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Stabilization of Lateritic Soil Using Bagasse Ash and Rice Husk Ash

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ABSTRACT
The lateritic soil in Epellema is known to have low load bearing characteristics. This research work was aimed to evaluate the suitability of bagasse Ash and Rice Husk Ash for stabilization of lateritic soil. The soil samples were collected from Epellema in Opobo/Nkoro local Government Area of Rivers State, Nigeria. The laboratory work involved index properties to classify the soil sample and the preliminary investigations show that the soil belongs to A-7-6 class of soil in the AASHTO classification system. The Research involved the use of several geotechnical laboratory test to determine some geotechnical properties of the lateritic Soil, this tests includes, moisture content test, sieve Analysis test, Atterberg limit test, specific Gravity test, Proctor Compaction test, CBR test and Tri-axial test. The soil was stabilized with concentration of 0% to 4% with an increment of 0.5% for BA and 0% to 10% with an increment of 2% for RHA. The Analysis shows that the BA and RHA decreased the MDD and increased the OMC but improved the CBR but did meet the minimum requirement for CBR for soil in Nigeria when they were used as stand-alone stabilizer. However, when the both additive were combined together, the Soil Geotechnical Properties improved, the values for CBR and cohesion (Tri-axial test) increased. The highest value for CBR (44.08%) and cohesion (174kpa) occurred at 4% BA and 10% RHA, The MDD of the Soil also increased when both additive were combined together, from the Research the highest MDD occurred at 4% BA and 10% RHA with MDD value of 1807kg/m^3 . The both stabilizers cannot be used as stand-alone stabilizer but can be profitably used as an Admixture with lime and cement or can be combined together to enhance the geotechnical of the soil to with stand load.

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I. INTRODUCTION

The need to bring down the growing cost of soil stabilizers and the cost of waste disposal has led to intense global research towards economic utilization of wastes for engineering purposes(Awarri*et al.*,2022). The safe disposal of industrial and agricultural waste products demands urgent and cost-effective solutions because of the debilitating effect of these materials on the environment and to the health hazards that these wastes constitute(Awarri& Otto, 2022). In order to make deficient soils useful and meet geotechnical engineering design requirements researchers (Otoko 2015; Chittaranjan, *et.al*, 2011;Onyelowe, 2012; Koteswara, 2012; Amadi, 2010; Iorliam, *et.al*, 2012; Awarri& Otto, 2022) focused more on the use of potentially cost effective materials that are locally available from industrial and agricultural waste in order to improve the properties of deficient soils. The over dependence on industrially manufactured soil improving additives (cement, lime etc.) have kept the cost of construction of stabilized road financially high. This hitherto have continued to deter the underdeveloped and poor nations of the world from providing accessible roads to meet the need of their rural dwellers who constitute large percentage of their population which are mostly rural farmers.

Thus, the possible use of agricultural waste, such as bagasse ash, will considerably reduce the cost of construction and as well as reduce or eliminate the environmental hazards caused by such waste. Bagasse ash is an agricultural waste obtained from milling of sugarcane.

Engineering properties of soils are commonly altered when these wastes are introduced as an admixture with lime or cement. Moreover, since recently, several studies have confirmed applicability of these wastes as a cement replacing material in concrete technology. However, their applicability as a standalone soil stabilization agent is still questionable.

Therefore, this study will be geared towards evaluating some of the engineering properties of rice husk and bagasse ash stabilized expansive soil. If the study leads to positive outputs, rice husk and bagasse ash can be used as soil stabilizing agent replacing the rather costly chemicals employed such as cement, lime, etc.

II. MATERIALS AND METHODS

2.1. Materials

The materials used in this study includes the following

- Laterite
- Rice Husk Ash
- Bagasse Ash
- Water

a. Methods

Soil samples were collected from site location at Epellema in Opobo/Nkoro Local Government Area, Rivers State, Nigeria. The samples taken went through various geotechnical test to ascertain the Geotechnical properties of the soil.

Index and Engineering properties tests were carried out on the natural soil in the first phase. In the second phase, the engineering properties tests were carried out on the soil samples treated with RHA and BA to see the effects of the additive on the geotechnical properties of the natural soil and also to determine the best proportion for stabilization. Laboratory experiment conducted were;

- Moisture content
- Sieve analysis
- Atterberg limit (Plastic Limit Test & Liquid Limit)
- Specific gravity
- Proctor Compaction test
- California Bearing Ratio Test
- Tri-axial Test

All the above tests were carried out on the natural soil to know its natural behavior, only proctor compaction test, California Bearing Ratio test and Tri-axial test were conducted on the treated soil at various percentages.

III. RESULTS AND DISCUSSIONS

The results for the index properties of the natural soil is presented in Table 1

Table 1: Summary of the Index properties of the Natural Soil

Properties of natural soil	Quantity
Natural Moisture Content (%)	13.36%
Liquid Limit (%)	41%
Plastic Limit (%)	27%
plasticity Index (%)	13.30%
specific gravity for natural soil	2.51
AASHTO classification	A-7-6
specific gravity for RHA	2.17
specific gravity for BGA	1.97

Table 2: Summary of Proctor Compaction Test Results of RHA as a Stabilizing Agent

% of RHA	MDD	OMC
0%	1721kg/m^3	14.44%
2%	1718kg/m^3	14.98%
4%	1715kg/m3	15.24%
6%	1710kg/m3	15.40%
8%	1702kg/m3	15.48%
10%	1694kg/m3	15.55%

The results presented in Table 2, the soil combined with RHA, shows general increase in OMC and decrease in MDD, the addition of RHA increased the amount of silica and Alumina, which made the mixture to require more water for the pozzolanic reaction (Osinubi, 2009). The increase in OMC could be attributed to the fact that RHA has a relatively low specific gravity of 2.17 when compared to the specific gravity 2.51 for the natural soil.

Table 3: Summary of Proctor Compaction Test Results of RHA as a Stabilizing Agent

% of BA	MDD	OMC
0%	1721kg/m^3	14.44%
2%	1716kg/m^3	14.87%
2.5%	1713kg/m3	14.98%
3%	1708kg/m3	15.02%
3.5%	1704kg/m3	15.33%
4%	1701kg/m3	15.46%

The results presented in Table 3, shows that addition of BA increases the OMC of the soil and reduces the MDD, this could be because of the low specific gravity of BA which is 1.97 when compared to the specific gravity of the natural soil that is 2.51.

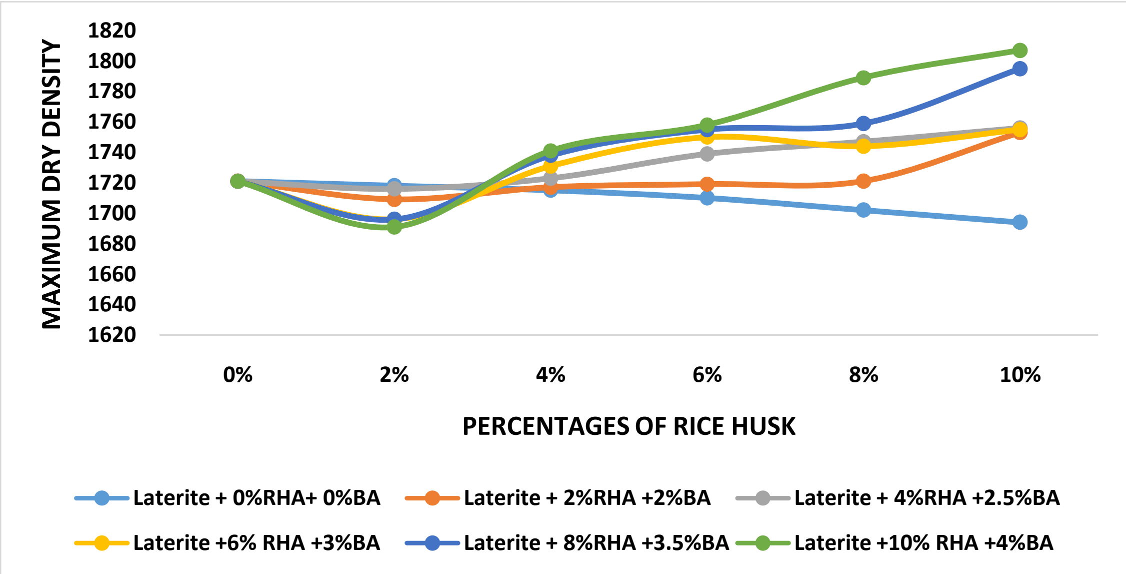

Fig.1: Graph showing combined Maximum Dry Density for RHA and BA

The graph in Fig 1. shows the combination of all the MDD for the combination of Rice Husk Ash and Bagasse Ash at various percentages, from the graph, it shows that the addition of RHA at interval of 2% as stand-alone additive, reduces the MDD of the soil from 1721kg/m^3 at 0% to 1694kg/m^3 at 10%' but when both RHA and BA where combined together, the MDD of the soil increased, the highest MDD occurred at 10%RHA+4%BA with MDD value of 1807kg/m^3 and the lowest MDD occurring at 2%RHA +2%BA with MDD value of 1716kg/m^3

This implies that soil gained its highest MDD at the addition of 10% RHA +4% BA

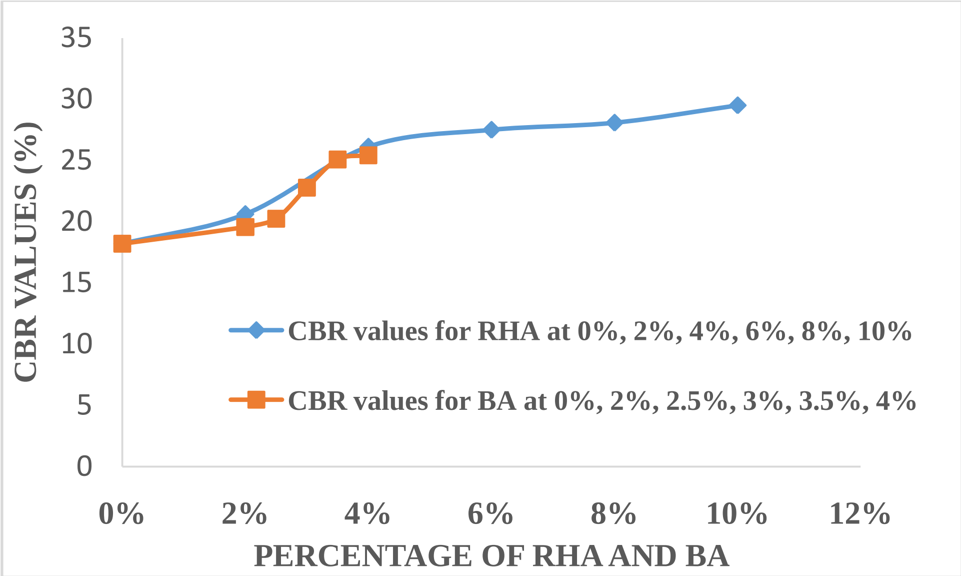

Fig. 2: Graph showing Percentage of RHA and BA

From Fig 2, it can be observed that the CBR values for the natural soil without additive is 18.19% but the CBR increased with the addition of BA to the soil from 2% to 4%, the highest CBR occurred at 4% BA with a CBR value of 25.41%, also the CBR values increased with the addition of RHA to the soil from 2% to 10% with highest CBR occurring at 10%RHA with a CBR of 29.58% but however this CBR value of 25.41 for BA and 29.58% for RHA did not meet the minimum CBR of 30% for Sub-grade as specified by the Nigerian General Specification 1997.

Table 4:

% of RHA + BA	CBR
2% RHA + 2% BA	27.58%
4% RHA + 2.5% BA	33.23%
6% RHA + 3.0% BA	34.06%
8% RHA + 3.5% BA	36.14%
10% RHA + 4.0 BA	44.03%

From Table 4, it can be observed that the CBR values for the natural soil without additive is 18.19% but the CBR increased with the addition of RHA + BA to the soil at various combined percentages, it was observed, that the peak values occurred at 4%RHA+2.5%BA with CBR value of 33.23%, 6%RHA +3%BA with a CBR value of 34.06%,8%RHA +3.5%BA with a CBR value of 36.14% and 10%RHA +4%BA with a CBR value of 44.03%,The optimum CBR values met the minimum CBR value of 30% for Sub-grade, as Specified by the Nigerian General Specification 1997

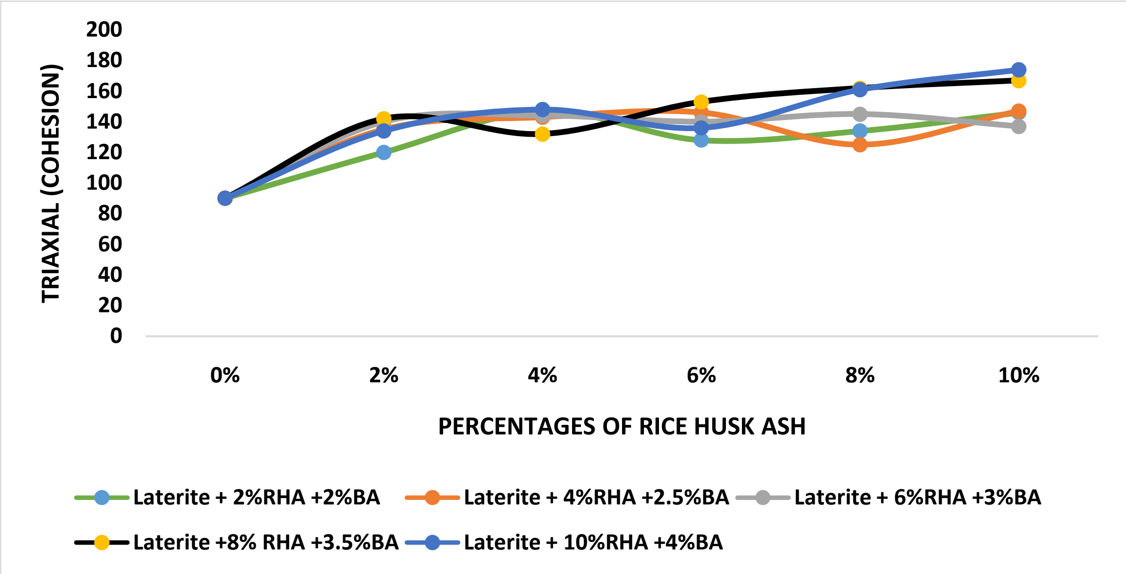

Figure 3: Graph Showing all Tri-axial Cohesion of all the Samples at Different Percentages.

The results of the Tri-axial test in Fig 3, show that Cohesion of the soil increases with the addition of RHA and BA together with the highest cohesion occurring at 10%RHA +4%BA with a Cohesion value of 174kPa

IV. CONCLUSION

The conclusion of this study is based on the set-out objectives and the conclusions are as follow:

1.
reatment of the lateritic Soil with RHA alone increased the CBR of the soil from 18.19% for 0% to 29.58% at 10% RHA and also treatment with BA alone also increased the CBR of the soil to 25.41% at 4%BA, however, the both CBR did not meet the minimum California Bearing Ratio of 30% required for sub-grade.

2.
hen both additive were combined together with Soil, the CBR increased significantly, the Maximum CBR occurred at 10%RHA +4%BA with a CBR value of 44.03%

3.
reatment with RHA and BA as stand-alone stabilizer reduced the MDD and increased the OMC of the lateritic soil, However the MDD of the soil increased when the two Additive were combined with the highest MDD occurring at 10%RHA +4%BA with MDD value of 1807kg/kgm^3

4.
he cohesion values for the tri-axial test also increased with the highest cohesion occurring at 10% for RHA (127kpa) at 4% for BA (112kpa). When both Additive Were Combined together the cohesion values increased more with the highest cohesion occurring at 10%RHA +4%BA with cohesion value of 174 kPa

REFERENCES

[1]. Amadi, A. (2010). Evaluation of changes in index properties of lateritic soil stabilized with fly ash. Leonardo Electronic Journal of Practices and Technologies, 17, 69-78.
[2]. Awarri, A. W., Akpila, S.B. & Jaja, G.W.T. (2022). Stability Analysis of Cement and Residue from Spent Calcium-Carbide Stabilized Cohesive Soils, Journal of Newviews in Engineering and Technology (JNET), 4(2), 29 – 35.
[3]. Awarri, A. W. & Otto, C. G. (2022). Settlement Analysis of Cement and Residue from Spent Calcium-Carbide Stabilized Cohesive Soils, IOSR Journal of Mechanical and Civil Engineering, 19(4), 45 – 51.
[4]. Awarri, A. W. & Otto, C. G. (2022). CostEffectiveness of Spent Calcium-carbide Residue in Soil Stabilization, International Journal of Trend in Research and Development, 9(4), 166 – 169.
[5]. Iorliam, A. Y., Agbede, I. O., & Joel, M. (2012). Effect of bamboo leaf ash on cement stabilization of Makurdi shale for use as flexible pavement construction material. American Journal of Scientific and Industrial Research, 3(3), 166-174.
[6]. Koteswara, R. D., Anusha, M., & Pranav, P. R. T. (2012). Effect of ferric chloride and rice husk ash in the stabilization of expansive soil for the pavement subgrades. Int J Eng Sci Adv Technol, 2(2), 146-153.
[7]. Onyelowe, K. C. (2012). Soil stabilization techniques and procedures in the developing countries-Nigeria. Glob. Jour. Engg. Tech, 5, 65-69.
[8]. Osinubi, K. J., Bafyau, V., &Eberemu, A. O. (2009). Bagasse ash stabilization of lateritic soil. In Appropriate technologies for environmental protection in the developing world (pp. 271-280). Springer, Dordrecht.
[9]. Otoko, G. R., & Simon, A. I. (2015). Stabilization of a deltaic marine clay (Chikoko) with Chloride compounds. Int Res J Eng Technol, 2(03), 2095-2097.