A Study on Dynamic Behavior and Shear Strength of Black Cotton Soil by using Glass Powder & Saw Dust

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Abstract- *This project thesis provides a brief overview of study on dynamic behavior of Black Cotton Soil by adding Saw Dust and Glass Powder. In Civil engineering aspects, obtaining strength for black cotton soil is moreover good. They exhibit swelling and shrinkage behavior when exposed to change in moisture content. The reduction in swelling depends on the size of the sand and the initial moisture content in the soil. It is proposed to composite black cotton soil using glass powder and saw dust. Based on this composition, it increases the compaction strength of soil, and if possible it reduces the shrinkage limit for attaining high settlement. Field methods discussed in this section will focus on the low-strain tests that are not large enough to induce significant non-linear non-elastic stress strain behavior. In this paper the changes in the geotechnical properties like plastic limit, liquid limit, specific gravity, optimum moisture content, maximum dry density, cohesion and California bearing ratio of Black cotton soil with 5% Sawdust and12.5% of Glass powder as contaminant is represented. After that the effect of sawdust as stabilizer on black cotton soil contaminated with 12.5% glass powder is observed.*

Keywords- Block cotton soil, Glass powder, Saw dust, CBR Test, Compaction test

I. INTRODUCTION

The term soil in soil engineering is defined as an unconsolidated material. In case of coarse grained soil, the mineralogical composition of the grain hardly affects the engineering properties of the soils. “Clay” is understood to mean a clay soil whose grains are predominantly composed of clay minerals and which has plasticity and cohesion. Owing to such soil of poor shear strength and high swelling & shrinkage, a diversity of ground improvement techniques such as soil stabilization and reinforcement are employed to improve mechanical behavior of soil.

1.1 Black Cotton Soil

It is heavy clay soil, varying from clay to loam with clay contents of 40 to 50%. It formed by the decomposition of rocks by long continued weathering. These soils mostly occur in the central and southern parts of India particularly in the Deccan plateau where they are known as regur.

The black cotton soil is a type of expansive soil with high plasticity and can retain moisture throughout the dry season which is why they are valuable for growing crops. It exhibits low bearing capacity, low permeability and high volume change due to presence of montmorillonite in its mineralogical content and these properties makes it unfit for construction of embankment and other engineering structures.

Black cotton soils are expansive clay with potential for shrinkage or swelling under moisture change. The soils are formed under conditions of poor drainage from basic rocks or limestone under alternating wet or dry climatic conditions. They usually exhibit high shrink-swell characteristics with surface cracks, opening during the dry seasons which are 15 cm wide and 3to3.5 mm deep. These cracks close during the wet season and an uneven soil surface is produced by irregular swelling and heaving. Such soils are especially troublesome as pavement sub-grades. The soil cause more damage to structure, particularly light building and pavement, than any other natural hazard, including earthquakes and floods. The name Black cotton soil (BCS) is derived from the fact that cotton plant thrives well on it.

The black cotton soils of northeastern Nigeria derive their origin from basalts of the upper Benue trough which covers a wide area extending north and east of the Jos Plateau and from quaternary sediments of lacustrine origin from the Chad basin consisting mainly of shales, clay and shale sediments. Specifically, Nigerian black cotton soils are formed from the weathering of shale and clayey sediments and basaltic rocks. The Nigerian black cotton soil contains more of the montmorillonite clay mineral with subsequent manifestation of swell properties and expansive tendencies. The soil is found in the north eastern parts of Nigeria, Cameroon, Lake Chad Basin, Sudan, Ethiopia, Kenya, South Zimbabwe and other Eastern African countries, India, Australia, South Western U.S.A., South Africa and Israel. Its color is dark-grey to black probably due to iron and titanium compounds present. Internationally known as „tropical black earths“. Black cotton

soil is one of the major soil deposits of India. The behavior of black cotton soil is specified as cohesive clay minerals.
Black Cotton Soils which depends on its application in civil engineering, different ways of stabilization are employed to give it more strength.

II. LITERATURE SURVEY

2.1.Montmorinolite

Montmorillonite (Na;Ca)0.33(Al;Mg)2Si4O10(OH)2 nH2O Crystal Data: Monoclinic.

Point Group: 2=m: Tiny scaly crystals, tabular on

S.No	Physical Properties of Glass Powder	
1	Specific gravity	2
2	Fineness Passing 150μm	99
3	Fineness Passing 90μm	9

lamellar or globular microcrystalline aggregates; clayey, compact, massive.

Physical Properties:
Cleavage: f001g, perfect.
Fracture: Uneven.
Hardness: 1
Optical Properties: Translucent.
Color: White, pale pink, blue, yellow, red, green.
Luster: Dull, earthy.
Class: Biaxial. Pleochroism:
X = colorless to pale brown, yellow-green;
Y = Optical dark brown to yellow-green, olive-green, pale yellow;
Z = brown to olive-green, pale yellow.

Chemical constituents:

Table 1: Chemical composition

SiO_2	51.14
Al_2O_3	19.76
Fe_2O_3	0.83
MgO	3.22
CaO	1.62
Na_2O	0.11
K_2O	0.04
H_2O+	7.99
H_2O	14.81
Total	99.82

Distribution:

A common clay mineral, with numerous localities worldwide. From Montmorillon, Vienne, France. South Dakota in ClaySpur, In the Itawamba mine, at Strasburg

Name:

After the occurrence at Montmorillon, France.

2.2 Saw Dust

The fine particles of wood that are fall from an object being sawed. By- product of cutting, grinding, drilling, wood with a saw tool from manufacturing industries.

The saw dust density is 0.21g/cm^3

2.3. Glass Powder

Glass powder is extremely fine powder made from ground glass. There are several types of geotechnical engineering problems associated with dynamic loading, some examples include: dynamic compaction, machine vibrations. When soils are subjected to dynamic loading that may cause a stability problem.

Table 2: Physical Properties of Glass Powder

S.No	Physical Properties of Glass Powder	
1	Specific gravity	2
2	Fineness Passing 150μm	99
3	Fineness Passing 90μm	9

Table:3 Chemical Properties of Glass Powder

S.No	Chemical Properties of Glass Powder	
1	pH	10.25
2	Colour	Grayish white

Table: 4 Chemical Composition of Glass Powder

S.No	Chemical Composition of Glass Powder	% by Mass
1.	SiO_2	67.330
2.	Al_2O_3	2.620
3.	Fe_2O_3	1.420
4.	TiO_2	0.157
5.	CaO	12.450
6.	MgO	2.738
7.	Na_2O	12.050
8.	K_2O	0.638

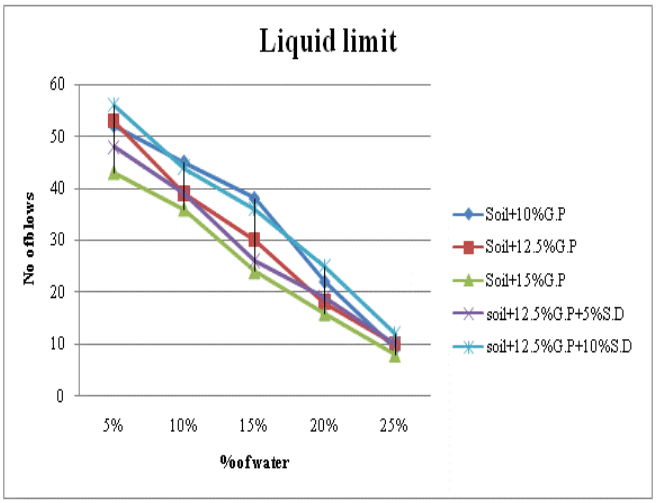
9.	ZrO_2	0.019
10.	ZnO	0.008
11.	SrO	0.016
12.	P_2O_5	0.051
13.	NiO	0.014
14.	CuO	0.009

III. ANALYZED RESULTS

3.1 Atterberg Limits:

The liquid limit of BC Soil shows the variation of soil when treated with12.5 % GP & 5% SD indicate in graph below. The overall variation in liquid limit could be attributed to the flocculation and aggregation of the clay particles and the accompanying reduction in surface area and increase in strength. This alteration of soil character probably occurred due to heat by the composition of SD & GP. Thus, this intimates the unconformity of atterberg‟s limits of the natural BCS taken.

3.2 Compaction character:



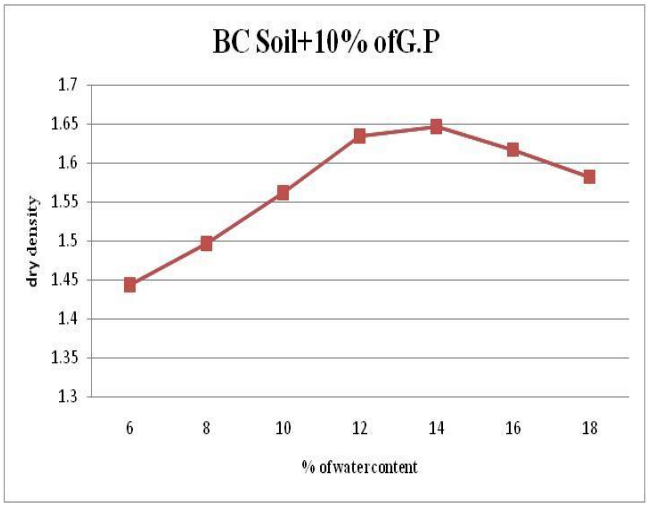
The admixtures used, mainly to increase the moisture content of the soil. This result gives strength up to the 20% of moisture content.

Bulk density 2.416 Mg/m^3 and Dry density 2.114 Mg/m^3 of the BC soil changes its natures when composed with 12.5% of GP + 5% of SD in the densities.

1.791 Mg/m3 and 1.493 Mg/m3 respectively.

Penetration depth (mm)	**Unit Standard load Kgf/ cm^2**	**Total Standard load (Kgf)**
2.50	70	1370
5	105	2055
7.5	134	1630
10.0	162	3180
12.5	183	3600

CBR Test Standard Loads at Specified Penetrations



IV. CONCLUSION

It was proposed for embankment of the soil, where its moisture content gives strength increases up to 20% with admixtures. Soil data has been obtained and analyzed accordingly with the scope of the study. All soil information where obtained from the lab annexure. Data acquired for the analysis of specific gravity, grain size distribution, liquid and plastic limit, compaction and CBR test gives intermediate results which can be performed for embankment and brick construction.

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