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CHARACTERISTICS STUDY ON BLACK COTTON SOIL ADMIXED WITH BRICK DUST AND RICE HUSK ASH

Shalini Mohan[1]

[1]*Assistant Professor, Dept.of Civil Engineering, KMP College of Engineering, Kerala, India*

Abstract – *In our country about one-fifth is covered by Black cotton soil. Owing to its undesirable high swelling and shrinkage, properties the soil is not good either as foundation or embankment material. To overcome this difficulty of black cotton soil, its properties are to be modified to suit the requirements in any specific case by means of stabilization. Therefore, it is necessary to properly choose the stabilizer through careful investigation to improve the strength, compressibility and permeability characteristics. At the same time, the economics of the process of the stabilization should also be considered. In this project the results obtained by studying the characteristics of black cotton soil admixed with brick dust and rice-husk ash is presented. The percentage of brick dust 10%,20%,30% and rice husk ash is 5%,10%,15% And the study shows that the addition of Brick dust and Rice Husk Ash good effect on the engineering properties of the soil.*

Key Words: **Black Cotton Soil, Brick Dust, Rice Husk Ash, Atterberg's limits, Compaction, Compressive Strength etc.**

1. INTRODUCTION

Soil stabilization is a technique aimed at increasing or maintaining the stability of soil mass and chemical alteration of soil to enhance their engineering properties." Soil stabilization aims at improving soil strength and increasing resistance to softening by water through bonding the soil particles together, water proofing the particles or combination of the two. In the past, soil stabilization was done by utilizing the binding properties of clay soils, cement-based products such as soil cement, and utilizing the "rammed earth" technique (compaction) and lime. Some of the renewable technologies are: enzymes, surfactants, biopolymers, and synthetic polymers, co-polymer based products, cross-linking styrene acrylic polymers, tree resins, ionic stabilizers, fiber reinforcement, calcium chloride, calcite, sodium chloride, magnesium chloride and more. Some of these new stabilizing techniques create hydrophobic surfaces and mass that prevent road failure from water penetration or heavy frosts by inhibiting the ingress of water into the treated layer.Soil stabilization is also done by various methods by adding fly ash, rise husk ash, chemicals, fibers, by different geo materials like geo synthetic, geo grid and geo form. Soil stabilization allows engineers to distribute a larger load with less material over a longer life cycle Black cotton soils are highly clay soil grayish to blackish in color. They contain montmorillonite clay mineral which has high expensive characteristics. BC soils have low shrinkage limit and high optimum moisture content. It is highly sensitive to moisture changes, compressible sub grade material. Hence the sub grade and its undesirable characteristics to be modified using a suitable stabilization technique. Here Brick dust and Rice Husk Ash are used as stabilizer.

1.1 Objective of the study

- To study the peculiar characteristics of black cotton soil
- To study the effects of brick dust in the engineering properties of black cotton soil
- To study the effects of Rice husk ash in the engineering properties of black cotton soil
- To study the effect of combination of Brick Dust & Rice Husk Ash in the engineering properties of Black cotton soil.

2. MATERIALS USED

2.1 Black Cotton Soil

Expansive soils, well-known as Black Cotton Soils in India, occupy about one-fifth of land area of the country. Black Cotton Soils are residual deposits formed from basalt or trap rocks. They contain significant amount of montmorillonite mineral[5]. Montmorillonite is the most common of all the clay minerals in expansive clay soils. The mineral made up of sheet like units.

Fig - 1: Black Cotton Soil

The Geotechnical properties of the black cotton soil before addition of stabilizers are shown in Table-1.

Table-1: Properties of Black Cotton Soil

PROPERTIES	BLACK COTTON SOIL
Specific Gravity	2.48
Liquid Limit (%)	57
Maximum Dry Density(G/Cm^3)	1.444

Optimum Moisture Content (%)	18.1
Unconfined Compressive Strength(kN/ m²)	
(7 Days Curing)	85
(28 Days Curing)	96.95

2.2 Brick Dust

Brick dust with its component burnt brick powder is a waste powder generated from the burning of bricks with the soil covered by surroundings. Due to burning of soil bricks it hardened and at the time of removal the set up we get the powder form of brick. It has red color and fine in nature. It has great ability to reduce the swelling potential of black cotton soil[1].

Fig -2: Brick Dust

Table-2: Chemical composition of Brick dust

CONSTITUTE COMPOSITION	PERCENTAGE
SiO_2	82.3
Al_2O_3	4.9
Fe_2O_3	1.2
CaO	2.36
MgO	1.82
Loss On Ignition (LOI)	6.2

2.3 Rice Husk Ash

Rice husk ash- Rice milling generates a byproduct known as husk. This surrounds the paddy grain. During milling of paddy about 78% of weight is received as rice, broken rice and bran. Rest 22% of the weight of paddy is received as husk. This husk is used as fuel in the rice mills to generate steam for the parboiling process . The specific gravity of R.H.A. is founded 1.85[4]

Fig -3: Rice husk ash

Table-3: Chemical composition of Rice Husk

CONSTITUENTS OF FLY ASH(%MASS)	VALUES
Silica(SiO 2)	60
Alumina(Al 2O 3)	25
Ferric oxide(Fe 2O3)	8.12
Calcium oxide(CaO)	2.9
Magnesium oxide(MgO)	0.82
Titanium oxide(TiO2)	0.24
Free lime content	0.75

3. METHODS OF TESTING

Different soil laboratory tests are conducted on the test sample including water content, particle size, liquid limit and Unconfined Compressive Strength (UCS) Tests. From these test results the Geotechnical properties of the soil were determined. Test sample for UCS is prepared at Optimum Moisture Content (OMC) and Dry Density (MDD) by conducting Procter test.

4. METHODOLOGY

Following are the combination which we have taken

- Combination of Black cotton soil+ brick dust. In this combination, black cotton soil is mixed by weight with brick dust on percentage basis i.e. 10%, 20%, and 30%.
- Combination of black cotton soil +max % of brick dust+ 5%, 10%,15% rice husk ash.

The following test are conducted

- Liquid limit
- Compaction test
- Unconfined compressive strength test

5. RESULT AND DISCUSSION

5.1. Liquid Limit Characteristics of Black Cotton Soil with Addition of Brick Dust

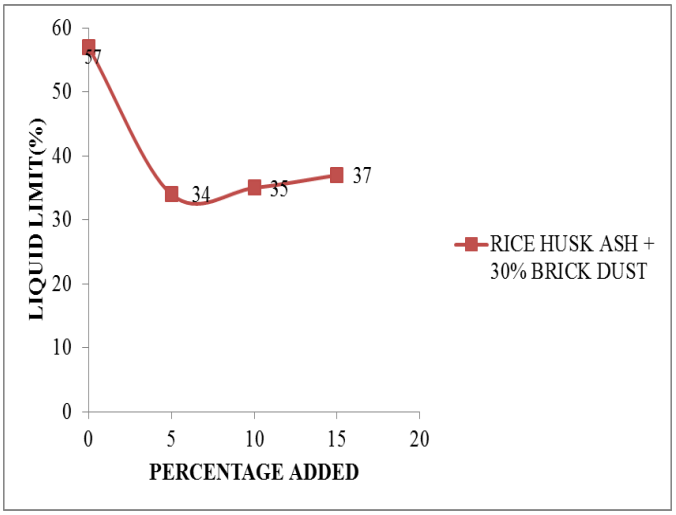

Chart-1: Variation Of Liquid Limit With 30 % of Brick dust+ different percentage of Rice Husk Ash

The liquid limit is decreased with the addition of Rice Husk Ash. The value of liquid limit is minimum at soil combination of 30 % Brick dust + 5 % Rice Husk Ash with a value of 34 %

5.2. Compaction Behavior of Black Cotton Soil with Addition of Brick Dust and Rice Husk Ash

Maximum dry density obtained at soil combination of 5 % Rice Husk Ash + 30 %Brick dust with a value of 1.569 g / cm3.Optimum moisture content obtained at soil combination of 5 % Rice Husk Ash + 30 %Brick dust with a value of 14.8 %

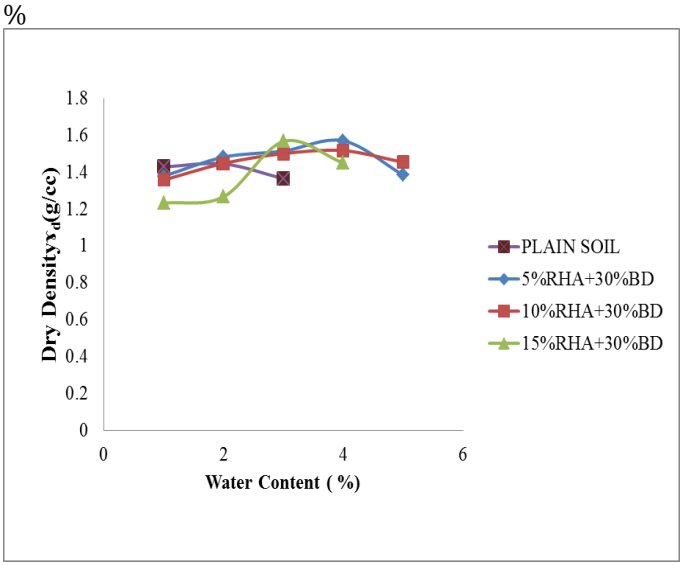

Chart-2: Compaction characteristics of Black cotton soil with 30 % Brick dust + different percentage of Rice Husk Ash

5.3. Unconfined Compressive Strength Of Black Cotton Soil With Brick Dust And Rice Husk Ash

Fig -4: Testing of UCC specimen

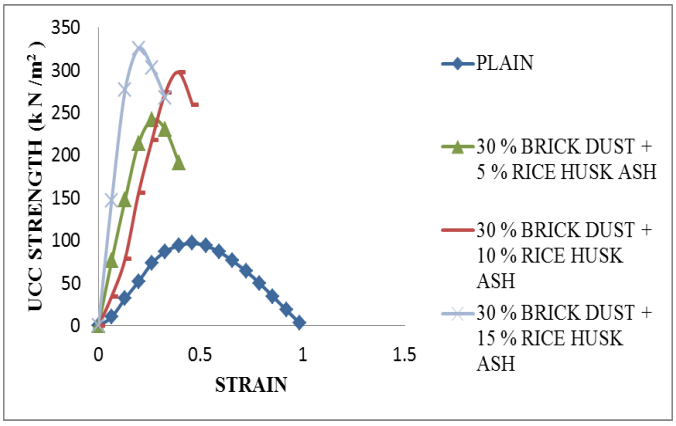

Chart-3: Variation of UCC value with addition of brick dust and rice husk ash at 28 days curing

Maximum UCC ratio obtained at soil combination of soil + 30 % Brick dust +15 % Rice Husk Ash with a value of 3.35

6. CONCLUSIONS

Based on the results presented in this paper, the following conclusions are drawn:

1) Soil stabilization using solid wastes is an effective & economical mean for enhancing the engineering performance of Black cotton soil

2) When soil is admixed with brick dust , the liquid limit is reduced up to 43 % for soil plus 30 % Brick dust combination.

3) For soil plus brick dust combination the maximum dry density is increased with increase in percentage of brick dust and it has maximum value of 1.664 g/cm3 with optimum moisture content 17.3 %.

4) For soil and brick dust combination, the UCC strength is maximum at 30 % Brick dust with a value of 209 k N/ m^2 with a UCC ratio of 2.157

5) The liquid limit is considerably reduced up to 34 % at 5 % Rice Husk Ash plus 30 % Brick dust combination

6) When soil is admixed with Brick dust and Rice Husk Ash, the maximum dry density is obtained at 5 % Rice Husk Ash plus 30 % Brick dust combination with a value of 1.516 kN / m^2 and optimum moisture content of 14.8 %.

7) The UCC value is maximum for 15 % Rice Husk Ash plus 30 % Brick dust with a value of 325.6 k N /m^2 and with a UCC ratio of 3.35.

8) The whole study shows that, the UCC strength is maximum when soil is admixed with 5 % Rice Husk Ash and Brick dust. And for the same combination the liquid limit is considerably reduced. But Dry density is maximum for soil plus 30 % Brick dust combination.

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