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O 25. AIR QUALITY OF O_3 AND NO_2 TIMELINE CHANGES IN KONYA CITY CENTER

Hysen Mankolli[1*], Sukru Dursun[2], Huseyin Toros[3]

[1]*Expert in Ecology, Plainfield, Illinois, USA*
[2]*Konya Technical Un, Engineering and Natural Science Faculty, Konya, Turkey*
[3]*ITU, Faculty of Aeronautics and Astronautics, Maslak, Istanbul, Turkey*

E-mail: *hysenmankolli@yahoo.com, sdursun@ktun.edu.tr, toros@itu.edu.tr*

ABSTRACT: In cases that air quality will change the living health or environmental quality, the composition of the air should not change or the substances that are dangerous to be in the air that not be present in the atmosphere. Air pollution, which is a result of urbanization and fuel use brought about by different life styles, can create a dangerous impact area on a global scale as well as in Turkey. Air pollution has a significant impact on human health, so the issue of air quality is of great importance all over the world. The management of the parameters related to the outdoor air quality is carried out in accordance with the Air Quality Assessment and Management Regulation. A country's or region's success in improving and protecting the air quality, local and national air pollution problems, and the support of citizens who are well informed and informed about the developments in pollution reduction are needed. For the investigation of air pollution in Konya, NO_2 and O_3 parameters have been evaluated. The stations are statistically analysed according to the measurement results made in the required periods. As a result of this, it is aimed to study on the continuously measured parameters and their effects, what the necessary measures should be in order to reduce the effect and what the applications could be by evaluating and graphing the data. In this study, the effect of temporal NO_2 and O_3 changes on air quality was evaluated.

Keywords: *Environment, Temporal change, Air quality, NO_2, O_3*

INTRODUCTION

Air pollution is the presence of pollutants, which can be found in solid, liquid and gaseous form, in the atmosphere in an amount or for a period of time that will harm human health, living life and ecological balance or prevent the use of material objects from life. The problem of air pollution emerged after the industrial revolution and especially in industrialized areas. Development is the whole of industrialization (Manisalidis et al., 2020; Dursun et al., 2021). Increasing environmental problems and the deterioration of the ecological balance caused by these problems, the health problems faced by living things and the decrease in living diversity, have presented the environment-friendly development model as a sustainable development model, and that the continuation of the world owes to the peace and balance between development and economy, ensuring the safety of all living things. has brought. Air pollution is only one of the environmental problems and it has become the most binding type of pollution that makes countries responsible to each other in the globalizing world (Vadrevu et al., 2017; Fenger 2009; Kılıç et al., 2020). All combustion processes, emission of combustion processes required for industry, emissions of fossil fuels required for heating, emissions from agricultural combustion, forest fires, emissions from motorized or mobile traffic, mining, process leaks, are the most important sources of nitrogen oxides (Molina 2021; Toros et al., 2013).

Air pollution, which is a result of urbanization brought about by modern life, has a global impact as well as local and regional. Due to the significant effects of air pollution on human health, the issue of air quality is given great importance all over the world. In order to solve air pollution problems and determine strategies, the scientific community and the relevant authority have focused on monitoring and analysing pollutant concentrations in the atmosphere. In addition to the responsibilities of the authorities regarding the protection and improvement of air quality, it is also among their responsibilities to provide the public with up-to-date information on air pollution through communication tools, since it is an issue that directly affects public health.

Ozone (O_3), which is a toxic pollutant near the earth's surface, consists of the combination of three oxygen atoms and is of vital importance in the stratosphere layer. Ozone, which is found at a very low

rate compared to the basic gases that make up the atmosphere, both affects the climate and plays an important role in the protection of living things on the earth's surface. Ozone, in particular, eliminates most of the ultraviolet rays coming from the sun together with oxygen within the stratosphere layer and prevents these rays from reaching the earth's surface, thus eliminating the corrosive effect. Nearly 90% of the ozone in the atmosphere is located in the stratosphere layer, which is between 10-50 levels from the earth's surface. The remaining 10% of ozone is in the troposphere layer, which extends from the ground to about 10-15 km (Wright, 2003). The ozone partial pressure is usually highest between the 15th and 25th kilometres in the lower stratosphere, and the maximum ozone density (10 ppmv) is reached between these distances. However, ozone molecules of different concentrations are located at a distance of about 50 km from the ground, and the total amount of ozone in this range is often called the ozone layer (Deniz et al. 2013; Mutlu et al., 2019).

Stratospheric ozone occurs naturally in the atmosphere and is naturally degraded in the stratosphere. In this region, ultraviolet (ultraviolet) radiation from the Sun separates the normal oxygen (O_2) molecule into two oxygen atoms, and then the O2 molecule combines with the O atom to form ozone (O_3). When atmospheric O_2 combines with O, some molecules, such as nitrogen, react, removing excess energy. If excess energy is not removed during the reaction, ozone (O_3) is converted back to oxygen (O_2+O).

In 1987, the Montreal Protocol on Depleting Substances of the Ozone Layer was signed. The main purpose is to eliminate all chemical substances that cause ozone depletion. The Protocol was subsequently amended four times (1990 London, 1992 Copenhagen, 1997 Montreal, 1999 Beijing). Turkey attended the Vienna (1985) and Montreal (1987) meetings and signed the Protocol with the London (1990) and Copenhagen (1994) amendments (Grubb et al., 1999; UN ECE, 2002; UN EP, 2002). In this framework, all countries of the world are tasked with the protection of stratospheric ozone and adequate measures should be taken in cooperation.

However, the ozone concentration at the ground level should not threaten the health of humans and other living things, and it should also be maintained at a level that will not harm the goods. The effects of ozone and photochemical oxidants on human health have been reported (Ertürk, 1993). For this, legal limits have been determined in the regulations related to air quality. Since the most important factor in ozone formation is caused by natural solar radiation, it will not be in the hands of people to limit it. However, it is important to take protective measures in case the measured values are possible to affect human health.

It is known that air pollution reduces the quality of life by directly or indirectly affecting human health. Today, local, regional and global problems due to air pollution concern all societies. Due to reasons such as rapid and intense urbanization, wrong planning and location of cities, increase in the number of motor vehicles in the city, irregular industrialization, poor quality fuel use, topographic and meteorological conditions, air pollution can be experienced in our big cities, especially in winter. Sulphur dioxide, which is the oldest and most effective in air pollution, can interact with other pollutants as it oxidizes and turns into sulphate and sulfuric acid after reaching the atmosphere. Together with other pollutants it can form drops or solid particles that can be transported over great distances. Sulphur dioxide and oxidation products are removed from the atmosphere through dry and moist deposits (acidic rain). Particulate Matter, the term denoting solid particles in the air, are pollutants as old and effective as SO2. So we have more information with these two parameters. Particulate Matter does not have a uniform chemical composition and can vary depending on its source.

After these two pollutants, Nitrogen Oxides (NO_x) is prominent in atmospheric air. Nitrogen monoxide (NO) and nitrogen dioxide (NO_2) are the main ones, but other nitrogen oxides form. Nitrogen oxides are usually (at 90%) depleted as NO. It is formed as a result of the reaction of NO and NO_2 with ozone or radicals (such as OH or HO_2). NO_2 is one of the most important air pollutants in urban areas, as it is the nitrogen oxide type that most affects human health. Nitrogen oxide (NO_x) emissions occur from sources created by humans. The main sources are vehicles in land, air and sea traffic and incinerators in industrial plants. Inversion is when warm air sits above cold air, preventing vertical mixing of air. Thus, the pollution is collected in the cold air layer near the ground level (Kara et al., 2019; Kara et al. 2020).

Nitrogen oxides and ozone concentrations are directly related in the atmospheric environment. Ozone (O_3), consisting of three oxygen atoms, is formed in special summer, sunny weather and hot seasons (NO_2 + sun rays = NO+ O => O+ O_2 = O_3). Ozone production is continuous and variable and is also affected by some pollutants in the atmosphere ((EPA-97/12; Toros 2000). It accelerates the formation of VOC and carbon monoxide. In some comparisons, ozone and other pollutants do not mix directly

with the ambient air. Near the surface ozone is composed of complex structures. Ozone is a very strong oxidizer and interacts with other air components in different ways. The effect of ozone in terms of public health is directly dependent on the ozone concentration and contact time (Abdul-Wahaba et al. 2005; Brown et al. 2006).

In this study, it is aimed to evaluate the ozone and nitrogen dioxide values, which are two important pollutants in the atmospheric environment, in Konya city center. In this evaluation, the variation and interaction of the values at different stations in different periods of the year will be investigated. By comparing the obtained data with national and international standards, information about air quality will be obtained.

MATERIALS AND METHODS

Research Area

Konya province has the largest surface area in Turkey in terms of surface area and is located in the central region of Turkey. The large area of the plains in the province, which consists of many plateaus, is important in the development of agriculture. The city, which is an agricultural city, is developed in industry. There are 4 big Organized Industrial Zones (OIZ) in the city center. 2/3 of the population of the province, which is in the top 5 in terms of population density in Turkey, lives in the city center. The development of the industry affects air pollution depending on the quality and quantity of fossil fuels used as an energy source depending meteorological and topographical structure. In addition, due to the fact that the industrial zones are in the direction of the prevailing wind, it causes an increase in air pollution in the winter months. Fossil fuel consumption, which is used for heating purposes, can also be shown as one of the sources of air pollution, since the winter months are very cold. The fact that the city center settlement area is on a flat plain and the high mountain ranges extending in the south-southwest direction affect the atmospheric distribution of pollutants formed in the city center by the prevailing winds in the north-northeast direction. For this reason, since the distribution of exhaust gas emissions in traffic is also affected, this can be counted among the causes of air pollution. Thus, besides the sources of air pollutants, the topographic structure and meteorological conditions in the region determine the formation of air pollution.

Measuring Stations

Air pollution in Konya city center has been determined by 2 air quality measurement stations for a long time, depending on its population. Their locations were determined in the city center by considering the living spaces of people and sources of air pollution. 2 of these stations belong to Environment-Urbanism Banak and 2 of them belong to Konya Metropolitan Municipality. Locations of air pollution measuring two devices belonging to the Ministry of Environment and Urbanization in the city centre of Konya (responsible Southern Central Anatolia Clean Air Centre Directorate, 2020), two air pollution measurement device belonging to Konya Metropolitan Municipality and thee new stations were include during last year in Konya city centre is given in

Three air quality monitoring stations belonging to Konya Metropolitan Municipality, which is affiliated to the National Air Quality Monitoring Network in Konya Province, and there is continuous sulphur dioxide (SO_2) particulate matter (PM_{10} and $PM_{2,.}$), nitrogen oxides (NO_X, NO, NO_2), ozone at the stations. (O_3), carbon monoxide (CO) and meteorological parameters are measured by automatic devices and are taken as hourly average values.

A total of 9 stations belonging to the Ministry of Environment and Urbanization operate in Konya, and 2 Konya Meram and Konya Selçuklu (Karkent) stations can be viewed online at www.havaizleme.gov.tr. Efforts are underway to connect all stations to the National Air Quality Monitoring Network (Table 1).

Measurements

Evaluation of measurements s network of four monitoring stations is in operation in the Konya region; Two monitoring stations are operated by the Metropolitan Municipality, while both are operated by the

Provincial Directorate. Particulate matter (PM_{10}) and sulphur dioxide (SO_2) are continuously measured to generate hourly average values at all stations. Both monitors are frequently calibrated and maintained to function properly. It is assumed that the results from each monitoring station represent a relatively large area.

During the data evaluation, if there are indicators indicating the existence of a short-term or longer-term special situation, the data are examined to clarify this situation. Special nitrogen dioxide (NO_2) and ozone (O_3) measurement campaigns have been carried out for a limited time (4 weeks in summer and 4 weeks in winter) to complete the air quality assessment with the data of pollutants that have not yet been measured. These pollutants are included in the regulation and are relevant substances in terms of health. This pollutant was added to the parameters of the specific measurement campaign to verify the low SO_2 levels observed in continuous monitoring in the network. These parameters were taken from the Konya Airport meteorology station, as meteorological parameters greatly affect the pollution levels. The evaluation results for each parameter are presented in the following sections and are compared with the limit values given in HKDYY where appropriate.

RESULS

Although ozone is considered a harmful gas for the environment in the atmosphere we breathe, that is, in the layers of the atmosphere close to the earth's surface, it has a very important function as it protects the living life from solar radiation with the layer it forms in the stratosphere in the upper layers of the atmosphere. ground level ozone; Nitrogen oxides and hydrocarbon primary pollutants are secondary air pollutant parameters formed by photochemical reactions accompanied by solar energy. Today, ozone concentrations are constantly increasing in residential areas, especially in developed countries. Similarly, the same increase is seen in rural areas and large forest areas. If there were no photochemical reaction, the ozone concentration in the atmosphere would be expected to increase continuously. Ozone is produced and decomposed by some photocatalytic reactions, so that a certain ozone concentration in the atmosphere remains relatively stable (Shayia et al, 2019).

The average daily ozone concentrations of the three air quality measurement stations in the province of Konya for the last 3 years (2018-2020) are shown in Figure 2. In Konya province, ozone measurements are not available at all stations, and activities related to the establishment of systems that can perform measurements over time and regular measurement of measurements are carried out. While the measurement process was started at only 2 stations in 2018, sufficient measurements could not be made in all periods. Towards the end of 2019, ozone measurement studies were started at the 3rd station. While 3 ozone measurements were made in 2020, the number of missing data decreased. In 2021, studies on ozone measurement were started at other stations. When the measurements of 2020 are examined, it is seen that the values in the summer months are higher than the winter months. It is seen that the data of Erenköy station among 3 stations are higher than the other two stations (Meram and Karatay) and the summer values are around 3 times the winter values. Since the main source of ozone formation is solar radiation, it is estimated that ozone formation is higher in summer months with the reduction of air pollution as well as effective daylight. Considering the values in Figure 2, although the air quality for 2020 is almost similar in all 3 regions, it is thought that there is a clear improvement in the Erenköy region during the summer months.

Nitrogen oxides have an important place and effect among air polluting gases. It is a very important resource for the plant world in the ecosystem after it returns to other forms, which is in the highest ratio in the composition of the atmosphere and does not have any negative effects on living life as it is. The most important source of nitrogen in the soil is provided by the reduction or oxidation of atmospheric nitrogen. For this, it is transported to the soil through nitrogen-fixing microorganisms and atmospheric reactions. Atmospheric nitrogen (N_2) produces nitrogen oxides (NO_x), especially nitrogen monoxide (NO) at high temperature (above 1,100 ºC) in combustion chambers. In city centres, it mostly occurs as a result of combustion in automobile engines. The main source of this gas comes out as a result of the breakdown of nitrogen fertilizers in the soil and reaches the atmosphere. According to the results of the research, the effect of NO_2 combined with other gases is greater than the negative effect it has alone. The gas rising up to the stratosphere layer damages the ozone (O_3) layer.

Daily mean concentration of nitrogen dioxide for 3 air quality stations (Erenköy, Karatay and Selcuklu) of Konya Province during curfews imposed due to the pandemic Corana-19 and early period in 2020.

Figure shows daily average NO_2 values of three stations and while the data of 3 stations were 40 µg/m^3 before the pandemic measures in 2 different periods, they do not show the period average below 20 µg/m^3 during the pandemic measures period. While the values of the Seljuk sage before the pandemic-measures were considerably higher than the other 2 stations and were 70 µg/m^3, it decreased to around 30 µg/m^3 during the period when the pandemic measures were implemented. The NO_2 values of the Karatay region have also decreased a little with the pandemic measures; but there was no significant change in Karatay station data. The decrease in the Seljuk region caused a change in the averages of the 3 stations.

In Second Period (16 March-31 May 2020), it is clearly seen lockdown effects on air pollution. It is observed that concentration of NO_2, has decreased by 55% accordingly thanks to measures such as the prohibition of transportation to big cities, curfews, and stopping of flights and O_3 values, have increased by 54%. The closure of businesses such as cafes, restaurants, coffee shops, shopping centers, and the suspension of the operations of cement and wood factories in Konya has a great role in increasing air quality especially.

CONCLUSION

Air pollution is a consequence of the modern age. With developing technologies, we can easily extract fossil fuels that have accumulated underground for millions of years. There is a frenzy of overproduction and consumption. In some parts of the world, people cannot reach the most basic resources of land, water, energy and food, while in some places they live in extreme luxury and waste is not counted. Unfortunately, the deprived people suffer more from the environmental destruction caused by excessive production, purchases and consumption. In the cities that we have built in a cramped order and confined ourselves to living in, the gas residues of mass production to meet the energy required for transportation, heating/illumination and our ever-increasing and diversifying consumption needs have filled the air with dense gas and dust residues. The most important factor polluting the air is combustion. Ground-level ozone, as an air pollutant parameter, primarily causes adverse effects on human health. On the other hand, it causes negative effects on forests and agricultural production. Ozone is produced locally in air pollutant sources and causes an increase in concentration on a local scale by being carried by air movements that cross the borders. In this respect, it is also defined as a regional-scale air pollutant parameter. Ozone is a very strong oxidizing agent. Ozone can seriously destroy the respiratory system. Since most of the ozone reaching the lungs cannot be excreted through the respiratory tract, ozone can cause deterioration in lung functions, changes in the structure of red blood cells, and irritation of the eyes, nose and respiratory system.

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