

# Utilization of Rice Husk with Lime in Subgrade Soil for a Rural Road

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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, in the present paper describes some results with probable analytical discussion of starting of a new research programme. 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 soaked and un-soaked CBR; compaction has been performed to evaluate the effects of the foreign materials on virgin soil. Result showed that only use of RHA decreases the strength whereas in addition of RHA with soil, a very little amount of lime improves the soil property to a great extent. Subsequently, result shows that for the mix, the optimum moisture content (OMC) increases and the maximum dry density (MDD) decreases.

## Keywords

Rice husk ash, Lime, CBR, OMC, MDD, soil stabilizing

## 1. 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. Alhassan (2008) has shown 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. Brooks (2009) reported 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. The effect of marble dust with RHA in a mix with

expansive soil has been studied by Sabat and Nanda (2011). It has been seen that with addition of RHA and marble dust with soil, the MDD decreases and OMC increases. Also the CBR and UCS values increase substantially due to adding these two with the natural soil. The study of Yulianto and Mochtar (2010) shows the effectiveness of using rice husk ash (RHA) and lime as a pozzolanic 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.

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.

## 2. MATERIAL USED

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.

### 2.1 Soil

Soil has been used as a base material in the study. it has been replaced partially with RHA and Lime by weight. Soil is collected from shallow depth from the nearby bank of Ganges. Soil properties are shown in the following Table 1 and based on liquid limit and plasticity index the soil is classified as "CH".

### 2.2 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 SiO<sub>2</sub>, Fe<sub>2</sub>O<sub>3</sub> and Al<sub>2</sub>O<sub>3</sub> as mentioned in various literatures.

### 2.3 Lime

Commercial limes are collected from local market.

**Table 1: Properties of Soil**

Properties	Values
Specific Gravity	2.65
Particle size distribution	
Sand (%)	8
Silt (%)	55
Clay (%)	37
Liquid Limit (%)	60
Plastic Limit (%)	35
Plasticity Index (%)	25
Max. Dry Density (gm/cm <sup>3</sup> )	1.57
Optimum Moisture Content (%)	22
Soaked C.B.R. (%)	8
Un-soaked C.B.R. (%)	14

**Table 2: Properties of Rice Husk Ash (RHA)**

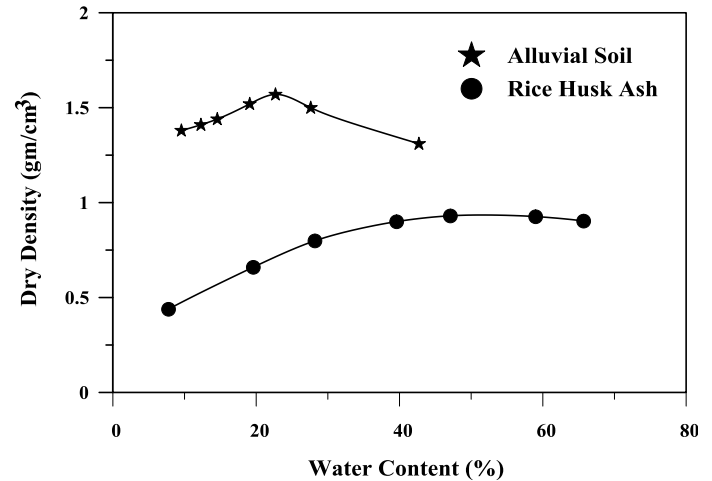
Properties	RHA
Specific Gravity	1.95
Particle Size Distribution	
Sand (%)	69
Silt (%)	31
Clay (%)	Nil
Atterberg Limits	Non - Plastic
Max. Dry Density (gm/cm <sup>3</sup> )	0.93
Optimum Moisture Content (%)	47
Soaked C.B.R. (%)	13.72
Un-soaked C.B.R. (%)	19.5

## 3. RESULTS AND DISCUSSIONS

The results from the experimental investigations are briefly discussed here. Results and discussions are presented separately according to the tests conducted.

### 3.1 Compaction Test

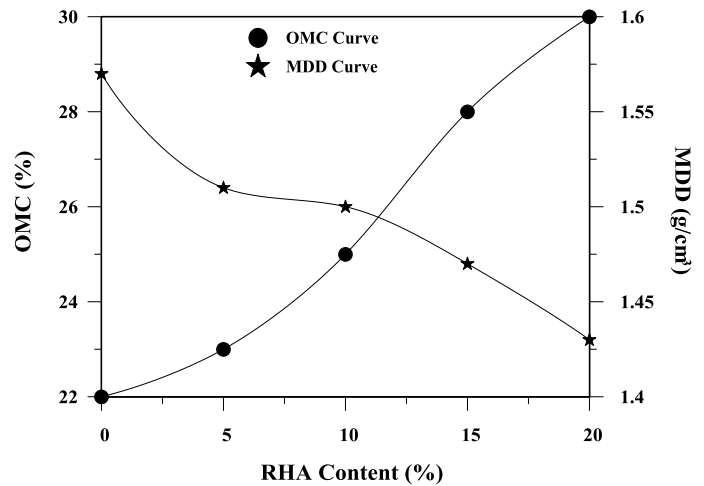
Series of compaction tests have been carried out with virgin soil as well as rice husk ash and mix of soil – RHA and soil – RHA – lime. Compaction curves have shown that adding RHA with virgin soil increased the OMC of the mix and decreased MDD value (Fig. 2). But adding lime to this soil – RHA mix increased both OMC and MDD of the ultimate mix (Fig. 4).



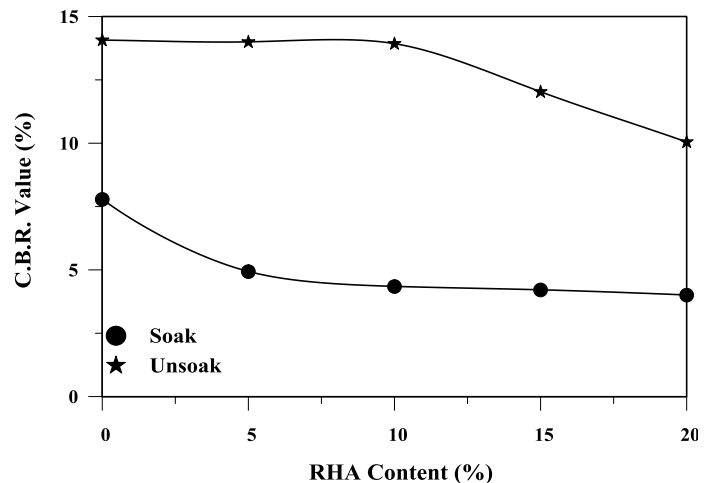
**Fig 1: Compaction behavior of Soil and RHA**

### 3.2 CBR Test

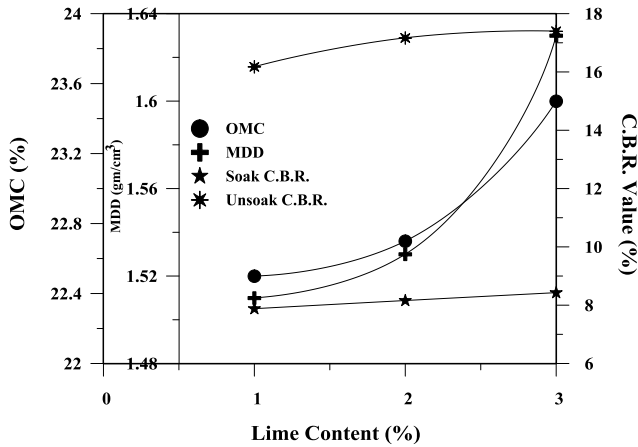
CBR tests were performed to evaluate the strength properties of the mix. It has been seen that with increase in RHA content in soil reduce its strength. But adding a very little amount of lime has increased the strength substantially both soaked and un-soaked conditions (Fig. 3 and 4).



**Fig 2: Variation of OMC and MDD with RHA content**



**Fig 3: Variation of C.B.R. value with RHA content**



**Fig 4: Variation of OMC, MDD, C.B.R. values with lime content with Soil + 5% RHA mix.**

When lime is mixed with the soil – RHA mix., the strength has been increased considerably. The RHA has good pozzolanic characteristics which with hydrated lime improves the strength of the mix. Having low air content and being a fine particle size, high plastic in nature and due to its water retention property, lime forms an excellent bonding with the RHA and soil which also improves its strength characteristics. This also eliminates easy migration water to penetrate the mix.

#### 4. CONCLUSIONS

From the above preliminary experimental study, the following conclusions can be drawn:

1. The main objective to use RHA is to reduce the burden of waste material which can be very effectively done by use it as a soil stabilizer by partially replace the soil with lime.
2. RHA can be used very effectively in the backfilling with soil as well as making the subgrades of the roads as it is being lighter in weight and if lime can be added, it will have a water proofing property as well.
3. The soaked and un-soaked CBR both improves considerably with adding of very less amount of lime.

4. The MDD and OMC of RHA – soil mix. decreased and increased respectively as the RHA content increased in soil.
5. The curing period of the mix may be a governing parameter as the hydration of lime is depended on it. So it is expected that as the curing period increased, the strength will be increase which may be another investigation parameter.

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