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O 48. EVALUATION OF GEOLOGICAL PROPERTIES OF SOLID WASTE LANDFILL

Bilgehan Yabgu Horasan[1*]

[1]*Selcuk University Sarayonu Vocational School of Higher Education Department of Environmental Protection and Technologies Sarayonu / Konya / Turkey*

E-mail: *bilgehanyabgu@gmail.com*

ABSTRACT: It is known that consumption and wastes increase in parallel with the increasing population, rapid urbanization, and industrialization. For this reason, the determination of solid waste landfills has become very significant. The geological characteristics of the region, which are included in the location criteria, have a significant impact. In this study, some of the geological and geotechnical parameters in Konya and the results from other studies were compared. A clay unit with low plasticity was observed and its properties were evaluated after the drilling results.

Keywords: *Konya, Solid Waste, landfill Area, Settlement, Geology*

INTRODUCTION

Urbanization, rapid population growth, industrialization, and rapid technological developments have brought many environmental problems with them. The amount and type of solid wastes produced by humans are increasing day by day along with the increase in population and needs (Karaca, 2008; Ozturk and Arici 2021). The problem of disposal and storage of solid wastes in a healthy and economical way has gained more importance compared to previous years (Yesilnacar et al. 2005). When determining the landfill areas, it is very important to know the geological-hydrogeological characteristics of the region in the process of storing wastes and making them harmless to the environment. (Karaguzel and Mutlutürk, 2005; Yılmaz, 2008). Landfill area selection is a multidisciplinary study subject, primarily geological factors should be carefully examined in landfill area selection. There is no single method in selecting a location for any engineering structure, and the methods may vary due to the different geological features and units of each region. Therefore, different geological models may arise in different regions (Yılmaz, 2008). It will be more appropriate in terms of design and planning to prepare the geological model engineering structure by considering the geology of the region. In this study, some of the geological and geotechnical properties (engineering properties of the ground) of the Konya and Kırıkkale solid waste landfills were evaluated by comparing them because they have similar geological properties.

MATERIAL AND METHOD

For this study, two 20 meters deep foundation drillings were made in Konya solid waste landfill. By using the dry system (Auger), 3.00 meters deep tube sample (UD) was drilled and Standard Penetration Test (SPT) was performed every 1.5 meters. Natural water content, Atterberg limits, and particle size distribution tests were carried out on the sample taken in accordance with TS 1900-1 and TS 1900-2 (2006) standards. The obtained results were evaluated by comparing them with the results of different studies published in Turkey and the world.

GEOLOGICAL SETTINGS

Konya Solid Waste Landfill Area

In the study area, the units on the surface are divided into three main groups: basement, ophiolitic and cover units (Figure 1). The basic units representing the first group are mostly delimited by the dip-slip Konya Fault Zone in the western part of the city and they morphologically form mountainous areas. The basic units consist of Sızma and Ardıçlı groups belonging to the Bozdağlar Massif. The ophiolitic units representing the second group are also seen in the western part of the city and in the Yükselen region

and Altınekin regions. The ophiolitic units consist of the Hatip ophiolite complex and Çayırbağı ophiolites. The third group of cover units is mostly concentrated in the settlement area and the surrounding plains. It consists of volcanic products and young clastics developed in the same period with the terrestrial and lacustrine clastics belonging to the Dilekçi Group, which extends on the basic units with an angle unconformity. During the Pleistocene and Holocene periods, different types of clastics occurred due to streams that have Lake-terrestrial transitions and carry materials into the lake (Arıcı, 2019; Arık and Ozturk, 2011; Ozturk and Baykal 2012; Ozturk and Baykal 2020). Konya Group, which is generally alluvial, consists of mainly yellowish brown, slightly cemented siltstone, sandstone, and conglomerate, which covers a significant part of the Konya province settlement area. Siltstones are the dominant rock type and contain sandstone interlayers. Konya Group has a large number of meshed stream facies representing the Pliocene Pleistocene transition, some of which can be separated lithologically and show the distribution in a size that can be mapped. These units consist of Beşyüzevler, Konya, Aslımyayla, Sakyatan and Göçü formations from west to east (Arıcı 2019). The landfill area is built on the Konya formation. Konya Formation is composed of yellowish, brown slightly attached siltstone, sandstone, and pebble stones. This unit covers the entire study area and includes densely residential areas and clayey and silty soils where agricultural activities are carried out (Arıcı 2019).
According to the geological geotechnical research report conducted in the landfill site, when SPT - N30 values are taken into account, it was found as Medium - Solid, according to Consistency Index it was found as Hard, and according to the liquidity index, it was found as plastic - solid or semi-solid. The natural unit volume weight is 18.2 kN / m3 and ML class is a fine-grained ground composed of inorganic silt up to 2.50 meters in the study area, rock flour, very fine sand, silty or clayey fine sand, CL-class inorganic clay with low plasticity, silt with low plasticity, pebbly clay, sandy clay, silty clay, weak clay (Horasan, 2006).

Kırıkkale Solid Waste Landfill Area

The geology of the Kırıkkale solid landfill is the unit called the Kasımağa formation, in which limestones and andesite blocks are observed occasionally with alternation of pebble stone, sandstone, claystone. There are units belonging to İncik and Kızılırmak formations in the area considered as a landfill (Savaş and Korkanç, 2010). İncik formation, consisting of regressive character, evaporitic, red-brown, gray-colored, parallel cross-bedded, low-angular / non-angular grained, medium-good-loosely attached terrestrial conglomerate, sandstone, mudstone alternation, was named by Birgili et al. (1975). The lower parts of the İncik formation consist of gypsum-anhydrite and mudstones alternating with medium-well-bonded, thin-medium-thick parallel-bedded sandstones, while the middle-upper levels are alternating with mudstones and increasingly cross-layered conglomerate and sandstones. Kızılırmak formation is alternated with sandstone, mudstone, and gypsum intermediate levels in places.
Kızılırmak formation constitutes the youngest unit formed in terrestrial conditions in the study area. The formation has deposited in fluvial and lacustrine environments. It covers materials from pebbles to sand size in lots of mud on the slopes. Since the color of the mud is red, the unit is generally colored red. Pebbles are derived from the old units on which they are located, depending on the region. In the middle of the basin, lacustrine facies are passed. Here, loose sandstone, generally mudstone and gypsum intercalated with them, and tuff and limestone levels in some places are observed. Layer structures become prominent in lacustrine facies while sorting, and grading can be observed. In addition, caliche formations can be observed in some places in the unit. Slope debris, fluvial and lacustrine facies within the unit are laterally transitive among themselves (Birgili et al., 1975). The Kzılırmak formation is gradationally transitive from the bottom to İncik formation. In the higher parts of the topography, especially acidic magmatic rocks and other older units are incompatible. At the top, they are covered with disharmony by current formations (alluviums) (Savaş and Korkanç 2010).
In the natural unit weight tests performed on samples taken from the boreholes in the landfill area, results between 18.05-18.64 kN / m3 were obtained. It has been determined that the units forming the floor of the solid waste landfill are predominantly composed of clay and silt, while the remaining part consists of sand and gravel. In addition, according to the Atterberg (Consistency) Limits experiments, it was determined that the majority of the samples consisted of CL group low plasticity clays. Considering the SPT-N30 values obtained from SPT tests performed at different depth levels in drillings, it has been determined that the foundation ground is "Very solid - hard" (Savaş and Korkanç 2010).

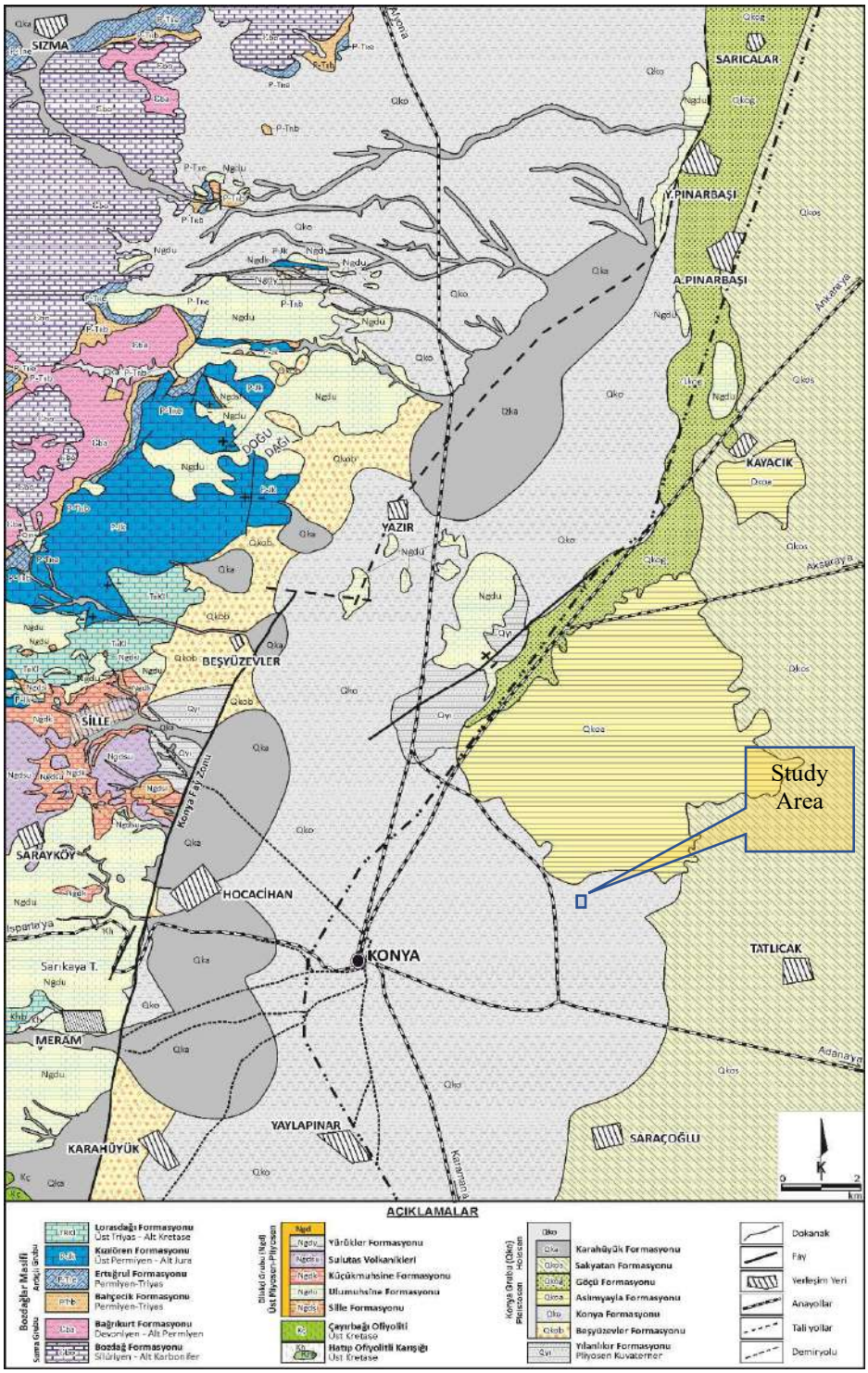

Figure 1. Study area geology map (Taken from Horasan 2014, edited)

DISCUSSION

Transportation and location of the settlement area, Meteorological, Geomorphological, Geological-Hydrogeological, Geotechnical investigations should be the first criteria that come to mind. The factors that play an important role in the selection of the relevant landfill sites for the disposal of solid wastes are mainly geological, hydrogeological, and geotechnical. Regional geology may not provide sufficient information in the development of a geological model for an engineering structure. In such a case, local geology should be studied in detail. Geological units that are seen in the study area, especially young

sediments (soil types) and rock types (their depositional environment and age), stratigraphic and tectonic structures should be investigated (Yılmaz, 2008). In this study, the researches made for Konya and Kırıkkale and the parameters used in different studies are evaluated in Table 1.

Table 1. Comparison of the Geological Geotechnical features of Konya Landfill Site

Factors	Parameter	For Konya	*For Kırıkkale	Source
Geology	Unconsolidated units	Low plasticity clay	Low plasticity clay	Langer (1995)
Distance to fault zones	>60 m	None	None	Langer (1995), EPA (1998)
Land Slope	α< 10°	0-10°	0-10°	Leao et al., (2004)
Groundwater depth	>3 m	> 6.5 m	>20 m	Bagchi (1994)
Impermeable Base Thickness	>3	~100	~100	Bagchi, 1994
Liquid Limit	20-40	32	41-53.6	Bagchi, 1994
Plastic Limit	10-20	18	20-27.3	Bagchi, 1994
Water Content	15-20	19.34	16.3-24.3	Bagchi, 1994

*Savaş and Korkanç, 2010

CONCLUSIONS

The basic parameters of environmental problems are urbanization, rapid population growth, and industrialization. It is known that the amount of waste increases day by day due to the rapid population growth and the increasing need for buildings. In this case, determining the location of the landfill has become very important. The geological geotechnical evaluation of the storage area is very important in preventing problems such as leachate mixing with groundwater. The area studied in this study largely meets the criteria required for a solid waste landfill according to the geotechnical properties, thickness, groundwater level, and permeability characteristics of the foundation ground. A clay unit was observed in the 20-meter drillings made in the region, and it is thought to be especially important in the protection of groundwater.

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