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Stabilization of Black Cotton Soil Using Natural Geotextile

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Abstract: **-- The soil is the major and most commonly used material in the field of Civil Engineering. Where ever it is used for construction, foundation, bricks, pavements it should provide considerable strength for the stability of the structure. The soil is a deposit of earth material, obtained naturally from the disintegration of rocks or decay of vegetation which can be excavated readily with power equipment in the field or disintegrated by mechanical means in the laboratory. There are various types of soil on the earth depending upon their material properties, size, texture &other. The black cotton soil is a type of expansive soil in which it expands in its volume in wet condition and shrinks in dry condition. Expansive soil causes more damages to the structures. Current research work shows that the strength of black cotton soil increases with increasing the percentage of rick husk (5% to 15%). Also, there may be an increase in the strength of soil by using coconut coir and jute.**

***Keyword*: Black Cotton Soil, Coir, Rice Husk Ash, Stabilization.**

I. INTRODUCTION

Soil is the major and most commonly used material in the field of Civil Engineering. Black cotton soil is a kind of expansive soil in which it expands in its volume in wet condition and shrinks in dry condition. Some situations construction on the clay soil is not avoidable one therefore soil stabilization is one of the most commonly used methods to increase the engineering properties of the soil, as a result of soil stabilization, the bearing capacity of the foundation of the structure is increased and its strength, water tightness, resistance to washout.

Mechanisms of stabilization

The basic methods of stabilization are cementation, bituminization, silicification, resinification, methods using electrochemical or thermal action, and artificial freezing. These methods can cause some effects on the environment. In the context of sustainable development the natural environment, the use of natural Fibers such as coir in geotechnical applications is desirable. Reinforcing the soil with coir Fibers/coir geo-textiles is a cost effective solution to the ground/soil improvement problems. The study includes the properties of coir Fiber, rice husk ash, jute and experimental workouts such as tri-axial test, Stress state during a tri-axial test, California bearing ratio, unconfined compression test, direct shear test.

II. LITERATURE REVIEW

A number of various studies along with International Jute Study Group, Bangladesh (IJSG) have reported that JGT have high potential characteristics in the field of different civil engineering construction. Main findings in connection with geotextiles characteristics can be summarized that the woven fabric from heavy and coarse jute yarn and having wide open mesh structure, geojute is the ideal erosion control material for soil slopes under all climatic conditions. Made from a natural fibre, geojute is eco-friendly, biodegradable and decomposing and thereby it adds to the soil rich organic nutrients.

Laxmikant Yadu, *et.al*(1)[2011] Studied on black cotton (BC) soil stabilization with fly ash (FA) and rice husk ash (RHA). The soil was stabilized with different percentages of FA (i.e., 5, 8, 10, 12, and 15%) and RHA (i.e., 3, 6, 9 11, 13, and 15%).The atterberg limits, specific gravity, california bearing ratio (CBR), and unconfined compressive strength (UCS) tests were performed on raw and stabilized soils. Results indicate that addition of FA and RHA reduces the plasticity index (PI) and specific gravity of the soil.
The moisture and density curves indicate that addition of RHA results in an increase in optimum moisture content

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(OMC) and decrease in maximum dry density (MDD), while these values decrease with addition of FA.

Anzar Hamid *et.al* (2)[2017] The stability of any pavement depends upon the stability of its subgrade soil. Subgrade governs the performance, life span and effectiveness of the pavement. The entire load coming over the pavement is ultimately borne by the subgrade. Thus, the subgrade plays a very important role in the pavement design. Now-a-days, many techniques are used to stabilize the subgrade soil, use of natural fibres being one of them. Natural fibres are cheap, easily available and eco friendly

Table: Properties of Coconut Coir

Sr.No.	Description	Value
1.	Diameter	0.5 mm
2.	Length	3cm to 5cm
3.	Specific gravity	1.3

Agus Setyo Muntohar (3)[2002] Studied on the utilization of ashes produced from uncontrolled rice husk burnt in Yogyakarta (Indonesia). In this research, a series of laboratory tests has been conducted. The tests were carried out individually or in a combination in which the Rice Husk Ash (RHA) content were varied from 7.5, 10, and 12.5 percent, and the lime content from 2, 4, 6, and 10 percent (by the dry weight of soil). All the samples have been remoulded at their optimum moisture content (OMC) and maximum dry density (MDD). The research shows that lime – rice husk ash decreased the swell of expansive soil and improved its strength and bearing capacity.

III. METHODOLOGY MATERIAL USED SOIL

Soil being cheapest and readily available construction material, has been popular with civil engineering.

COCONUT COIR FIBRE

Coconut coir fiber belongs to group of hard structural fibres. It is an important commercial product obtained from the husk of coconut. The coir fiber is elastic enough to twist without breaking and it holds a curl as though permanently waved. So this coir fiber waste can be used in stabilization of soil and thus it can be effectively disposed of. Addition of fiber resulted in decrease in plasticity and increase in hydraulic conductivity.

The main advantage of coir material is this it is locally available and is very cheap. This is biodegradable and hence do not create disposal problem in environment. Diameter is 0.5mm. The coir is cut into pieces of 3cm to 5cm, as those percentage remains 0.25, 0.50, 0.75, 1%.

Properties of coconut coir fiber

Coconut coir fiber has high water holding capacity, can hold up to eight times of water than its weight. It also has ideal P_H value up to 6 to 6.7. It has excellent drainage and porosity. It is a biodegradable and can be easily degrades very slowly and has life span of 3 to 4 years.

Fig. Coconut coir fibre

RICE HUSK ASH

Rice Husk Ash (RHA) is obtained from the burning of rice husk. The husk is a by-product of the rice milling industry. By weight, 10% of the rice grain is rice husk. The Rice Husk Ash would appear to be an inert material with the silica in the crystalline form suggested by the structure of the particles, it is very unlikely that it would react with lime to form calcium silicates. It is also unlikely that it would be as reactive as Rice Husk Ash, which is more finely divided. So Rice Husk Ash would give great results when it used as a stabilizing material.

Properties of Rice Husk Ash

Hygroscopic nature

To be hygroscopic means a material is able to absorb or adsorb water from its surroundings.

Easily flammable

Flammability is the ability of a substance to burn or ignite, causing fire or combustion. The ash is a very good thermal insulation material

Exothermic nature

An exothermic reaction is a chemical or physical reaction that releases heat. It gives net energy to its surroundings. That is, the energy needed to initiate the reaction is less than the energy released.

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Fig. Rice husk ash

JUTE GEOTEXTILE

Jute is 100 percent bio-degradable and thus environment-friendly. Jute fibers are always known as strong, coarse, environment friendly, and organic. It increase shear strength, Dry density, CBR, Decrease permeability, settlement. It is the second most important vegetable fiber after cotton, in terms of usage, global consumption, production, and availability.

Properties of jute fiber

Thermal Conductivity

The thermal conductivity is the reciprocal of the thermal insulation. They established the relationship between fabric properties and thermal conductivity of various developed jute.

Strength and Extensibility

Jute is a strong but low extensible fibre mainly due to composite like structure with highly oriented long chain molecules.

Jute Geotensile strength

It increase shear strength, Dry density, CBR, Decrease permeability, settlement.

Fig. Jute geotextile

IV. EXPERIMENTAL WORK

We performed various tests on soil as follows.
Specific gravity
Liquid Limits
Plastic Limit
Sieve analysis

Standard proctor test

In the Proctor test, the soil is compacted in a mold that has a volume of 944 cm^3. The diameter of the mold is 101.6 mm. During the laboratory test, the mold is attached to a base plate at the bottom .The soil is mixed with varying amounts of water and then compacted in three equal layers by a hammer that delivers 25 blows to each layer. The hammer has a mass of 2.5 kg and has a drop of 30.5 mm.

For each test, the moist unit weight of compaction, ϒ calculated.

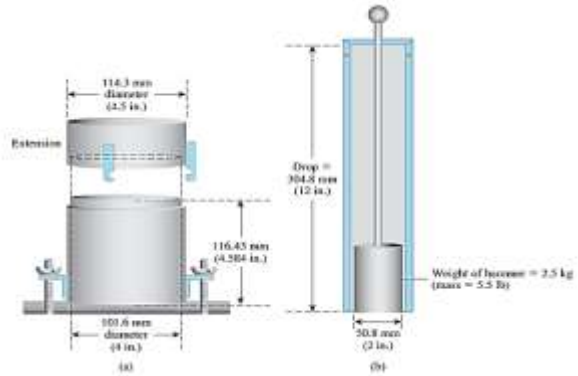

Fig. Standard Proctor Test

V. PERFORMANCE ANALYSIS

Specific Gravity-1.118
Plastic Limit- 66.67
Liquid Limit- 41.56

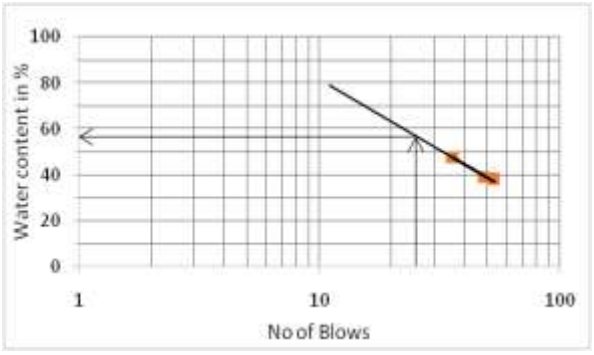

Fig. Liquid Limit chart

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Sieve Analysis

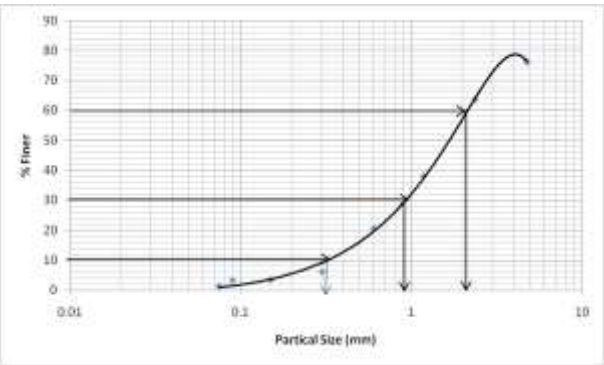

Fig. Particle size Distribution Curve

Standard Proctor Test

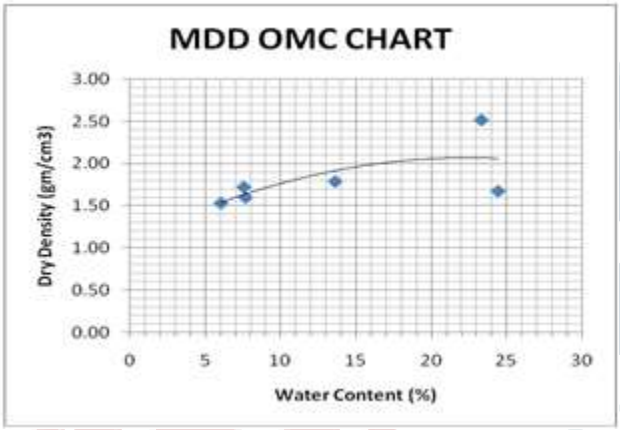

Fig.: MDD OMC for BC Soil

Fig. Performed Standard Proctor Test on BC Soil

Test performed by using Rice husk ash with increasing percentage (5% to 11%)

Fig. Mixing of Rice Husk Ash with Soil

Case I: By using 5% Rice Husk Ash

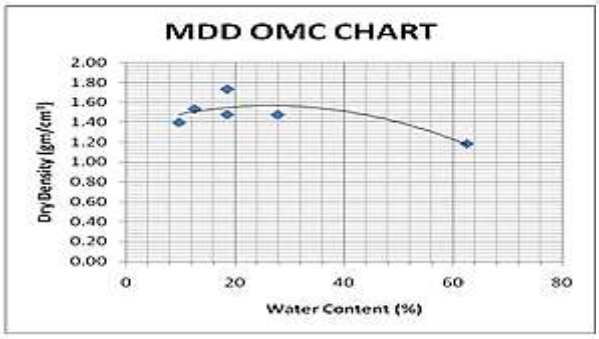

Fig. 5% Rice Husk Ash SPT

Case II: by using 8% Rice Husk Ash

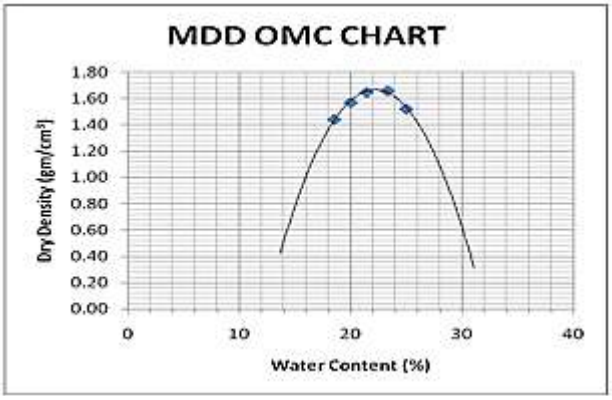

Fig. 8% Rice Husk Ash

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Case III: By using 11% Rice husk Ash

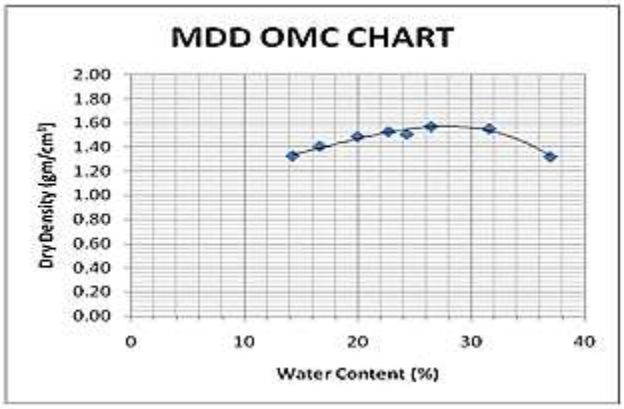

Fig. 11 % Rice Husk Ash

Case IV: Combine graph of 5%, 8% and 11%.

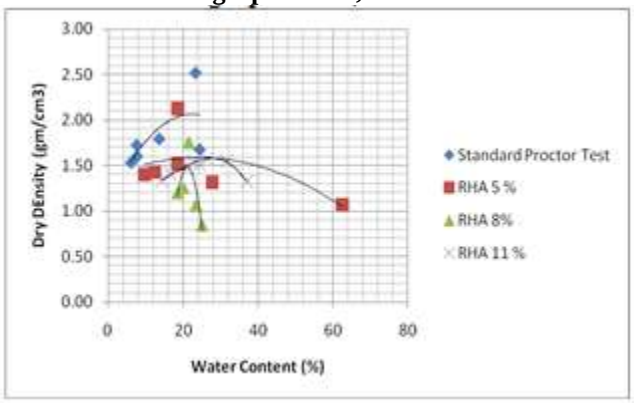

Fig. Combine graph

VI. CONCLUSION

The experimental work on soil mixing with rice husk ash in various proportions, and the conclusion based on present study are as follows: As the percentage of rise husk ash increases, there is increase in MDD and with decrease in OMC and gives maximum results for 8% RHS. And expected results on performance of Jute geotextile mixing with soil, there is increasing the strength of soil, which is very effective in weak subgrade and also reducing their compressibility. Coir fiber also result in controls the swelling behavior of black cotton soil.

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