

Experimental Investigation on Clay with Rice Husk Ash and RBI Grade 81

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ABSTRACT: Clay are those soils which swell when come in contact with water and shrink when it becomes dry or when water squeeze out from it. Due of this behavior of soil, damage occurs in embankment construction, foundation of structures etc. To overcome from this problem various techniques are to be used, so that strength and durability of clay can be better. *Stabilization* is the best technique which can be reduced the consistency limits as well as shear strength of the soil. In this present study, experimental investigation are conducted to find out the improvement in the various engineering properties of soil after the addition of Rice husk ash and RBI grade 81 into the clay. From the LL, PL, and PI tests 86:10:04(Clay: RHA: RBI grade 81) optimum mix arrived UCS and CBR tests were conducted on the optimum mix for 3, 7 and 28 days curing periods. Comparatively with clay optimum mix shows increased in percentage i.e. 782% and 166% in UCS and CBR respectively.

KEYWORDS: Clay, Rice Husk Ash, RBI grade 81, Stabilization, CBR value, UCS value, Compaction, Consistency limits.

I. INTRODUCTION

Clayey soils are microscopic and sub-microscopic particles that change significantly in volume with changes in water content. In monsoon they imbibe water and swell and in summer they shrink on evaporation of water there from. Because of this alternative swelling and shrinkage lightly loaded civil engineering structure like residential buildings, pavements and canal linings are severely damaged. It is therefore, necessary to mitigate the problems posed by clayey soils. Stabilization of clayey soil with various additives has also attained lot of success. In this study, Rice husk Ash and RBI 81 is added to the clayey soil which resulted in considerable improvement in the strength characteristics of the expansive soil. This group is characterized by the presence of montmorillonite in the mineralogy which is capable of large volume changes from the dry to the saturated state. As the population increasing there is shortage of land has been coming, so we need to accept all type of soil for the construction. At the time of construction the poor behaviour of soil leads to the failure of structure. To overcome from such problem improvement in the properties of soil is needed and it is done by the technique known as stabilization. "Stabilization" is defined as the technique which is used to improve the engineering properties of soil either by mechanical way or by admixing.

II. LITERATURE REVIEW

The various papers have been studied regarding stabilization of different soil with rice husk ash and RBI grade 81. Following are the papers with their author name are as given:

Argaw Asha Ashango et al. (2014) checked static and cyclic properties of clay subgrade stabilized with rice husk ash and Portland slag cement. In this paper on the basis of unconfined compressive strength test results, the optimum mix is obtained is of 82.5% soil + 7.5% PSC + 10 % RHA. The increase in strength of the optimum mix is about 29.8%, 37.2% and 48.55% for a curing period of 7, 14, 30 days respectively. The soaked CBR test gives about 91.75% higher

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values as compared to unsoaked CBR test for curing period of 30 days. From the study it has been observed that based on dry density, strength, durability and CBR values above aforementioned mix is suitable for pavement subgrade material.

Agus Setyo Muntohar et al. (2013) had given paper on the engineering properties of silty soil with lime and rha and reinforced with waste plastic fiber. The results indicate that the proposed method is very effective to improve the engineering properties of the silty soil in terms of compressive strength, California Bearing Ratio, shear strength and failure characteristics, the optimum amount of fiber mixed in soil / lime / rha mixtures ranges from 0.4- 0.8% of the dry mass. Lime and rha mixtures enhanced the compressive and tensile strength of the soil up to 4× and 5× respectively. The inclusion of fibers reduced the friction angle.

Haricharan et al. (2011) had given the paper laboratory investigation of expansive soil stabilized with natural inorganic stabilizer (i.e. RBI grade 81)". In this paper it is found that the application of RBI Grade 81 chemical stabilizer causes the liquid limit to decrease and the plastic limit to increase. It can be seen that as the percentage of RBI 81 added increases, the maximum dry density and optimum moisture content increase and decrease respectively, indicating the behavior of expansive soil associated with the addition of stabilizer.

Manisha Gunturi et al. (2011) had given paper on effect of RBI-81 on CBR and Swell Behavior of Expansive Soil. In this paper it is found that RBI grade 81 stabilizer gives satisfactory results for both the soils in terms of strength and swelling. Effect of RBI Grade 81 on problematic Kaolinite and lateritic soils at various curing periods was studied (Anitha K.R. et al 2009) and concluded better results of various properties like CBR, Atterberg limits, and modified compaction tests. From the study the researchers reported that laterite and Kaolinite soils shows the better performance with the addition of RBI stabilizer of 2% and 6%.

III. MATERIALS AND METHODOLOGY

For conducting different geotechnical tests, the clayey soil has been mixed with RHA from 0% to 20% at an increment of 5% and RBI grade 81 from 0% to 6% at an increment of 2%. The basic tests performed includes are:

Atterberg's limits (IS: 2720, Part-V),

Compaction characteristics (IS: 2720, Part-VII),

Unconfined Compressive Strength (IS: 2720, Part-X),

California Bearing Ratio (IS: 2720 Part-VI).

The materials we used in our project are briefly described:

Clay: Clay is an expansive soil. It has the property to swell when comes in contact with water and it shrinks when water get evaporated from it due to increase in temperature. But as we know that clay particle is very finer when there is excess amount of water the clay particles going to swell. That's why the clay has very high compressibility as well as low bearing strength. The soil collected from Kapurthala, Punjab, India.

Rice husk Ash: Due to milling of rice, the generation of rice husk takes place. From rice 22% of husk produced, this rice husk is burn under the temperature of 500°C to get Rice husk ash. And this rice husk ash is used for the stabilization of soil which improves the properties of soil. The RHA collected from Thermal plant of Ludhiana, Punjab, India.

RBI Grade 81: RBI means Road Building International. The application of RBI Grade 81 chemical stabilizer causes the liquid limit to decrease and the plastic limit to increase, thereby decreasing the plasticity index of clayey soil under investigation. RBI grade 81 contains fibre in it. It was collected from Alchemist group named company established in New Delhi.

IV. RESULTS AND DISCUSSIONS

1. Consistency limits tests

Consistency limits define the state of soil in which it exists. This test includes the determination of liquid limit, plastic limit and plasticity index of clay. From the tests done it has been found that there is decrease in the liquid limit and

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plasticity index till optimum mix (86: 10: 04) after that the value increases from 50.4 % and 25.4 % to 41 % and 12.43 % respectively. And there is increase in the plastic limit from 25 % to 28.57 %.

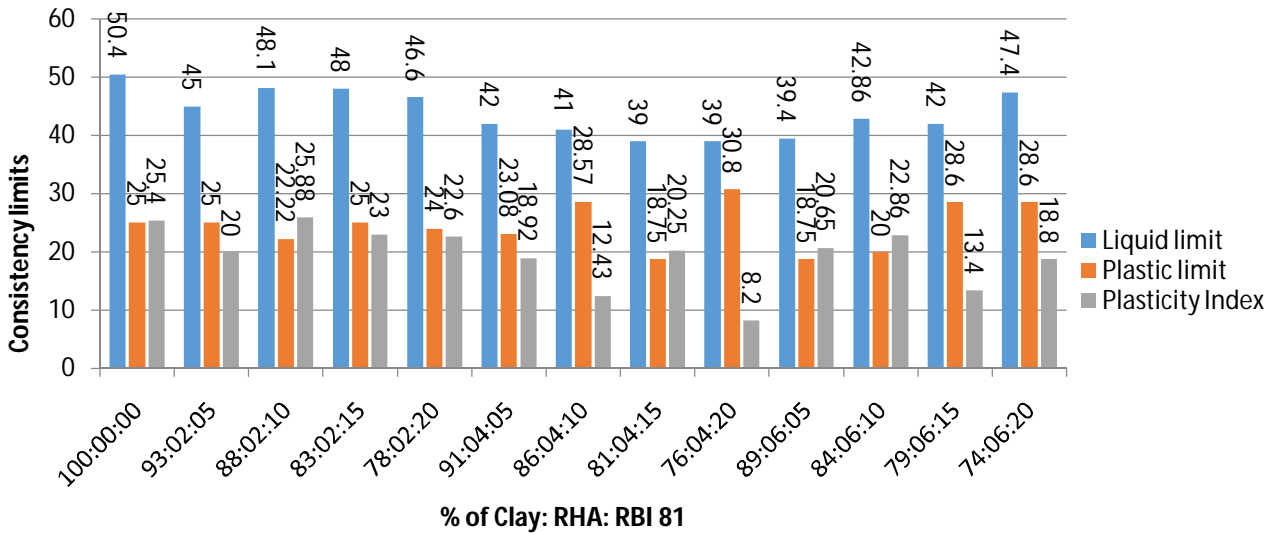


Fig. 1 Consistency limits at various percentage of mix

2. Moisture–density relationship

The MDD of stabilized soil decreases with increase in RHA. The MDD and OMC for clay soil are 1.87 Kg/mm³ and 11% respectively. The MDD and OMC for the optimum mix are 1.76Kg/mm³and 15%, respectively. The optimum mix is determined from the consistency’s limit test. The OMC increases from 11% to 15% and the MDD decreases from 1.87 to 1.76Kg/mm³from virgin soil to stabilized clay soil. The increase in OMC (from 11% to 15%) is observed at 10%RHA, 4% of RBI grade 81 and 86%of clay.

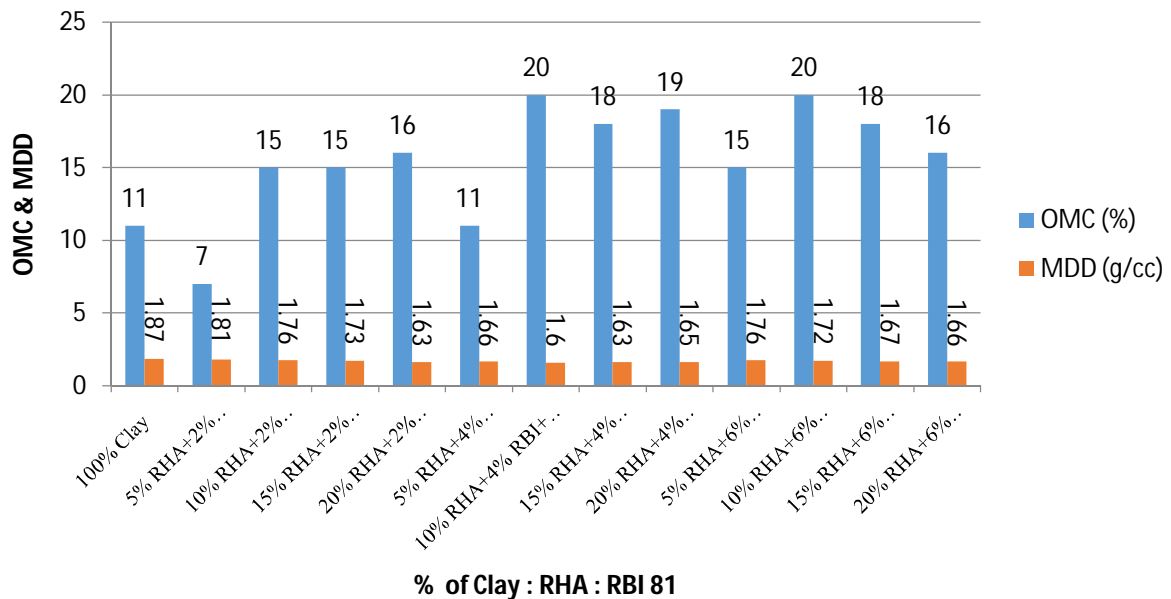


Fig. 2 OMC and MDD Comparison with different mix

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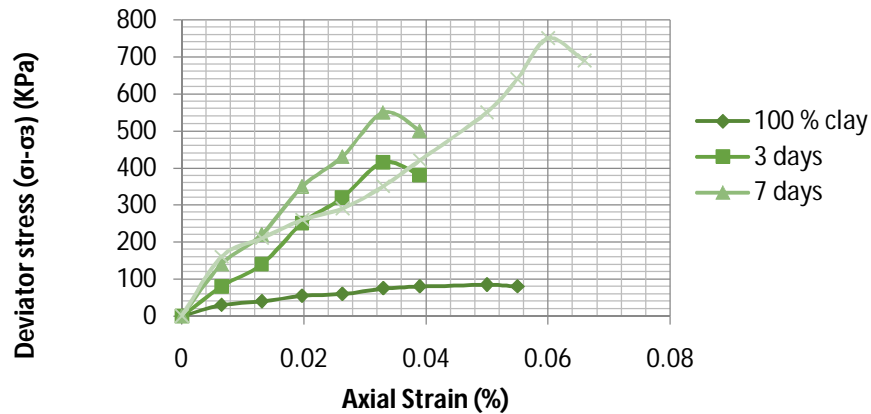


Fig. 3 Stress v/s Strain of optimum mix

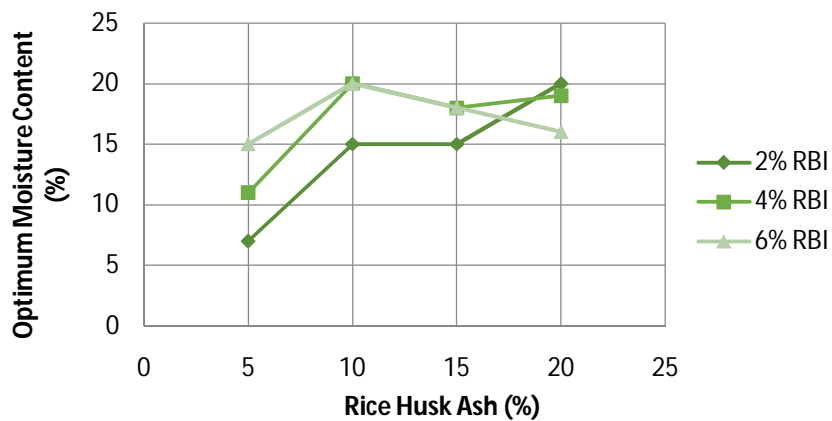


Fig. 4 OMC v/s proportion of RHA with 2%, 4%, 6% of RBI

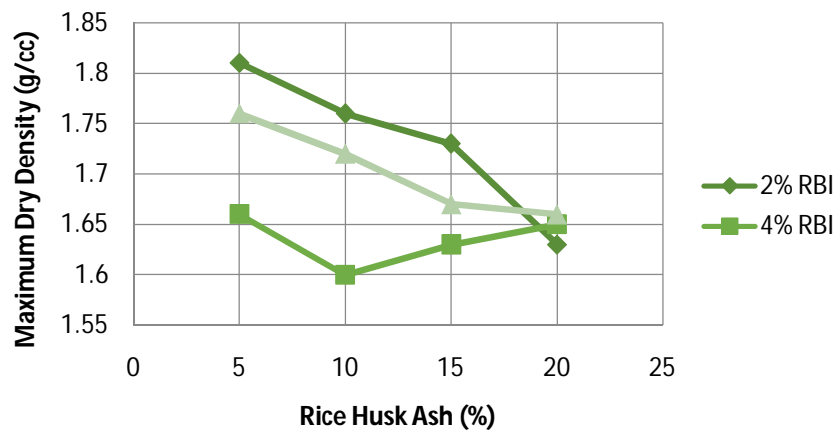


Fig. 5 MDD v/s proportion of RHA with 2%, 4%, 6% of RBI

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3. Unconfined compressive strength

The optimum mix is the mix having highest UCS values for the given condition and which is found to be 86% Soil, 4% RBI grade 81 and 10% RHA. For clay soil, the UCS value is 85 KPa and this value increased to 200 KPa for 5% increase in RHA and 2% increase in RBI grade 81. Also, the strength increases from 85 to 750 kN/m² for 10% increase in RHA and 4% increase in RBI grade 81 in the mix. The strength of treated soil is greater than untreated soil. Generally, the result shows that the strength of the mix is increased up to 10% of RHA for different mixtures of RBI grade 81. For different curing periods, the strength of the stabilized soil increases with increase in curing periods. The UCS value of the stabilized mix increases from 200 to 550 KPa for the 7-day curing period for 4% of RBI grade 81 and 10% RHA. Typically, for 86% Soil, 4% RBI grade 81 and 10% RHA mix, the UCS value increases from 85 to 415 KPa, 550 KPa and 750 KPa for 3, 7 and 28 days of curing periods, respectively. The increase in compressive strength is due to frictional resistance from RHA and cohesion from the clay. The stress-strain curve for UCS tests for the optimum mix at different curing.

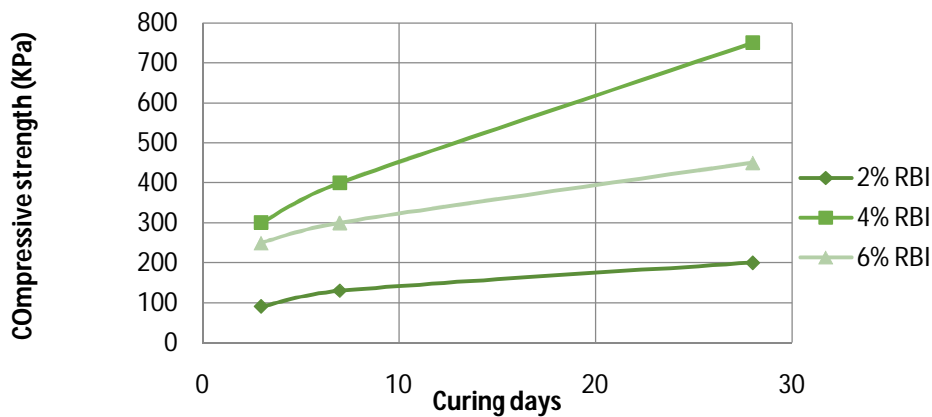


Fig. 6 Compressive strength v/s curing days of 5 % RHA with 2%, 4%, 6% of RBI

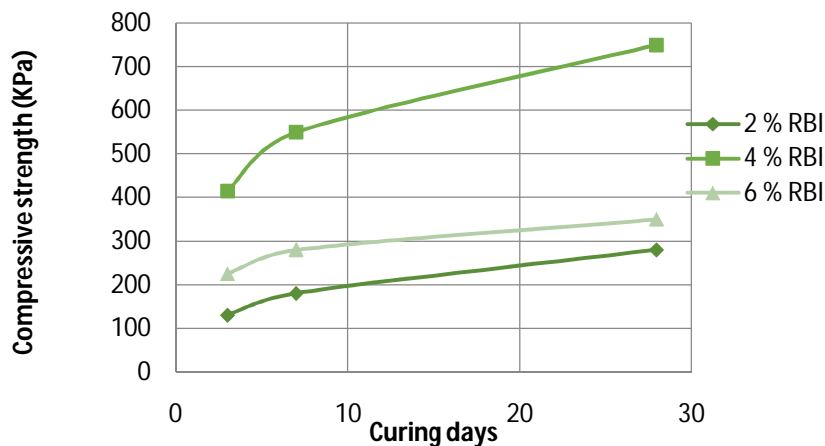


Fig. 5 Compressive strength v/s curing days of 10 % RHA with 2%, 4%, 6% of RBI

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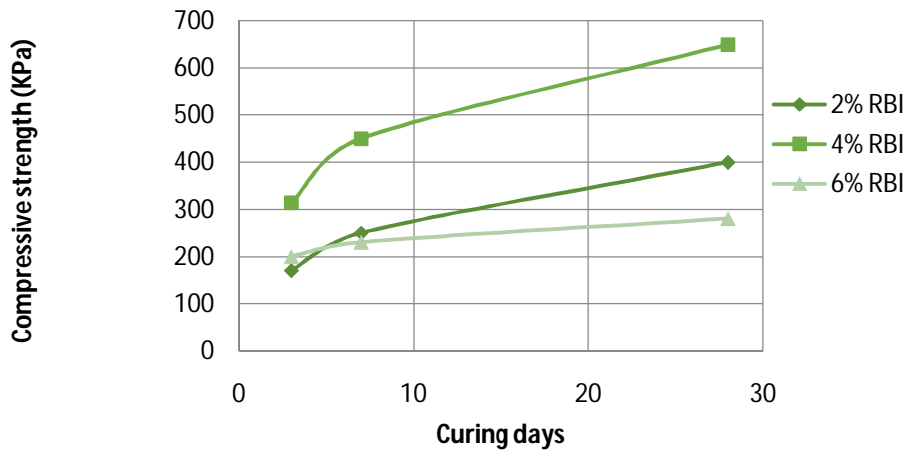


Fig. 6 Compressive strength v/s curing days of 15 % RHA with 2%, 4%, 6% of RBI

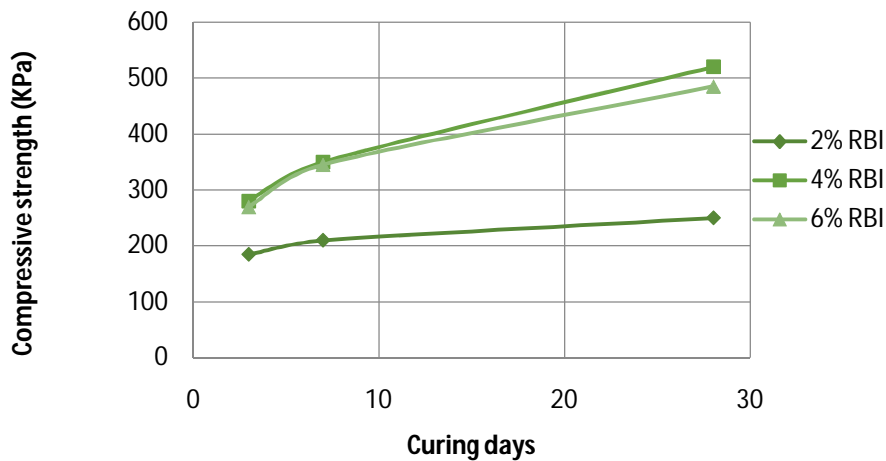


Fig. 7 Compressive strength v/s curing days of 20 % RHA with 2, 4, 6% of RBI grade 81

4. CBR tests

The CBR test is a simple strength test that compares the bearing capacity of a material with that of a well-graded crushed stone (thus, a high quality crushed stone material should have a CBR @ 100%) (AASHTO 2000). The CBR tests were carried out on stabilized soil for different mix proportions. The un-soaked CBR value increases from 1.35% to 3.6% and E value increases from 1.2 to 3.2 with increase in RHA up to 10% and RBI grade 81 up to 4%.

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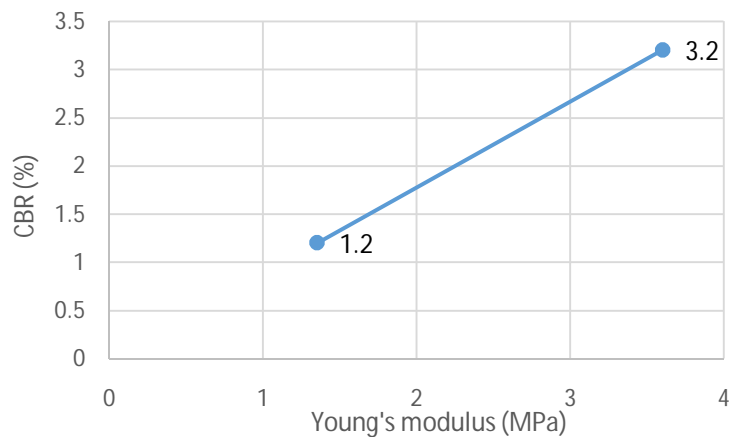


Fig. 8 CBR v/s Young's value

V. CONCLUSIONS

Following conclusions are taken out:

1. The optimum mix is found to be 86% clay, 10 % RHA and 4 % RBI with the help of consistency limit test and compaction test.
2. The MDD goes on decreasing and OMC goes on increasing, with increase in percentage of addition RBI grade 81 and Rice husk ash into the soil.
3. The compressive strength of soil from UCS test increases with the addition of RHA and RBI grade 81 with increase in curing periods of 3,7 and 28 days.
4. The CBR Value Of optimum mix increases with increase in elastic value.

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