Effect of Sugarcane Bagasse on Soil Properties

Paulin Pinky P J
Jissy P Dumas, Jyothika J, Ayline Thomas
UG Students,
Department of civil Engineering,, Christ Knowledge City,
Muvattupuzha, Kerala

Er.Lakshmipriya A. R
Asst.Professor,
Department of civil Engineering,
Christ Knowledge City,

Abstract: **This paper finds some of the geotechnical properties of laterite soil modified with sugarcane bagasse with a view to obtain a cheaper and effective replacement for the typical soil stabilizers and efficient bio waste disposal technique. Geotechnical strength tests (light compaction test, unconfined compression test and hydraulic tests (permeability) were also performed on the sample, at the stabilized state. The results showed that sugarcane bagasse improved some of the geotechnical properties of the soil sample. Sugarcane bagasse which is a major contaminant to air and water bodies must be carefully removed from the atmosphere. Moreover it is an efficient and sustainable method for disposal of this bio waste.**

Keywords: Sugarcane bagasse; laterite soil; unconfined compression test; permeability; compaction

I.INTRODUCTION

With increasing urbanization and modernizations the total geographical land is not meeting the land requirements of the modern population. The solution to this problem was sorted to use the waste lands available. The geotechnical engineers design foundation and other structures on the ground after investigation of the type of soil and its characteristics which may be uneconomical. Although the ground improvement techniques are also quite expensive, yet they may prove to be cost effective in many cases especially when coupled along with bio waste disposal techniques.

Agriculture serves to be one of the most important sectors of production all over the world. Production of large quantity of agricultural wastes becomes a major problem of waste management. The improper management of such waste cause serious environmental problems like air pollution, water pollution finally influencing the local ecosystems. Many researches were done around the world experimenting different biowaste to improve the soil properties such as compaction, shear strength, permeability etc. One among the biowastes includes sugarcane bagasse. Major problem that the sugar manufacturing industries are facing is the clearance of the bagasse waste which is a by-product of the crushed sugarcane, the fibrous part of the cane from which the juice is extracted. Previous studies established that treatment of soil with sugarcane bagasse ash could be a safe way of reducing the menace.

Various experiments were conducted to determine the effect of properties of the soil with the addition of various waste materials. Ground improvement projects using sugarcane bagasse have shown promising results on improving the engineering properties.

II.TESTS CONDUCTED

Representative soil samples used for this experimental study were laterite soil. The initial properties of the soil sample were determined and were tabulated as below:

TABLE I SUMMARY OF THE PRELIMINARY ANALYSIS OF SOIL SAMPLES

Sl.No.	Properties	Values
1	Natural Moisture Content(%)	8.10
2	Specific Gravity	2.28
3	Atterberg's Limits Liquid Limit(%)	47
4	Maximum Dry Density(g/cc)	1.64
5	Optimum water Content(%)	16
6	California Bearing Ratio Value at 5mm(%)	29.5
7	Shear Strength (g/cm^2)	21.05

III. ENGINEERING PROPERTIES

Tests conducted to find out the engineering properties are:-

- UCC
- Proctor
- Permeability

A. Unconfined Compression Test

150g sample of the soil passing through 425µ IS Sieve was taken and mixed with different percentage of sugarcane bagasse(0%,2%,4%,6%). The sample was then mixed with about 16% by weight of sample of water in an evaporating dish. The prepared sample is put in the mould and compressed to size. The specimen is extracted carefully. Place the specimen on compression testing machine. Fix the dial guage and proving ring to read zero. Apply the compression load to produce an axial strain at an amount of 0.5 to 1% per minute. Note the readings of the dial guage and proving ring. Continue the compression till the specimen fails or 20% vertical deformation is reached whichever occurs earlier.

B. Compaction Test

About 3 kg of oven dried soil passing through IS 480 sieve was taken. Particular percentage of sugarcane bagasse (0%,2%,4%,6%) was added to soil and thoroughly mixed. Knowing the natural moisture content, add as much water

as required to make the water content 12% and mix it thoroughly. Weigh the empty mould with base, but without collar accurately. Place the collar, fill the mould with prepared sample for about more than 1/3rd height and smoothen the surface by gently pressing. Compact the moist soil in three equal layers by the rammer of wt. 2.6kg and free fall 310mm with 25 numbers of evenly distributed blows to each layer for 1000cc mould. Scratch the soil surface with spatula before placing succeeding layer. Remove the collar and trim off the excess soil. Remove all the loose soil on the outside of the mould and take weight of the mould with base plate and soil. Take representative sample for determining water content. Repeat the aboveprocedure for 4-5 times with increasing water content until the total weight decreases or remains the same

C. Permeability Test

2kg of oven-dried soil was taken from a thoroughly mixed sample of the soil and it was mixed with different percentages of sugarcane bagasse(0%,2%,4%,6%). Fill the cylindrical mould to the required level with the soil sample on filter paper, keeping the saturated porous stone at the bottom. Place the other porous stone at the top above another filter paper. Keep the rubber ring on top of the mould and position the collar. Connect the inflow of the top plate to falling head stand pipe. Open the air valve and allow water to flow. When all air has been expelled from the cap close the air valve. When a steady state of flow is reached, measure the head above the tail water level at a particular instant and after a known interval of time, measure the (dropped) head.

IV.RESULT ANALYSIS

A. *Unconfined CompressionTest*

Fig.I shows the change of unconfined compressive strength with different percentage of sugarcane bagasse. It is found that the unconfined compressive strength increases as we add on sugarcane baggase and decreases after a particular percentage addition of sugarcane bagasse. Unconfined compressive strength increased from 2.908 kg/cm^2 for 2% sugarcane bagasse to be 7.261kg/cm^2 for 4 % sugarcane bagasse content in the soil and thereafter decreased to 2.539kg/cm^2 for 6% sugarcane bagasse as shown in *Table.I.*

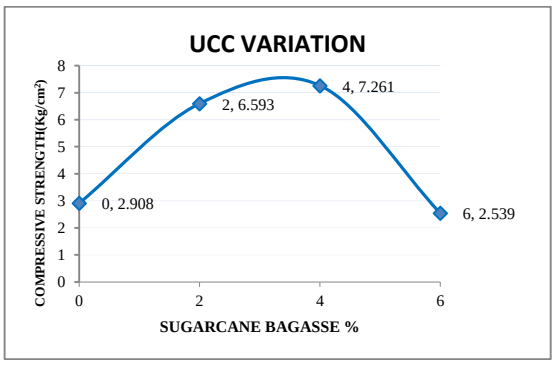

Fig I Unconfined Compressive Test

TABLE-II VARIATION IN UNCONFINED COMPRESSIVE STRENGTH

Sugarcane bagasse %	0	2	4	6
UCC (kg/ cm^2)	2.908	6.593	7.261	2.539

B. Compaction Test

1. Variation in Optimum Moisture Content

Fig. II shows the change of optimum moisture content with different percentage of sugarcane bagasse. It is found that the optimum moisture content increases till 4 % sugarcane baggase and decreases afterwards.. OMC increased from 16% for parent soil to 25 % for 4 % sugarcane baggase and decreased thereafter till 21.2% for 6% sugarcane bagasse as shown in *Table.II.*

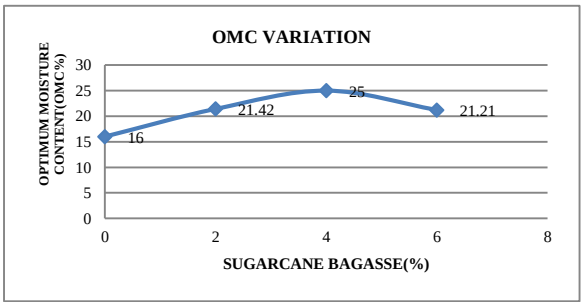

Fig 2 Variation In Optimum Moisture Content

TABLE III VARIATION IN OPTIMUM MOISTURE CONTENT

Sugarcane bagasse %	0	2	4	6
OMC (%)	16	21.42	25	21.21

2.Variation in Dry Density

Fig. III shows the variation in dry density with different percentage addition of sugarcane bagasse. It is found that dry density drops down with increase in the sugarcane bagasse content. Dry density found to be 1.644 g/cc for parent soil and it decreased to 1.1944 for 6% sugarcane bagasse as shown in *Table.III.*

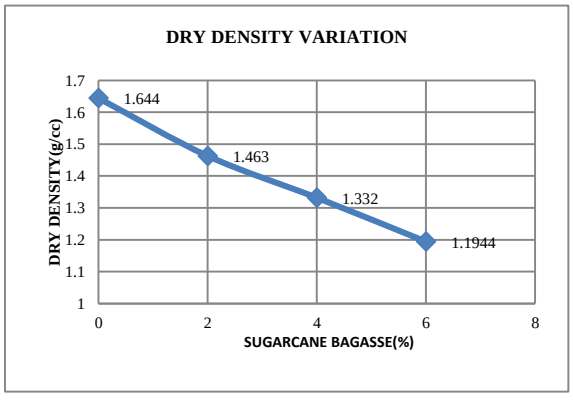

Fig. 3 Variation In Dry Density

TABLE IV VARIATION IN DRY DENSITY

Sugarcane bagasse %	0	2	4	6
DryDensity (g/cc)	1.644	1.463	1.332	1.194

C. Permeability Test

Fig.IV shows the variation of permeability with different percentage of sugarcane bagasse. It is found that the permeability increses with increase in sugarcane bagasse. Permeability was found to decrease from $5.57x10^{-3}$ cm/s for 0% sugarcane bagasse to $2.67x10^{-3}$ cm/s for 6% sugarcane bagasse content in the soil as shown in *Table.IV*

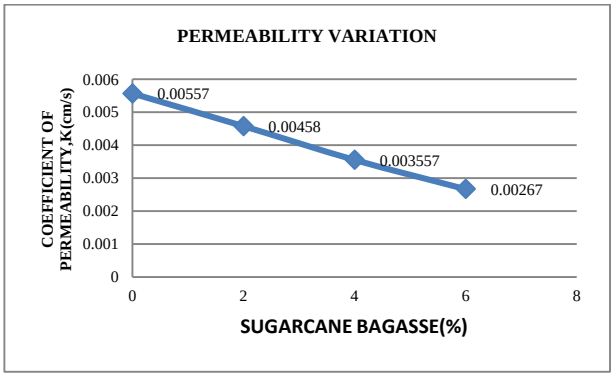

Fig 4 Permeability Variation

TABLE V PERMEABILITY VARIATION

Sugarcane bagasse %	0	2	4	6
Permeability (cm/s)	$5.57x10^{-3}$	$4.58x10^{-3}$	$3.55x10^{-3}$	$2.66x10^{-3}$

V APPLICATIONS

The areas where its applications prevail are;
Soil mixed with sugarcane baggase can be effectively used as land fill in pavement construction.
Useful bio-waste disposal, road construction, and ground improvement technique.
Best results were obtained between 2-4% sugarcane bagasse content.

VI CONCLUSION

The variation of different engineering properties of soil such as dry density, optimum moisture content (OMC), unconfined compressive strength and permeability were studied with different percentage by weight of sugarcane bagasse and the following variations were found out:

- The dry density of soil sample decreases as sugarcane baggase content increases.
- The optimum moisture content (OMC) increased from 0% sugarcane bagasse to 4% sugarcane bagasse and then decreased thereafter.
- The unconfined compressive strength of soil sample increases as the sugarcane bagasse content increases till a particular percentage and decreases thereafter.
- The permeability decreases as the sugarcane bagasse content increases.

ACKNOWLEDGMENT

We Paulin Pinky P J, Jissy P Dumas, Jyothika J, Ayline Thomas, convey our sincere thanks to Er. Laksmipriya A.R, Er. Reshma Theresa (HOD of Civil Department) and our dear parents for their sincere support and constant guidance. At last but not least, I thank almighty for his constant blessings, showered on me.

REFERENCES

[1] Amu O.O., Ogunniyi S.A. and Oladeji O.O. "Geotechnical properties of lateritic soil stabilized with sugarcane straw Ash" *American Journal Of Scientific And Industrial Research* PAGE: 323-331
[2] Arora K.R, *Soil Mechanics and Foundation engineering* LaxmiPublications , Chennai, India.
[3] Ayothiraman R. (2011) "Improvement Of Subgrade Soil With Shredded Waste Tyre Chips" *Proceedings Of Indian Geotechnical Conference Kochi* (Paper No. H- 033)
[4] Bhuvaneshwari S. , R. G. Robinson , S. R. Gandhi (2005) "Stabilization Of Expansive Soils Using Flyash" *Fly Ash India 2005, New Delhi* VIII 5.1- 5.10
[5] Bindu Sebastian, Sobha Cyrus Babu.T.Jose (2011) "Effect Of Inclusion Of Coir Fiber On The Shear Strength Of Marine Clay" *Proceedings Of Indian Geotechnical Conference Kochi* (Paper No.H-070)
[6] EmillianiAnakGeliga and Dygku Salma Awg Ismail (2010) "Geotechnical Properties of Fly Ash and its Application on Soft Soil Stabilization" *UNIMAS E-Journal of Civil Engineering*, Vol. 1: issue 2 /April 2010
[7] Fidelis O. Okafori and Ugochukwu. N. Okonkwo (2009) "Effects of Rice Husk Ash on Some Geotechnical Properties of Lateritic Soil" *Leonardo electronic journal of practices* Issue 15 p 67-74
[8] Julius K. M'Ndegwa (2011) "The Effect of Cane Molasses on Strength of Expansive Clay Soil" *Journal of Emerging Trends in Engineering and Applied Sciences (JETEAS) 2 (6)* PG : 1034-1041
[9] Khandaker M. Anwar Hossain, M.ASCE (2011) "Stabilized Soils Incorporating Combinations Of Rice Husk Ash And Cement Kiln Dust" *Journal Of Materials In CivilEngineering* © ASCE PAGE ; 1320-1327
[10] Musa Alhassan (2008). "Potentials of Rice Husk Ash for Soil Stabilization".*AU J.T.* Vol.11 (4).pp. 246-250.
[11] Ogunribido T.H.T. MNMGS, MTRCN (2011) "Potentials Of Sugar Cane Straw Ash For Lateritic Soil Stabilization In Road Construction" *Int. J Sci. Emerging Tech* Vol-3 No 5 PG 102-106
[12] Robert M Brooks (2009). "Soil stabilization with Flyash and Rice husk ash" *International Journal of Research and Reviews in Applied Sciences.*Vol.1. pp.209-217.
[13] Sivakumar G. L. Babu and A. K. Vasudevan (2008) "Seepage Velocity and Piping Resistance of Coir Fiber Mixed Soils" *Journal Of Irrigation And Drainage Engineering* © ASCE Pg : 485 -492