Utilization of Rice husk ash as a soil stabilizer

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Abstract - *Rice husk ash (RHA) is an agricultural waste generated due to burning of rice husk for various purposes. It is a pozzolanic material, main constituent is silica. This study mainly focuses on the potential use of RHA as a soil stabilizer. The effect of RHA on soil compaction characteristics and strength characteristics are studied. It has been found that there is a decrease of maximum dry density (MDD) and an increase of optimum moisture content (OMC) when the soil is treated with 5 to 20% of RHA by dry weight of the soil. The unconfined compressive strength (UCS) increases up to 10% addition of RHA by dry weight of soil, there after it decreases. For the best stabilization effect the optimum percentage of RHA was found to be 10% by weight of dry soil sample*.

Key Words*: *Husk Ash, soil stabilizer, OMC, MDD,UCS.

1. INTRODUCTION

The available soil at various locations may not be fit as a construction material and supporting material to huge multi-storeyed buildings due to its higher compressibility and poor bearing capacity. If unsuitable soil are encountered at the site of a proposed structure, one of the following procedures may be adopted-abandon the site and relocate the structure elsewhere, redesign the planned structure or foundation according to the poor ground conditions, by means of deep foundations (like piles) extending to a suitable bearing material (to carry the weight of the structure to competent stratum), improve the properties of the ground prior to construction either by removing the poor material and substitute for it with a suitable material or treat the soil in place to improve its properties (Ground modification).

In present days, ground modification is mostly selected as a construction practice. Present days waste materials from various industries are using as soil stabilizers all over the world. This is mainly due the excessive production of waste materials like fly ash, plastics, rice husk ash (RHA), marble dust etc. They create great disposal problems and also affect the environment badly. So the use of some of these waste materials in construction practices will reduce the problem in a great extent. Also the conventional soil stabilization techniques are generally expensive, involving large quantities of costly materials. Due to shortage of energy, materials and also the high cost of construction operation, there is a need to go for alternate low cost materials.

India is a major rice producing country, and the husk generated during the milling is used as a fuel in the boiler for processing paddy. About 20 million tonnes of RHA is produced annually. This RHA is a great threat to environment causing damage to the land and surrounding area in which it is dumped. So we have to find ways to manage this waste effectively without affecting any damage to environment.

This study mainly focuses on finding the effect of RHA on soil compaction characteristics and strength characteristics and also its potential as a soil stabilizer.

2. MATERIALS USED

The materials used in this study are high plasticity clayey soil and Rice Husk Ash (RHA)

A. Clayey soil

The soil was collected from Bolgatty, Ernakulam. The basic geotechnical properties related to the soil are shown in the Table 1.

Table 1-: Geotechnical properties of soil used

Properties	Values
Specific gravity	2.5
Liquid limit (%) (IS 2720 PART 5)	72
Plastic limit (%) (IS 2720 PART 5)	32.63
Plastic index (%) (IS 2720 PART 5)	39.63
Shrinkage limit (%) (IS 2720 PART 5)	10.78
IS Classification	CH
Optimum moisture content (%) (IS 2720 PART7)	32
Maximum dry density (kN/m^3) (IS 2720 PART 7)	15.205
Percentage of clay (IS 2720 PART 4)	50
Percentage of silt (IS 2720 PART 4)	38
Percentage of sand (IS 2720 PART 4)	12
UCC strength (kN/m^2) (IS 2720 PART 10)	50.606
Free Swell Index (IS 2720 PART40)	25

B. Rice husk ash (RHA)

The RHA was collected from Rani rice mill, Kottayam. The important properties of RHA are detailed in the Table 2.

Table 2- : Properties of RHA

Properties	Values
Specific gravity	2.01
SiO_2 (%)	86
Al_2O_3 (%)	2.6
Fe_2O_3 (%)	1.8
CaO (%)	3.6
MgO (%)	0.27
Loss on ignition (%)	4.2

3. EXPERIMENTAL INVESTIGATION

✓ **Compaction test(IS 2720 PART 7)**

The compaction tests on the clay-RHA mixture were performed by using the standard proctor compaction method. The relationship between the dry density and the moisture content for the clay- RHA mixtures with 5 to 20% of RHA by dry weight of soil sample by an increment of 5% was obtained.

✓ **Unconfined compressive strength (UCS) test (IS 2720 PART 10)**

The UCS test on clay-RHA mixture were performed. The relationship between the UCS value with 5 to 20% of RHA by dry weight of soil sample by an increment of 5% was obtained.

4. RESULTS OBTAINED

4.1 Compaction characteristics

The variations of MDD and OMC with different percentage of RHA by dry weight of soil are shown in Fig 1 and 2 respectively. The MDD get decreased and OMC get increased with the increase in the RHA content.

The MDD decreases irrespective of increase in percentage addition of RHA. MDD of soil decreases from 15.205 kN/m^3 to 11.180 kN/m^3 when 20% of RHA was used. The decrease in the MDD can be attributed to the replacement of soil by the RHA in the mixture which have relatively lower specific gravity (2.01) compared to that of the soil which is 2.5 [4][5]. It may also be attributed to coating of the soil by the RHA which result to large particles with larger voids and hence less density[6]. The decrease in the MDD may also be explained by considering the RHA as filler (with lower specific gravity) in the soil voids.

The OMC increases irrespective of percentage addition of RHA. The OMC increases to a value of 43 % from 32% when 20% RHA was added to the soil. The increase in the optimum moisture content may be caused by the absorption of water by the RHA [1].

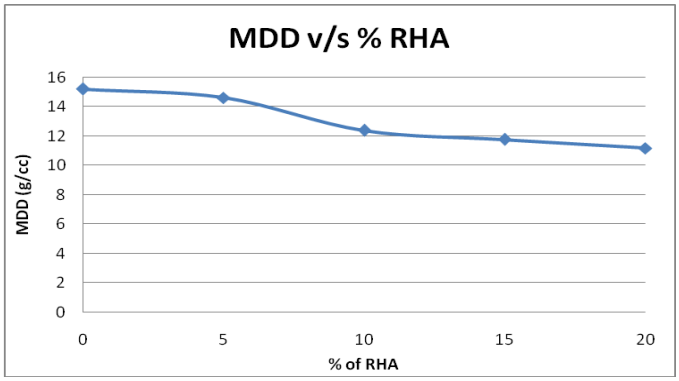

Fig 1- : Variation of maximum dry density with different percentages of RHA

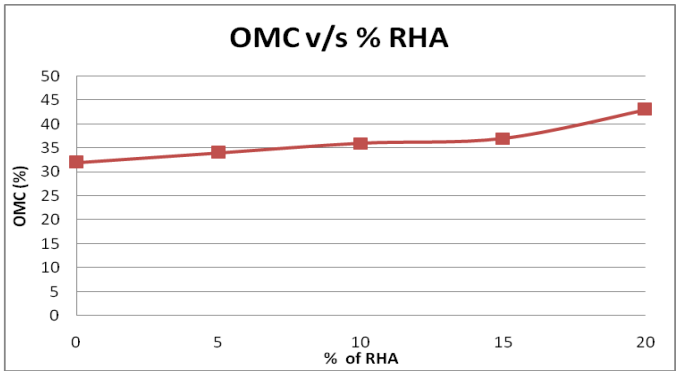

Fig 2- : Variation of optimum moisture content with different percentages of RHA

4.2 Strength characteristics

Unconfined compressive strength (UCS) is the most common method for finding the strength of stabilized soil. Variation of UCS with different percentages of RHA by dry weight of soil is shown in Fig 3. The UCS value increases upto 10% addition of RHA, thereafter UCS get decreases.

The UCS of soil increases from 50.606 kN/m^2 to 71.78 kN/m^2, when 10 percentage of RHA was added, this is because of the frictional resistance from RHA in addition to the cohesion from expansive soil. Reduction in UCS after the addition of 10% of RHA occurs due to reduction in cohesion because of the reduction in soil content[1].

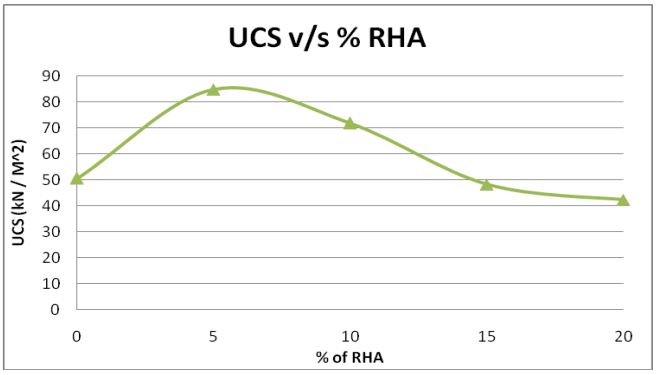

Fig 3- : Variation of UCS value with different percentages of RHA

5. CONCLUSION

- ✓ MDD goes on decreasing and OMC goes on increasing with the increasing percentage addition of rice husk ash on the soil.
- ✓ Maximum UCS of soil found at 10% addition of rice husk ash on soil.
- ✓ For best stabilization effect optimum percentage of rice husk ash on soil is obtained as 10% by weight of dry soil.
- ✓ RHA can be used as a soil stabilizer.

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