STABILIZATION OF MARINE CLAY *CHIKOKO* USING RICE HUSK ASH - CEMENT

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ABSTRACT

Marine clay locally known as Chikoko soil around Niger Delta region of Nigeria is characterized as clay of high plasticity, low undrained shear strength, high Atterberg Limits and high natural moisture content. It therefore requires stabilization especially when use as base or sub-base course for road and other construction works. This study presents the suitability of using rice husk ash with a blend of cement to stabilizing marine clay Chikoko soil from the Eagle Island River in Portharcourt, Nigeria. The soil is stabilized with 15%, 30%, and 45% of Rice Husk ash and 6% and 8% of cement. The results indicated an increase in MDD at OMC of 22 – 23%. It further revealed 30% RHA content and 8% cement content as the optimum for the blend for optimum stabilization of the marine clay also known as Chikoko Soil. A proper use of agricultural waste such as rice husk ash as stabilizing agent improved the strength property of the soil and in a way, provide a better use of this material (Rice Husk Ash) which currently serves a less economical purpose or in worse scenario constitutes environmental nuisance.

Keywords: *California Bearing Ratio; Cement, Optimum Moisture Content, Rice Husk Ash (RHA), Soil Stabilization, Unconfined Compressive Stress*

INTRODUCTION

Construction within most Niger Delta areas, especially Rivers State is expensive considering the nature of the soil. Soil properties within this region vary widely and construction of structures on this soil depend on many factors among which the soil bearing capacity is major. Chikoko soil, a marine clay soil is a weak soil with low shear strength (Otoko and Aitsebaomo, 2009). Therefore there is the need to stabilize this soil in order to improve its strength characteristics so as to increase the load bearing capacity with the aim of enhancing its usage for construction purposes.

Rice husk is an agricultural waste obtained from rice milling. About 108 tons of rice husk is generated

annually in the world. In Nigeria, about 25 million tons of rice is produced annually, while in Ebonyi State, about 250,000 tons of grains is produced in 2017 (UNWFP, 2018). The husk from the production of this tons if not properly managed constitutes environmental nuisance. Soil stabilization is a technique used for a variety of engineering work, especially on soils that are weak in their mechanical properties. The main objective is to increase the strength or stability of soil and to reduce the construction cost by making best use of the locally available material. Over time, cement and lime are the two main materials used for stabilizing soils. Thus the use of agricultural waste such as rice husk ash (RHA) considerably reduces the cost of construction and as well reducing the environmental hazards they cause. This work is focused on investigating the optimum amount of RHA for practical purposes through the observation of effect of RHA on some geotechnical properties of soft *Chikoko* soil which are relevant for evaluating performance of sub grade soil. Rice husk is an agricu1tural waste obtained from milling of rice.

The RHA is therefore being used to partially replace the more expensive stabilizing agents (cement/lime) because it has adequate cementation property required to bind the material to a satisfactory durability, especially marine clay (*Chikoko*) soil of Niger Delta region, Nigeria.

METHODOLOGY

The soils considered in this study were collected from the different locations along Eagles Island River bank in Portharcourt, Rivers State, Southern Nigeria at a depth of 1.5m to 2.5m using the disturbed sampling method. The properties of the soil used in the investigation are given in Table 1. The index properties of the soil characterized and classified the soil as Clay with high plasticity (CH) and A – 7 – 6 using the USCS and AASHTO system of Soil Classification respectively. Test methods consisted of standard laboratory testing of soil samples in accordance with BS 1377 (1990). The RHA was collected from Abakaliki Rice Mill, Ebonyi State, Nigeria. After its collection, it was spread on ground and air dried to facilitate burning. Rice, husk was burnt to ashes using the brick kiln in the Rivers State University and there after sieved through 0.075mm to get very fine ash. Then it will be stored in air tight containers to prevent moisture loss and any form of contamination

To undertake the second phase of the research, a handful of sample was collected into the crucible and kept in the oven at a temperature of 105°C for 24 hours so as to remove moisture content in the soil sample. Thereafter, four selected percentages of RHA, 0% 15%, 30% and 45% are mixed with soil in eighteen different tests. In each case, the cement content of 6% and 8% respectively is mixed with the RHA-soil to get adequate cementation property for the mix. For the above eighteen different proportions, tests are carried out to observe and determine the changes in the properties of soil i.e. Maximum dry density, Optimum moisture content and Compaction characteristics determined.

RESULTS AND DISCUSSION

The results of the index properties of samples is shown in Table 1. Results indicate variation in Dry density and Moisture content with varying percentage stabilizer incorporation. Figure 1 to 4 shows variation of DD with MC at different percentage RHA contents. There is an observed increase in dry density

while the OMC is increased with increase in the RHA content. Results are similar for mixes with both 6% and 8% cement content.

Table 1: Properties of Soil Sample

Characteristics		Description
Natural moisture content (%)		8.47
Specific gravity		2.73
Percentage passing sieve No 200 (0.075mm)		78.9
Liquid limit (%)		50.1
Plastic limit (%)		35.6
Plasticity index (%)		15.8
Maximum dry density (g/cm^3)		1.54
Optimum moisture content (%)		20.0
Soil Classification	USCS	CH
	AASHTO	A – 7 – 6

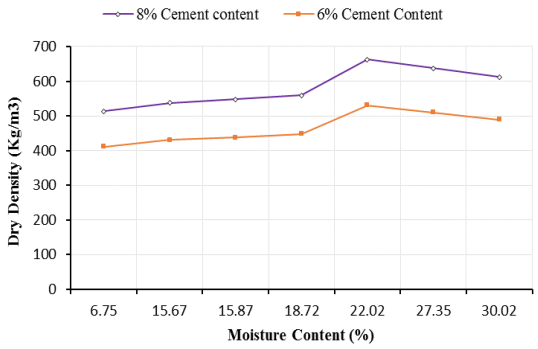

Figure 1: Variation of DD with MC at 0% RHA

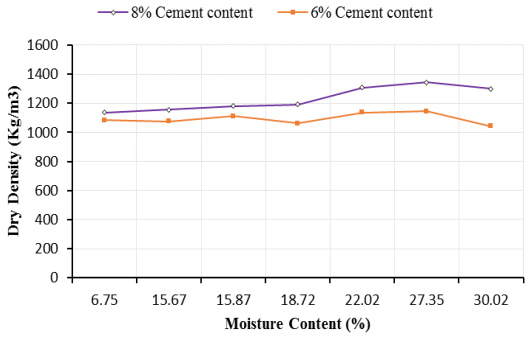

Figure 2: Variation of DD with MC at 15% RHA

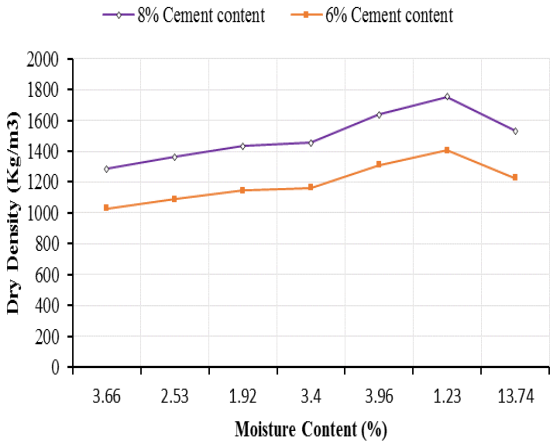

Figure 3: Variation of DD with MC at 30% RHA

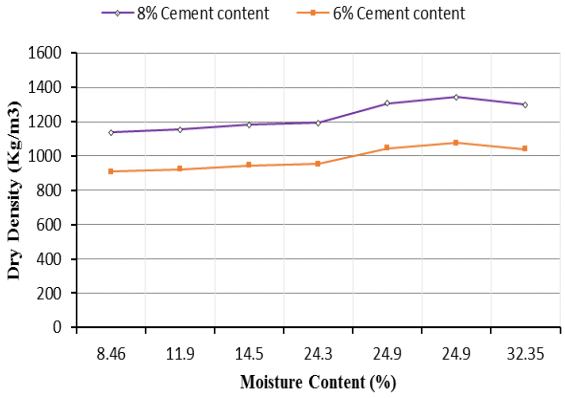

Figure 4: Variation of DD with MC at 45% RHA

The increase in MDD with cement content as shown in Figure 5 is attributed to the relative higher specific gravity of cement (3.16) to that of the chikoko clay (2.73). The increase in OMC with cement content is as a result of water needed for the complete hydration of cement. The result indicates an increasing MDD from 0 to 30% RHA then decrease with increasing RHA content with the maximum at 8% cement content.

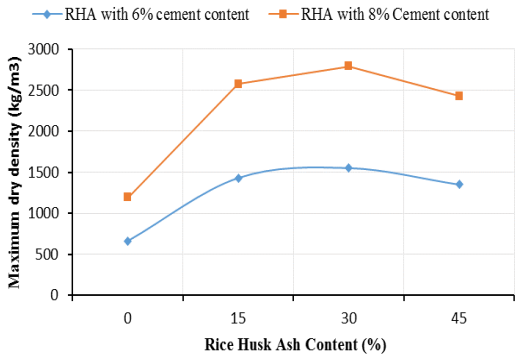

Figure 5: Variation of MDD with RHA-Cement Blend

CONCLUSION

From the result obtained, the following conclusion were drawn:

i. Marine clay soil (Chikoko) is generally weak in strength, agreeing with USCS and AASHTO system of soil classification, the soil could be termed Clay soil of High Plasticity (CH).

ii. Marine clay soil (Chikoko) is characterized by low undrained shear strength, high Atterberg limits and high natural water contents.

iii. The result indicates an increasing MDD from 0 to 30% RHA then decrease with increasing RHA content.

iv. The maximum dry density was achieved at Moisture content up to 22.5% using 30% RHA content, and 8% cement content.

v. Stabilization of marine clay (Chikoko) soil can be achieved with RHA-Cement blend for effective performance.

RECOMMENDATIONS

Rice husk ash has good potential for use in geotechnical applications. The relative low unit weight of RHA and its cementitious properties makes it possible to blend well with cement and well suited for placement over soft or low bearing strength soils. Its ease of compaction, insensitiveness to changes in moisture content, good frictional properties can be exploited in the construction industry.

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