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Compaction Characteristics of B.C Soil through Pore Fluids

Md Khaja Moniuddin[1]* and Manjularani P[2]

[1]*Assistant Professor, Department of Civil Engineering, B.K.I.T, Bhalki, Bidar, Karnataka, India*
[2]*Assistant Professor, Don Bosco Institute of Technology, Bangalore, Karnataka, India*

Abstract

The industrial structure and their foundations are exposed to hazardous environments and hence behavior should be given a due consideration in the design and execution. Similarly are employed in design of the landflls as impermeable membranes due to their low permeability. Clay liners eliminate or limit the movement of leachate from the landflls. The landflls liners are exposed to various chemical, biological and physical events, due to movement

Keywords: Black cotton soils; Compaction; Montmorillonite; Maximum dry density; Optimum moisture content

Introduction

Contaminant migration from land lls or contaminated sites depends on di erent site speci c conditions like-geology and hydrology of the site, climate, type of waste material, type of contamination and type of liner system if any. ere are several of mechanisms through which individual contaminants a ect the engineering properties, including chemical reaction such as dissolutions or precipitation and physico-chemical phenomena a ecting intermolecular forces in water solutions. e compressive e ective stress in liners, when applied during permeation may play a key role in controlling the chemically induced changes in hydraulic conductivity and compressibility. e role of mechanical and chemical e ects in controlling the engineering properties of clay is of great importance. Expansive soils are commonly found in arid and semi aired regions. In India, about 20% of the soil cover is comprises of expansive soils also commonly known as black cotton soil. Principally such soils contain montmorillonite as main clay mineral and they exhibit high swelling and shrinkage with the seasonal moisture uctuations. e B.C soils are also varying in their clay content and activity from region to region.

Currently the in uence of organic and inorganic contaminates on the properties of black cotton soils is under focus. In this paper the behavior of black cotton soils, essentially containing montmorillonite as principal clay mineral and having clay fraction in di erent proportions is investigated, with speci c reference to its compaction in the presence of inorganic chemical uids as pore uids. e e ects of various chemicals on the Index and compressibility characteristics are reported in the literature review. e object of proposed investigation is to conduct a systematic investigation on the compaction characteristics of black cotton soils with the pore solutions having chloride anions.

Literature is reviewed with reference to the e ect of pore uids on the geotechnical properties of the soils. e published research on the e ect of contaminants on the shear strength followed by the work on compression characteristics is presented.

Physico-chemical interaction between clays and contaminants depends upon Structure of clay minerals.

***Corresponding author:** Md Khaja Moniuddin, Assistant Professor, Department of Civil Engineering, B.K.I.T, Bhalki, Bidar, Karnataka, India, Tel: 084842-62288; E-mail: mdkhajamoniuddin@gmail.com

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decreased from 866% for water (dielectric constant = 80.4) to 149.2% for hexane (dielectric constant =1.89). But for kailonite the liquid limit decreased from 230% for hexane to 127% for water. Based on these observations the mechanisms controlling the liquid limit behavior of clays are explained.

It was observed that through the liquid limit is a measure of shearing resistance, with the use of organic pore uids and water of di erent dielectric constants, it was shown that the liquid limit of the clay was primarily controlled by the shearing resistance at the particulate level and the thickness of the di use double layer.

An increase in dielectric constant decrease antiparticle shearing resistance and increase the double layer thickness. A decrease in the shearing resistance results in lower liquid limit where as an increase in the double layer thickness shows higher liquid limit. ese e ects obviously oppose each other and the liquid limit of the particular clay will depend on which of the two predominates. For kaolinite, a non – expanding lattice type of clay, the contribution due to di use double layer is signi cant and the liquid limit is primarily governed by shearing resistance at particulate level. Hence an increase in dielectric constant results in lower liquid limits.

According to Nelson and Miller [3] the macro scale soil properties re ect the micro scale nature of the soil and they are more conveniently measured in engineering works than micro scale factors, macro scale factors are primary indicators of soil behavior. Commonly determined property such as plasticity can provide a great deal of insight in to the soil behavior. Soil consistency as quanti ed by Atterberg limits is the most widely used indicator. Most expansive soils can exist in plastic condition over a wide range of moisture contents. is behavior results from the capacity of clay minerals to contain large amount of water between particles and yet retain coherent structure through the inter particle electrical forces. e soil plasticity is in uenced by the same micro scale factors that control swell potential and provides a useful indicator of swell potential.

Although for montmorillonite the liquid limit should be governed by shearing resistance, because it is expanding lattice type of clay, the contribution of di use double layer overrides and governs the liquid limit. Hence, an increase in the dielectric constant results in higher liquid limit. e e ect of increasing salt concentration (inorganic solutions) on the liquid limit of clays is reported by Schmitz and Passen [4]. Depending on their mineralogy, clays show considerable change in their properties when they are exposed to salt solutions. Four di erent clays were exposed to various concentrations of three salt solutions. e salts used were NaCl, KC1 and $CaCl_2$. It was observed that there was a signi cant decrease in liquid limit up to the concentration of 0.1M (molarities) of salt. Further increase in the concentration does not cause signi cant changes in liquid limits. e decrease followed the second order exponential decay function. An empirical formulation describing the decay in the value of the liquid limit, as a function of clay fraction was proposed. E ect of inorganic salt solutions on the consistency limits of two clays is reported by Arasan and Yetimoglu [5]. e e ect of four salt solutions (i.e. ammonium chloride (NH_4Cl), Potassiums chloride (KCl), Copper sulpate ($CuSO_4$) and Iron sulphate ($FeSO_4$) as leachate compounds on the consistency limits of two commercial clays : one having low plasticity (CL) and another having high plasticity (CH) is reported. Tests were performed using both distilled water and salt solutions at eight di erent concentrations varying between 0.0001 and 1M. It was observed that for CL clay, the liquid limit and plastic limit increased with increase in the salt concentration up to 0.2 M beyond which the clays behaved as non-plastic soil. All the salt solutions with concentration up to 0.2 M signi cantly reduced the liquid limit of CH clays. For NHsolutiok(c71i8sonsv
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us the pollution e ects on geotechnical properties depend on type and amount of chemical present in them. e e ects are transmitted through changes in ion distribution near clay surface and subsequent changes in soil structure. Di use double layer theory can be used to explain changes in soil properties in di erent environments.

In the literature limited numbers of studies are reported on the e ect of solutions comprising the compounds of chloride on the compaction. Most of the research is focused on the investigation on Index properties and consistency limits of higher activity clays.

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of 60% irrespective of their clay fractions, are sensitive to the changes in the cations and anions present the pore uids.

2. e OMC values reduced and MDD values increased exponentially for black cotton soils having liquid limit 60% the addition of pore uids of NaCl, $CaCl_2$ $NaSo_4$ and $CaSo_4$ with both