

Strength Characteristics of Cohesive Soil using Ricehusk Ash, Banana Fiber and Bamboo Fiber

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Abstract— Stabilization otherwise known as soil improvement is the process of improving the property of soil by using various admixtures. In this research work the soil improvement is done by using ricehusk ash, banana fiber and bamboo fiber. The soil is treated with different percentage of ricehusk ash and optimum percentage is found out. Then bamboo fiber and banana fiber of different percentage is added to the soil with optimum percentage of ricehusk ash. The main objective is to Study the strength behavior of soil reinforced with fiber.

Keywords— Soilstabilisation, Ricehuskash(RHA), Bamboo Fiber, Banana Fiber, Compaction, UCC, CBR

I. INTRODUCTION

Stabilization of soil is done from olden days to improve or increase the shear strength of soil. Various stabilization methods are being practiced from which the new method include stabilization of soil by incorporating fiber in to the soil. The stabilization plays a important role when construction is to be done on clayey soil because there may be swelling in presence of water and shrinkage during dry climates that is stabilization is mainly done on the soil which cannot be used as it is available in nature, So proper care should be taken while construction is to be done on clayey soil. In this study Kaolinite is used as the soil sample and is stabilized by adding rice husk ash, bamboo fiber and banana fiber. Firstly kaolinite is treated with ricehusk ash and optimum percentage is found out, then bamboo fiber and banana fiber is added to that optimum amount of RHA and the test is carried out and the optimum amount is found out.

A. Objective of the Study

- To study the changes in properties of cohesive soil by adding different percentage of ricehusk ash and banana fiber and bamboo fiber.
- To assess the usefulness of banana fibers and bamboo fibers as soil reinforcement.
- To study the effect of quantity of fiber on compaction, UCC and CBR
- Reduce the construction cost by making use of locally available materials.

II. MATERIALS AND METHODS

A. MATERIALS

1) Soil:

Experiments were carried out on Kaolinite clay taken from Sulekha clay factory, Thonackal in Trivandrum district, Kerala. "Fig.1," shows the sample of clayey soil and "Table.I," shows the properties of soil.

Table.I. Properties of Soil

Properties	Soil
Specific Gravity	2.64
Liquid limit, W_L	61%
Plastic limit, W_P	40 %
Plasticity index, I_P	21%
Shrinkage limit, W_s	25%
Percentage of clay	70%
Percentage of silt	30%
Unconfined compressive strength, q_u	0.28 kg/cm ²
California bearing ratio	2.14%
USCS Classification	CI



Fig.1. Kaolinite

2) *Ricehusk ash:*

Ricehusk ash was collected from Santhigiri Rice Mills, Trivandrum. There rice husk is collected from paddy fields. It is then heaped and burned to prepare rise husk ash, “Fig.2,” shows Ricehusk ash and “Table.II,” shows the properties of Ricehusk ash.

Table II. Properties of Ricehusk ash

Constituent	%
Silica – SiO ₂	89.24
Alumina – Al ₂ O ₃	2.69
Carbon	2.56
Calcium oxide – Ca O	1.96
Magnesium oxide- Mg O	0.48
Potassium oxide – Ka O	0.66
Ferric oxide - Fe ₂ O ₃	0.56



Fig.2.Ricehusk ash

3) *Banana fiber:*

Banana fiber is extracted from Banana by decortications by using knife and is kept for drying for 2 days and then cut into needed size. Fiber was obtained from Trivandrum.“Table.III,” shows properties of banana fiber. And “Fig .3,”shows Banana fiber.

Table III. Properties of banana fiber

Parameter	Values
Colour	Light Brown
Average diameter (mm)	0.73
Average length (mm)	25



Fig.3.Banana fiber

4) *Bamboo fiber:*

The bamboo fiber is made from the starchy pulp of bamboo plants. Fiber was obtained from Trivandrum,“Table.IV,”shows the properties of bamboo fiber and “Fig.4,” Shows the Bamboo fiber.

Table IV. Properties of bamboo fiber

Parameter	Values
Colour	Light Brown
Average diameter (mm)	0.85
Average length (mm)	25



Fig.4. Bamboo fiber

B. *Methodology*

Laboratory tests (Atterberg’s limit, compaction, UCC,CBR) were carried out on clayey soil sample, and on combination of soil, Ricehusk ash and Banana fiber and Bamboo fiber to determine the properties of soil sample.

- The stabilization of clayey soil with Ricehusk ash is carried out by blending the soil with different percentages of Ricehusk ash(3%, 6%, 9%, 12%) and optimum amount of Ricehusk ash and varying percentage of Bamboo fiber (0.5%,1%,1.5%,2%) and Banana fiber (.25%,0.4%,0.5%,0.75)%is added and determine the strength characteristics of soil.

III. RESULTS AND DISCUSSIONS

After the determination of basic properties of clayey soil, soil stabilized with RHA Bamboo fiber and Banana fiber, the strength parameters like MDD, and UCC were determined by conducting compaction, and UCC (unconfined compressive stress) tests.

A. Results of MDD for clayey soil stabilized with Ricehusk ash

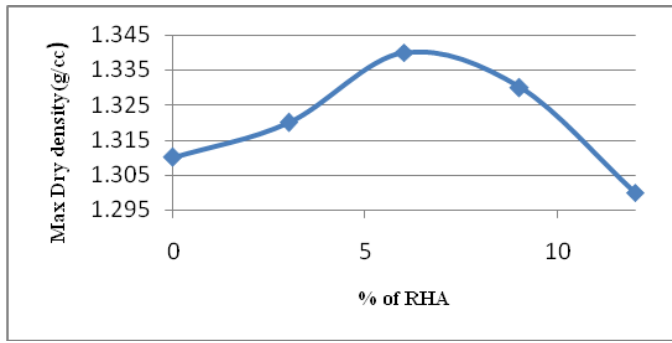


Fig.5. Graph showing % of RHA v/s MDD

From the “Fig. 5,” the maximum dry density is obtained when 6% of RHA is added to the clayey soil. After adding more percentage of RHA to the clayey soil the MDD is decreasing.

B. Results of unconfined compression test for clayey soil stabilized with Ricehusk ash

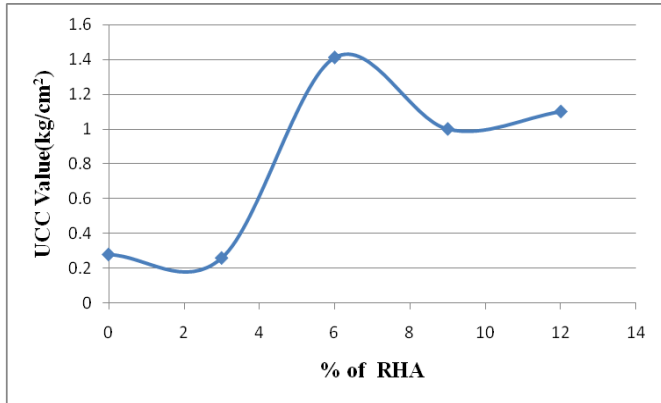


Fig.6. Graph showing % of RHA v/s UCC value

From the “Fig 6,” the maximum UCC value is obtained when 6% of RHA is added to the clayey soil. By adding more percentage of RHA to the clayey soil the UCC value is decreasing.

C. Results of California bearing ratio test for clayey soil stabilized with Ricehusk ash

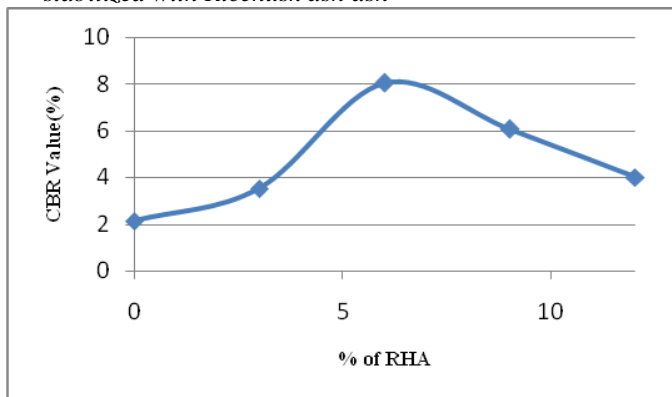


Fig.7. Graph showing % of Ricehusk ash v/s CBR value

From the “Fig.7,” CBR value is obtained when 6% of Ricehusk ash is added to the clayey soil. By adding more percentage of Ricehusk ash to the clayey soil the UCC value is decreasing.

D. Results of MDD for clayey soil stabilized with optimum amount of RHA and varying percentage of Bamboo fiber

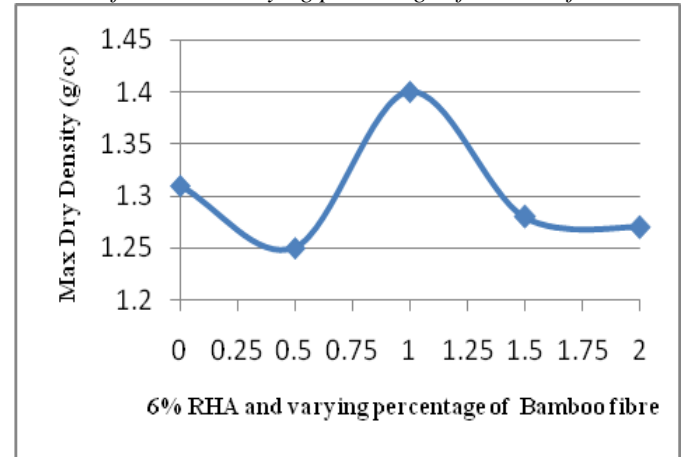


Fig.8. Graph showing 6% of RHA and varying % of Bamboo fiber v/s MDD

From the test result the optimum amount of RHA added to the soil is 6%. From the “Fig.8,” when optimum amount of RHA and varying percentage of Bamboo fiber is added to the soil the maximum dry density is obtained at 1%.

E. Results of unconfined compression test for clayey soil stabilized with optimum amount of RHA and varying percentage of Bamboo fiber

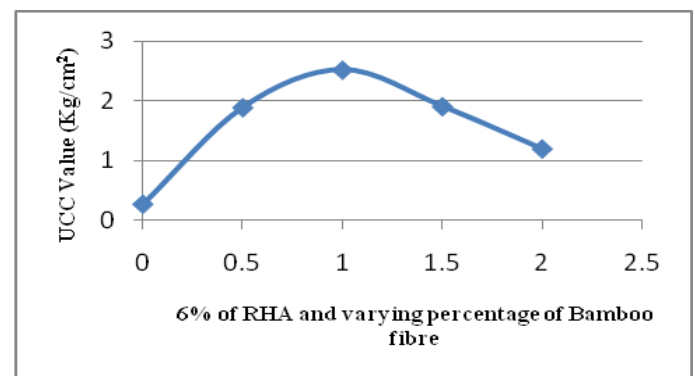


Fig.9. Graph showing 6% of RHA and varying % of Bamboo fiber v/s UCC value.

From test result the UCC value is obtained at 1%. From the “Fig.9,” when optimum amount of RHA and varying percentage of bamboo fiber is added to the soil.

F. Results of California bearing ratio test for clayey soil stabilized with optimum amount of RHA and varying percentage of Bamboo fiber

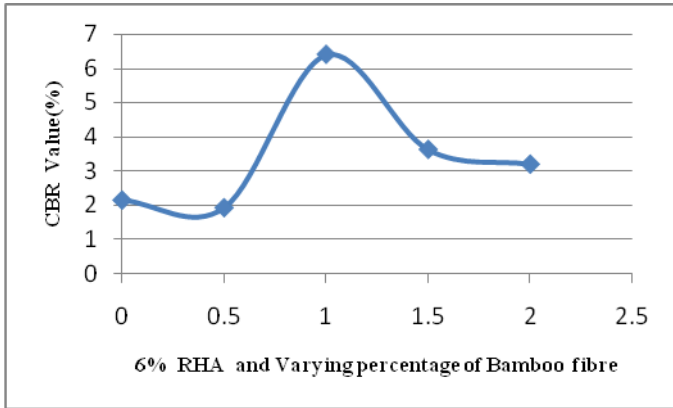


Fig.10. Graph showing 6% of RHA and varying % of Bamboo fiber v/s CBR value

From the test result the CBR value is obtained at 1%. From the “Fig.10,” when optimum amount of RHA and varying percentage of Bamboo fiber added to the soil.

G. Results of MDD for clayey soil stabilized with optimum amount of RHA and varying percentage of Banana fiber

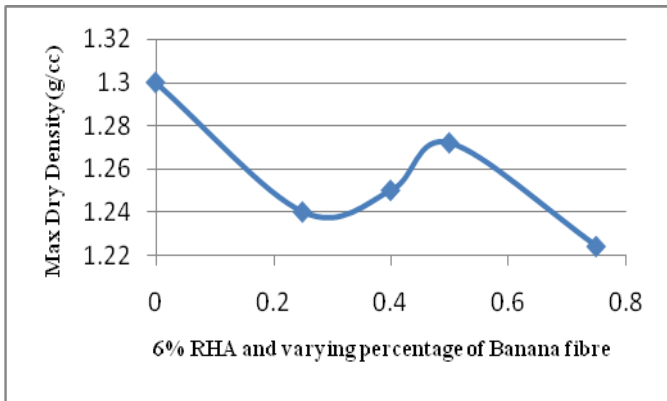


Fig.11. Graph showing 6% of RHA and varying % of Banana fiber v/s MDD

From the “Fig.11,” when optimum amount of RHA and varying percentage of Banana fiber is added to the soil the maximum dry density is obtained at 0.5%.

H. Results of unconfined compression test for clayey soil stabilized with optimum amount of RHA and varying percentage of Bananafiber

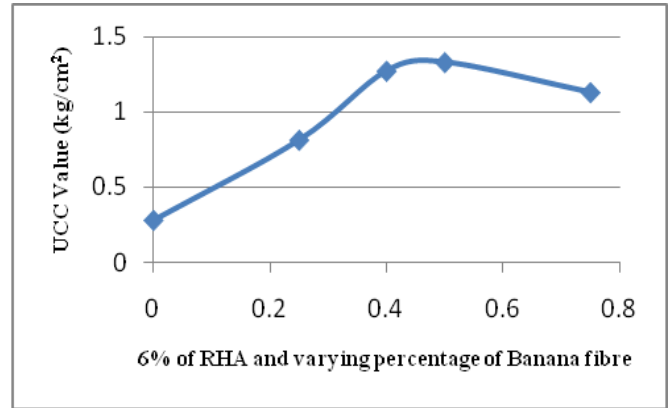


Fig.12. Graph showing 6% of RHA and varying % of Banana fiber v/s UCC value.

From the “Fig.12,” the UCC value is obtained at 0.5% when optimum amount of RHA and varying percentage of Banana fiber added to the soil.

I. Results of California bearing ratio test for clayey soil stabilized with optimum amount of RHA and varying percentage of Bananafiber

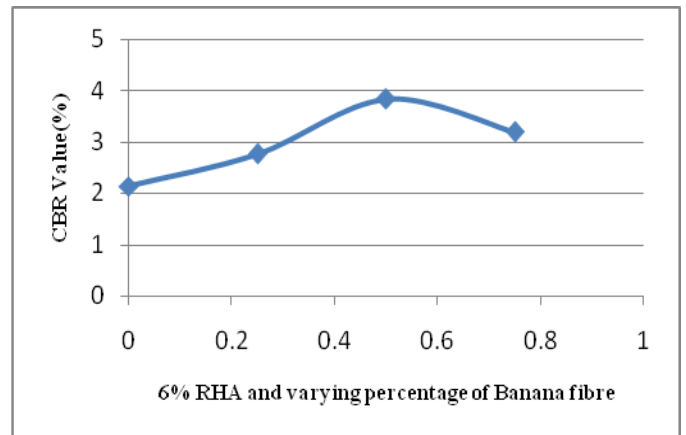


Fig.13. Graph showing 6% of RHA and varying % of Banana fiber v/s CBR value

From the “Fig.13,” the CBR value is obtained at 0.5% when optimum amount of RHA and varying percentage of Banana fiber added to the soil.

IV . CONCLUSION

From the test results it is found that properties of the clayey soil have been improved by the addition of RHA, Bamboo fiber and Banana fiber .The maximum dry density increases and the optimum moisture content increases with the addition of RHA, Bamboo fiber and Banana fiber. But when the optimum amount of RHA is added to the varying percentage of Bamboo fiber and Banana fiber the optimum moisture content is increasing and maximum dry density is decreasing. From the test results it has found that the optimum percentage of RHA is 6%. By adding the optimum percentage of RHA to the varying percentage of Bamboo fiber and Banana fiber to the soil the optimum percentage obtained is 1% and 0.5%.

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