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# Study on Soil Stabilization Using Rice Husk Ash and Cement In Marshy Soils

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**ABSTRACT-**The current study was conducted on marshy soils found at Rakh Arth Bemina in Srinagar, J&K,India with the goal of quantifying the effect of rice husk ash and cement on the soil's dry density, optimum moisture content and shear strength. The tests were performed on the original soil sample first, followed by the same tests on the other three samples with Rice Husk Ash(RHA) contents of 10%, 18%, and 22%, respectively, and each containing 8% Cement(C). When 18 percent RHA was used, the goal of increasing optimum moisture content and decreasing maximum dry density was met. As compared to the original sample, the maximum shear strength got increased by 14.8%. Hence,the optimal RHA content is 18%. As a result, rice husk ash combined with a small amount of cement can be a better stabiliser for marshy soils, preventing failure and increasing strength.

**KEYWORDS-**Soil stabilization, Rice Husk Ash, Cement, Optimum Moisture Content, Shear strength.

## I. INTRODUCTION

Soil stabilisation is the process of enhancing the soil's engineering properties and thereby increasing its stability when the land available for development is not suitable for the planned use. Civil engineering projects on marshy soils have traditionally included methods for improving soil properties. The technique of soil stabilization is utilized in many engineering works, the most well-known of which are pavement development, with the primary objective of increasing soil strength while bringing down development costs by utilizing locally accessible materials. All things considered, the two essential materials utilized for soil adjustment were concrete and lime. On account of the sharp expansion in the expense of energy, the costs of these materials have risen quickly. Consequently, the utilization of farming waste, (for example, rice husk debris - RHA) will altogether decrease development costs while likewise diminishing the ecological risks they cause being an agricultural waste obtained during the processing of rice.

Past RHA(Rice Husk Ash) research [1]-[3] has shown that it has promising possibilities for improving the engineering properties of soils for sub-grade purposes. Along these lines, the objective of this study was to decide the ideal measure of RHA for engineering purposes by noticing the impact of RHA on some geotechnical properties of marshy soils that are significant for analysing soil performance for development purposes. In any case, because of the absence of the cementation property needed to bind the material [4]-[7], RHA can be utilized as a partial replacement for the expensive soil stabilizers(concrete/lime)[8]. Thus, in the current review, a modest quantity of cement was blended in with RHA, and the impact of soil stabilization on soil properties was noticed, with the most extreme improvement deciding the optimum content[9]-[11].

## II. MATERIALS

The marshy soil in the project work was collected from Rakh Arth at Bemina in Srinagar in the state of J&K,India.The soil sample was collected from a depth of 2m from the natural ground surface.The physical characteristics of soil are given in Table 1.

Table 1: Physical characteristics of marshy soil

| **Soil Depth** | **2m** |
|---|---|
| Colour | Light Grey |
| Specific gravity | 2.61 |
| Passing 75 micron Sieve | 62.84% |
| Cu | 2.43 |
| Cc | 1.09 |
| Classification | Well graded soil |
| Compaction properties | Modified Proctor |
| Optimum moisture content | 12.7% |
| Maximum dry density (g/cc) | 1.811 |

Rice husk ash with grey to white in colour having specific gravity of 2.14 and bulk density of 0.781g/cm3 was brought from a local vendor and the binder cement from local market.

## III. METHODOLOGY

Several tests and analyses were performed to investigate the effect of RHA and cement on marshy soil, including Atterberg limit tests, particle size distribution, specific gravity, optimum moisture content, maximum dry density, and direct shear strength testing.Based on these tests optimum quantity of RHA and cement required for effective stabilisation of marshy soil was determined[12]. The experimental work was done in two phases.In the underlying phase,the fundamental tests on original soil sample were completed as per the significant arrangements of the IS code. In the 2nd phase the same tests were repeated with the addition of different percentages of RHA and cement & the deviations from the initial phase were noted very carefully. In the initial phase, the liquid limit tests were carried out using a mechanical liquid limit device, whereas the plastic limit is obtained by the thread rolling method as per CITATION IS22 \l 1033 ((V)-1985, IS:2720 (V)-1985)[13]. The optimum moisture content and maximum dry density of soils were determined by performing the Modified Proctor Test as per CITATION IS23 \l 1033 (2720(VII)-1980.) and then DST(Direct Shear Test) was performed. In the 2nd phase, the soil was mixed with 10%,18% & 22% of RHA and 8% of cement and then all the tests were repeated according to the codal provisions [14].

## IV. RESULTS AND DISCUSSIONS

### A. *Compaction Characteristics*

The variation of optimum moisture content and maximum dry density with various percentages of RHA is shown in Figure 1 and Figure 2. The decrease in maximum dry density when 10% and 18% RHA were applied can be explained by the RHA working well with the soil particles, occupying the spaces in the soil and preventing water from migrating into the soil specimen and crystallising in it[15]. The increase in maximum dry density was attributable to the excess RHA particles that stayed free and did not combine with the soil particles when 22% RHA was sprayed. The reduction in maximum dry density was due to the absorption and retention of more water by these extra particles[16].

The control mix sample had the lowest optimum moisture content, which tended to increase after utilising the RHA which decreases the quantity of free silt and clay fraction and coarser materials with larger surface areas are formed. These processes require water. This implies also that more water is needed in order to compact the soil-RHA mixtures.then when 22% of RHA is used, the optimum moisture content decreased.

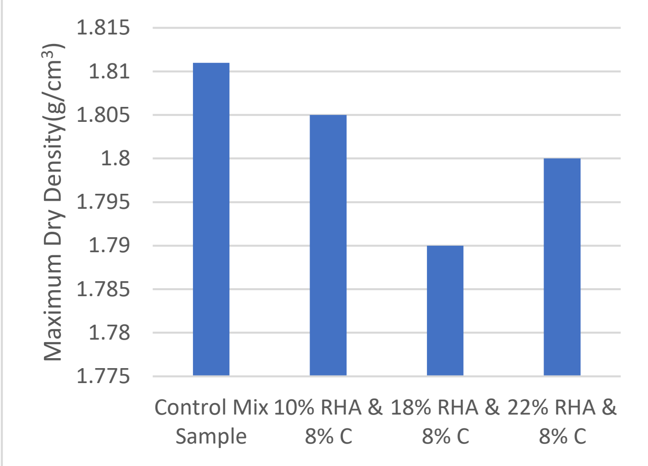


Figure 1: Variation of Maximum Dry Density with RHA content

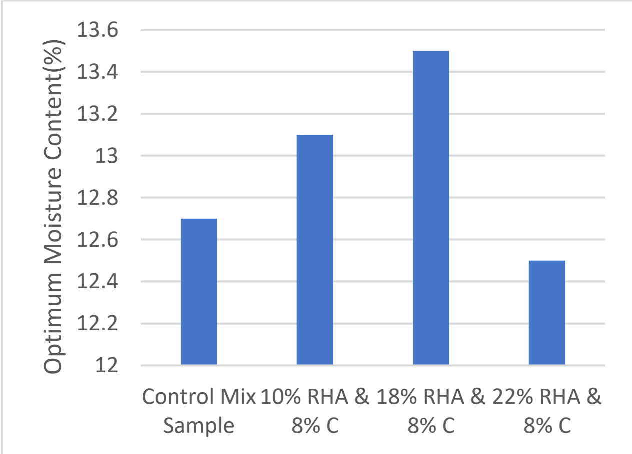


Figure 2: Variation of Optimum Moisture content with RHA content

### *B. Direct Shear Strength*

Variation of Direct shear strength with different percentages of RHA and cement is shown in Figure 3. Cohesiveness increased from 0.002Kg/cm2 to 0.191Kg/cm2, while maximum shear strength decreased from 1.035Kg/cm2 to 0.983Kg/cm2[17].This is due to the soil-additive admixture starting to react with each other but not yet reaching the maximum reaction, there are still some particles that was not mixed well with soil which made the soil loose a bit of its shear strength, but in terms of cohesion the particles have seemed to get more cohesion and this has to make the soil more resistible to shear if it was given enough time to settle.

When 18 percent RHA was applied to the soil, it increased both cohesion and shear strength because the RHA particles and soil particles were mixed well [18]. For the angle of internal friction Φ, its decrease at the beginning was because of the less friction that happened when the force was applied due to the increase of the cohesion, while when increased later was due to the increase in the RHA percentage,thus its lightweight reduced the friction that came into effect when force was applied.

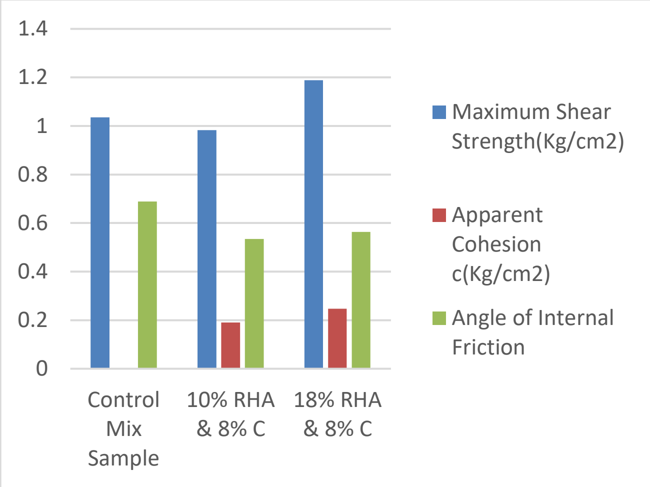


Figure. 3: Variation of direct shear strength with RHA content

## V. CONCLUSION

From the results following conclusions can be drawn:

- The maximum dry density when using 18% RHA was decreased in comparison to the normal sample and the optimum moisture content was increased when using the optimum percentage of RHA (18%) indicating that the optimal percentage of RHA is 18% to be used as a stabilizer.
- The maximum shear strength was increased for the 18% of rice husk ash to 1.189Kg/cm2 in comparison with normal sample which is 1.035Kg/cm2, the overall increase in shear strength as 14.8%.

## VI. RECOMMENDATION

Seeing the outcomes, it can be suggested that the stabilized soil can be utilized for lodging settlement.

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