# Improvement of Alluvial Soil by Mixing With Rice Husk Ash

**Abhishek Mondal, Joyanta Maity, Arghyakamal Bhattacharya**

***Abstract*— Rice Husk Ash (RHA) is an industrial waste generated from Rice-mill. It being very light weight, has a chance of transportation by wind and hence creates a disposal problem. It can be collected and utilised in some geotechnical improvement works if it is mixed with clay in proper quantities. As the available soil near construction site does not reach the required specification for the construction of pavements it requires an efficient and economical method to improve the soil properties. Several methods of soil improvements have been developed and in this study rice husk ash have been used for the stabilization of soil. Alluvial deposit of Hooghly River collected from Chinsurah has been used as the test material in this study where as Rice Husk Ash were collected from locally available Rice Mill around Kolkata. This paper aims in finding out the improvement of various geotechnical parameters upon application of RHA. California Bearing Ratio (CBR), Maximum Dry Density (MDD), Optimum Moisture Content (OMC) are the three major parameters which has been studied for its variation with change in RHA content. Hooghly river deposit has been used as the test material. It was found that the CBR value increases with increase in RHA content whereas the MDD decreases with increase in RHA content and OMC increases with increase in RHA content.**

***Index Terms*— Rice Husk Ash, California Bearing Ratio, Maximum Dry Density, Optimum Moisture Content**

## I. INTRODUCTION

Since the property of the soil does not reach the required specification for the construction of pavements it requires an efficient and economical method to improve the soil properties. Several methods of soil improvements have been developed and in this study rice husk ash have been used for the stabilization of soil. Rice husk ash is the waste product of rice mills. Following China, India is the largest producer of rice. Approximately half of the world's population depend on rice as an important staple food. During milling of paddy about 78% of weight is received as rice, broken rice and bran and remaining 22% of the weight is received as husk.

This paper presents results of the study of using RHA on the geotechnical properties of soil. Standard Proctor Test, CBR and Unconfined Compression Test have been conducted to arrive at the results. CBR Tests results show that soil can be successfully used for pavement design by effective stabilization.

## II. PROPOSED INVESTIGATION

### *[1] Materials Used*

**Soil:** Alluvial deposit of Hooghly River collected from Chinsurah has been used as the test material. It is predominantly of clayey silt nature. It can be considered as medium plastic. Physical properties of the soil is furnished in Table 1

Table 1: Physical Properties of Soil

| | |
|---|---|
| Classification (I.S) | MI |
| Specific Gravity | 2.47 |
| Particle size distribution | $D_{60}$ = 0.028<br>$D_{30}$ = 0.007<br>$D_{10}$ = 0.0015<br>$C_u$ = 18.67<br>$C_c$ = 1.17 |
| Liquid Limit | 35.15 |
| Plastic Limit | 28.15 |
| Standard Proctor Test | OMC = 12%<br>MDD = 1.47 gm/cc |
| CBR Test | Unsoaked = 6%<br>Soaked = 4.5% |

**Rice Husk Ash (RHA):** Rice Husk Ash were collected from locally available Rice Mill around Kolkata. Figure 1 and 2 describes the production of Rice Husk Ash from Rice Husk obtained from mill.

**Fig 1: Rice Husk**

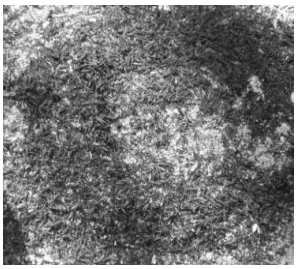

**Fig 2: Rice Husk Ash**

Physical properties of RHA have been given in Table 2

**Table 1:** Physical Properties of RHA

| | |
|---|---|
| Specific Gravity | 1.30 |
| Atterberg's Limit | Non Plastic |
| Standard Proctor Test | OMC = 28%<br>MDD = 1.03 gm/cc |

### *[2] Test Programme*

A systematic experimental programme has been undertaken for different soil rice husk ash mix composite to determine the optimum percentage of rice husk ash to be added with soil for attaining highest CBR value. Various percentage of RHA was mixed with soil viz, 3%, 6%, 9%, 12% and 15% and then tested in laboratory for determination of various strength properties. For this standard Proctor tests have been first conducted as per IS codal provision, to determine the optimum moisture content and corresponding maximum dry density for each combination of rice husk ash – soil mix. Further unsoaked and soaked CBR tests have been conducted as per IS codal provision for each mixture combination at respective optimum moisture content.

## III. EXPERIMENT AND RESULT

Results of the experiments conducted in the present investigation have been presented here.

Standard proctor tests and California Bearing ratio test have been conducted in the laboratory for each series and the experimental results are presented in the following section.

**5.1 Light compaction tests (As per IS-2720 Part VII):-**

To determine maximum dry density and corresponding optimum moisture content, light compaction tests have been conducted for different soil rice husk ash mix composites as per I.S. codal provision.

**5.2 California Bearing Ratio test (As per IS-2720 Part XVI) :-**

To determine the California bearing ratio by conducting a load penetration test as per IS code in the laboratory. The values of CBR for different soil-admixture composite are reported. Soaked CBR test has also been performed by soaking into water for 96 hours.

The summary of the test results has been shown in Table 3.

**Table 3:** Summary of the experimental results of light compaction test

| Description | OMC | MDD (gm/cc) | CBR (Unsoaked) | CBR (Soaked) |
|---|---|---|---|---|
| 0% R.H.A + Soil | 12 | 1.47 | 6% | 4.5% |
| 3% R.H.A + Soil | 13.7 | 1.65 | 7.0% | 6.9% |
| 6% R.H.A + Soil | 14.3 | 1.57 | 7.7% | 7.2% |
| 9% R.H.A + Soil | 14.7 | 1.55 | 8.75% | 8.2% |
| 12% R.H.A + Soil | 14.9 | 1.53 | 9.5% | 8.79% |
| 15% R.H.A + Soil | 15.2 | 1.49 | 10.08% | 9.2% |

The variation of MDD, OMC and unsoaked CBR with respect to different RHA content have been furnished in fig 3 to 5.

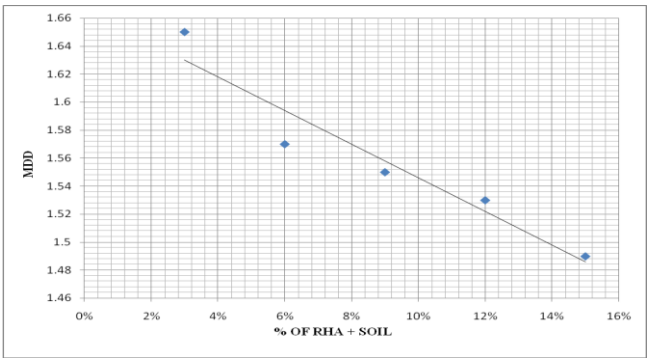


Fig : 3 Comparison graph between % of RHA and MDD

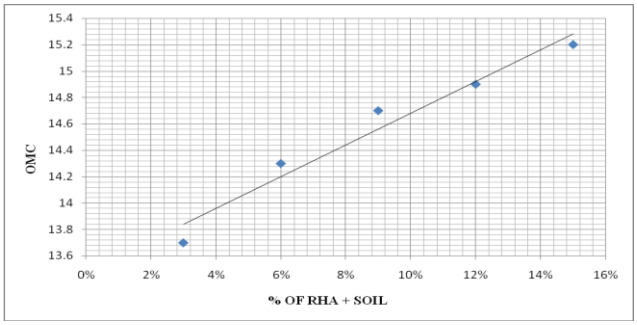


Fig : 4 Comparison graph between % of RHA and OMC

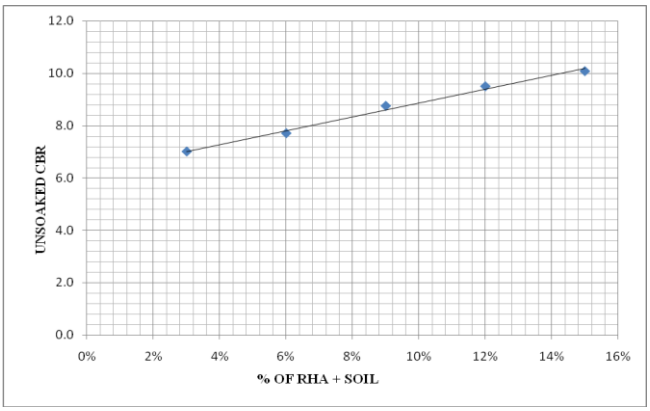


Fig : 5 Comparison graph between % RHA and CBR

From the above figures, it is found that as the percentage of RHA increases, the value of Maximum Dry Density decreases whereas the value of OMC increases.

Further it has been observed that the value of CBR increases with increase in percentage of RHA.

## IV. CONCLUSION

Based on the experiments carried out on soil and soil fiber composite, the following observations and conclusion are drawn:

[1] As the percentages of rice husk ash (RHA) increases, the maximum dry density (MDD) of RHA mix composite decreases. The decrease in density for RHA mix composite is due to replacement of soil with greater specific weight by RHA of less specific weight.

[2] As the percentage of rice husk ash (RHA) increases the optimum moisture content (OMC) of RHA mix composite increases. This may be interpreted as because of the greater water absorption capacity of RHA.

**[3]** As the percentage of RHA increases, both CBR values in unsoaked and soaked condition increases though the rate of increase is much lower in case of higher RHA content. This result attributes in the ground improvement capabilities of RHA if mixed with soil in a certain percentage.

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