*), has been considered one of the best-suited forage crops for KOP region. Forage kochia has got importance about prevention and control of wind erosion and wildfire in arid or semiarid areas, in addition to, soil conservation in salt-affected soil and dry land. Its various biological properties such as, naturally occurring in the Central Anatolian Region, high salt tolerance, cold and drought tolerance, and its promotion of bio-diversity and ground cover, have a vital role in rangeland improvement. Moreover, forage kochia remains green during dry fodder period, and cattle, sheep, and goat graze gladly on the forage (Acar 2013).

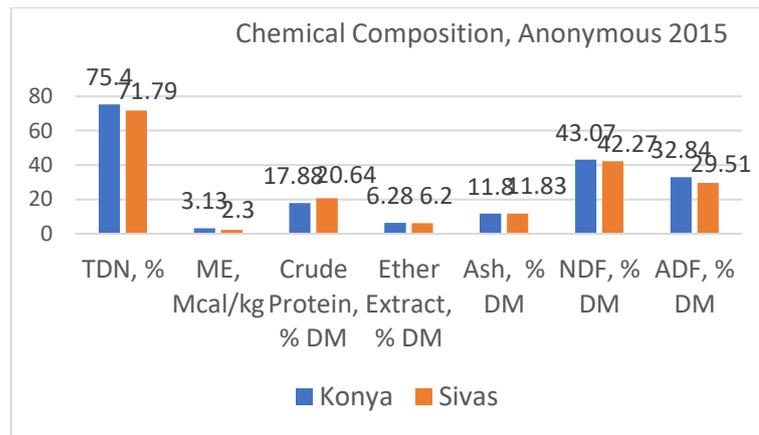
The *Kochia* genus, which belongs to the *Chenopodiaceae* family, have demonstrated a wide variation in terms of morphology. There are different ecotype of forage kochia, and these properties produce to the difference in morphology (i.e., plant height, stem color, canopy, and leaf dimension), vegetation period, and soil adaptation capability (Kitchen and Monsen 2008). Forage kochia have a root system dig down deep up to 6.5 m. The plant height of forage kochia is between 30 and 80 cm (Tilley et al. 2012, Acar 2013, Acar and Koç 2019). It is stated that Forage kochia is more a decumbent plant than other *Bassia* species, and it has got varying stem color (i.e., green, yellow, orange, red and purple). The leaf height of forage kochia is 4-30 mm, and the leaf weight is between 1.0 and 1.5 mm (Safiallah et al. 2017). The morphology of *Bassia* species is effected from climate and environmental conditions. This genus is decreased to their leaf surface and is an increase in leaf hairiness in adaptation to environmental conditions (Safiallah et al. 2017). Forage kochia is occurred to wind-pollinated, and the anther and stigma in the flower of forage kochia have a yellow and red color (Creech 2012, Guo et al. 2014, Acar et al. 2016).

Two forage kochia varieties (i.e., Immigrant and Snowstorm) sold commercially in the world, and these varieties are used in drought and salty rangelands improvement in the world (Tilley et al. 2012). In our country, forage kochia have a high potential for economic yield obtain from rangelands having salinity and drought problems in KOP region. For this reason, the practices to rangeland improvement with forage kochia are started, especially in Konya. This review's target is awareness arising from the

importance of forage kochia by stating researches carried out and work in progress in Konya Selcuk University related to forage kochia.

**2. FEED VALUE OF THE RESEARCHES CARRIED OUT AND CONTINUOUS IN KONYA**

Green fodder of forage kochia has got 13-18% crude protein; the crude protein ratio in dry forage is between 9% and 11% (El Shereef 2016). In a research carried out in Konya was determined as crude protein 17% DM, NDF 43% and ADF 32% in grown Konya condition (Figure 1). However, forage kochia grown in Sivas condition was determined that crude protein was 20.64% DM, NDF was 42, 27% DM and ADF was 29, 51% DM. According to this search, it was stated that forage kochia grown in Konya could be more digestible than grown in Sivas (Anonymous 2015). There are in progress to researches related to the feed value of different types of forage kochia (Figure 2).



**Figure 1.** Feed value of the researches carried out and Konya (Anonymous 2015)



**Figure 2.** The Studies of Feed Value in Different Times- Start in 2018

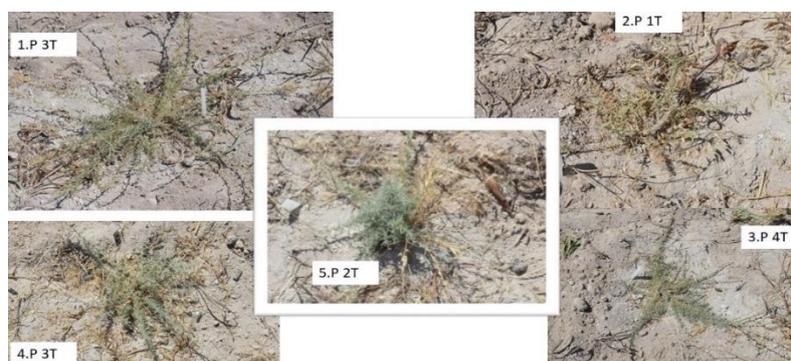
**3. MORPHOLOGICAL PROPERTIES OF THE RESEARCHES CARRIED OUT AND CONTINUOUS IN KONYA**

Immigrant and Snowstorm forage kochia varieties have 1500-2500 kg ha<sup>-1</sup> hay yield (Waldron et al. 2013). However; in the search carried out Konya was stated that the populations belong the Konya province had got 1070- 4090 kg ha<sup>-1</sup> hay yield (Acar 2013, Acar et al. 2016, Acar and Koç, 2019).

**Table 1.** The Morphological properties of two different kinds of research carried out in Selçuklu and Karatay of Konya's cities having different soil types (Derived from Acar et al. 2016, Acar and Koç 2019)

	Selcuk University Faculty of Agriculture - Selçuklu (Acar and Koç 2019)			Bahri Dağdaş International Agricultural Research Institute - Karatay (Acar et al. 2016)		
	Red Form	Intermediate Form	Green Form	Red Form	Intermediate Form	Green Form
<b>Plant Height (cm)</b>	78,67	81,33	65,33	88,30	84,50	83,70
<b>Plant Diameter (cm)</b>	115,33	121,00	95,00	64,30	86,30	99,00
<b>Hay yield per Plant (g plant<sup>-1</sup>)</b>	235,40	168,87	117,73	142,60	368,60	172,00
<b>Hay Yield (kg ha<sup>-1</sup>)</b>	2589,7	1858,0	1295,0	1580,5	4090,0	1910,1
<b>Seed Yield per Plant (g plant<sup>-1</sup>)</b>	16,96	16,39	19,63	21,80	24,30	15,30
<b>Seed Yield (kg ha<sup>-1</sup>)</b>	186,6	180,3	216,0	240,2	270,0	160,7
<b>1000 seed Weight (g)</b>	2,84	2,66	2,43	2,33	2,35	2,30

In Selçuklu was prominence to red form (i.e., 2589.7 kg ha<sup>-1</sup>) in terms of hay yield when the values at two different kinds of research carried out in Selçuklu (Acar and Koç 2019) and Karatay (Acar et al. 2016) of Konya's cities having different soil types was compared (Table 1). However, In Karatay was determined that intermediate form had higher hay yield (i.e., 4090 kg ha<sup>-1</sup>) than other phenotypes. In these studies could be comprehensible that in the yield properties of varying forage kochia population, different time of life and grown in several soil types could be shown in variation. There are in progress to Ph.D. thesis related to the morphologic variance of the forage kochia population grown in artificial pasture having drought and salinity problems in Konya (Figure 3).



**Figure 3.** The Searches Belongs to Rangeland Improvement with Forage Kochia- start in 2017 (Ph.D. thesis)

Other Researches in Progress: Also, there are in progress to the research of rooting with hormone and seed viability of forage kochia (Figure 4).



**Figure 4.** The Research of Rooting with Hormone - start in 2018 (L) and The Studies of Seed Viability-begin in 2018 (R).

#### 4. CONCLUSION

It can be stated that the difference in the chemical composition of forage kochia grown in a different region of Turkey is less seen than the variation between morphological properties of this species grown in a different location in Konya. We think that it could create awareness about forage kochia which is important shrub forage crops in soil protect, and to improve on rangeland yields in drought conditions in Turkey, and researches continuity related to this species is vitally important in terms of Turkish Agriculture.

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## P 11. THE INVESTIGATION OF DEGRADATION OF RHODAMINE B DYE BY USING SILVER DOPED FE-MMT NANOCOMPOSITE

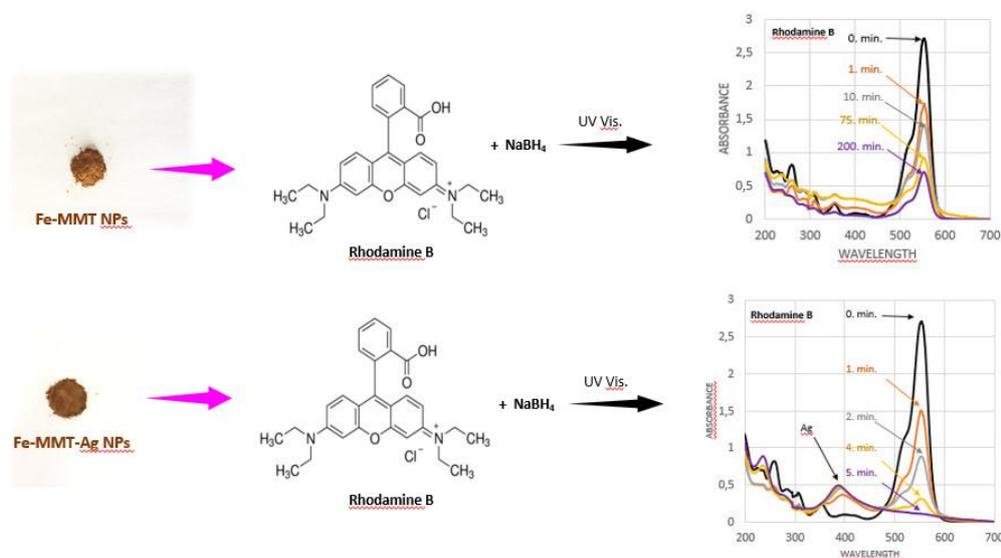
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**ABSTRACT:** Nowadays, synthetic dyes used in industries such as leather, textile, plastic, paint, paper, food, printing, pharmaceuticals and cosmetic pose a serious threat. These dyes have a carcinogenic and toxic effect. Also, these dyes are much dangerous for ecosystem living beings as well as human life [1]. Rhodamine B (RhB), the kind of these synthetic dyes, is mostly used as a colorant in foodstuff and textile [2]. The adverse effects such as carcinogenic, neurotoxicity and chronic toxicity have been reported experimentally harmful toward humans and animals [3]. On that note, removal of RhB is an issue to consider. In this study, silver doped magnetic-clay (Fe-MMT-Ag) nanocomposite was synthesized and characterized by SEM, XRD and IR. Fe-MMT-Ag nanocomposite was used in order to degradation of RhB (Figure 1.). Sodium borohydride (NaBH<sub>4</sub>) used as reducing agent during the dye degradation experiment. Fe-MMT-Ag exhibited high RhB removal rate, which reached 96,4% within 5 min. However, when Fe-MMT used alone in order to degradation of RhB, reached %75,98 within 200 min. As a result, when used Ag doped Fe-MMT nanocomposite there has been a significant improvement in the degradation of RhB. Fe-MMT magnetic nanoclay has lower and weaker catalytic properties compare to Ag doped Fe-MMT nanocomposite. Briefly, the catalytic effect of silver was evident.



**Keywords:** Rhodamine B, Silver, Nanocomposite, Degradation

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**P 12. PHYSIOLOGICAL INVESTIGATION OF DEVELOPED HYBRID BREAD WHEAT  
LINES UNDER HIGH BORON AND SALT APPLICATION**

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**ABSTRACT:** In order to enable agriculture in the areas with restricted use for supporting the rapidly growing world population, there is a need to develop grain crops that can be grown in stress conditions. Wheat production is limited by many abiotic stresses, such as nutrients deficiency or toxicity. Stress conditions such as salinity and boron toxicity that are generally seen together in arid and semi-arid regions adversely affect the growth in plants and limit the production efficiency. Although most studies have been focused on the boron deficiency depending on the general soil situation in the world, it is known that plants are exposed to boron toxicity in many regions of the world including Turkey which has the richest boron deposits in the world. The most appropriate method towards boron toxicity and salinity problems is the identification and the development of boron and salt toxicity tolerant plants. In this study, it was aimed to develop tolerant bread wheat varieties that can be grown in the regions with boron and salt toxicity problems in soil. In the experiment, along with the salt tolerant Australian genotypes, boron toxicity tolerant Turkish genotype, Bolal and developed backcross3 wheat population (BC3) containing the salt tolerant Nax1 and Nax2 genes were involved. Hence, the effects of the functions of the salt tolerant genes present in the BC3 population on growth parameters and plant EC content were investigated in this study.

*Keywords: Backcross, Boron Toxicity, Salt Stress, Bread Wheat, Breeding*

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**P 13. DETERMINATION OF TOTAL AND ACTIVE IRON CONTENT OF STRAWBERRY  
GENOTYPES GROWN IN TURKEY**

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**ABSTRACT:** Strawberry is a fruit that is available in the market when fresh fruits are limited, cultivated in different climatic zones, its investments are returned in short time, is suitable for small family business and preferred for consumption by human being. Due to cultivation of strawberries under various soil environments, producers face several challenges. Central Anatolian region of Turkey with arid and semi-arid climate suffers from iron deficiency due to low organic matter content, high pH and lime characteristics of the soil. This causes chlorosis in plants that are sensitive to iron deficiency. The occurrence of iron deficiency may vary between species and even genotypes. For the determination of iron deficiency in plants, it is not possible to determine the amount of iron available in plants by only analyzing the total Fe content of the plants. Hence, it is necessary to determine the active Fe content which is metabolically used by the plants. For this study, 12 strawberry varieties grown in Turkey with 4 replicates each, were tested under greenhouse conditions to determine their response towards different iron supply, that were 0 ppm Fe and 10 ppm Fe. Results demonstrated that G2, G11, and G12 genotypes had the highest total Fe content during the flowering period with respect to Fe fertilization. However, active Fe concentrations were found to be the highest in G4, G1, and G3 strawberry genotypes under Fe application. The results showed that the use of iron-enriched fertilizers increased the active iron content in plants.

*Keywords: Strawberry, Iron, Total Fe content, Active Fe content*

**P 14. PHYSIOLOGICAL CONFIRMATION OF ROLE OF SALT TOLERANT GENES IN  
DEVELOPED TURKISH DURUM WHEAT GENOTYPE**

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**ABSTRACT:** Environmental pollution, soil and water salinity leads to a reduction in global water resources. The decrease in the agricultural land due to the increasing human population is a major threat for agricultural sustainability. Various abiotic stresses such as strong winds, extreme temperatures, soil salinity, drought and floods affect the cultivation and production of agricultural products. Among different abiotic stresses, soil salinity is one of the most destructive environmental stresses for cultivated land area, which leads to a decrease in product yield and quality. A large part of Turkish soil has high pH and salinity characteristics. Therefore, plant nutrients are not available for plants in suitable forms. Being an important cereal for world including Turkey, it is beneficial to develop wheat genotypes that are tolerant to abiotic stresses. Given the absence of the D genome in durum wheat, it is less tolerant towards salt stress. Mirzabey, one of the most common durum wheat varieties produced in Turkey, and Australian durum wheat lines, 5004 and 5020-7 containing Nax genes were crossed and salt tolerance genes were transferred. Thus, in this study, Mirzabey genotype, 5004 and 5020-7 wheat lines, and 3rd generation back-crossed hybrid populations were used as the experimental material. Two salt doses, 0 mM NaCl and 100 mM NaCl, were administered. The growth parameters of the studied material and the leaf EC contents were examined. On the basis of the measured physiological parameters, the plants with the transferred salt tolerant Nax genes were more resistant towards salt stress.

*Keywords: Durum wheat, salt stress, backcrossing, MAS*

**P 15. ESTIMATION OF MANCOZEB-BASED FUNGICIDES AS POTENTIAL POLLUTANTS BY INDUCEMENT OF PHYTO- AND GENOTOXICITY ON ALLIUM CEPA L. ALBANIAN ECOTYPE DRISHTI**

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**ABSTRACT:** Pesticide pollution issues are increasingly occurring all over the world. In order to estimate the potential polluting effects of some mancozeb-based fungicides the present study investigated their phytotoxicity and genotoxicity on seeds and root meristematic cells of *Allium cepa* L. Albanian ecotype Drishti. Seed germination capacity, root length, evaluation of EC<sub>50</sub>-s, mitotic index, frequencies of micronuclei, chromosomal aberrations and types were applied as toxicity indicator parameters after the treatment under three time exposure periods (24, 36 and 48 hours) of biological materials with four concentrations (0.04-0.16%) of AGRIA-MANCOZEB 80 WP, MANFIL 75 WG and DITHANE M-45 blue 72 WP. The result revealed limitation in seed germination and significant root growth restriction mainly after 36- and 48 hours exposure of Manfil and AGRIA-MANCOZEB, having even EC<sub>50</sub> values included into field applications. Obvious reduction of meristematic activity and increased chromosomal abnormalities and micronuclei incidence were recorded particularly at the highest concentrations of fungicide samples after 48 h exposure. The current data distinctly emphasized the phyto- and genotoxic effects on a non-target crop and assay as onion of all investigated mancozeb-based fungicides, broadly used in Albanian agriculture during the last decade, demonstrating their potential pollution impact on environment and human population health. Our findings should serve as a prominent alert for the prospective risk situation caused from indiscriminate use of fungicides, their active ingredient purity and toxic consequences on food chain organisms.

*Keywords: Environmental pollution, Mancozeb-based fungicides, Allium cepa L. assay*

## **1. INTRODUCTION**

Extent and persistent use of a broad pesticides spectrum has created the problematic occurrence of environmental pollution issues all over the world. Despite the enormous economical profits of farmers, only a small part of applied pesticide doses achieves the targeted pest (USEPA, 2005) consequently impairing each environmental component and respective biota. Mismanagement and even abuse of fungicides application in particular directly engender to degradation of soil fertility and to the quantity and quality of crops production. The contaminated crop yield due to accumulation of fungicide residues is getting a serious threat for the health of livestock and human consumers. The data of scientific reports during the last decades are plausible to motivate further assessment of potential toxic effects of certain fungicide groups on non-target agricultural plants at biochemical, cytogenetic and physiological level. According to Gupta (2018) more than 80% of all oncogenic risk from the use of pesticides derives from a few fungicides.

Mancozeb-based fungicides appertain to the ethylenebisdithiocarbamates category of synthetically produced pesticides. They are labelled to control acting by contact on fungi development and dispersion through different crops, fruit trees, forestry, decorative plants, garden and park lawns and hedges. Mancozeb itself consist in a mixture of [1,2ethanediybis] carbamodithioate](2-)manganese with [1,2-ethanediybis [carbamodithioate](2-)zinc salt. More than 1/3<sup>rd</sup> of total sold mancozeb as active ingredient is usually applied in co-formulation with other fungicide classes or pesticides (Runcle et al., 2017). Derivatives of mancozeb as ethylene bisisothiocyanate sulfide and ethylene bisisothiocyanate directly harm the mitochondrial and cytoplasmatic activity of sulphhydryl group containing enzymes, thus inhibiting important biochemical processes into fungal cells (Gullino et al., 2010). Mancozeb-based fungicides are present in plant protection programs from pests and pesticide markets by more than 70 years, but periodic scientific reports are often contradictory according to the ecotoxicological

consequences. Last decades studies evidence the deleterious effects on water quality, soil enzymes, different species of soil bacteria, plants, nematodes, aquatic invertebrates, fishes, mice, rats and even human health (Houeto et al., 1995; Steenland et al., 1997; Easton et al., 2001; Untiedt and Blanke, 2004; USEPA, 2005; Corsini et al., 2006; Mubeen et al., 2006; Rossi et al., 2006; Cecconi et al., 2017; Axelstad et al. 2011; Tripathi et al., 2011; Dias et al., 2014; Atamaniuk et al., 2014; Walia et al., 2014; Pavlic et al., 2015; Hoffman et al., 2015; López-Fernández et al., 2016; Saha et al. 2016; Todt et al. 2016; Runkle et al. 2017; Kwon et al. 2018; Morales-Ovalles et al., 2018; Palmerini et al., 2018; Yahia et al., 2019). The benefit of toxicological databases co-structured on bio-monitoring information is to establish the adequate biological models for the evaluation and prediction of potential effects of chemicals, being thus an important objective of public health, with the intention to avoiding or minimize direct and indirect living beings and human exposure to toxic and even mutagenic substances (Rouabhi, 2010; Elskus, 2012; USEPA, 2018).. They can give comprehensive data according to additive, synergic or antagonist bio-effects at organism (toxicity) and molecular (genotoxicity) levels, which may not be easily identified with specific physic-chemical analyses (Power and Boumphrey, 2004). The use of higher plants as biotests has been standardized and is widely utilized, because they present several advantages compared with other organisms such as: high reproductive capacity, short-term and easy application during *in vivo*, *in vitro* and *in situ* methods, more ethically appropriate compared to animal tests and low cost (Kristen, 1997; Grant, 1999; Maluszynska and Juchimiuk, 2005; Ma et al., 2005; Mesi et al., 2012; Iqbal et al., 2019). Being a biological early warning tool in short-term monitoring procedures, the *Allium cepa* L. (2n=16) test is broadly applied for the detection at morpho-, cyto- and genetic level of toxic effects induced from contaminant substances (Fiskeşjö, 1993; 1994; 1997; Leme & Marin-Morales, 2009; Tedesco and Laughinghouse, 2012; Khannah and Sonia, 2013; Bonciu et al., 2018), pesticides in general (Antonise-Wiez, D. 1990; Nithyameenakshi et al., 2006, Feretti et al., 2007; Asita and Matebesi, 2010; Turkoğlu, 2012; Mesi and Kopluku, 2013; 2015; Pratte-Santos 2015; Boumaza et al., 2016; Dizdari et al., 2017; Dizdari and Bala, 2019) and mancozeb-based fungicides in particular (Barakat et al., 2010; Fatma et al., 2018).

The present study is focused on the estimation of three mancozeb-based fungicides (commonly used in Albanian agriculture) AGRIA-MANCOZEB 80 WP, MANFIL 75 WG and DITHANE M-45 blue 72 WP as potential pollutants by assessing the phyto- and genotoxicity effects on *Allium cepa* L. native ecotype Drishti assay.

## **2. MATERIAL AND METHOD**

### **2.1. Treatment solutions**

The mancozeb-based fungicides AGRIA-MANCOZEB 80 WP, MANFIL 75 WG and DITHANE M-45 blue 72 WP were purchased from the Albanian pesticide markets. Drinking water was used as negative control (NC) and to dilute the fungicide samples obtaining four definitive concentrations: 0.04, 0.08, 0.12 and 0.16% applied to establish the further full-scale toxicity test.

### **2.2. Biological material and test procedures**

Healthy-looking and uniform size seeds and bulbs of *Allium cepa* L. native ecotype Drishti were used as biological material and kept at room temperature (22±0.2° C). The germinating seeds and newly emerged roots of onion bulbs were exposed for 24, 36 and 48 hours to the chosen concentrations of mancozeb-based fungicides. Sets of 20 seeds per sample were formerly sterilized with NaOCl 50%, soaked for 24 h in distilled water and then allowed to germinate in 18.5 cm Petri dishes between two layers of sterile moist cotton with a total of 28 respective treatment solutions. Seeds were considered fully germinated, if their radicle was apparently emerged. Simultaneous experiments were set up with ten test tubes per fungicide, concentration and exposure period sample, overturning the bulbs with the root primordia into the liquid, after removing the outer dry scales. An additional recovery period till 96 hours with drinking water (NC) followed the treatment of both biological materials after respective exposure times with different fungicide and concentrations to permit the evaluation of mean root length (MRL) and EC<sub>50</sub> values of onion bulbs and seed germination capacity as phytotoxicity parameters. Seed germination capacity (GC) was expressed as a percentage of germinated seeds to the total number of seeds per champion. The corresponding EC<sub>50</sub> values (effective concentrations of different chemicals and mixtures, permitting 50 % growth of the sample under

study in relation to control) of assessed Mancozeb-based fungicides were statistically evaluated by plotting on graph root length values as percentage to negative control against treatment concentrations and using the trend-line equations with the biggest R<sup>2</sup> values (polynomial, order 3. To examine cytotoxic and genotoxic effects of tested fungicides and even damage fixation on meristematic cells the following microscopic endpoints: mitotic index (MI), frequencies of aberrant mitotic cells (FAC), chromosomal aberrations (CA) types and interphase cells with micronuclei (FMN) in root meristem, were observed and quantified. Root tips of 10 mm taken from 5 bulbs, randomly chosen in each sample series, were placed on slides and the terminal root tips (1-2 mm) were cut off and used for further preparation of microscopy slides, in accordance with the standard procedure for orceine staining of squashed material (Singh, 2016). The total number of dividing cells (NDC) was determined in 1000 examined cells in the field of view per each slide, then MI was scored as percent ratio of NDC. The formation of micronuclei was examined in about 1000 cells per slide at interphase, taking in account only the cells with intact cellular and nuclear membranes. 1500 dividing cells (300 cells/slide) have been observed for the characterization and classification of chromosome aberrations (CA). The frequencies of micronuclei (MNC), aberrant cells (FAC) and CA types were expressed as percent ratio.

### 2.3 Statistical analyzes

Analysis of Variance One-way ANOVA and post-hoc Student Newman-Keuls (SNK) tests were used to test for significant differences of all evaluated parameters in *A. cepa* L. seeds and roots, exposed to different mancozeb-based fungicides, concentrations and exposure times. All the results were expressed as the mean of three replicates per sample. Parameter differences between fungicide treatments, duration and corresponding NC-s were considered statistically significant at level 5%.

### 3. RESEARCH FINDINGS

The data related to the morphological and cyto-genetic analyzes made in the current investigation on *A. cepa* L. native ecotype Drishti seeds and rootlets are represented in tables 1 and 2 figures 1-3. It can be punctuated that the estimated parameter values differed mostly in dependent manner from tested mancozeb-based fungicides, concentration treatments and exposure time, displaying successive phyto- and genotoxicity induced (with lot significant changes as compared to the respective NC values, second ANOVA and SNK tests).

**Table 1.** Phytotoxic effects of Mancozeb-based fungicides on seeds and roots of *A. cepa* L.

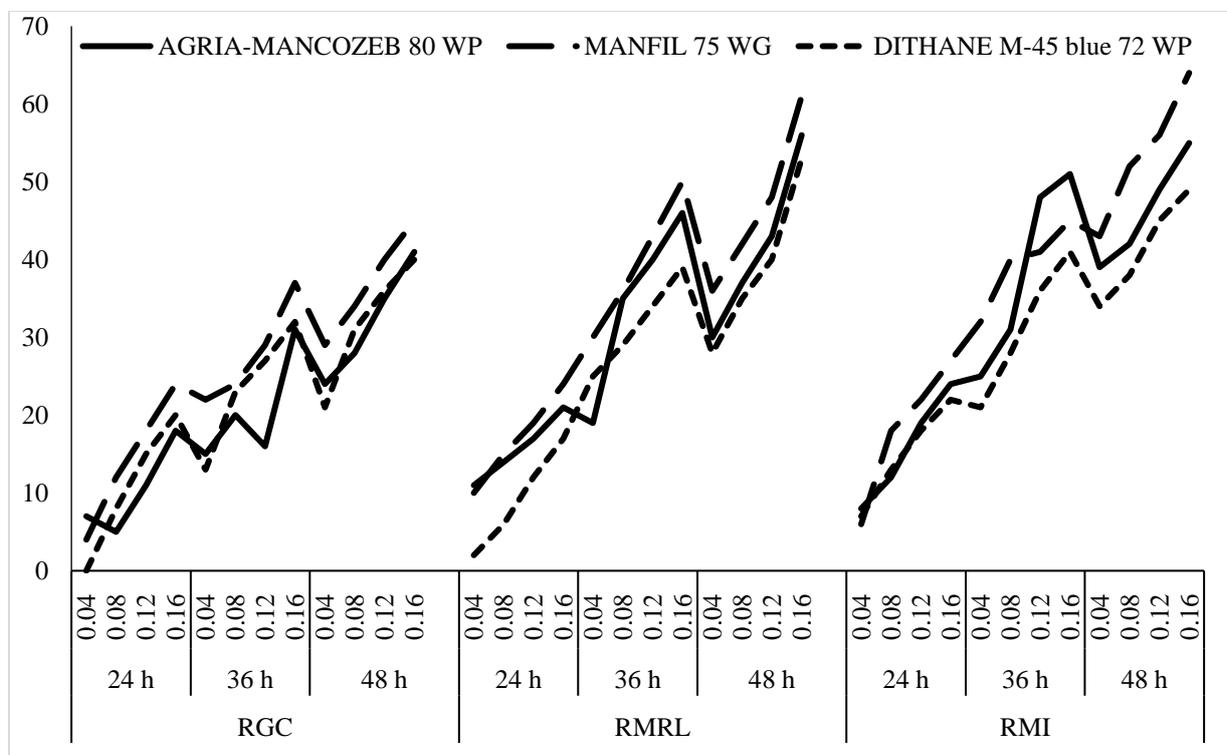
Exposure time (h)	Tested solutions	Conc. (%)	GC±SD (%)	MRL±SD (cm)	MI±SD (%)
24	NC	0	91.7±5.3	5.56±0.76	15.68±1.62
	AGRIA-MANCOZEB 80 WP	0.04	84.6±6.0	4.95±0.69 <sup>a</sup>	14.43±0.96
		0.08	86.4±3.3	4.78±0.55 <sup>a</sup>	13.79±1.05 <sup>ab</sup>
		0.12	80.1±5.7 <sup>a</sup>	4.61±0.88 <sup>a</sup>	12.70±0.89 <sup>a</sup>
		0.16	74.7±4.9 <sup>ab</sup>	4.39±0.43 <sup>b</sup>	11.93±0.44 <sup>b</sup>
	MANFIL 75 WG	0.04	87.3±6.2 <sup>a</sup>	5.06±0.51 <sup>a</sup>	14.74±1.06 <sup>a</sup>
		0.08	80.1±4.5 <sup>ab</sup>	4.72±0.38 <sup>a</sup>	12.86±1.01 <sup>ab</sup>
		0.12	74.6±2.8 <sup>b</sup>	4.55±0.29 <sup>a</sup>	12.23±0.66 <sup>*bc</sup>
		0.16	69.1±3.9 <sup>b</sup>	4.23±0.16 <sup>*b</sup>	11.45±0.90 <sup>*bc</sup>
	DITHANE M-45 blue 72 WP	0.04	112.8±8.4	5.45±0.82	14.58±1.33 <sup>a</sup>
		0.08	83.7±4.1 <sup>a</sup>	5.22±0.32	13.64±1.12 <sup>ab</sup>
		0.12	77.3±2.9 <sup>ab</sup>	4.89±0.27 <sup>a</sup>	12.86±0.75 <sup>ab</sup> <sup>b</sup>
0.16		72.8±3.1 <sup>b</sup>	4.65±0.54 <sup>a</sup>	12.17±0.98 <sup>*bc</sup>	
36	AGRIA-MANCOZEB 80 WP	0.04	77.2±5.6 <sup>ab</sup>	4.47±0.46 <sup>ab</sup>	11.76±0.69 <sup>*bc</sup>
		0.08	72.6±3.5 <sup>b</sup>	3.61±0.53 <sup>*c</sup>	10.82±1.06 <sup>**c</sup>
		0.12	67.3±4.9 <sup>*bc</sup>	3.34±0.29 <sup>**e</sup>	8.14±0.53 <sup>**f</sup>
		0.16	62.8±3.8 <sup>*b</sup>	3.01±0.66 <sup>**h</sup>	7.63±0.14 <sup>**</sup>
	MANFIL 75 WG	0.04	71.0±5.8 <sup>b</sup>	3.89±0.41 <sup>*bc</sup>	10.66±0.74 <sup>**cd</sup>
		0.08	69.2±2.7 <sup>b</sup>	3.56±0.39 <sup>cd</sup>	9.41±0.38 <sup>**e</sup>
		0.12	64.5±3.0 <sup>*c</sup>	3.17±0.22 <sup>**eh</sup>	9.25±0.78 <sup>**e</sup>
		0.16	57.3±1.9 <sup>*d</sup>	2.67±0.17 <sup>**h</sup>	8.62±0.14 <sup>**hi</sup>

48	DITHANE M-45 blue 72 WP	0.04	79.2±6.2ab	4.17±0.55*ab	12.39±0.66* <sup>b</sup>
		0.08	70.1±4.1c	3.94±0.28* <sup>b</sup>	11.29±0.81* <sup>c</sup>
		0.12	66.4±2.5c	3.67±0.49* <sup>cd</sup>	10.07±0.49* <sup>de</sup>
		0.16	61.9±4.0* <sup>cd</sup>	3.39±0.46* <sup>de</sup>	9.26±0.57* <sup>de</sup>
	AGRIA-MANCOZEB 80 WP	0.04	69.1±3.3bc	3.74±0.38* <sup>c</sup>	9.59±0.45* <sup>de</sup>
		0.08	65.5±1.9c	3.52±0.44* <sup>d</sup>	9.08±0.62* <sup>ef</sup>
		0.12	59.2±4.7* <sup>d</sup>	3.13±0.10* <sup>de</sup>	7.93±0.21* <sup>f</sup>
		0.16	53.7±2.2* <sup>de</sup>	2.45±0.32* <sup>hi</sup>	7.01±0.07* <sup>g</sup>
	MANFIL 75 WG	0.04	64.6±4.4* <sup>bc</sup>	3.59±0.58* <sup>cd</sup>	8.93±0.73* <sup>ef</sup>
		0.08	60.1±2.7* <sup>d</sup>	3.22±0.10* <sup>de</sup>	7.52±0.39* <sup>g</sup>
		0.12	54.4±0.9* <sup>e</sup>	2.96±0.17* <sup>h</sup>	6.87±0.28* <sup>gi</sup>
		0.16	50.2±1.2* <sup>f</sup>	2.17±0.09* <sup>i</sup>	6.11±0.19* <sup>i</sup>
	DITHANE M-45 blue 72 WP	0.04	71.8±5.6bc	4.08±0.79* <sup>bc</sup>	10.35±0.65* <sup>de</sup>
		0.08	62.7±4.6* <sup>cd</sup>	3.61±0.35* <sup>cd</sup>	9.72±0.33* <sup>de</sup>
		0.12	58.2±3.1* <sup>d</sup>	3.31±0.26* <sup>de</sup>	8.60±0.47* <sup>ef</sup>
		0.16	54.9±1.6* <sup>e</sup>	2.61±0.12* <sup>h</sup>	7.88±0.25* <sup>f</sup>

Means labelled with asterisks and letters within columns are significantly different from respective NC-s according to One-Way ANOVA test (\* P<0.05; \*\* P<0.001) and between exposure periods and fungicide concentrations in SNK test (p<0.05). NC-negative control; MRL-mean root length; MI-mitotic index; SD – standard deviation.

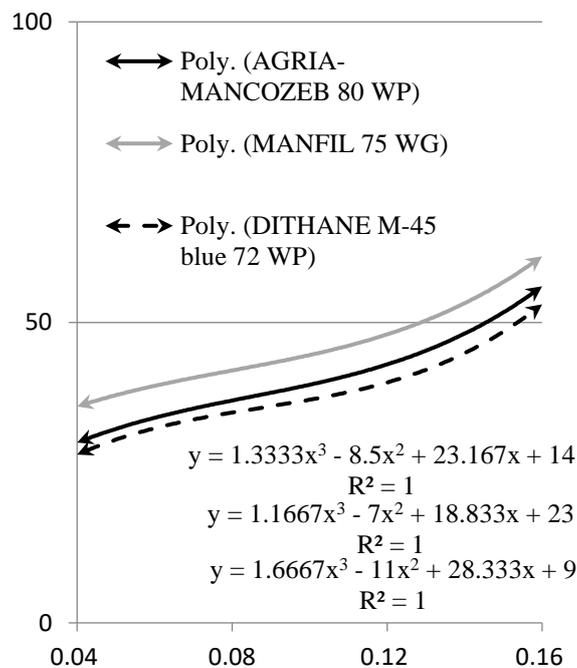
The results (Tab. 1 and Fig. 1) showed that AGRIA-MANCOZEB 80 WP, MANFIL 75 WG and DITHANE M-45 blue 72 WP application induced limitation of germination capacity of *A. cepa* seeds, particularly at the longest exposure and highest concentration treatments.

Significant reduction started at 0.12% concentration (after 36 h) under MANFIL 75 WG solution, where GC decreased with 29% of corresponding NC value (91.7%, P<0.05) The same fungicide formulation predominantly decreased GC through concentrations and time exposures raising the minimal value at 0.16% cc after 48 h (57.5%, as compared with the GC under 0.04% treatment after 24 h, p<0.05 using SNK test).



**Figure 1.** Comparative phytotoxicity induced on *A. cepa* L. assay by selected mancozeb-based fungicides (respective cc-s in %). RGC, RMRL, RMI – reductions of germination capacity, mean root length and mitotic index (expressed in % of respective NC values)

The longitudinal growth (MRL) and the mitotic activity (MI) of emerging rootlets from onion bulbs were respectively reduced (as compared to the respective values of control) at: 11-56% and 8-55% by AGRIA-MANCOZEB 80 WP; 10-61% and 6-64% by MANFIL 75 WG; 2-53% and 7-49% by DITHANE M-45 blue 72 WP after bulbs exposure for 24-48 hours at concentrations 0.04-0.16% of each fungicide (Fig. 1 and Tab. 1). Significant differences of MRL and MI from corresponding NC-s (5.56 cm and 15.68 %,  $P < 0.05$ ) were firstly observed after the shortest exposure (24 h) at the highest concentration 0.16% of MANFIL 75 WG (for MRL) and 0.12% (for MI), while the first cumulative toxic effects on MRL (over 55% of corresponding NC) were found out only on bulbs treated with 0.16% cc-s of AGRIA-MANCOZEB 80 WP and MANFIL 75 WG after 48 h. Additionally, AGRIA-MANCOZEB 80 WP induced the first sublethal effect on proliferation activity of root meristem after 36h exposure under the most concentrated treatment, while no lethal effect on mitosis was observed. A sloping significant reduction ( $p < 0.05$ ) of both MRL and MI from the lowest cc-s of the shortest time exposure to the highest and longest ones resulted across all tested fungicides, particularly under MANFIL treatment where after 48h in 0.16% concentration MRL and MI resulted only 43 and 41% of respective values screened under 0.04% concentration after 24 h exposure. The extrapolated  $EC_{50}$  values used as a phytotoxicity threshold endpoint in the current study indicated that AGRIA-MANCOZEB 80 WP, MANFIL 75 WG and DITHANE M-45 blue 72 WP dimidiated the longitudinal root growth at the respective concentrations: 0.147%, 0.128% and 0.155% (Fig. 2).



**Figure 2.** Evaluation of the  $EC_{50}$ -s of selected mancozeb-based fungicides (respective cc-s in %)

The data of undertaken microscopy investigation detected a considerable presence of chromosomal aberrations, positively correlated with the addition of tested fungicides' concentrations and exposure duration (Tab. 2 and Fig. 3). Recorded FAC values resulted significantly higher since at the shortest time treatment of onion roots (24h) by 0.08% concentration of AGRIA-MANCOZEB 80 WP and MANFIL 75 WG, exceeding by 253 and 281% the NC value of 1.17% ( $P < 0.05$ ). The most increasing slope of the chromosomal aberrations incidence was induced by 36h concentration treatments resulting respectively: 3-8 (AGRIA-MANCOZEB 80 WP); 4-11.5 (MANFIL 75 WG) and 2.7-6.9 (DITHANE M-45 blue 72 WP) folds higher than NC ( $P < 0.05$  and  $P < 0.01$ , such was the case of all MANFIL cc-s). It could be noticed only a slightly greater significance of 48 h FAC values between the same concentrations as compared to 36h ones for MANFIL and DITHANE fungicides ( $p < 0.05$ ), contrariwise from AGRIA-MANCOZEB, where 0.16% concentration multiplied 4.7 folds the observed quantity of meristematic aberrant cells having CA with individualized ones under 24 h 0.4% cc. The types of

chromosomal aberrations recorded in the present study included mostly stickiness, bridges, disturbed metaphases, c-metaphases and c-anaphases, laggard chromosomes and fragments. Sticky chromosomes were found present predominantly during metaphase after the exposure duration of 24 and 36 h, then their presence decreased non significantly. 36h treatment concentrations 0.12 and 0.16% of AGRIA-MANCOZEB 80 WP and MANFIL 75 WG induced the highest stickiness observed (reaching 52% and 61% of the total respective FAC values). A positive correlation between the increased incidences of bridges and laggard chromosomes and the achievement of ana-telophase stage of meristematic root cells of onions; prolongation of time duration and addition of fungicides concentration was detected, as well.

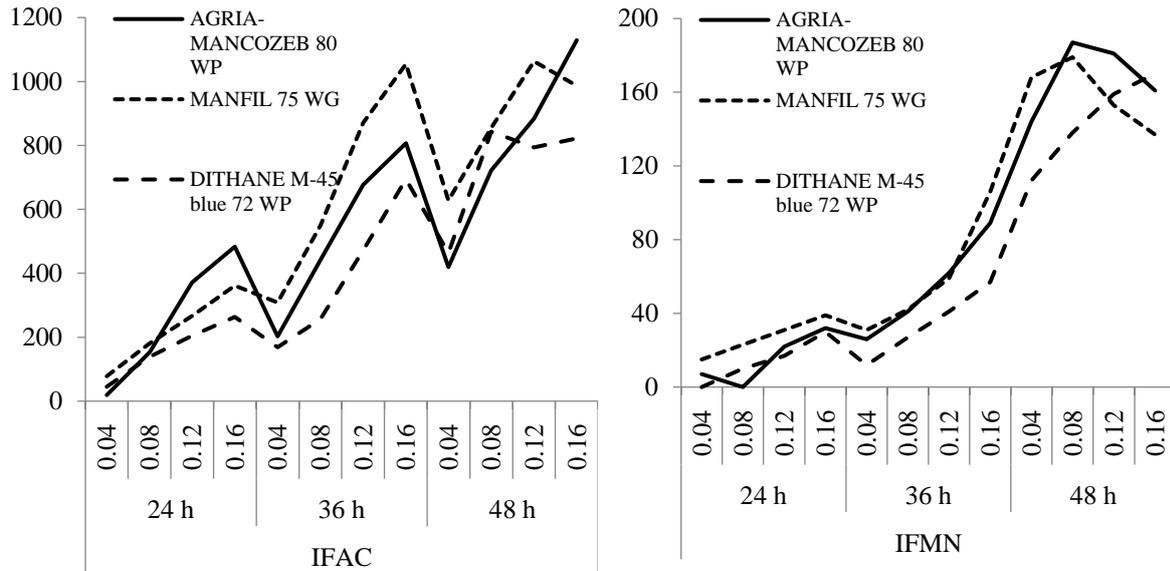
**Table 2.** Genotoxic effects of Mancozeb-based fungicides on root meristem of *Allium cepa* L.

Exposure periods (h)	Tested solutions	Cc (%)	FAC ±SD (%)	FMN ±SD (%)	
24	NC	0	1.17±0.82	0.0131±0.0022	
	AGRIA-MANCOZEB 80 WP	0.04	1.39±0.07 <sup>a</sup>	0.0139±0.0019	
		0.08	2.97±0.24 <sup>*ab</sup>	0.0127±0.0041	
		0.12	5.46±0.38 <sup>**c</sup>	0.0159±0.0012	
		0.16	6.82±0.43 <sup>**de</sup>	0.0171±0.0034 <sup>a</sup>	
	MANFIL 75 WG	0.04	2.08±0.01	0.0149±0.0039	
		0.08	3.29±0.22 <sup>*a</sup>	0.0160±0.0018	
		0.12	4.31±0.51 <sup>*b</sup>	0.0172±0.0039 <sup>a</sup>	
		0.16	5.39±0.16 <sup>**f</sup>	0.0181±0.0024 <sup>ab</sup>	
	DITHANE M-45 blue 72 WP	0.04	1.73±0.09	0.0118±0.0007	
		0.08	2.81±0.12 <sup>a</sup>	0.0143±0.0032	
		0.12	3.71±0.27 <sup>*b</sup>	0.0152±0.0014	
		0.16	3.12±0.34 <sup>*cd</sup>	0.0169±0.0055 <sup>a</sup>	
	36	AGRIA-MANCOZEB 80 WP	0.04	3.57±0.44 <sup>*c</sup>	0.0164±0.0021
			0.08	6.32±0.58 <sup>**e</sup>	0.0143±0.0068
			0.12	9.09±0.08 <sup>**f</sup>	0.0211±0.0091 <sup>b</sup>
0.16			10.61±0.93 <sup>**g</sup>	0.245±0.0043 <sup>bc</sup>	
MANFIL 75 WG		0.04	4.77±0.60 <sup>**b</sup>	0.0172±0.0031 <sup>a</sup>	
		0.08	7.56±0.66 <sup>**e</sup>	0.0185±0.0054 <sup>b</sup>	
		0.12	11.35±1.13 <sup>**</sup>	0.0207±0.0044 <sup>b</sup>	
		0.16	13.51±0.98 <sup>**g</sup>	0.0268±0.0079 <sup>c</sup>	
DITHANE M-45 blue 72 WP		0.04	3.14±0.25 <sup>*a</sup>	0.0146±0.0022	
		0.08	4.18±0.32 <sup>*cd</sup>	0.0165±0.0072 <sup>a</sup>	
		0.12	6.69±0.83 <sup>**f</sup>	0.0183±0.0051 <sup>ab</sup>	
		0.16	9.29±0.75 <sup>**g</sup>	0.0204±0.0064 <sup>b</sup>	
48		AGRIA-MANCOZEB 80 WP	0.04	6.07±0.79 <sup>**d</sup>	0.0317±0.0056 <sup>*cd</sup>
			0.08	9.62±0.64 <sup>**g</sup>	0.0373±0.0082 <sup>*d</sup>
			0.12	11.51±1.06 <sup>**fg</sup>	0.0182±0.0061 <sup>ab</sup>
			0.16	14.38±1.23 <sup>**h</sup>	0.0339±0.0024 <sup>*d</sup>
	MANFIL 75 WG	0.04	8.52±0.46 <sup>**e</sup>	0.0367±0.0079 <sup>*d</sup>	
		0.08	11.17±1.19 <sup>**g</sup>	0.0362±0.0037 <sup>*d</sup>	
		0.12	13.61±1.25 <sup>**h</sup>	0.0328±0.0045 <sup>*d</sup>	
		0.16	12.72±1.03 <sup>**gh</sup>	0.0178±0.0022 <sup>a</sup>	
	DITHANE M-45 blue 72 WP	0.04	6.58±0.39 <sup>**bc</sup>	0.0275±0.0031 <sup>c</sup>	
		0.08	11.03±0.58 <sup>**f</sup>	0.0309±0.0098 <sup>cd</sup>	
		0.12	10.46±0.96 <sup>**f</sup>	0.0337±0.0015 <sup>*c</sup>	
		0.16	10.79±1.01 <sup>**fg</sup>	0.0351±0.0029 <sup>*d</sup>	

Within each column means labeled with asterisks and letters are significantly different from respective NC-s according to One-Way ANOVA test (\* P<0.05; \*\* P<0.001) and between exposure periods and fungicide concentrations in SNK test (p<0.05). NC-negative control; FAC - frequencies of mitotic cells

with chromosomal aberrations; FMN - frequencies of interphase cells with micronuclei; SD – standard deviation.

For DITHANE lagging were present only at 48h samples for example and their frequency was notably enhanced ( $P < 0.05$  and  $p < 0.05$ ) as compared to NC and through 0.04-0.16% concentrations. Bridges were observed throughout all tested fungicides, time duration and concentrations, excluding 24h ones of DITHANE, constantly increasing after 48h exposure in particular. Altered display of metaphasic disturbance, c-meta- and c-anaphases were present under MANFIL and AGRIA-MANCOZEB 36h treatments, showing significant changes from 24h samples and NC. Insignificant breaks and fragments resulted in almost all 36 and 48h samples, but mainly in meristematic root cells which underwent the 48h treatment with 0.12 and 0.16% cc MANFIL solutions.



**Figure 3.** Comparative genotoxicity induced on *A. cepa* L. assay by selected mancozeb-based fungicides (respective cc-s in %). IFAC and IMNC -increase of frequencies of root meristem cells with chromosome aberrations and micronucleated interphase cells (expressed in % of respective NC values)

Despite the successive augmentation there was found no significant presence of micronucleated dividing cells at interphase stage in *A. cepa* roots treated for 24 and 36 h with the tested concentrations of mancozeb-based fungicides. The observed MN frequencies after 48h root treatments revealed interesting significant differences ( $P < 0.05$ ) compared to NC (0.0131% of NDC): 0.08% cc-s of AGRIA-MANCOZEB 80 WP and MANFIL 75 WG resulted the most mutagenic ones increasing up to 287 and 281% the micronuclei occurrence, contrary to the concentrations: 0.12% of AGRIA-MANCOZEB, 0.16% of MANFIL; 0.04 and 0.08% of DITHANE which did not induce significant changes from NC value. DITHANE samples inflicted the most significant FMN changes ( $p < 0.05$ ) through concentrations and time exposures, achieving a MN trebling (under 0.16% cc and 48 h treatment) in comparison with the lowest concentration (0.04%) and shortest period (24h) treatment.

#### 4. CONCLUSIONS AND DISCUSSION

The treatment of seeds with mancozeb-based fungicides is commonly used to prevent the impairment from fungal diseases. Seed germination constitutes a decisive and crucial phase of plant life cycle, closely related to the environmental conditions. The present data demonstrated limitation on seed germination of *A. cepa* L. native ecotype Drishti depending from tested fungicides' concentrations and particularly time exposure. Due to the short hife-life of Mancozeb in soil the hiperaccumulation on rhizosphere soil solutions could potentially damage radicle emergence, prevent the water and nutrient absorption, reduce the efficiency of respiratory enzyme complexes, translocation of energy containing substances to developing embryo, which might retard or inhibit the detected seed germination. Several publications highlighted similar phytotoxic effects of different fungicides and mancozeb particularly on non-target

crops physiology (Siddiqui and Ahmed, 2002; Untiedt and Blanke, 2004; Muuben et al., 2006; Dias et al., 2014; Sathees et al., 2014; Fatma et al. 2018; Monika & Kidwai, 2017; Shahid et al., 2018).

In order to assess the short-term phytotoxicity induced on higher plant assays the detection of hazards implication on the impairment of root growth processes is often applied. If the length of emerging bulbous rootlets of *A. cepa* is reduced over 55% as compared to negative control sample the rhizotoxic effects of chemical under study should be considered as strong (Fiskesjö G, 1993; Mesi & Kopluku, 2015, Bonciu E, et al. 2018; Dizdari & Bala, 2019). Moreover, if the mitotic activity of root meristematic cells is reduced below 50% and 22% of NC, it respectively demonstrates sublethal and lethal effects on the organism under study (Panda & Sahu, 1985; Antonise-Wiez D, 1990). The present data match with above mentioned statements, making evident the fact that, if common onions face into soil to high concentrations and remain exposed against solutions of mancozeb-based formulations, they can potentially undergo harmful toxicity on root growth. The recorded reduction of mitotic activity could happen because of mitotic cycle arrest at the G<sub>2</sub> phase and/or S-phase extension without inhibiting the synthesis of DNA (Barakat et al., 2010). In addition it should be emphasized that mancozeb-based fungicides acting by contact against fungi could seriously poison non target roots and soil organisms, since the rate of significant root growth reduction was found present even in the concentrations interval of the shortest exposure period (MANFIL 75 WG and DITHANE M-45 blue 72 WP). In the same context threshold toxicity tests are often applied to verify the point at which chemical pollutants exert significant growth damages (Fiskesjö, 1994, 1997; Mesi & Kopluku, 2013, 2015). The extrapolated EC<sub>50</sub> values in the present study indicated that AGRIA-MANCOZEB 80 WP, MANFIL 75 WG and DITHANE M-45 blue 72 WP could affect the longitudinal onion root growth at such concentrations of tested mancozeb fungicide formulations which are routinely applied in Albanian agriculture. These simulating experimental data approved the effectiveness of the EC<sub>50</sub> evaluation parameter to permit the use of the same assessed concentrations and time periods for potential inducement of genotoxic effects, due to the presence of sufficient meristematic cells undertaking mitosis, whatever allows to further inquire for chromosomal abnormalities. Root growth inhibition due to pesticide toxicity could be due to the suppression of root cell division/root elongation or to the extension of cell cycle (Mesli & Kopluku, 2015), followed consequently by reduced penetration of roots into the soil and inefficiency of plant to fulfil the demands for water and mineral nutrition uptake. This is sustained by the present results, with revealed a positive correlation between induction of cumulative phytotoxic effects on root length and reduced capability of root meristematic cells to be divided under mancozeb chemical stress.

According to Iqbal et al. (2019) cytogenetic assays are rather appropriate to identify the harmful effects of known chemicals in different concentrations and time exposures, because the method is considered much more sensitive as compared with distinct physical, chemical, saprobiological, radiological or simply genetic methods. The deteriorated mitotic activity of root meristematic tissue is commonly associated with the rise of chromosomal anomalies and present micronucleated cells during interphase. The phenomena reflect indeed the capability of chemicals under study to induce genotoxic effects and in some cases occur in concentrations low order than those of phytotoxicity incidences (Dizdari & Kapcari, 2017). It is a crucial purpose and a rational reason to necessarily include in such eco-toxicological studies the assessment of genotoxicity. Root meristematic tissue of *Allium cepa* is applied as an effective detector of genotoxic and mutagenic potency of environmental pollutants, especially pesticides due to the excellent correlation of data with those of the mammalian systems (Grant & Salamone, 1994; Fiskesjö, 1997; Ferretti et al., 2007; Leme & Marin-Morales, 2009; Asita & Matebesi, 2010; Pratte-Santos et al., 2015; Bonciu et al., 2018). As mentioned by Tedesco and Laughinghouse (2012) it is one of the most efficient methods for detecting and measuring the degree of alterations in the system subjected to carcinogens/mutagens or chemical causing damage and allow to describe the effects of these damages by observing chromosomal aberrations. Such is the case of the present data which detected abundant occurrence of chromosomal aberrations and less micronuclei, induced by the treatment with tested mancozeb-based formulations and positively correlated with respective increase of concentrations and time exposure.

Predominant CA types detected in the present investigation as sticky chromosomes, bridges and fragments occur because of chromatin dysfunction (Mesli & Kopluku, 2013), while disturbed metaphase and anaphase were due to inhibition of normal spindle formation. As summarized by Boumaza et al. (2016) stickiness is inflicted by the chromosomal DNA degradation/depolymerization, DNA

condensation, sub-chromatid linkage between chromosomes, chromosomal protein adhesion, lead par consequence to cell death, due to considerable level of genotoxicity induced by tested mancozeb fungicides. Additionally, the abundant presence of anaphase bridges particularly at the longest time treatment and highest concentrations applied documents the potential clastogenic effects of active ingredient mancozeb on *A. cepa* roots. Anaphase bridges can potentially lead to chromosomal breaks found present mostly as fragments. The chromosome lagging detected in significant percentages of total FAC in the Dithane highest concentration is usually induced by a weak c-mitotic effect and indicate relevant risk of aneuploidy (Amin, 2002). Chromosomal breakage, lagging or aneuploidy often induce the formation of micronuclei, bodies made of chromatin material and located in cytoplasm mainly during interphase. This phenomenon indicates potential mutagenic effects of tested chemicals and respective concentrations, being predictive even for cancer (Maluszynska and Juchimiuk, 2005, Ma et al. 2005; Dizdari & Bala, 2019). Similar DNA damage and apoptosis by mancozeb have been also reported Calviello et al. (2006) in rats.

Concluding the increasing range of morpho- and genotoxicity induced by different concentrations and duration treatments on *A. cepa* bulbous roots with tested fungicides resulted as follow: DITHANE M-45 blue 72 WP < AGRIA-MANCOZEB 80 WP < MANFIL 75 WG. To our knowledge no previous research investigations according the toxic activity of trade formulations of mancozeb-based fungicides used in Albania on plants and particularly on an Albanian native ecotype of common onion was previously reported. The current data should serve as a real alert according to the purity of their active ingredient and production origin, uncontrolled field appliance of doses and proper periods, which can bring to substantial toxic concentrations of analyzed fungicides, engendering as significant hazards to each ecosystem component and human health as dietary recipient in food chains.

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## P 16. THE PROTECTION OF BEE PRESENCE IN PASTURELAND

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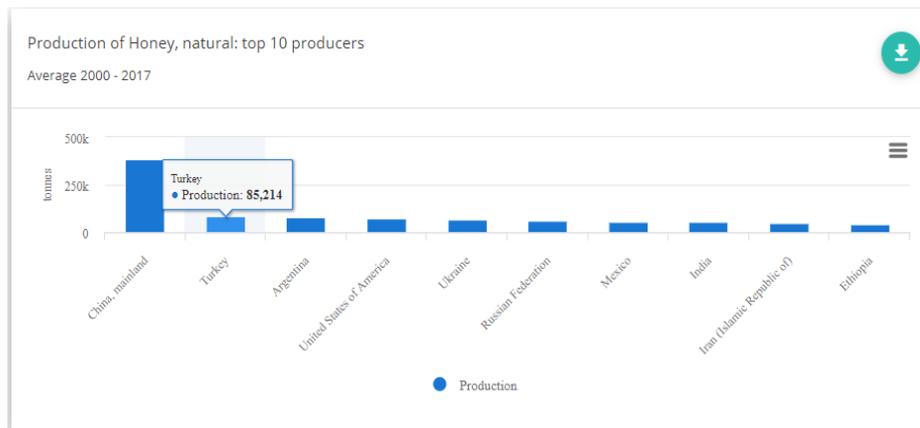
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**ABSTRACT:** The honeybee is vitally important creatures to supply of foodstuffs such as honey, nectar, pollen, royal jelly, etc. and being pollinator of about 77% of 82 plant species which are used as edible in the world. The bee presences are decreased day by day in our country and the whole world due to using pesticide, overgrazing like similar reasons. The pastureland, which is natural areas are not only a forage source for cattle, sheep, and goat, but also these areas provide survival changes of other creatures in nature. Increasing beekeeping activity in rangelands can be obtained to quality honey production from these areas, and enhance to spread of the plants which are pollinated by honeybees in pastureland as the increase in these plants seed yields. For this purpose, forage crops using in rangeland improvement to the protection of bee life and enhancing of bee presence are sainfoin (*Onobrychis sativa*), chickpea milkvetch (*Astragalus cicer*), dandelion (*Taraxacum officinale*), wild rocket (*Diplotaxis tenuifolia*), etc. These forage plants having long blooming period could be meet a nectar needs of the bees. In this review inform about actions to be taken for the protection of bee presence, and forage crops which can be used for that purpose.

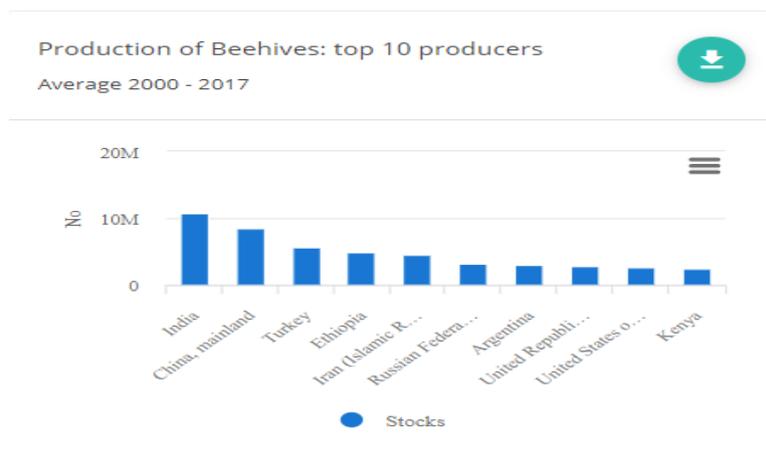
*Keywords: Beekeeping, Forage Crops, Rangeland Improvement, Rangeland Yields*

### 1. PRODUCTION OF HONEY AND BEEHIVES IN THE TURKEY

The honeybee is vitally important creatures to supply of foodstuffs such as honey, nectar, pollen, royal jelly, etc. and being pollinator of about 77% of 82 plant species which are used as edible in the world. In 2017, India was on the first rank in the production of beehives while China (mainland) came in first in the production of honey. In 2017, Turkey came in second in the production of honey, and in third in production of beehives in whole the world (Figure 1-2) (FAOSTAT 2019). In Turkey is produced about 114,471 tons of honey, and is had by 7,9 million beehives. In Turkey, Muğla is on the first rank in the production of hives while Ordu came in first in the production of honey (Table 1) (Anonymous 2018).



**Figure 1.** Production of Honey in the World (FAOSTAT 2019)



**Figure 2.** Production of Beehives in the World (FAOSTAT 2019)

**Table 1.** Production of Beehives and Production of Honey in Turkey (Anonymous 2018)

Production of Beehives			Production of Honey		
Province	% in Turkey	No	Province	% in Turkey	Tons
Muğla	12	958000	Ordu	14,7	16800
Ordu	7	562000	Muğla	13,9	15900
Adana	5,7	455000	Adana	9,4	10700
Aydın	3,5	279417	Aydın	3,8	4343
Mersin	3,4	271433	Mersin	3,4	3886
Antalya	2,8	223533	Sivas	3,2	3657
İzmir	2,7	215550	Balıkesir	2,5	2857
Sivas	2,7	215550	İzmir	2,5	2857
Balıkesir	2,1	167650	Antalya	2,2	2514
Trabzon	2,1	167650	Van	1,7	1943
Total	44	3515783,33	Total	57,3	65457
Production of Beehives in Turkey		7,900,000	Production of Honey in Turkey		114,471

## 2. SOME NECTAR AND POLLEN PLANTS IN TURKEY

The bee presences are decreased day by day in our country and the whole world due to using pesticide, overgrazing like similar reasons. In the world should be increased to the density of plants which are nectar and pollen source in their habitat for preventing to increasing bee death. In Turkey's Flora have grant plant diversity (i.e., about 12 thousand plants), and the rangelands in our country are habitat to part of these plants (Avcı 2005, 2013). The pastures are essential areas in terms of beekeeping and quality fodder in animal production owing to a plentiful variety of species. It is one of the crucial issues that the nectar and pollen plants cannot damage other creatures to live in there. In this review is given in Table 2 to had access to 34 nectar and pollen plants which have feed value or not and have not toxic effect in case of grazing, and found naturally in Turkey's pastureland.

**Table 2.** Some nectar and pollen plants which have feed value or not, and found naturally in Turkey's pastureland (Derived from Karaca et al. 2008, Özhatay et al. 2016, Anomim 2019)

No	Name	Source of Pollen/ Nectar	Blooming Period
1	<i>Alcea pallida</i>	Pollen & Nectar	June- October
2	<i>Astragalus cicer</i>	Pollen & Nectar	May- July
3	<i>Ballota acetabulosa</i>	Nectar	June- July
4	<i>Bellis pernnis</i>	Pollen	March-August
5	<i>Centaurea triumfettii</i>	Pollen & Nectar	May-August
6	<i>Cichorium intybus</i>	Pollen & Nectar	April- July
7	<i>Diplotaxis tenuifolia</i>	Pollen & Nectar	April- November
8	<i>Dorycnium graecum</i>	Pollen & Nectar	April- August
9	<i>Filipendula vulgaris</i>	Pollen & Nectar	May- July
10	<i>Genista carinalis</i>	Pollen & Nectar	May- June
11	<i>Hedysarum varium</i>	Pollen & Nectar	June- July
12	<i>Lavandula angustifolia</i>	Pollen & Nectar	July- August
13	<i>Lotus corniculatus</i>	Pollen & Nectar	May- September
14	<i>Malva sylvestris</i>	Pollen & Nectar	May-October
15	<i>Onobrychis sativa</i>	Pollen & Nectar	May- June
16	<i>Onobrychis tournefortis</i>	Pollen & Nectar	April- May (June)
17	<i>Ononis natrix</i>	Pollen & Nectar	April- July
18	<i>Origanum vulgare</i>	Nectar	May- October
19	<i>Phlomis armenica</i>	Nectar	June- August (September)
20	<i>Sanguisorba minor</i>	Pollen	June- July
21	<i>Tamarix sp.</i>	Pollen & Nectar	Early Spring- Late Autumn
22	<i>Taraxacum officinale</i>	Pollen & Nectar	May- June
23	<i>Thymus longicaulis</i>	Nectar	April- June
24	<i>Trifolium angustifolium</i>	Pollen & Nectar	March-April
25	<i>Trifolium arvense</i>	Pollen & Nectar	March-May
26	<i>Trifolium constantinopolitanum</i>	Pollen & Nectar	April- June
27	<i>Trifolium fragiferum</i>	Pollen & Nectar	April- August
28	<i>Trifolium nigrescens</i>	Pollen & Nectar	March- October
29	<i>Trifolium pratense</i>	Pollen & Nectar	May- September
30	<i>Trifolium purpureum</i>	Pollen & Nectar	January- July
31	<i>Trifolium repens</i>	Pollen & Nectar	March- September
32	<i>Trifolium resupinatum</i>	Pollen & Nectar	May- June
33	<i>Trifolium uniflorum</i>	Pollen & Nectar	March-May
34	<i>Verbascum bugulifolium</i>	Pollen	April- June

### 3. ACTIONS TO BE TAKEN

Ten provinces, shown in Table 1, are produced 58% of the honey in Turkey, and Konya isn't within these provinces. However, Koç et al. (2018) stated to grow the excellent plant diversity in Konya which have steppe formation. We are the opinion that beekeeping activity should be increased in Konya and like that. For this reason, nectar and pollen plants can be added to pasture mixture in rangeland improvement in this region.

The bee activities can be increased by using honeyed plants such as *Lavandula*, *Genista*, *Tamarix* as hedge plants in pastureland. Also, the beehive can be added to grow in the pollination of nectar and

pollen plants in the pasture mixture during the mellowing period for the spread of seeds in the grazing system. Thus, it can be increased to bee products, and to plant composition in rangeland.

#### **4. CONCLUSION**

The pastureland has a critical role in pollen and nectar source in Turkey. This situation is essential with regards to provide sustainability via natural seeding of rangeland as well as beekeeping. Because the pollination of grazing crops occurs via the bee, this mutual relationship is taken into consideration in range management and especially pasture improvement. We are the opinion to thinking of grazing animals needs in the development of rangeland, which are a vital source for bee, besides thinking of plants which are a benefit to bee, and non-noxious these animals.

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**P 17. EFFECTS OF ELEMENTAL SULFUR AND K-HUMAT ALONGSIDE FESO<sub>4</sub> AND FEEDDHA APPLICATIONS ON IRON NUTRITION OF CORN**

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**ABSTRACT:** This study was aimed at determining the effects of FeSO<sub>4</sub>.7H<sub>2</sub>O (19% Fe) and FeEDDHA (6%) compounds, which were supplied with elemental sulfur and K-Humat on the active and total iron content of corn plant in greenhouse conditions, and the study was conducted with four replications according to a randomized complete block design. In the experiment, 0 (control) and 10 mg Fe kg<sup>-1</sup> iron were applied to soil before planting. FeSO<sub>4</sub>.7H<sub>2</sub>O (19% Fe) and FeEDDHA (6%) with an ortho-ortho isomer of ratio 6 as an iron source were used in the study. Ferrous sulfate alone, 400 mg kg<sup>-1</sup> elemental sulfur and 250 mg kg<sup>-1</sup> K-humate were applied in 3 different forms. ANT CIN 98 corn variety was cultivated in an experimental soil characterized by mild alkaline reaction (7.53), clay loam texture, high lime content (28%), poor organic matter (1.68%) and insufficient level of iron (1.21 mg kg<sup>-1</sup>). In the experiment, it was determined that the active and total iron contents of the corn plant leaves varied depending on the iron sources and this change was statistically significant at 1%. While the active and total iron contents in the leaves of corn plant were 18.2 and 50.9 mg kg<sup>-1</sup> in the control, respectively, these values respectively increased in the ratio of 26% and 28% by FeSO<sub>4</sub>.7H<sub>2</sub>O, 15% and 5% by FeSO<sub>4</sub>.7H<sub>2</sub>O + Elemental S, 73% and 28% by FeSO<sub>4</sub>.7H<sub>2</sub>O + K-Humat, and 95% and 37% by FeEDDHA application. In addition, although iron supply of corn plant was sufficient in all applications according to the total iron contents of plant leaves (50-250 mg Fe kg<sup>-1</sup>), iron deficiency symptoms were observed in control, FeSO<sub>4</sub>.7H<sub>2</sub>O and FeSO<sub>4</sub>.7H<sub>2</sub>O + Elemental S applications. Under this circumstance, it shows that the total iron content of the plant leaves is not an important indicator for determining the iron nutrition status of the corn plant and also increase in total and especially active iron contents of the plant by the application of these sources is not sufficient. FeSO<sub>4</sub>.7H<sub>2</sub>O + K-Humat and FeEDDHA applications did not show any signs of iron deficiency in corn plant leaves. Thus, we think that the iron content is higher than the control, rather than the increase in the total iron content of the leaves with the application of these sources. As a matter of fact, it was observed that the ratio of the active iron content in the total iron was 51% for FeEDDHA, followed by FeSO<sub>4</sub>.7H<sub>2</sub>O + K-Humat with 48%, FeSO<sub>4</sub>.7H<sub>2</sub>O + Elemental S with 43%, Control with 36% and FeSO<sub>4</sub>.7H<sub>2</sub>O with 32%. The failure of FeSO<sub>4</sub>.7H<sub>2</sub>O + Elemental S in the iron nutrition of the plant was due to the lack of pH decrease induced by sufficiently conversion of the elemental S to sulphate by the microbial pathways and the low organic matter in the soil. It was also determined that FeEDDHA was the best source of iron in terms of feeding of the plant while FeSO<sub>4</sub>.7H<sub>2</sub>O + K-Humat could be preferred in terms of economic status.

*Keywords: Active iron, FeEDDHA, FeSO<sub>4</sub>.7H<sub>2</sub>O., elemental S, K-Humate, corn, total iron*

**P 18. THE EFFECT OF PHYSICAL HETEROGENEITY ON THE USABILITY OF  
BASALTS AS RAILWAY BALLAST: A CASE STUDY FROM THE EVCİLER BASALTS,  
ANKARA-CENTRAL TURKEY**

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**ABSTRACT:** The quality of railway ballast has a profound effect on the maintenance of integrity of railway. Therefore, ballast materials are expected to fulfill many specific criteria, such as crack-free, low porosity and clay content, high compressive strength, resistance to abrasion and weathering etc. Basalts are widely used as railway ballast worldwide. Based on field observation, petrographic and physico-mechanical tests, we investigated the usability of the Evciler Basalt (Elmadağ Volcanic Complex-EVC, Ankara) as railway ballast in this study. The EVC is one of the most important Miocene volcanic field, comprising mafic mildly alkaline and intermediate to felsic calc-alkaline lavas. The mafic lavas are called as the Evciler basalts and represented by alkali basalts. They display porphyritic texture with olivine and clinopyroxene phenocrysts in an intergranular groundmass including mainly plagioclase, clinopyroxene, lesser opaque and rare anorthoclase. The field characteristics of the basalts resemble those of “aa lavas”. Based on the field observations, we identified three zones from top to bottom in a few meters cooling unit of the basalts: (A) a vesiculated flow top, (B) a massive interior, and (C) a basal breccia. Following the physico-mechanical tests, we observed that water absorption, Los Angeles abrasion and magnesium sulphate soundness of the zone B are the lowest, but particle density of the zone B ranges between those of the zone A and C. Based on the obtained data, we found that the zone B is appropriate for ballast material in just conventional railway rather than the zone A and C. Accordingly, our findings show that small-scale vertical physical heterogeneity is so high in a basaltic flow, and it is advised to be careful for selection of ballast material from basaltic volcanic rocks.

*Keywords: Railway Ballast, Physical Heterogeneity, Basalt, Evciler, Ankara*

**P 19. INVESTIGATION OF THE CHANGES THAT OCCUR IN CARROT PLANT IN  
BORON DEFICIENCY AND TOXICITY CONDITIONS**

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**ABSTRACT:** Stress factors that affect the growth and development negatively and cause physiological and metabolic changes can lead to a decrease in product quality and quantity. As a result of the deficiency or toxicity of plant nutrients, the plant cannot fulfill its metabolic function. In our country's Central Anatolia Region, micro-elemental problems are experienced in a large proportion. Boron is one of these elements. Boron deficiency is observed in 26.6% of our region's soils and boron toxicity in 18%. For this reason, determination of mechanisms of resistance to boron deficiency and toxicity of plant species grown in the soils of our region play an important role. In this study, it is aimed to investigate the physiological changes of inadequate and toxic levels of boron applications, in the development of the carrot plant, which is important in our country and agricultural region. The Nantes-Orange Carrot variety, which is commercially important, was used in the study. After the seeds fully germinated into seedlings, Hoagland nutrient solution control, (0mM B), 0.5 mM B, 1 mM B, 2 mM B containing nutrient solutions were given. Changes occurring in the carrot genotype in boron deficiency and boron toxic conditions were compared with the control group. Basic growth parameters and B element contents of the stem were determined. In the carrot variety, with respect to the control, reductions occurred in the plant height, and the plant fresh and dry weight values under boron deficiency conditions and boron toxic conditions. It was determined that the greatest decreases occurred in boron 0 ppm B and 2 mM B doses.

*Key Words: Boron Toxicity, Boron Deficiency, Carrot.*

**P 20. INVESTIGATION OF DROUGHT TOLERANCE MECHANISM IN THE ROOTS OF PUMPKIN GENOTYPES**

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**ABSTRACT:** Drought is one of the most important factors affecting agricultural production within environmental components. Drought stress, when the usable areas in the world are classified according to natural stress factors, has the highest share (i.e. 26%). The product quality of the cultivated plants exposed to drought stress is adversely affected and leads to loss of productivity. For this reason, it is important to determine the plant species resistant to drought stress, to explain the tolerance mechanisms and to determine the factors that increase or affect the drought resistance of the plants. In this study, 6% PEG 6000 was applied in a Hoagland nutrient solution to create osmotic stress in pumpkin genotypes. In the study, the previously genetically determined sensitive genotype C-27 (*Cucurbita pepo* L.) and the drought-tolerant C-26 (*Cucurbita pepo* L.) genotype were used. Measurements of root size, and root fresh weight and root dry weight values of pumpkin genotypes increased compared to the control in the C-26 genotype while, decreases in the C-27 genotype were observed. It has been determined that PEG 6000 application increases H<sub>2</sub>O<sub>2</sub> accumulation in pumpkin genotypes. In addition, it was determined that the scavenging activity of the pumpkin genotypes exposed to drought stress increased and that these increases were greatest in the C-27 genotype.

*Keywords: Pumpkin, Drought stress, H<sub>2</sub>O<sub>2</sub>*

**P 21. PURE TORSIONAL MOMENT CAPACITIES OF FULL-SCALE REINFORCED  
CONCRETE BEAMS SUBJECTED TO CORROSION**

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**ABSTRACT:** The negative results resulting from the corrosion of reinforced concrete reinforcement are important for the investigation of corrosion in the reinforced concrete reinforcement. Corrosion affects the performance levels of reinforced concrete structures in addition to shortening the service life of the economic sense, and in the following stages of the destruction of structures can lead to destruction. With the resulting corrosion; the reduction of the reinforcement cross-sectional area leads to negative results such as the volume increase caused by the corrosion product and the decrease in the bond strength between the concrete and the reinforcement. With these results, the bearing capacity, bending and torsional strength of reinforced concrete elements are reduced, and the targeted building performance is avoided. Studies on estimating the bending behavior of rusted reinforced concrete elements are sufficiently available in the current literature; The behavior of rusted reinforced concrete elements under the effect of simple torsion has not been studied yet. This behavior, combined with the primary crack widths formed by corrosion, adversely affects the torsional stiffness according to the cracked section. For this purpose, 6 reinforced concrete beams of C25 concrete class were rusted at different rates by using accelerated corrosion method. In order to obtain the real corrosion rates, the reinforced concrete reinforcements were removed by mechanical and chemical cleaning before the beams were removed after the loading tests. In order to find the actual mass losses of all windings and longitudinal reinforcements, the masses of the reinforcements in the precision balance were recorded and compared with the first masses and the actual corrosion rates were also obtained. At the end of the experiment, the effects of the actual corrosion rates on the torsional moment capacity of the reinforced concrete beams, moment-curvature relations, crack width and distribution were investigated. Corroded reinforced concrete beams torsion behavior by examining; It is thought that torsional strength can be a model for estimating the torsional moments of corroded reinforced concrete beams with the help of empirical model which is developed depending on the corrosion rate and thus to evaluate existing structures.

*Keywords: corrosion; steel bars; pure torsion; beams; reinforced concrete.*

**P 22. REMOVAL OF METHYLENE BLUE FROM WATER BY USING CHITOSAN-CARBON BASED COMPOSITE MEMBRANES**

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**ABSTRACT:** Chitosan and its modified forms are widely used for the removal of contaminants from aqueous solutions due to their several advantages such as being biocompatible and biodegradable, non-toxic and having a suitable hydrophilic property. In this study, a vinasse based biochar-chitosan composite membrane was prepared and its potential for the removal of methylene blue from aqueous solution was investigated. For this purpose, composite membranes were prepared by using different amount of biochar and chitosan dissolved in 1% (v/v) acetic acid and FT-IR, SEM and TGA techniques were used for their characterization. It was shown that the resulting membranes could be successfully used for the removal of methylene blue from aqueous solution.

*Keywords: Chitosan, Vinasse, Biochar, Composite membrane, Methylene blue*

### P 23. SYNTHESIS OF SOME HYDRAZIDE-OXIME AND INVESTIGATION OF THEIR ANTIBACTERIAL PROPERTIES

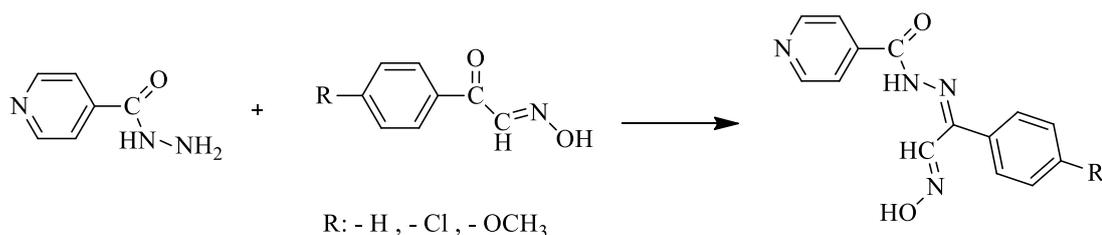
Ghadah Taha Ahmet Altai<sup>1</sup>, İbrahim Karataş<sup>1\*</sup>, Fatih Sevgi<sup>2</sup>

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**ABSTRACT:** Oxime compounds and their derivatives are effective on chelate formation, biodegradability, as well as photochemical and biological reactions. Nowadays, studies on the antibacterial properties of oxime and its derivatives and the synthesis of compounds demonstrating new antibacterial properties have gained importance. In this study, the hydrazide compounds known to have antibacterial properties were synthesized by condensation of some oxime compounds with hydrazide-oxime derivatives were synthesized and their effects against some bacteria were investigated. For this purpose, isonitrosoacetophenone (keto oxime) derivatives were synthesized from acetophenone, 4-chloroacetophenone, and 4-methoxyacetophenone. Then, The N-[2-(hydroxyimino)-1-(phenylethylidene)] isonicotiohydrazide and its derivatives were synthesized from their condensation reactions with isonicotinic acid hydrazide. The structures of these compounds have been elucidated using available literature information and FT-IR, <sup>1</sup>H-NMR techniques.



Furthermore, the anti-bacterial effects of synthesized substitute hydrazide-oxime derivatives against *Escherichiacoli* ATCC 25922, *Pseudomonasaeruginosa* ATCC 15442, methicillin-sensitive *Staphylococcus aureus* ATCC 25923 (MSSA), *Klebsiellapneumoniae* ATCC 70603, *Salmonella enteritidis* ATCC 13076 and *Sarcinalutea* ATCC 9341 strains were investigated.

*Keywords: Oxime, Hydrazide-oxime, Antibacterial Properties*

## **P 24. CHARACTERIZING OF THE RAW MATERIALS AND UTILITIES FOR THE LABORATORY-SCALE BIODIESEL PRODUCTION**

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**ABSTRACT:** Nowadays it is a well known fact that biodiesel is a renewable resource based fuel for use in diesel engines. From the most of the studies referred in the specialized literature it can be made from various oils including corn, soybean, canola, cottonseed, peanut, etc. and from animal fats, but as usually it has a more scientific term as Fatty Acid MethylEster (FAME).

The oils and fats contain triglycerides that are chemically converted into FAME by a process called “transesterification” and the fuel produced is more environmentally friendly than petroleum diesel.

Raw materials for the biodiesel production can be as follows: vegetable oils, grasses from the animal wastes and recycled; but also the waste cooking oils which has been main objective of our study. These materials all have considerable content of the triglycerides, free organic fatty acids, and other ingredients as contaminants of them, strongly depended from the way of their pretreatment before delivery.

We have considered mains olive, wheat oil, sunflower oil, soya oil, cotton oil, palm oil; as well as waste cooking oil from restaurants and fast food bars, caw and pig grease, etc.

Since biodiesel is an ester of the fatty acids it is needed also a specific catalyst for the facilitating the starting of the transesterification process, and we have used both basic and acidic chemically content of it. Also, for the biodiesel production there are necessary some utilities and auxiliary materials, which we have characterizing them all for the study performed in the laboratory scale. The characteristics of all the raw and other needed materials we have shown in the full version of our paper.

*Keywords: Biodiesel, renewable resource, waste cooking oil, transesterification, catalyst*

### **1. INTRODUCTION**

Based on the latest forecasts, the world population will grow substantially to 9 billion by 2050. This will cause further rapid growth in energy demand, significant decline in global fossil fuel reserves, and intensification of environmental challenges global ones such as global warming and climate change due to increased greenhouse gas emissions (GHG). Given the diminishing resources of fossil fuels, as well as the unstable and unstable nature of these fuels, it is necessary to find alternative energy sources. In fact, the search for renewable energy with fewer GHG emissions and the capacity of air pollution is important at the global level (OECD, 2012).

Among the various renewable platforms, biomass-based energy production has attracted a lot of attention due to the huge amount of biomass (eg, plants and wastes) produced globally and the potentials it has to mitigate harmful environmental impacts associated with fossil fuels.

Among biodiversity-oriented biomass fuels, biodiesel is considered to have great potential as a green and technologically feasible alternative to fossil fossil fuels. Biodiesel is derived from vegetable seed oils and animal fats and is a mixture of alkyl esters if long fatty acids, mainly produced by the method of transesterification.

The physical-chemical properties of biodiesel are very similar to those of oil, and therefore can be used as an alternative to oil in conventional diesel engines without the need for any modification.

Other biodiesel benefits include the highest number of cetane, fire point and lubrication, sulfur deficiency, and lower aromatic content compared to petroleum. (Demirbas,2009 )

Biodiesel is mainly produced from edible oils, i e soybean, canola, palm trees, rapeseed etc. However, the application of these oil crops as a nutrient to the production of biodiesel is accompanied by adverse impacts on global food security, particularly in developing countries suffering from tangible economy

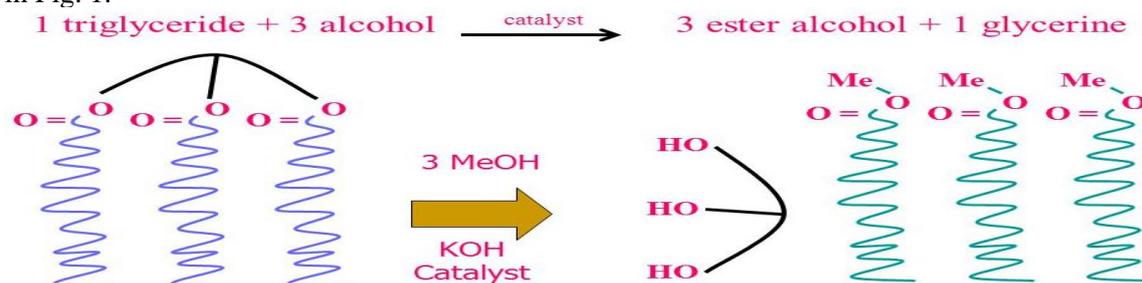
and agriculture. On the other hand, given such adverse effects on the price of food and food security, the production of biodiesel from food in the food grade can not be economically feasible.

Therefore, raw oils, animal waste greases and vegetable oils used are used for the production of biodiesel. The most important oil plants with high potential for biodiesel production include *Jatropha curcas*, camelina (*Camelina sativa*), castor beans (*Ricinus communis* L.), neem (*Azadirachta indica* A.), karanja (*Pongamia pinnata* L.) mahua (*Madhuca* spp.), simarouba (*Simarouba glauca* DC.) and cheura (*Diploknema butyracea*).

However, current oil yields from these plants are generally insufficient to meet bioenergy requirements, while the resulting oils are characterized by trace amounts of water, high water content and free fatty acid content. Thus, genetic improvements to increase oil production and properties have attracted considerable attention. (Alaba., 2016; del Pilar Rodriguez, 2016)

In the EU Directive 2003/30 / EC, biodiesel is defined as "methyl ester" produced from vegetable or animal oils, of oil quality to be used as biofuel. "The latest EU Directive 2009 / 28 / EC has set targets for achieving by 2020, a share of 20% of energy from renewable energy sources in the EU's overall energy consumption and a 10% share of renewable energy sources in each country the consumption of transport energy. In this context, special attention is paid to the role played by the development of a sustainable and responsible biofuel production, without affecting the food chain.

Nowadays most biodiesel is produced through triglycerides transesterification of edible oils with methanol, in the presence of an alkaline catalyst (Lotero., 2005). The so obtained product has low viscosity and is a biofuel (fatty methyl ester) that can replace petroleum-based diesel fuel with no need of engine modifications (Suwannakarn., 2005). Furthermore, if compared to fossil fuel, the formed ester fuels are non-toxic, safe to handle, and biodegradable. Glycerine is also obtained as by-product as shown in Fig. 1.



**Figure.1:** Transesterification of a triglyceride

Current oil production systems raise environmental concerns because the lands have been intensively cultivated, requiring high fertilizers and water inputs. These practices, intended to increase production, should be carefully reduced or regulated to prevent greenhouse gas emissions or other environmental impacts. To do this, improved agronomic practices such as the use of mixed species or crop rotation undoubtedly play a key role in mitigating negative impacts and increasing biodiversity. A profound understanding of microbial soil diversity, its effects on nutrient supply, and consequently on yield, is essential for sustainable cutting systems (The Royal Society, 2008).

Energy crops for industrial destinations can represent a strategic opportunity to use land and generate revenue. However, in addition to the environmental aspects, there are economic concerns regarding the landing of land for food cultivation. In a high market tension, it may have a big impact on food / food prices, increasing inequality, especially in developing countries. In addition, increased food demand may result in slowing production of bio waste due to lower availability of raw material. This was noted in 2007 with industrial factories that use only 50% of their production capacity (Carvoli, 2008).

For all these reasons, it is desirable to produce biodiesel from crops specifically selected for their high productivity and characterized by low input requirements or low-cost ready-to-eat foods such as waste cooking oils (WCO), animal fats and greases (Zhang , 2003).

Meanwhile available food crops for biodiesel production are limited to several species (mainly palm / soybeans in the USA and palm oil / rapeseed in the EU), the purpose of using dedicated alternative

sources opens a wide choice for new species that can to be more suitable for specific conditions that result in high yield.

The WHO's high potential is also recognized by EU Directive 2009/28 / EC, where livestock or animal waste livestock is reported to save about 88% of greenhouse gas emissions, a fairly high value compared to biodiesel From ordinary vegetable oils, greenhouse gas savings range from 36 to 62%. The main issue presented by such a raw material is the need for its standardization, particularly with regard to acidity reduction. Several methods have been proposed to solve this problem. Among them, it is worth mentioning, in addition to the method of alkali refining, the addition of excess catalyst extraction with a solvent, the distillation refining process and the pre-esterification method (*Pirola, 2010; Bianchi, 2010*).

The latter seems to be the most attractive approach and has recently received a lot of attention.

### **1.1 Non-edible oil crops in the Mediterranean area**

A considerable amount of studies are available in major and alternative crops for the production of raw material for biodiesel. Authors made a selection of the most promising crops to be introduced into the Mediterranean area, considering that currently the Mediterranean basin includes not only mild climate, but also arid soils. Some of them have been effectively tested within the project mentioned as part of a single rotation program.

Among the oil crops, the Brassicaceae family has an extraordinary position. Rapeseed (*Brassica napus*) is the third-largest oil production with 12% of the world market of plant plants with the best cultivated crops in cold-hot regions (*Carlsson, 2009*).

However, the great biodiversity of Brassicaceae refers to the original species, among which *Brassica juncea*, *Brassica nigra*, *Brassica rapa*, *Brassica carinata*, *Sinapis alba*, *Camelina sativa*, *Eruca sativa* ssp. *oleifera*, etc. In addition to potentials as raw material for biodiesel, their high content of glucosinolates (GSL) makes them capable of recovering marginalized lands from terrestrial pests such as nematodes (eg nematode galling by the genus *Meloidogyne* and cyst nematodes from *Heterodera* and *Globodera* genera) (*Romero et al., 2009; Curto & Lazzari, 2006*).

On the other hand, an unexpected source of oil seems to come out of tobacco culture. Pending changes in the tobacco market, new varieties for energy production are emerging. Tobacco, as drought-resistant species, appears to be a good option to deal with the shift of some early trees to dry lands caused by climate change.

### **1.2. Standardization of the raw materials for biodiesel production**

Characterization of oil before continuing with standardization of raw materials is a very important issue. Some properties remain virtually unchanged from the initial material to the finished biodiesel, or they are, however, predetermined. It is very important to check that the values of such chemical and physical properties of oil are in the range of those required by standard regulations. The experimental procedures for obtaining such property values are also standardized and are shown in the regulations.

**Table 1:** European Standard specifications for biodiesel

<b>Specification</b>	<b>Units</b>	<b>Min</b>	<b>Max</b>	<b>Methods</b>
<b>Ester content</b>	% (m/m)	96.5	-	EN 14103
<b>Density 15°C</b>	kg/m <sup>3</sup>	860	900	EN ISO 3675 EN ISO 12185
<b>Viscosity 40°C</b>	mm <sup>2</sup> /s	3.50	5.00	EN ISO 3104
<b>Sulphur</b>	mg/kg	-	10.0	preEN ISO 20846 preEN ISO 20884
<b>Carbon residue (10% dist.residue)</b>	% (m/m)	-	0.30	EN ISO 10370
<b>Cetane number</b>		51.0		EN ISO 5165
<b>Sulphated ash</b>	mg/kg	-	0.02	ISO 3987
<b>Water</b>	mg/kg	-	500	EN ISO 12937
<b>Total contamination</b>	h (hours)	-	24	EN 12662

<b>Cu corrosion max</b>	-	-	EN ISO 2160
<b>Oxidation stability, 110°C</b>	h (hours)	6.0	-
<b>EN 14112</b>			
<b>Acid value</b>	mg KOH/g	-	0.5
<b>EN 14104</b>			
<b>Iodine value</b>	gr I2/100 gr	-	120
<b>EN 14111</b>			
<b>Linoleic acid ME</b>	% (m/m)	-	12.0
<b>EN 14103</b>			
<b>Methanol</b>	% (m/m)	-	0.20
<b>EN 14110</b>			
<b>Monoglyceride</b>	% (m/m)	-	0.80
<b>EN 14105</b>			
<b>Diglyceride</b>	% (m/m)	-	0.20
<b>EN 14105</b>			
<b>Triglyceride</b>	% (m/m)	-	0.20
<b>EN 14105</b>			
<b>Free glycerol</b>	% (m/m)	-	0.02
<b>EN 14105</b>			
<b>Total glycerol</b>	% (m/m)	-	0.25
<b>EN 14105</b>			
<b>Gp I metals (Na+K)</b>	mg/kg	-	5.0
<b>EN 14108</b>			
			EN14109
<b>Gp II metals (Ca+Mg)</b>	mg/kg	-	5.0
<b>EN 14538</b>			
<b>Phosphorous</b>	mg/kg	-	5.0
<b>EN 14538</b>			

The high content of sulphur and phosphorus in the available materials causes mostly engine wear and in particular shorten the life of the catalyst. Biodiesel derived from soybeans, rapeseed, sunflowers and tobacco oils are known to contain virtually no sulphur.

Soybean, sunflower, peanut and rapeseed oils contain a high percentage of the acidic linoleic acids, so they affect the properties of ester extracted with a low melting point and the cetane number.

Determination of the amount of methyl ester of linoleic acid is achieved by gas chromatography using an internal standard as the substrate is trans esterified and also allows the determination of the amount of methyl ester of other acids.

In the tables below we will provide the European biodiesel standard, the oil profile for each edible oil and the main characteristics of Waste Cooking Oil (WCO) as one of the first major raw materials for Biodiesel production.

**Table 2:** Indicative acidic composition of some raw materials for biodiesel production

<b>Oil</b>	<b>Comon Name</b>	<b>Fatty acid composition, wt%</b>
<b>Arachis hypogea</b>	Peanut	11.9 (16:0), 3.0 (18:0), 40.0 (18:1), 40.7 (18:2), 1.2 (20:0), 3.2 (22:0)
<b>Brassica juncea</b>	Indian mustard	3.6 (16:0), 1.1 (18:0), 13.9 (18:1), 21.5 (18:2), 13.7 (18:3), 8.7 (20:1), 33.5 (22:1)
<b>Brassica napus</b>	Canola	4.7 (16:0), 0.1 (16:1), 1.6 (18:0), 66.0 (18:1), 21.2 (18:2), 5.2 (18:3), 0.9 (20:0), 0.3 (22:0)
<b>Carthamus tinctorius</b>	Safflower	0.1 (14:0), 6.4 (16:0), 2.2 (18:0), 14.1 (18:1), 76.6 (18:2), 0.2 (18:3), 0.2 (20:0) 0.2 (22:0)
<b>Elaeis guineensis</b>	Palm	0.5 (12:0), 1.0 (14:0), 38.7 (16:0), 3.3 (18:0), 45.5 (18:1), 10.8 (18:2), 0.1 (18:3), 0.1 (20:0)
<b>Glycine max</b>	Soybean	10.7 (16:0), 3.0 (18:0), 24.0 (18:1), 56.6 (18:2), 5.3 (18:3), 0.2 (20:0), 0.2 (22:0)
<b>Helianthus annus</b>	Sunflower	6.6 (16:0), 3.1 (18:0), 22.4 (18:1), 66.2 (18:2), 1.0 (18:3), 0.3 (20:0), 0.4 (22:0)
<b>Jatropha curcas</b>	Physic nut	0.1 (12:0), 0.2 (14:0), 14.8 (16:0), 0.8 (16:1), 4.2 (18:0), 41.0 (18:1), 38.6 (18:2), 0.3 (18:3)
<b>Nicotiana tabacum</b>	Tobacco	6.6 (16:0), 3.1 (18:0), 22.4 (18:1), 66.2 (18:2), 1.0 (18:3), 0.3 (20:0), 0.4 (22:0)

<b>Lard</b>	-	4.8 (14:0), 28.4 (16:0), 4.7 (16:1) 14.8 (18:0), 44.6 (18:1), 2.7 (18:2)
<b>Yellow grease</b>	-	1.0 (14:0), 23.0 (16:0), 1.0 (16:1) 10.0 (18:0), 50.0 (18:1), 15.0 (18:2)
<b>Brown grease</b>	-	1.7 (14:0), 23.0 (16:0), 3.1 (16:1) 12.5 (18:0), 42.5 (18:1), 12.2 (18:2), 0.8 (18:3)

**Table 3 :** Iodine value, viscosities and densities of WCO as alternative oas raw material for biodiesel production

<b>Oil</b>	<b>Iodine value (gI2/100g oil)</b>	<b>Viscosity (mm2/s 40 °C)</b>	<b>Density (kg/m3 15° C)</b>
<b>WCO</b>	54	82.2	918

### 1.3. Oil standardization: Free fatty acids esterification reaction

As mentioned in the introduction paragraph, the use of unrefined, unrefined oils presents the standardization problem before the trans esterification process, particularly with regard to acidity reduction. In fact, oils, in addition to triglycerides, contain acid free base facade (FFA).

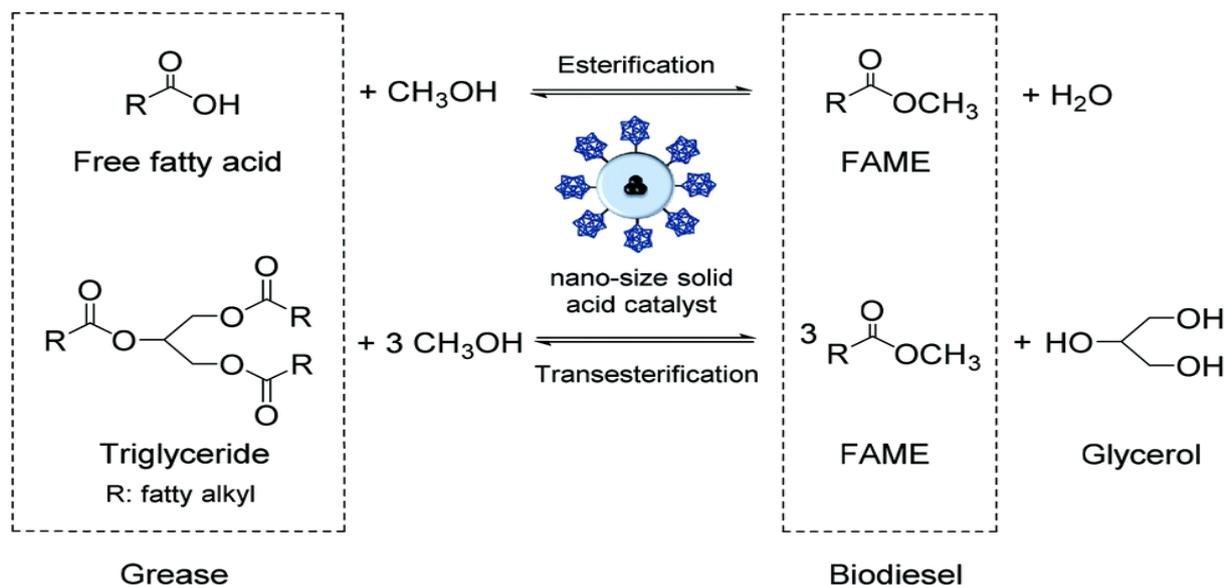
The latter are able to react with the alkaline catalyst used for the trans esterification reaction that brings soaps that prevent contact between the reagents.

A FFA content lower than 0.5% wt is also required by the EN 14214.

Among the various deacidification methods listed in the introduction, the authors have been paying close attention to the pre-esterification process (*Loreto 2005; Pirola 2010; Bianchi, 2010*).

This method is particularly suitable as it is not only able to reduce the acidity of the oils but also provides methyl esters at this stage, thus increasing the final yield on biodiesel.

A scheme of the FFA esterification reaction is given in Fig.2.



**Fig. 2.** Scheme of the Free Fatty Acid Esterification Reaction.

Using heterogeneous catalysts is usually preferred for use homogeneous catalysts, as it prevents neutralization and separation costs, except that they are not corrosive, thus avoiding the use of expensive building materials. Another important advantage is that recovered catalysts can be used potentially for a long time and / or multiple reaction cycles.

## 2. RESULTS AND DISCUSSION

The use of oil crops derived from alternative crops or residual oils as raw material for the production of biodegradable is a very convenient way to reduce the production costs of this biofuels.

From a chemical point of view, the high concentration of FFA that contains these raw materials (residues or alternative culture) leading to the formation of soaps during the final phase of transesterification can easily be overcome by performing a pre-esterification reaction.

This treatment allows lowering of the raw material content below the limit required by the biodiesel standard, while also avoiding the formation of soaps during the transesterification phase. FFA fragmentation is also beneficial in increasing final biodiesel productivity as it produces methyl esters.

The cooking oil (WCO) at first sight does not seem to represent a raw material of good potential for the production of biodiesel due to its properties that hardly match the required standards. But it has been proven that it is possible to use this kind of nutrient from its use in blends with other oils characterized by lower viscosity.

The authors have successfully deacidified WCO and then also receiving an increase in the reaction rate. It should be noted that in Albania the only low cost alternative and the substantial amount of raw material is considered only WCO because we do not have a developed industry of edible or non-edible oil production. The cost of importing edible or non-edible oil is very high and WCO remains the best alternative to Biodiesel production in Albania.

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**P 25. ASSESSMENT OF PARTICULATE MATTER AND CRUSHED POWDER IN  
INDUSTRIAL AREA OF VAN PROVINCE**

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**ABSTRACT:** In this study, air pollutant parameters spreading from the ready-mix concrete plant located in Çaldıran District of Van province were investigated within the scope of Particulate Matter (PM<sub>10</sub>) and Decayed Dust Industry Air Pollution Control Regulation of Turkish Republic. TS 2342 standard method for the measurement of precipitated dust was used, while the TS EN 12341 standard method was used to measure Particulate Matter (PM<sub>10</sub>). Mass flow rate of dust emissions from concrete production activities in the ready mixed concrete plant with over one kg/h as a result of mass production. Industrial Air Pollution Control Regulation Annex-2 is higher than the values given in Table 2.1 was performed with AEORMOD modelling programme. According to modelling results; Concrete Production of Ready-Mixed Concrete Plant will originate from Controlled Requirements; Additive value to air pollution of 24 hour particulate matter (PM) emissions is 14,86 µg/m<sup>3</sup>, contribution to air pollution of annual particulate matter (PM) emissions is 0.68 µg / m<sup>3</sup>, 12.36 mg / m<sup>2</sup> / day for collapsing dust emissions and 1.324 mg / m<sup>2</sup> / day for collapsed dust emissions.

*Keywords: Particulate Matter, air quality, Van Province, Industry, air pollution*

**P 26. ATMOSPHERIC DEPOSITION OF AIR POLLUTANTS**

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**ABSTRACT:** Air pollution and its effects are important environmental problems. There are various gas and particulate pollutants that are released into the atmosphere by natural and anthropogenic sources or formed in the atmosphere. These pollutants in gas form (SO<sub>2</sub>, NO<sub>x</sub>, VOCs etc) and particulate form (PM<sub>10</sub>, PM<sub>2.5</sub> etc) can affect human and living lives and cause material damage. The concentration of these pollutants in the atmosphere may decrease forms temporally or spatially according to proximity of the source and meteorological conditions. The removal of pollutants from the atmosphere can take place in two different ways. Pollutants can be transferred from atmosphere to other environmental ecosystems wet deposition when precipitation (rain, snow) is observed and other times by dry deposition, Anthropogenic acidic gases and soil-derived components react with water and return to the ground surface in the form of rainfall and snow by wet deposition. With dry precipitation, it is possible to spontaneously deposited these pollutants without precipitation in periods. Atmospheric deposition has various effects on aquatic and terrestrial ecosystems. It can be effective in decreasing the species and amount of sensitive fish and molluscs by increasing acidity in aquatic ecosystems. In terrestrial ecosystems, degradation and productivity of fertile agricultural lands and forest areas are reduced. It causes soil nutrients such as Ca<sup>2+</sup>, K<sup>+</sup>, Mg<sup>2+</sup> and Na<sup>+</sup> to be washed from soil into groundwater. It destroys artifacts made of stones such as marble, limestone and calcareous sandstone and causes crumbs and dispersions. In metallic and iron works, it causes corrosion. The effect of acidic precipitation can be manifested in continental and global dimensions. The effect of acidic atmospheric deposition can be manifested in continental and global scales. In this study, it is aimed to make a review of the researches on the chemical composition and effects of total atmospheric deposition samples in our country and in the world.

*Keywords: Air pollutants, wet deposition, dry deposition, atmospheric deposition*

**P 27. EMISSION INVENTORIES OF GREENHOUSE GASES AND OTHER AIR  
POLLUTANTS**

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**ABSTRACT:** Air pollution can be defined as the presence of one or more air pollutants in the atmosphere in amounts and times that damage human, plant and animal life, commercial or personal property and environmental quality. Sulfur dioxide, nitrogen oxides, hydrocarbons, volatile organic compounds and particulate matters are examples of air pollutants. They are described as greenhouse gases such as water vapor, carbon dioxide, ozone, methane, nitrite oxide and greenhouse gases. The greenhouse effect in a natural phenomenon linked to the absorption of solar energy by the earth's atmosphere. Part of the long-wave infrared radiation emitted by the sun is not reflected back into space by the Earth's but is absorbed by greenhouse gases (GHGs) naturally occurring in atmosphere. This radiation is transformed into heat, resulting in a stable average temperature of 15°C in the Earth's atmosphere. The Intergovernmental Panel on Climate Change (IPCC) projects a minimum temperature increase of 1.4°C and projected sea level increase of 0.2m by 2100. The main contributors regarding greenhouse gases are fossil fuels burning for electricity production and utilisation in industry, deforestation, transportation system, agricultural waste burning, livestock emissions, sanitary landfill. Establishing emission inventories in estimating greenhouse gases and other air pollutants levels is also known. Emission inventories are the reports of the type and amount of the pollutants originating from the heating, traffic, industry, agriculture (agriculture, livestock) in the designated regions. In the past, different emission inventory studies have been completed in different scales around the world, such as IPCC-AR4, ECE-EMEP, EDGAR, CORINAIR. In this study, greenhouse gas generation processes and emission inventories methodology of air pollutants are taken into consideration. For this purpose, emission inventory studies prepared for greenhouse gas and other pollutants in our country and in the world have been examined and a review has been made.

*Keywords: air pollutants, greenhouse gases, emission inventory, IPCC*

**P 28. ENVIRONMENTAL IMPACTS OF THE INTEGRATED DRY GRANULATION  
METHOD APPLICATION OF FERRONICKEL SLAG**

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**ABSTRACT:** Environmentally responsible and rentable metallurgical industries put among their key objectives the development of utilization schemes of all of its middle – products. The smelting process of nickel oxides ores is almost slag process, where about 75% of the calcine pass to slag. In the New Ferronickel smelt plant in Kosova, produced slag is thrown in the landfill without adequate proper treatment. Such exploiting concepts, without any valorisation strategy, have resulted with the no effective manufacturing cost, irrational use of resources and high concentrations of polluting components. This slag represents the mid - product, with the high value effects in economy and environment. Developed research in terms of opportunities to use it, prove that the application of the integrated dry granulation method will transform slag into a resource with improved qualities (composition and properties - by adjusting it in the valuable aggregate for cement products, asphalt concrete and all other of the construction industry). In renewable energy source, through returning it in production process and reduce its pollution impacts. Quantitative – qualitative assessments and potential economic- environmental impacts, are research object in the laboratories of the New Co "Ferronikeli", Xella-Kosovo, AHN Group - Prishtina, "Ramtech - Zagreb, Silcapor - Kosovo, etc. Obtained results are presented in this paper

*Keywords: Slag, granulation, resources, energy recuperation, products performance*

## **1. INTRODUCTION**

Results that are based in the technological analysis of the ferronickel benefit from nickel oxide ore at the smelter of Kosovo show that the melting in the electric furnace is slag process, since 75% of the calcine passes in slag. The main physical - mechanical properties of slag depend on: chemical composition, formation temperature, method of production and solidification. Slags of non ferrous metals of the ferronickel high furnaces, according to their physical-mechanical properties represent very valuable raw materials for construction and chemical industries. In this smeltery under the current scheme, slag periodically streams from electric furnaces and through special channel is subject of the granulation water process. Such processing concepts have degraded most of the technological properties, not guaranteeing the quality control (properties and composition) of slag, environmental presence and effective cost manufacturing. Lack of an adequate treatment of deposits over 8 million tons of slag, which excel with high level of pollution are exposed to atmospheric rainfalls and wind, and thus have substantially degraded not only the quality of life but also opportunities for sustainable economic development. Steams of granulation process with water, particles releasing and wool of slag (in size between 30 $\mu$  dhe 5  $\mu$ ), have high capability of the emission and imitation and impacts of water drainage are just some of the findings of this study, which were sufficient for most environmental organizations to evaluate this landfill as "environmental hotspot"<sup>3</sup>. Changing approach of the slag processing together with its reuse programs will reflect important impacts in establishing balancing relations between the rational use of natural resources, sustainable economic development and environmental sustainability. Processing by the "integrated dry granulation", will result with slag aggregates in good physical condition (appropriate for producing of cement), opportunities to regenerate energy during its cooling process, increasing its applicability in industry, improving the performance of products of specific areas of industry and generally ensure a sustainable economic growth.

## 2. INTEGRATED DRY GRANULATION OF MOLTEN SLAG

Until recently metallurgical industries realize over 35% of all slag production with wet method. Such processes are accompanied by high costs, environmental problems and other technical - technological difficulties of production. Some of the modern technologies of processing of steel are realizing granulation of the molten slag through the new approaches which allow controlling the cooling process of slag and regeneration of process energy. Molten slag contains approximately 80% of the overall energy of minerals melting in the electric furnace. Under the current processing method all the heat transferred with slag is lost. In regard of the heat regeneration from slag processing according project concept "Integrated dry granulation" by Dr. Dongsheng Xie, it would potentially ensure the storing of this energy (in the form of hot air and steam). Control of slag cooling process, will result with aggregates with higher content of hyaline, granulometry appropriate state and the highest level of its application. Energy returning in the technological process may include: use of hot air before ore heating in rotary furnace or any other power plant, heating the boiler for metal casting from electric furnaces, or for steam producing and energy generation. A similar concept of granulation has been the subject of studies by a huge number of scientists, particularly in Japan and United Kingdom.

For the first time in industrial conditions as a pilot project, high furnace slag is treated (re-melted at 1400-1500 °C) in quantities of 10 kg / min by the company "Sumitomo Metals Industry" in Japan (fig.1). Such design solution conceptually will be based on the two-stage process, which would include dry granulation and heat storage in the switcher. Granulator receiver and atomism of the molten slag up to the formation of steel hot granules (8000 °C), which pass in the second stage in heat exchanger to be exposed again to draft where further cooling takes place, to maximise the heat in the storage exchanger, which as a closed system prevents discharge of vapours and gases on the environment.

All industrial analysis of the process for the ferronickel benefit in Kosovo, argue the possibilities of the slag processing by the "integrated dry granulation" method. The main impacts of the process would be: improvement of physical - mechanical properties of slag, energy regeneration via hot air (with approximate temperature of 600 °C), increasing the possibilities of exploitation of mid-process products provided, optimization of manufacturing process and environmental acceptance.

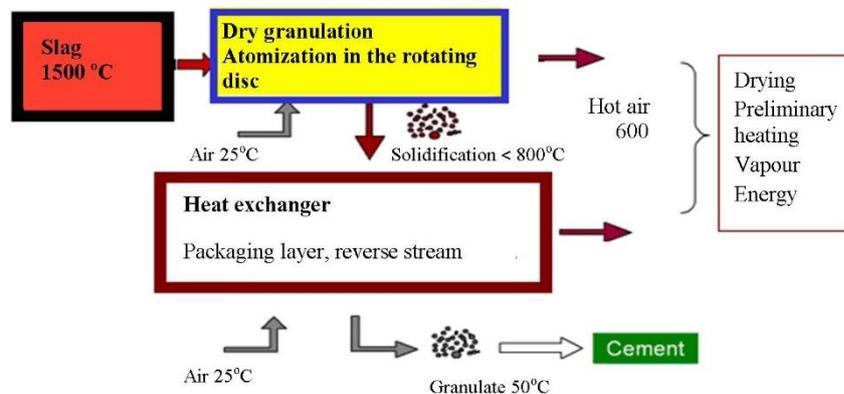


Fig .1 Concept of integrated dry granulation designed according CSRIO's

## 3. ECONOMIC-ENVIRONMENTAL IMPACTS BY APPLICATION OF THE "INTEGRATED DRY GRANULATION" METHOD OF FE-NI SLAG

Overall level of slag utilization of Ni, Cr and Cu, and knowledge about the behaviour of their products is still low. Association's reports of (Samaria, NAS, NAPA, etc.) that deal with quantity - quality assessments of metallurgical slag prove the validity and its application areas are exclusively dependent on solution design, methods of processing, marketing and organization of slag market. Practice of using the Fe-Ni slag produced in "Falcondo" in Bonao, argue that a more effective utilization of resources and energy resources through all stages of the calcine of electric furnaces in the smelter of "Ferronikeli" in Kosovo produced by current technological parameters, does not guarantee likable technical qualities, environmental presence and production manufacturing effective cost, and degrade most of its properties. Designed solutions by new methods of processing, will increase the requirements for valorisation of

over 1.200.000 t ore / year, 11.000 t Ni / year, and over 800.000 t slag/year, while according to the current approach, all mid-products of process are unused and the rate of utilization of the metal is still not high. Keeping under control parameters of slag cooling process is the main condition in the improvement of technical qualities of slag. Fulfilment of technical criteria such as structural construction, favourable relations between hyaline and crystalline phases, good interactive capability between its constituent components, correction and keeping under control of any negative attribute of slag are some of the conditions that will affect the growth of its applicability in the industry. Mineralogical construction and concentration of minerals, olivine, pyroxene, trydimite, magnesiumwustite, crystobalite, monticellit, mervinit and minerals, besides the constituent components of the process greatly depend on the slag processing method.

Even under the current parameters ferronickel slag of Kosovo progresses with most of the physical - mechanical properties (table 1) compared with the quality of mineral aggregates which are assessed as highly precious by technical performance and by the level of applicability in the construction industry. According to the basic data from the study, quality and standard technical requirements for construction mineralsandezitet, basalt and other eruptive aggregates, their replacement with the ferronickel slag aggregate processed according to method "integrated dry granulations" will display special effects through:

- Advanced technical qualities compared with traditional aggregates which are accompanied by technological difficulties and high costs during phases as: research, mining, exploration, washing, purifying, comminution, drying, homogenization, environmental protection , etc..
- Heat maximizing in storage exchanger and its return in the process will increase the production capacity, the utilization of metal coefficient, oxidation-reduction capabilities of ore in rotary furnace, and it will reduce specific energy consumption and eliminate the majority of technical-technological barriers and generally optimize the process.
- Savings of connecting materials (gypsum, lime, cement, bitumen, etc.) in cases where it is used as aggregate to replace the traditional aggregate or as additional material.
- Benefits from increased performance of slag products through the long- life, the coefficient of friction, resistance towards environmental impacts during exploitation etc when it will be used as aggregate for asphalt concrete production
- Benefits from capital decreasing of production costs, savings in maintenance and management of industrial landfills, re-cultivation, etc.

Cooling of 1 (ton) of slag melt in temperature of 1500 °C to environment temperature, contains heat from 1.8 to 2.5 GJ. Calculation of produced amount of slag from electric furnace (2 \* 1280 t / day), its preservation and its return in the process would be a valuable potential energy. Keeping and re-use of energy released by the cooling process can serve the function of:

- drying in the oxidation reduction process of ore, through returning of the hot air,
- decreasing of specific energy consumption (according to empirical data, slag transfers 80% of the overall heat from the melting of the nickel oxide ores and raising of the temperature of 1°C is equivalent to the reduction of specific consumption of electricity in electric furnace of 5.6 (kWh / t charge),
- pre- reduction of ores and partial reduction to the metal, with energy savings of about 300 (kWh / t fry) electric furnace,
- reduction of manufacturing costs, the technological progress and increasing production capacities, and the economy of the whole production process,
- regeneration of energy through the production of steam for production of electricity, production of technological steam for drying of the ore, heating of the boilers for the metal acceptance,
- as the environmental requirements are increasing, Kosovo slag landfill, according to the present state is counted as "environmental hotspot" because of the non utilization and growing layer of slag. Slag processing by integrating closed system will increase the degree of applicability of this mid-product, will reduce the polluting effects from useless expenditure during slag cooling, will reduce pollution from vapour release, other solid particles and overall reduction of heat emissions from "greenhouse effect" which comes during the heat release in the atmosphere,

- reducing water consumption and its content in slag (according the current method contains 15-20% water), and which will also decrease the polluting effects of Ni, Co, Cu, Fe +2, Fe +3, and other heavy metals transferred by water drainage during transport and slag storage .

**Table 1.** Properties of some types of mineral aggregate and slag of the Ferronickel in Kosovo

Properties	Andezite	Bazalt	FeNi slag
Durability against consumption and erosion (cm <sup>3</sup> /50 cm <sup>2</sup> )	8,05	8,65	7,52
Specific density (g/cm <sup>3</sup> )	2.640	3.250	2.80±3
Inhale of water for large grain aggregate(%)	0.80	0.73	0.56
Tha sand equivalent (%)	76,2	76,5	95,3
Inhale of bitumen by aggregate (%)	100/90	100/95	100/98
Illustrative values of the rock	63	59	55
Sustainability from dynamic shocks (breaking and consumption ) – LA % (m/m)	12	11,8	10
Sustainability of crushing in cylinders % (m/m)	10,1- 14,5	11,3 – 13,2	19,7 - 20,3

#### 4. DISCUSSION OF RESULTS

Slag of electric furnaces "of Fe-Ni smelter" in Kosovo is melted ore, created during the reduction of nickel oxide ore. It represents a complex oxide system with excellent physical - mechanical properties. Processing of slag according the current manner does not guarantee control of the solidification process, and thus the physical - mechanical properties. Cooling under the pressure of water has stimulated high concentrations of crystalline phase, weakening the binding properties, small fractions and generally degradation of technical properties that limit its application. Slag production by "integrated dry granulations" method enables slag products with high content og hyaline, appropriate for the benefit of quality cements. Use of heat released during slag cooling will be used to produce steam and electricity production. Estimates of economy and manufacturing costs of slag processing according to the study( having in consideration slag with high content and regeneration of energy) would result in savings up to 23% of electricity consumption, 48% of fuel oil consumption, 27% of manufacturing costs, and overall optimization of the production process of feronickel .

#### 5. CONCLUSION

Processing of the feronickel slag with "integrated dry granulations" method would be a key factor for valorisation of deposit of 8 million tonnes in valuable resources, which still continue to be treated as industrial residue problem for the environment, increasing the coefficient of metal, reducing maintenance costs for environmental protection, generation of new working places, reducing imports and generally increase the gross domestic product. The application of the method of "integrated dry granulations", compilation of the program on industrial waste management, marketing and organization of the right market of slag will ensure not only slag open market, but also the energy regeneration benefits through savings on water, energy resources (electricity and fuel oil) etc, and optimization of process through recovering of energy accumulated during the slag cooling process.

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**P 29. STUDY OF EMBRYOGENIC AND HISTOGENESIS TECHNIQUES OF SP.  
CASTANEA SATIVA OF THE BURREL AREA**

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**ABSTRACT:** Chestnut is one of the most remarkable trees in terms of greatness, hardness and endurance, as well as the most nutritious fruits in terms of nutritional value. It is not much known as industrial useful wood and therefore the use of this wood is scarce in the furniture and production of wood for construction. In patriarchal times, chestnuts have been used as wood for the production of beams in the construction of houses because it is distinguished for a high resistance to atmospheric and biological agents. Its fruits are used as nutrition not only delicious but also nourishing. Traditional culture has recognized chestnut as a tree of bread or as a means of exchange with other foods. Economic importance, even though it has been declining, chestnuts still occupy an important place in the agricultural economies of Albania, especially with the recent efforts of the Albanian government to turn the Albanian cultural identity as its representative, as in the highly urbanized foreign markets is especially demanding as a bio species. For livestock this species has emerged as valuable food for their fattening by farmers. Green dough and fruit are very nutritious, and farmers use these for feeding small livestock as sheep or goat in the dry summer period and that of dense autumn rains. Green Fruit of *Castanea sativa* Mill carefully squeezed without damaging the embryo brought from the village of Gjoçaj with geographic coordinates 42°11'78"N 20°06'29". We have used cleavage methods, colloid methods, and biochemical protocols.

*Keywords: Chestnut, nutrition, Castanea sativa, colloid method.*

**P 30. OPEN MINES AND ENVIRONMENTAL PROBLEMS**

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**ABSTRACT:** Many environmental problems may arise in the vicinity of open pit mines. These include water pollution, green tissue damage, soil pollution, image pollution, acid mine drainage, gas and dust emissions. In addition, the removal of the surface soil with open mining and the destruction of the forest areas in general and changing the soil profile in such regions is also an important problem in terms of soil quality. In open mines, pollutants in different gas and particulate form are also released during production. These emissions can be seen during drilling, blasting, transportation, unloading, storage. These emissions can be seen during drilling, blasting, transportation, unloading, storage. These pollutants can affect not only the quarry area but also the near and far surroundings. Atmospheric conditions, the size and shape of particulate matter are also important in this transport of pollutants. Fine particles can also be transported to long distances for long periods of time. Human and living health can be affected by this situation and structural materials may be damaged. The most common effects on human health can be listed as asthma crises, decreased lung function, dyspnea, irregularities in heart rhythm, before time deaths from heart lung diseases according to the duration and concentration of exposure to dust. This study includes a literature review on the environmental problems, particulate pollution and effects of open mines.

*Keywords: open mining, environmental problems, particulate matter, human health*

**P 31. PARTICULATE MATTERS AND ITS EFFECTS ON HUMAN HEALTH**

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**ABSTRACT:** The impact of air pollutants on health is one of the major problems of the world in the past and today. Air pollutants are present in gas and particulate form sourced by natural or anthropogenic. Particulate matter (PM) is called particles which are separated from each other in solid or liquid phase which can be suspended in air for a while. The PM can be formed released directly by the sources of pollutants (primary) or by particulate condensation of gases or by chemical reactions in the atmosphere (secondary). PM is directly released into atmosphere from various natural sources (soil, dust storms, sea sprays and ocean surfaces, volcanoes, forest, pasture fires, etc.) or anthropogenic sources (heating processes, garbage incinerator, steam generators, fires, domestic heating, traffic, agriculture and construction activities. PM sources differ in size ranges, formation mechanisms and chemical compositions. Therefore, they have various chemical and physical properties. Cancer containing organic chemicals (such as PAH, furan) are very dangerous for health. Zinc ammonium sulfate in the smoke components can be converted into sulfuric acid in the lung. Since soot, fly ash, gasoline and diesel exhaust particles contain cancers components such as benzo (a) pyrene, cancer evidents can be increased if they are inhaled for a long time. Health effects vary depending on the particle size and concentration. Health effects vary depending on the particle size and concentration. Especially in the range of 0.002µm-10µm is important for health. Coarse particles (PM10-2.5) can worsen respiratory disorders such as asthma and may cause negative affect both lung functions and heart rhytm depending on the duration of exposure. Fine particles (PM2.5) may cause various health problems, including before time death. The aim of this study is to review the effects of particulate matter pollution and its effects on human health.

*Keywords: air pollution, particulate matter, human health*

**P 32. THE EFFECT OF WHOLEMEAL SOURDOUGH ON THE QUALITY OF SHORT  
DOUGH BISCUITS**

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**ABSTRACT:** Sourdough fermentation has been also used in the production of several bakery products like cake, cracker, and pizza. Some physical quality losses such as decreasing the spread ratio and increasing the thickness and hardness value have been observed in the production of wholemeal flour (WMF) biscuits. The aim of this study is to reduce some physical quality losses of WMF biscuits by using WMF sourdough fermentation. WMF biscuits with the substitution level of 10%, 15%, 25%, 35%, and 50% wheat flour were produced and compared with WMF sourdough biscuits containing same WMF ratio. Spread ratio of the biscuits decreased, while the wholemeal flour ratio increased in the formulation ( $p<0.05$ ). The hardness value of WMF sourdough biscuits were not significantly different than control biscuits (0% WMF) while the addition of wholemeal flour increased the hardness values WMF biscuits ( $p<0.05$ ). The brightness  $L^*$  value of the wholemeal flour biscuits decreases when adding 25% wholemeal flour, while  $a^*$  value (redness) increased ( $p<0.05$ ). The control biscuits and WMF sourdough biscuits containing 15% WMF showed the highest general acceptability scores according to the sensory analysis. The lowest scores were obtained with the increasing level WMF in the WMF sourdough biscuits. Reduction the hardness value and raise in the sensory scores were observed when the 15% WMF ratio were achieved by WMF sourdough fermentation. It was concluded that sourdough fermentation could be used to reduce the hardness of whole wheat flour biscuits in this study.

*Keywords: Biscuit, wholemeal flour, sourdough fermentation*

**P 33. IN LAMPS POWER LOSSES' AVAILABILITY IN BUILDING HEATING**

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**ABSTRACT:** Lighting lamps and armatures plays an important role in electrical energy consumption. A lighting device, regardless how high luminous efficiency, it has minimum 75-80 per cent of energy from taken power supply radiates heat around. Incandescent-based lighting devices, you can find the 95% of those. While this ratio is determined, it is based on the wavelengths of light that can be seen by the human eye. In this study, which is required for the formation of luminous flux, a portion of the energy losses, aims to use for heating in winter conditions. Exterior lighting devices to be mounted near of a high building as factories, schools etc. to be taken outside the building were discussed. Thus, the heating energy savings can be achieved modelled for the purpose of application, results are shown that may occur.

*Keywords: Lighting, Lamp, Heating, Environmental, Efficiency*

**P 34. HYDRAULIC MODELING OF POTABLE WATER INFRASTRUCTURE SYSTEMS**

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**ABSTRACT:** Hydraulic modeling is a mathematical model of the system by analyzing the hydraulic behavior of the infrastructure systems (water, sewage, drainage and flood). Mainly with hydraulic modeling in potable water lines; analysis of hydraulic behavior of lines, traceability and sustainability of the system, leak-leak detection and pressure management. In order to create hydraulic modeling, it is very important to digitize existing facilities in the field and to verify the numerical data. Simulation of potable water lines by hydraulic modeling and developing software technologies have become easier today. The location of the measuring points and the measurement equipment in potable water systems are extremely important. By revising the data in the field with the mathematical data, the calibration of the model plays a very important role in terms of close hydraulic behavior analysis. The system management is ensured to be economical, stable and sustainable as a result of the analysis of the production and operating costs of the system with the hydraulic modeling, leak-leakage and pressure management, the traceability of the system and the early warning systems and the sustainability of the system with more linear and rapid data. In this article, the aim of hydraulic modeling in potable water infrastructure systems, the necessary measurement, data and software to be performed, the adequacy of the Konya Province scale and the determination of the current situation, the benefits and the evaluation of the results are included.

*Keywords: Hydraulic modeling, potable water management, hydraulic analysis*

**P 35. ANALYSIS OF ICHTHYIC TYPES PARASITES IN THE ALBANIAN PART OF  
OHRID LAKE**

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**ABSTRACT:** The study was conducted in some areas of the Albanian part of the shore of Ohrid Lake. Parasitological evaluations were carried out in three sampling stations. In all cases, both during field and laboratory analysis, the parasitological examination was carried out using fresh fish or canned fish, for a cohort, in formalin interval 4%. The largest number of taxonon consisted of Monogonea (7 taxonon or 28% of the total number of taxonon identified). The second group was Nematoda helminths (6 taxonon or 24% of the total number). From the group crushed worms The Ohrid Lake fish cattle had parasites 4 taxonon (16% of the total number). We have found the same degree of representation (from 2 taxonon or 8% of the total number) for Ciliophora monocytes, Digenea typed worms, Acanthocephala poultry and Crustacea arthropods. Squid (*Squalius cephalus*) was the species of fish that carried the largest number of parasitic species (9 species).

*Keywords: Ohrid Lake, parasitological examination, species of fish, parasitic species .*

**P 36. IMPACT OF POLLUTION CAUSING WATER TURBIDITY ON OHRID LAKE OVER  
TRANSPARENCY VALUES SECCHI (ZSD, m) AND EUPHOTIC DEEPH (Zeu, m)**

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**ABSTRACT:** In the Ohrid Lake the transparency of the waters of the Tushemisht area, for the depth range of 1.0-5.0 m was higher compared to the transparency of the waters of skater's jets area. In the depths that are included in the bathymetric interval of 10.0 m to 30.0 m the differences in ZSD values between these two lake areas ranged from 0.14 m to 0.01 m. These values show that water transparency tends to be unified with the transition from small bathing values to its relatively high values. The Diapason of differences proved in average transparency Values Secchi may be indicative of the approximate levels of turbidity and water pollution in the areas of skater's jetty and Tushemisht and for less pollution of water in the Lin area, compared to the two other areas. The total average euphotic depth ( $Z_{eu} = 7.105 \pm 0.797$  m) resulted 3.06 times greater compared to the general average value of the Secchi  $ZSD = M = 2.325 \pm 0.287$ . There is strong correlation between these two parameters ( $r = 0.967$ ).

**Keywords:** Secchi depth, euphotic depth, turbidity, water pollution, conversion factor.

**P 37. DEVELOPING A MOBILE APPLICATION WITH CULTUREL HERITAGE  
CONTENT**

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**ABSTRACT:** The most important feature that makes our country different from The Worlds and European Countries is the richness of our natural and cultural heritage. The capital of the Hitite Civilization (Hattusha), which has been established in Anatolia on the land of Anatolia, has established its first central state in Çorum, Anatolia. As a result of a series of works carried out jointly by the Governorship of Çorum, Çorum Municipality, and Hitit University, the city has become one of the nine values World Heritage List at UNESCO. Photographs are done and the cultural values are collected in books, this culturel datas had published at Çorum Provincial Culture and Tourism Directorate Website. Traditionally, archives consist of content (historical documents, manuscripts, books, documents, audio and visual materials) in electronic libraries of all kinds of electronic objects that create historical perceptual information in culture of Çorum. By combining these data with geographic data, mobile app can be discovered by providing mobile access to a public cultural heritage with the constant access to internet of all ages in the present age, providing the users with the objects that interest them and providing them with maps showing their current location.

**Keywords:** Culturel Heritage, Mobile Application, Geographic Location, Smart Phones



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