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Modern Soil Stabilization using Biomass and Chemicals

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ABSTRACT: Emerging trend of using waste material in soil stabilizing or soil strengthening is being working out all over the world in present days. The main reason behind this trend is the excessive production of waste like fly ash, plastics, rice husk ash (RHA) which is not only hazards but also creating deposition problems. Using some of these waste materials in construction practice will reduce the problem in a great extent. However before using these materials in practice, systematic analysis of the experimental result is a must so that it should not create a new problem. With this objective, RHA has been used with a small amount of lime of different quantity to stabilize a highly plastic soil. The percentage by weight of virgin soil has been partially replaced by RHA and lime to improve its strength property as CBR value. Series of laboratory tests like CBR, Compaction, Unconfined Compressive Strength and Direct Shear Test.

KEYWORDS: Rice Husk Ash, Black cotton soil, Soil Stabilization and Index properties.

I. INTRODUCTION

The history of stabilization of soil has a long background with hundreds of research results. Several research results with waste materials such as fly ash, plastics; rice husk ash has also been published with their benefits. Some of the recent relevant research work has briefly mentioned here. The potential benefits of using RHA with the natural soil. It has been reported that both CBR as well as unconfined compression values has increased with the addition of RHA with natural soil. Also the OMC (Optimum Moisture Content) increase while MDD (Maximum Dry Density) has decreased due to RHA mixed with natural soil [1]. the soil stabilization with RHA and fly ash mixed with natural soil. In this study also showed improvement in CBR values and unconfined compression strength [2]. The effect of marble dust with RHA in a mix with expansive soil. It has been seen that with addition of RHA and marble dust with soil, the MDD deceases and OMC increases. Also the CBR and UCS values increase substantially due to adding these two with the natural soil [6]. The effectiveness of using rice husk ash (RHA) and lime as a pozolanic material with natural soil. The results showed good improvement on its physical and engineering behavior of the stabilized peat soil. The values of wet unit weight and specific gravity increase while the water content and void ratio decrease with the increase of curing period. The increment of curing period is also altered its engineering behavior that is increasing the soil strength and reducing its compressibility [7].

In this study, the percentage of RHA and lime has been varied to see its effect on the strength and index properties. Compaction, CBR and the basic material testing are done according to the Indian Specifications.

II. LITERATURE REVIEW

Many projects suggested on the development of soil stabilization from rice husk ash. This paper present an experimental investigation, carried out to study the effects of Rice Husk Ash on index properties of black cotton soil stabilized with 3% lime. Remoulded expansive clay was blended with RHA and Lime and strength tests were conducted. The potential of RHA blend as a swell reduction layer between the footing of a foundation and sub grade was studied. In order to examine the importance of the study, a cost comparison was made for the preparation of the

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sub-base of a highway project with and without the admixture stabilizations. When the RHA content was increased from 0 to 20%, in compaction test moisture content increased by 20% to 37.5% while CBR improved by 7.1%. Therefore, an RHA content of 10% and a lime content of 3% are recommended for strengthening the expansive subgrade soil. A cement content of 3% is recommended for blending into RHA for forming a swell reduction layer because of its satisfactory performance in the laboratory tests.

III. MATERIALS AND METHODOLOGY

MATERIALS

Soil, rice husk ash and lime have used in this study. The details of physical properties of these materials are summarized in the following sections.

Soil

Soil has been used as a base material in the study. it has been replaced partially with RHA and Lime by weight. Soil properties are shown in the following Table 1 and based on specific gravity, liquid limit, plasticity index plastic limit, Compaction direct shear test California bearing ratio.

Table 1: Properties of Block Cotton Soil

Sl no	Particulars	Test Value
1	Moisture content	12.16%
2	Specific gravity	3
3	Plastic limit	23.6%
4	Liquid limit	25.78%
5	Particle size distribution	Cu=3.55, Cc=1.58 Well and uniformly graded
6	Maximum dry density	1.7g/cc
7	Optimum moisture content	18.01%
8	Direct shear test	C=1.04kg/cm ² φ=0
10	California bearing ratio	5.9

Rice Husk Ash

Rice husk ash, basically a waste material, is produce by rice - mill industry while processing rice from paddy. About 20 – 22% rice husk is generated from paddy and about 25% of this total husk become ash when burn. It is non – plastic in nature. Its properties also varied depending on its burning temperature.

RHA has a good pozzolanic property. It is non – plastic in nature. RHA was collected from local rice mill. It physical properties are shown in the following Table 2. However the chemical characteristics of the aforementioned RHA have not done but it is mostly comprised by SiO₂, Fe₂O₃ and Al₂O₃ as mentioned in various literatures.



Fig.1: Rice Husk



Fig.2: Rice Husk Ash

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METHODOLOGY

- The laboratory tests carried out first was on the natural soil which include particle size distribution, Atterberg limits, Compaction, CBR and UCS.
- Specimen for unconfined compressive strength (UCS) and California bearing ratio (CBR) tests are prepared at the optimum moisture contents (OMC) and Maximum dry densities (MDD).
- Three different percentages of Rice Husk Ash, are mixed with soil in three different tests. Tests are carried out to observe the changes in the properties of soil i.e. MDD, OMC, CBR, and UCS

IV.RESULT AND DISCUSSION

Compaction test

Series of compaction tests have been carried out with virgin soil as well as rice husk ash and mix of soil – RHA and soil – RHA – lime. Compaction curves have shown that adding RHA with virgin soil increased the OMC of the mix and decreased MDD value (Fig. 3). But adding lime to this soil – RHA mix increased both OMC and MDD of the ultimate mix.

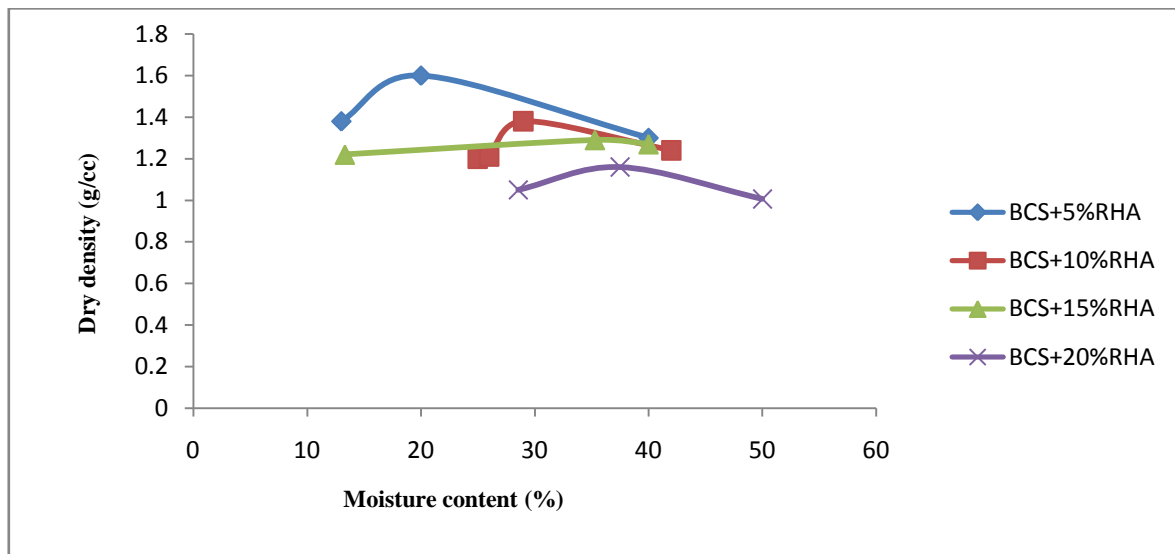


Fig. 3 Influence of block cotton soil + different percentage of RHA + 3% of lime on compaction characteristics

A curve showing the relationship between dry density and water content is plotted. The water content corresponding to the maximum dry density is found from the graph curve for the data tabulated above, the optimum water content is found to be 20%, 29%, 35.29%, and 37.5% corresponding maximum dry density of 1.6g/cc, 1.38g/cc, 1.29g/cc, and 1.16g/cc.

CBR Test

CBR tests were performed to evaluate the strength properties of the mix. It has been seen that with increase in RHA content in soil reduce its strength. But adding a very little amount of lime has increased the strength substantially both soaked and un-soaked conditions

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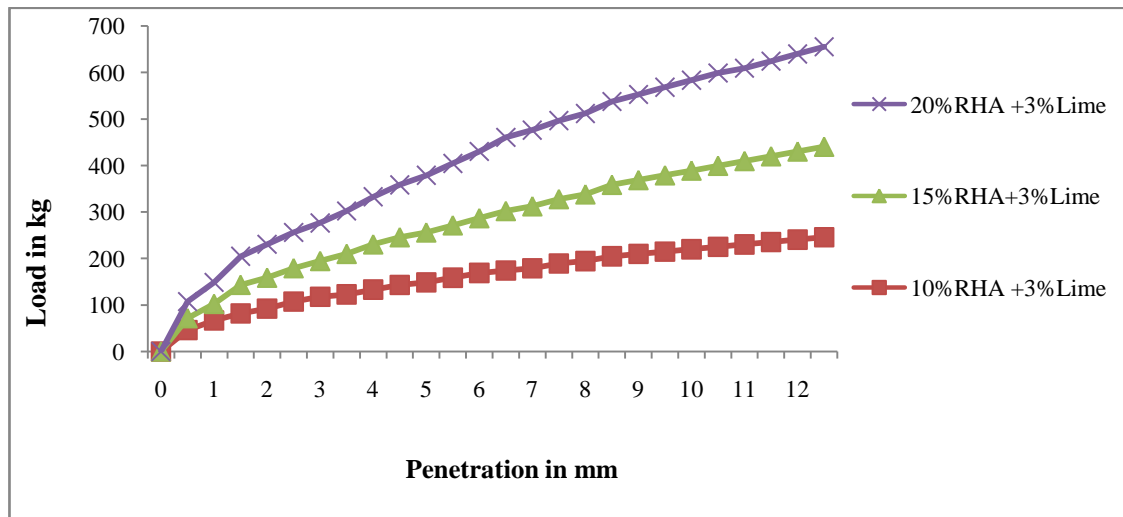


Fig.4: Influence of block cotton soil + different percentage of RHA + 3% of lime on CBR characteristics

Plot the load penetration curve. If the initial portion of the curve is concave upwards, apply the correction by drawing a tangent to the curve at the point of greatest slope. The corrected origin will be the point where the tangent meets the abscissa. Find and record the corrected load reading corresponding to each penetration. Corresponding to the penetration value at which the CBR is desired, corrected load values are found from the curve and CBR is calculated.

V. CONCLUSION

1. The optimum percentage of RHA and Lime for stabilization of black cotton soil is 5%, 10%, 15% and 20% respectively.
2. With the increase in Rice Husk Ash percentage the optimum moisture content increases from 20 to 38%.
3. Maximum dry density decreases from 1.6 to 1.16g/cc.
4. It was observed that by the addition of RHA for BC Soil, the CBR values have been increased with the addition of 10% RHA.
5. There was a also an improvement in the un-soaked CBR (7.8% @ 10% RHA Content) compared with CBR of natural soil (5.9%).

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