ANKARA CLAY: ITS GEOLOGY, MINERALOGY, PROPERTIES AND APPLICATION

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Upper Miocene-Pliocene continental clastic rocks show a wide-spread distribution in Ankara region. They are well exposed in a number of diverse sized depressions which are separated by a series of highlands. Ankara Basin is an approximately ENE-WSW trending, 18–20 km long and 6–8 km wide depression. It is sedimentary fill, the Yalincak Formation, from bottom to top, consists of three lithofacies as debris flow conglomerate, braidplain conglomerates to sandstones and flood plain finer clastics. They were underlined unconformably by the Triassic graywacke-shale with carbonate blocks, Liassic clastics, Upper Jurassic-Lower Cretaceous limestones, Upper Miocene-Lower Pliocene volcanics and fluvial-lacustrine sedimentary rocks (Kocygit and Turkmenoglu, 1991).

The flood plain finer clastics of the Late Pliocene age Yalincak Formation were referred as "Ankara Clay" which consists of stiff and fissured reddish brown mudstone characterised by caliche nodules and black patches of manganese oxide. The reddish colour (2,5 YR Munsell colour) is due to due high pigmenting colour of hematite and maghemite. This level is dominated by laminations, lensoidal channel conglomerates and normal to reverse type of growth faults. These are the evidences of unstable fluvial setting, climate with seasonal rains and pedogenic episodes interrupting frequently sedimentation of the Ankara Basin. A toposequential relationship is indicated between the palaeosols (relict Red Mediterranean soils) and Ankara Clay based on the erosive conditions and topography in the Late Pliocene period (Mermut, 1976; Cangir and Kapur, 1983). The red colour is related to oxidising conditions and periodic wetting and drying. The red pigment is primarily hematite which was produced by dehydration process during periods of extended subaerial exposure.

The dominant clay minerals in Ankara Clay are discrete illite, smectite, kaolinite, chlorite, mixed layer illite-smectite and mixed layer chlorite-smectite. Kaolinite is also present in small quantities. The degree of crystallinity of clay minerals is poor as revealed by XRD and FTIR data (Aras, 1991). Clay flakes are simply and tightly consolidated and the compaction process cause parallel orientation of them. The non-clay minerals are zoned plagioclase, calcite, quartz, maghemite, hematite, goethite and ilmenite. The coarse fraction of mudstone is derived from graywacke, limestone, andesite, quartzite and schist. Illite and chlorite were originated from schist, phyllite and graywacke while young andesitic volcanics supplied smectite into the depositional basin. The mixed layer clay minerals are the weathering products in an oxidative environment (Aras, 1991; Saglam et al., 2003). Chemically, the bulk samples of Ankara Clay contains 64–57% SiO_2, 11–19% Al_2O_3, 6–8% total Fe_2O, 2–6% MgO, 1–3% CaO, 0.4–1% Na_2O and 2–4% K_2O. The clay fraction, on the other hand, comprise 10–12% total iron as shown by Saglam (2002). This indicate that iron-rich smectite, illite and chlorite and amorphous Fe-oxides dominates the clay fraction.

Extensive studies has been conducted by engineers on the geotechnical properties of Ankara Clay since the majority of the rapid growing Ankara city is sitting on this unit and its expansive character causes important damage on light buildings, road pavements and other engineering structures (Ordemir et al., 1977; Kasapoglu, 1982; Teoman et al, 2003). These properties are treated with special emphasis on its expansive properties which cause important damage on the engineering structures due to swelling, slope instabilities, settlement and landslides. Data collected for geotechnical engineering applications mainly involves mineralogy, grain size distribution, unit weight, specific gravity, compressibility, shear strength, Atterberg limits and index values (liquid limit, plastic limit, plasticity index), moisture content and cation exchange capacity. Works carried out for this purpose indicate highly plastic and expansive character of Ankara Clay. Therefore, research on the stabilisation of the clay material became a necessity.

Due to rapid growth in population, Ankara city faces a yet unsolved environmental pollution problem caused by the disposal of the huge volumes of municipal waste. Widespread occurrence of Ankara Clay makes it a potential material to be used as a landfill liner. Some investigations (Sezer et al., 2003) treated Ankara Clay with special emphasis on its sorption capacity and hydraulic conductivity characteristics in addition to the clay mineralogical composition. The studies show that Ankara clay can be effectively utilised as a component of barrier design in sanitary landfills because of the suitability of its above characteristics.

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