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# To study Soil Stabilization of Black Cotton Soil (BC) Using Fly Ash and Rice Husk Ash

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**Abstract-***Civil engineers face a worldwide problem working with expansive soil, as they are considered a potential natural hazard which can cause extensive damage to structures if not treated adequately. Expansive soils swell on infiltration of water and shrink when they dry out. Black cotton soil shrink considerably when they dry out, resulting in formation of extensive cracks and experiences high swelling when soaked in water, and they have low compressive strength at higher water content. The objective of this study is to improve strength characteristics of black cotton soil as construction material when mixed Rice Husk Ash (RHA) and Fly Ash (FA) which are waste materials. The soil was stabilized with different of FA ( i.e. 0, 12, 22, and 32% ) and RHA ( i.e.,0, 4.5, 9, 13.5 and 18% ). Standard proctor test (SPT) and Unconfined compressive strength tests were (UCS) were performed on raw and stabilized soils .The results indicate addition of RHA and FA increases SPT and UCS, indicating improvement in the strength properties of the soil. Based on the SPT and UCS tests, the optimum amount of FA and RHA was found to be 12% and 9% respectively*.

***Key Words***: (**Black cotton soil, Fly ash, Rice husk ash, SPT and UCS)**

## 1. INTRODUCTION

In India about 20% of land is covered by black cotton soil. Black cotton soil is the problematic soil that has the tendency for shrinkage or selling due to change of water content. Excessive heave associated with swelling of expansive soil can cause considerable distress to engineering structures, therefore it important either to remove the existing soil and replace it with non-expansive soil or to improve the engineering properties of the existing of the soil by stabilization. Replacing the existing soil might not be practicable option, therefore the most appropriate approach is to stabilize the soil with suitable stabilizers. Various types of soil stabilizers such as lime, cement, fly ash, kiln dust and locally available materials like rice husk ash, slate dust etc. are being used for soil stabilization. This investigation is done to study the change in index properties and strength characteristics of black cotton soil corresponding to different proportions of fly ash and rice husk ash. The selection and the amount of stabilizers to be used depend mainly on mineralogical composition of soil. The objective of this study is to upgrade Black cotton soil as a construction material using RHA and FA, which are waste materials.

### 1.1 Objective of study

The main focus of the present study is

1. To find the ways to use industrial waste by products in soil stabilization, thus reducing the cost of stabilization.
2. To determine the strength characteristics of soil on addition of best percentages of FA and RHA.

### 1.2 Materials Used

The resources used for the trial work are, Black cotton soil (BCS), Fly ash (FA) and Rice husk ash (RHA).

1. BLACK COTTON SOIL
   The black cotton soil samples were collected from Deccan plateau made up of black basalt soil. This type of soil is humus and is best suited for cultivation of cotton.
2. Fly ash
   It is the ash produced in small dark flecks by the burning of powdered coal or other materials carried into air. The fly ash was collected from brick kilns located at canal road in Jammu
3. Rice husk ash
   Rice husk is the coating on seed or grain of rice, it is the waste material released as a by product of rice milling industry. Rice husk ash is obtained from the burning of rice husk.

**Table-1:** Characteristics of materials used

| Sr.no | Property | Value |
|---|---|---|
| 1 | liquid limit | 65% |
| 2 | plastic limit | 27% |
| 3 | plasticity index | 38% |
| 4 | specific gravity of black cotton soil | 2.58 |
| 5 | specific gravity of fly ash | 1.85 |
| 6 | specific gravity of Rice Husk Ash | 1.9 |
| 7 | MDD of Black cotton soil | 1.49gm/cc |
| 8 | OMC of black cotton soil | 26.70% |

## 2. METHODOLOGY

Firstly the raw natural soil was tested in laboratory, which include Attreberg's limits, plasticity index , standard proctor test(SPT) and unconfined compressive strength test (UCS). For SPT and UCS tests, oven dried soil sample was first pulverized in pulverization machine then it was passed through 475 micron IS sieve and standard proctor test was conducted on a soil sample of 3 Kg. the tets were prepared at optimum moisture content (OMC) and maximum dry density (MDD). Similarly a series of laboratory tests were conducted on different soil samples with black cotton soil (BCS) mixed with fly ash (FA) and rice husk ash (RHA) in different percentages i.e. 0%,12%, 22% and 32% for fly ash and 0%, 4.5%, 9%, 13.2% and 18% for rice husk ash by weight. Tests were carried out to examine the changes in the soil properties, optimum moisture content, maximum dry density and confined compressive strength of soil.

## 3.RESULTS AND DISCUSSION

### 3.2 COMPARISON CURVE

**STANDARD PROCTOR TEST Standard**

Increase in proportion of rice husk ash addition with soil decreases the maximum dry density of the prepared soil

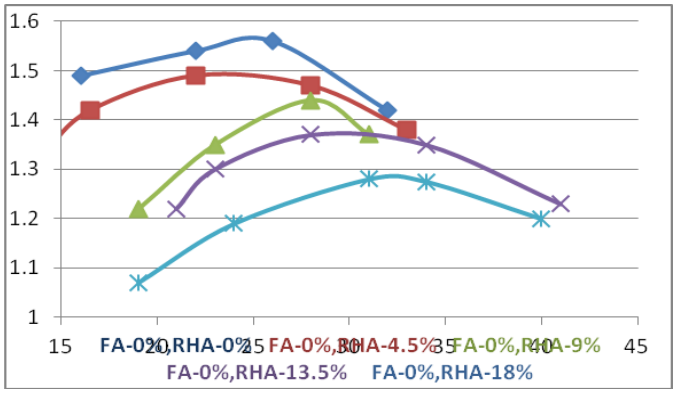


**Chart -1**: FA-0%,RHA-(0,4.5,9,13.5,18)

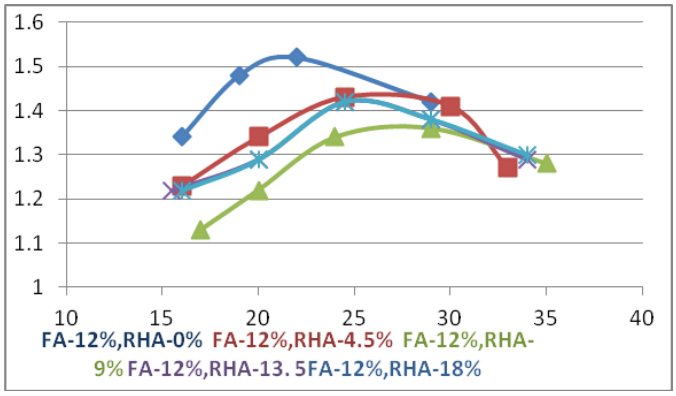


**Chart-2** FA-12%,RHA-(0,4.5,9,13.5,18)

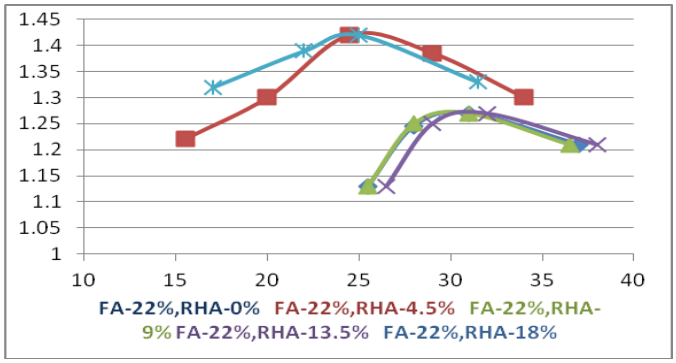


**Chart-3**: FA-22%,RHA-(0,4.5,9,13.5,18)

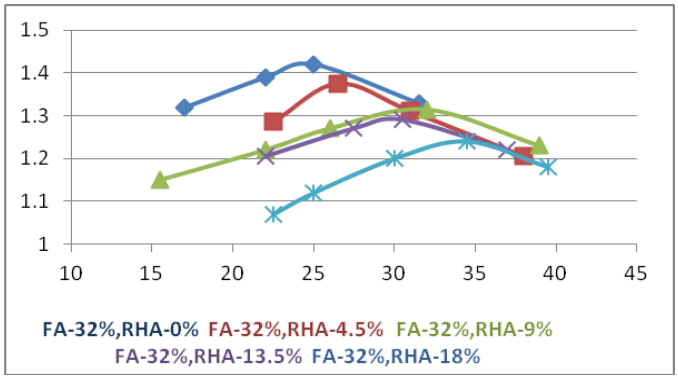


**Chart-4:** FA-32%,RHA-(0,4.5,9,13.5,18)

## UNCONFINED COMPRESSION TEST

Experiments reveal mixing of FA and RHA with black cotton soil increases the strength of soil by 2.250 Kg/mm2. Although the best ratio of additives was proved to be 4.5% RHA and 0%% FA, and the strength of soil was improved to 2.588 Kg/mm2.

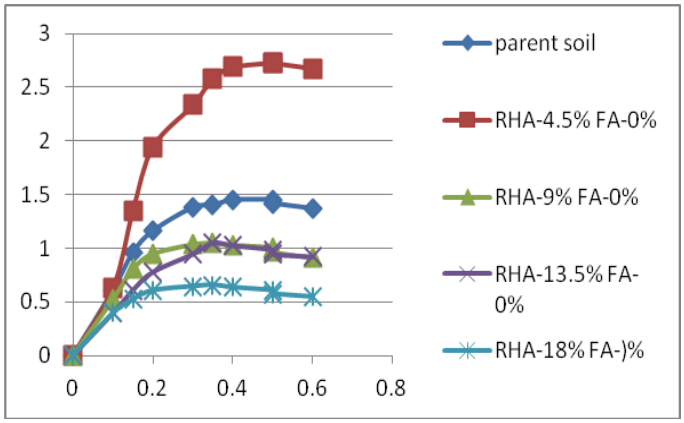


**Chart-5**: FA-0%,RHA(0,4.5,9,13.5,18)

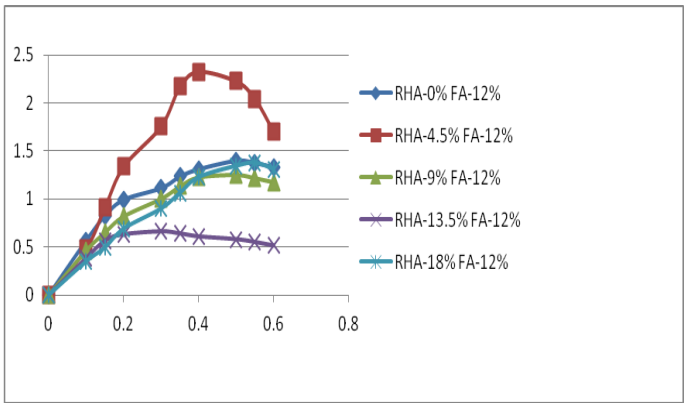


**Chart-6:** FA-12%,RHA(0,4.5,9,13.5,18**)**

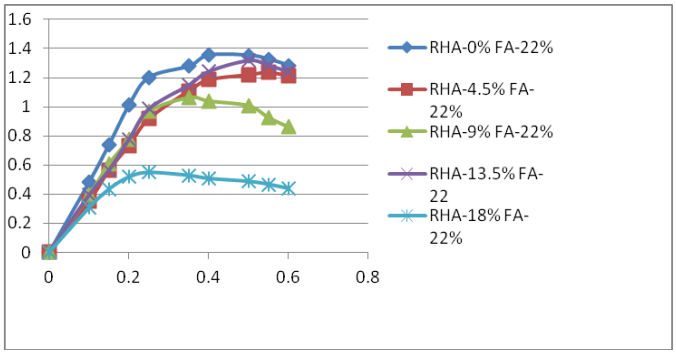


**Chart-7**: FA-22%,RHA(0,4.5,9,13.5,18)

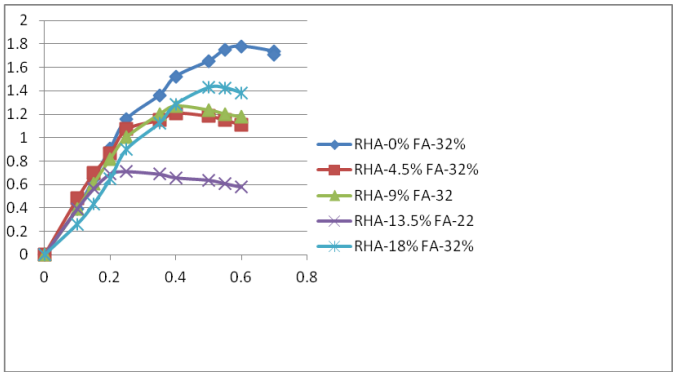


**Chart-8:** FA-32%, RHA(0,4.5,9,13.5,18)

## 4. CONCLUSIONS

1. Rice husk added in increasing proportion with the alluvial soil decreases the maximum dry density of the soil on the other hand the optimum moisture content of the mixed soil increases regularly with the increased percentage of rice husk ash.
2. The specific gravity of the fly ash is 1.85 which is lighter than conventional earth material which will be advantageous in constructing light weight embankments over soft compressible soil .
3. Mixing FA and RHA in black cotton soil advances the strength of soil when mixed in appropriate ratio. Experiments reveal that 12% fly ash and 4.5% rice husk ash when mixed in BCS the strength of soil increases by 2.284 kg/mm$^2$ as shown in figure 4.10. which is more than parent soil strength.
4. Although the most appropriate ratio of FA and RHA for increasing the black cotton soil strength as determined by experimental result is 0% FA and 5% RHA which improve soil strength to 2.688 kg/mm$^2$(fig. 4.1) which is better than strength of parent soil sample.

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