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Study of Clayey Soils with Nonwoven Geotextiles as Liners in Landfill Stabilization

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Abstract: ***Landfills are highly complex, well-engineered series of cells in or above the ground level. Soil stabilization is the alteration of soils to enhance their physical properties. Landfill stabilization increase the shear strength of soil thus improving the load bearing capacity. Geotextiles are permeable fabrics which, when used in association with soil, have the ability to separate, filter, reinforce, protect or drain. All have a wide range of applications and are currently used to advantage in many civil engineering applications including roads, airfields, railroads, embankments, retaining structures, reservoirs, canals, dams, bank protection and coastal engineering. Typically made from polyester, they are classified into woven, needle punched, heat bonded. nonwoven geotextiles are manufactured by bonding materials together made of synthetics and used in separation applications. Non-woven geotextiles have more gaps of plastic membrane and right choice where pooling water is major concern i.e. drainage systems. In this present study, different geotextiles gives varying advantages. The permeability of the soil can be reduced to desired coefficient and also increased based on the type of geotextile used. The angle of shearing resistance (angle of internal friction) would be lower than that of the unreinforced soils. The performance of the geotextiles depends upon the index properties of the soil.***

Keywords: geotextile, landfill, clayey soils, angle of internal friction

I. INTRODUCTION

The prefix of geotextile, geo is related to earth and the textile word is used for fabric .The American Society of Agricultural Engineers (ASAE) explains a geotextile as a artificial and fabric material provided in between the soil sub grade, in the construction of retaining wall,etc to amplify mobilization of water and decelerate soil movement, because of the membrane which behaves as separation and strengthening material. A geotextile should compose of a steady system that resists its respective structure during grasping, positioning and service period Geotextile cloth, agricultural synthetic and geosynthetics are the other ingredients can be used for same purpose. The foremost purpose of geotextile is to disintegrate sub base from the sub grade, results into a durable and reinforced pavement. This is done by providing a stiff mass between the two layers of soil sub grade. By increasing the molecular weight tensile strength, impact strength, heat resistance, stress, crack resistance elongation would be increased. By contracting the molecular weight, we would get increased impact strength, decreased processability, and decreased stress crack resistance. With more and and crystallinity we would get increase in stiffness, increase in heat resistance, increase in tensile strength, increase in modulus, increase in chemical resistance, decrease in diffusive permeability, decrease in elongation or strain at failure, decrease in flexibility, decrease in impact strength and decrease in stress crack resistance. Based on their structure and the manufacturing technique, geotextiles can be predominantly classified into woven and nonwoven.

A. Types Of Geotextiles

Geotextiles are made up of polymers such as polyester or polypropylene. They are divided into 3 categories on the basis of the way they are prepared:

1) Woven Fabric Geotextiles
2) Non-Woven Geotextiles
3) Knitted Geotextiles

Non-Woven Geotextile

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II. EXPERIMENTAL STUDIES

This section provides the information about the index properties and the engineering properties of the soils used i.e., red soil and black cotton soil, testing on soils.

A. Materials Used

The materials used in this project are given below:

1) Black cotton soil
2) Non-Woven geotextile

The following are the tests done on soil with geotextile and without geotextile in laboratory to determine the index properties and engineering properties and these are the results drawn. All the experiments are done according to IS:2720 specifications.

a) Specific gravity of soil at 27^0 C =**2.69**
b) Free swell index=93%
c) Liquid limit=76% (organic clay)
d) Plastic limit=42.86%
e) Plasticity index =33.34%
f) Specific gravity by density bottle method=2.85
g) Compaction OMC=19%, MDD=1.7gm/cc
h) Direct shear test on clay soil without geotextile

- c=0.06 kg/cm^2, $\phi = 18^0$
- Shear strength, S =0.38 kg/cm^2

i) Direct shear test on clay soil by placing geotextile at center of shear box

- c=0.01 kg/cm^2, $\phi = 22^0$, shear strength, S =0.414 kg/cm^2

j) Direct shear test on clay soil by placing geotextile at bottom shear box

- . c=0.09 kg/cm^2, $\phi = 20^0$, shear strength=0.96 kg/sq.cm

k) California bearing ratio test,
For clayey soils
CBR at 2.5mm=7.81, CBR at 5mm=5.498
CBR values by placing geotextile
For clayey soils
CBR at 2mm=15.8, CBR at 5mm=11.25

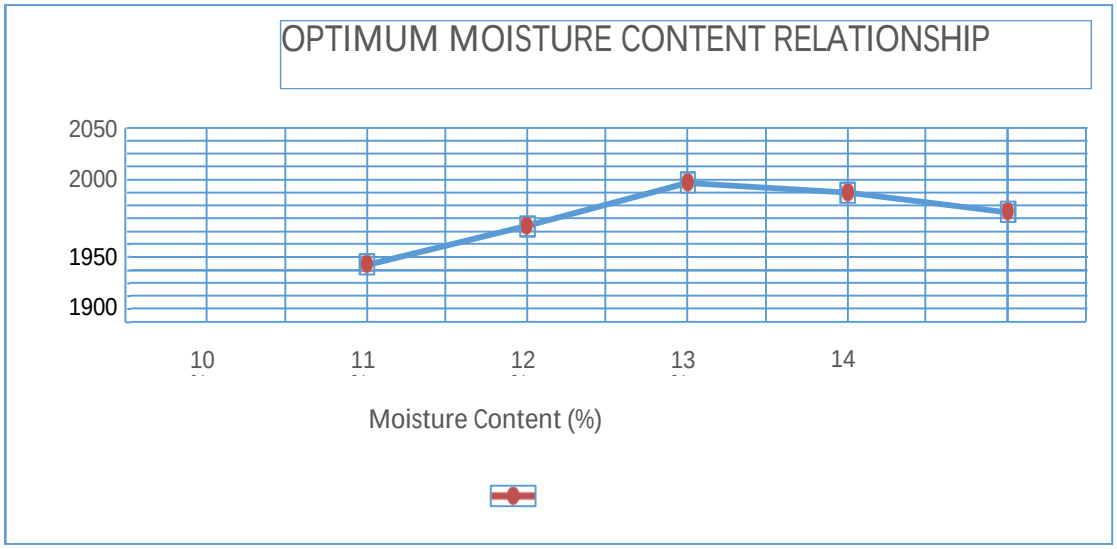

Fig.2 plot showing the dry density versus OMC of clayey soil

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III. CONCLUSIONS

A. Compared to clayey soils strength of silty soils is more by placing nonwoven geotextile as reinforcing material.
B. Silty soils are more advantageous than clayey soils due to its water content percentages.
C. Nonwoven geotextile is good for drainage as it has more gaps and allow filtration, thus advantageous in landfills.
D. By placing nonwoven geotextile at the center of red soil in shear box the shear is increased by this shear is more by placing geotextile which allows filtration and increase drainage conditions.
E. It is concluded that these geotextiles are useful in landfill stabilization.
F. Liquid limit of taken black cotton soil which is clayey soil is low when compared to red soil which is silty soil.
G. Plastic limit for clay soil is more when compared to silty soil.
H. Thus, the plasticity index is high for clayey soil than silty soil which is high plastic clay.

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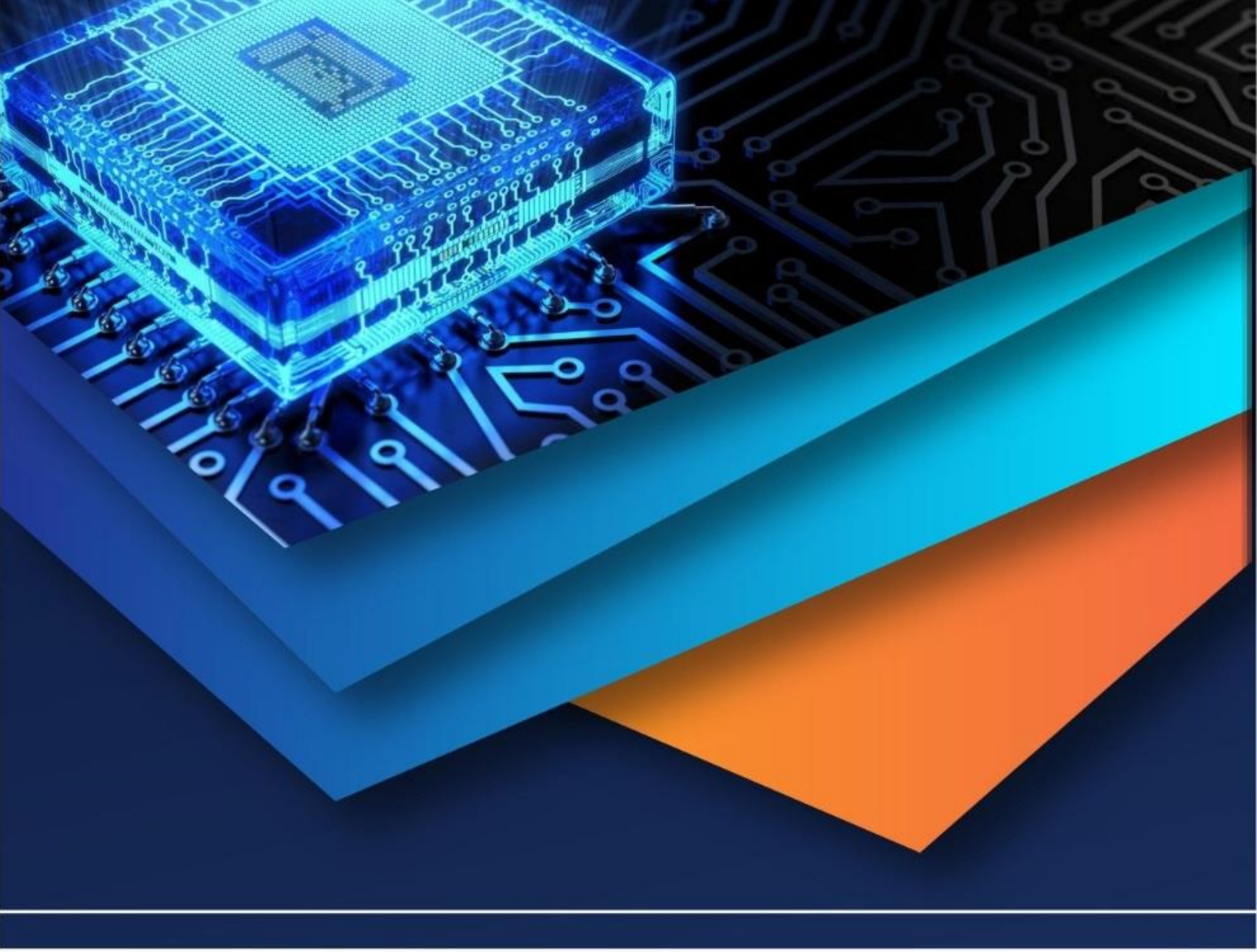

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