Stabilization of Expansive Soils by Using Corncob Ash

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Abstract – *Black cotton soils are considered to be problematic soils as these soils as these soils undergo large volumetric changes with the change in moisture content due to the presence of montmorillonite mineral. Increase moisture content causes swelling of the soil and loss of strength and decrease in moisture content to improve the engineering properties of some local soils for construction of stabilized pavement layers, stabilizes earth buildings and support layer for the foundation of buildings. The paper aims at providing experimental insights on the engineering properties of black cotton soil stabilized with corncob ash (CA) to ascertain its suitability varying ratio and unconfined compression strength, considering CA contents, varying from 0 to 20% were carried out. The results show that the addition of CA to the soil generally reduced its plasticity, swell potential and increased its strength. CA stabilization being more economical and environment friendly, improved the geotechnical properties of the soil for pavement layer material application.*

***Key Words*: Expansive soil, corncob ash**

1. INTRODUCTION

Geotechnical engineering, particularly the remedy and usage of soil (or earth) in production is a venerable technical field, dating to the start of human civilization, in historic Mesoptamia and Babilonia, mud become common place creation material for various forms of bricks(i.e. sun-dried and kiln-fired) to create formation of the city. Sumarians widely used bitumen as a binder to decorate of earth walls.

The main intention improvement (i.e.,engineered soil)is engineering exacting soil, including its strength (i.e., resistance), hydraulic conductivity and durability against repeating wetting and drying, as well as for ecological revitalization. Too most important methods are predictably applied to produce engineered soil: mechanical improvement and chemical treatment. Mechanical development is a development of reinforcing during physical processes such as compaction, drainage, external loading (e.g., surcharge), consolidation, or other means. Chemical treatment involves compound reaction such as hydration or pozzolanic reactions inside the mud to create artificial binding, hydrate (C-S-H) between soil particles. Soil stabilization in a huge experience consists of various strategies used for editing to decorate its engineering performance. By stabilization residences of soil, i.e., extent balance, strength, compressibility, permeability, sturdiness and dust manipulate is improved, which makes the soil suitable for use. Physical method occupies physical processes to improve soil properties. This includes compaction methods and drainage. Compaction processes lead to increase in water resistance capacity of soil. Drainage is less ordinary due to generally needy connection between method effectiveness and cost. But, compaction is very common method. Although, it makes soil extra opposing to water, this resistance will be reducing over time.

Objectives

The aim of the research work therefore, was to further find use for corncob ash as a replacement for cement in the stabilization of soils in pavement construction in the belief that the more use that is found for biomass wastes like corncob, the less they will constitute an environmental hazard. The specific objective of this work is to investigate the influence of corn cob ash on the geotechnical properties of locally available soil namely; Atterberg limits, Compaction characteristics, California Bearing Ratio and the Unconfined Compression Strength.

LITERATURE REVIEW

General reviews about corncob ash

Ogunfolami reported that mixing of the CCA as a partial replacement with ordinary Portland cement can be carried out at the point of need i.e., on site.

Adesanya and Raheem studied the use of CCA blended cement produced in the controlled circumstances. The studies revealed that the compressive strength properties of the CCA- blended cement concrete is less than that of sample made with plain concrete at early curing ages but significant improvement is noticed at later ages (after 90 days).Thus, there is necessary to look for ways to improve the strength characters during early ages.

Raheem et al. Concluded that the addition of admixtures in corncob ash cement concrete increases compressive strength character at short term and long term curing periods irrespective of the type of binding materials used. There is a chances of increase in strength can be achieved at early ages by using accelerators. With plasticizer, high strength can be achieved at both short term and long term periods while with water reducing agents and retarder, greater strength can be achieved at long term only.

Olafusi and Olutoge reported that although CCA is recommended to use as a partial replacement as a cementitiious material in high strength concrete, but due to addition of CCA in production of high strength concrete would take more time to attain its designed strength and also the concrete made with CCA as admixture would require water/ cement ratio less than 0.40. Hence to enhance workability by use of super plasticizers is strongly advised.

METERIALS AND METHODOLOGY

In this study following materials are taken in to consideration.

- ✓ Expansive soil
- ✓ Corncob ash

Expansive soil: Expansive soils which are also called as swell-shrink soil, have the tendency to shrink and swell with variation in moisture content. A s a result of this variation in the soil, significant distress occurs in the soil, which is subsequently followed by damage to the overlying structures. During periods of greater moisture, like monsoons, these soils imbibe the water, and swell; subsequently, they become soft and their water holding capacity diminishes.

Corncob ash: Corncob comprises three natural parts: the chaff and the pith forming the light part and the woody ring which forms the hard part of the cob. Ash is the residue of burned plant parts like bark, wood, sawdust, leaves, woody debris, pulp, husk, hulls, fronds and other plant debris.Ash has been used for soil liming and for traditional pest controlled to some crawling pests. Corncob ash is obtained from the residue of combusted corncobs.

Table: 1 Expansive soil Limits (IS CODE)

S.NO	PROPERTIES		LIMIT	IS CODE
1.	Liquid limit		40% to 100%	**IS-2720,Part-5,1985**
2.	Plastic limit		20% to 65%	
3.	Plasticity index		20% to 30%	
4.	Standard proctor compaction	OMC	20 TO 30%	**IS-2720,Part-7,1980/1987**
5.		MDD	1.8	
6.	Free swell index		>50%	**IS-2720,Part-40,1977**
7.	Specific gravity		2.6 to 2.7	**IS-2720 Part-3, section1-1980**

Methodology Adopted:

To evaluate the effect of Corncob ash as a stabilizing additive in expansive soils. Soil trail varied through a variety of proportion of Corncob ash (4%, 8%, 12%, 16%, 20%). The Indian Standard codes were followed during the conduction of the following experiments:

- ✓ Standard proctor test-IS:2720 (Part-7)-1980
- ✓ Unconfined compressive strength (UCS) test-IS:2720 (Part-10)-1991
- ✓ California bearing ratio (CBR) test-IS:2720 (Part 16)-1987
- ✓ Free swell index test-IS2720 (Part 40)-1977
- ✓ Liquid & Plastic limit test-IS 2720 (Part 5)-1985

RESULTS:

Table: 2 Variation of OMC and MDD values for different soil mixtures with Corncob ash

Soil	OMC (%)	MDD (%)
96%BC+4%CA	22	1.5
92%BC+8%CA	23	1.52
88%BC+12%CA	21	1.53
84%BC+16%CA	24	1.47
80%BC+20%CA	21.34	1.42

Graph:

Comparison of results from various % of CA from STP test

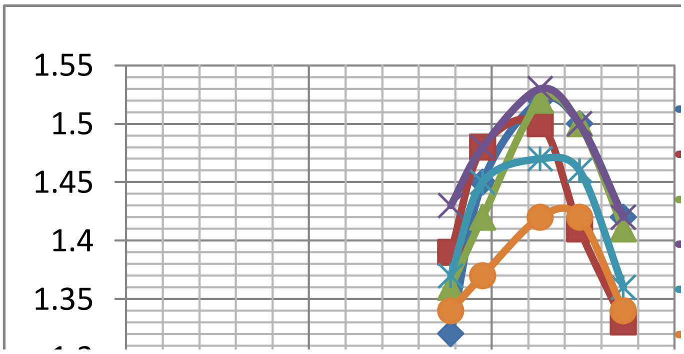


Table: 3 Variation of UCS Values for different soil mixtures

Soil	Uc strength	Shear strength (kg/cm²)
96%BC+4%CA	0.195	0.0975
92%BC+8%CA	0.206	0.103
88%BC+12%CA	0.176	0.088
84%BC+16%CA	0.17	0.085
80%BC+20%CA	0.166	0.083

Graph: Comparision of results from UCS test

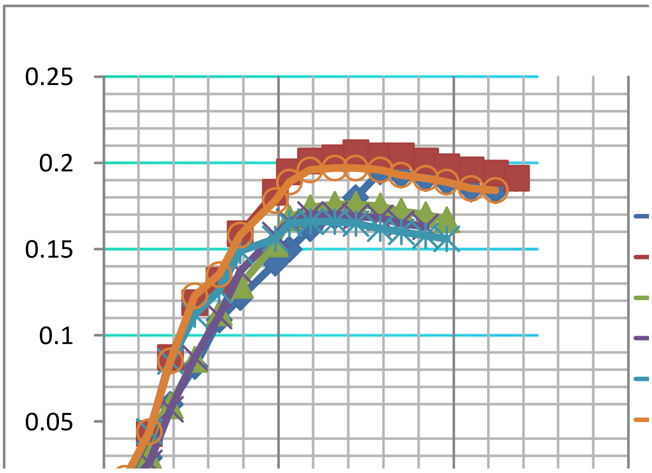
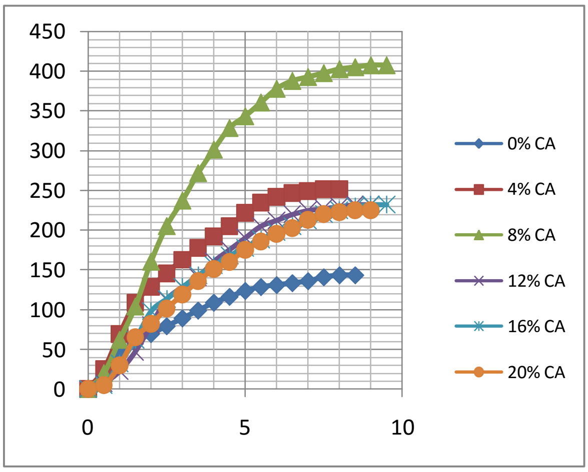


Table: 3 Variation of C.B.R values for different soil mixtures

Soil	C.B.R. value
96%BC+4%CA	6.12
92%BC+8%CA	7.23
88%BC+12%CA	6.54
84%BC+16%CA	5.77
80%BC+20%CA	5.6

Graph: Comparison of results from CBR



DISCUSSION:

Black cotton soil is combined with altering percentage of corncob ash (from 0% to 20%) by weight to observe its effect as an additive on the expansive soil. MDD was found to change with varying content of corncob ash.UCS and CBR tests are conducted with varying content of corncob ash in the black cotton soil. The liquid limit of the soil-corncob ash mixture with the changing corncob ash content.

CONCLUSION:

The Maximum Dry Density (MDD) value of the black cotton soil initially decreased with the addition of corn cob ash. Then, it showed increment with increasing corn cob ash content in the soil- corn cob ash mixture. The maximum value of MDD was observed for a mixture of soil and 12% of corn cob ash content by weight. The MDD values consistently decreased thereafter. The Unconfined Compressive Strength (UCS) of the soil with variation of corn cob ash content showed similar trend as that of the MDD values, except the fact that the peak value was observed for a corn cob ash content of 8% by weight.

In un-soaked California Bearing Ratio (CBR) tests of soil conducted with varying corn cob ash content, the CBR increased gradually with the increase in corn cob ash content till its valuation was 8% by weight of the total mixture; it decreased thereafter. With the increasing corn cob ash content in the soil- corn cob ash mixture, the decrease in value of free swell ratio was remarked. This decrease was also reciprocated by the plasticity index values. Plasticity index values are directly proportional to percent swell in an expansive soil, thus affecting the swelling behavior of the soil- corn cob ash mixture.

Thus, corn cob ash as an additive decreases the swelling, and increases the strength of the black cotton soil.

REFERENCES:

1. AASHTO (1986). Standard for transportation materials and methods of sampling and testing, fourteenth edition. AASHTO: Washington, DC.

2. Adesanya, D. A., and Raheem, A. A. (2009a). A study of the workability andcompressive strength characteristics of corn cob ash blended cement concrete.Construction and Building Materials, 23, pp 311-317.

3. Adesanya, D. A., and Raheem, A. A. (2009b). Development of corn cob ash blendedcement. Construction and Building Materials, 23, pp 347-352.

4. Akinwumi, I. I., Adeyeri, J. B., and Ejohwomu, O. A. (2012). Effects of steel slagaddition on the plasticity, strength and permeability of a lateritic soil, in 2nd International Conference of Sustainable Design, Engineering and Construction proceedings, ASCE, Texas, 457-464.

5. Akinwumi, I. I., Diwa, D., and Obianigwe, N. (2014a). Effects of crude oil contamination on the index properties, strength and permeability of lateritic clay. International Journal of Applied Sciences and Engineering Research, 3(4), pp 816-824.

6. Akinwumi, I. I., Maiyaki, U., Adubi, S., Daramola, S., and Ekanem, B. (2014b). Effects of waste engine oil contamination on the plasticity, strength and permeability of lateritic clay. International Journal of Scientific and Technology Research, 3(9), pp 331-335.

7. Akinwumi, I. I. (2014a). Earth building construction processes in Benin City, Nigeria and engineering classification of earth materials used. Indian Journal of Traditional Knowledge, 13(4), pp 686-690.

8. Akinwumi, I. I. (2014b). Soil modification by the application of steel slag. Periodica Polytechnica Civil Engineering, 58(4), pp 371-377.

9. Akinwumi, I. I. (2014c). Plasticity, strength and permeability of reclaimed asphalt pavement and lateritic soil blends. International Journal of Scientific and Engineering Research, 5(6), pp 631-636.

10. ASTM (1992). Annual book of ASTM standards. American society for testing and materials, ASTM International: West Conshohocken, PA.

11. ASTM C618 (2003). Standard specification for coal fly ash and raw or calcined natural pozzolan for use in concrete. American society for testing and materials, ASTM International: West Conshohocken, PA.

12. Awoyera, P., and Akinwumi, I. I. (2014). Compressive strength development forcement, lime and termite-hill stabilised lateritic bricks. The International Journal ofEngineering and Science, 3(2), 37-43.