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Effect of Alternative Materials on Properties of Expansive Soil for Construction of Road Subgrade by using Cocnut Husk Ash

Akkim Sridhar Reddy[1], P. Hanuma[2]

[2]Assistant Professor, [1,2]Department of Civil Engineering,
[1,2]Sri Sunflower College of Engineering &Technology, Lankapalli, Andhra Pradesh, India

ABSTRACT
Pavement engineers have long recognized the long-term benefits of improving the strength and durability of pavement soil by mixing in a cementitious binder during reconstruction or new construction. In lieu of these, this research was carried out to study the effects of coconut waste ash (CWA) on lime stabilized lateritic soil for road construction. Natural lateritic soil was collected from a borrow pit nearer location Preliminary tests such as natural moisture content, specific gravity, particle size distribution and Atterberg limits were carried out on the soil for classification and identification purposes according to BS 1377 part 2 (1990). Strength tests such as compaction, California bearing ratio and unconfined bearing ratio were also carried out on the natural lateritic soil and stabilized soil according to BS 1924 (1990). The soil sample was mixed with lime in the proportions of 2, 4, 6, 8 and 10%, and were each subjected to Atterberg limits tests and strengths to determine the optimum quantity of lime for stabilizing soil. The plastic index varied from 13.93 – 9.33% and 23.64 – 14.46% for lime stabilized soils with optimum values obtained at 8 and 6% respectively. Plastic index decreased as the percentages of lime and CWA increased for CWA of ratio 1:1, 3:2 and 2:3 i.e. PI varied from 8.63 to 11.91%. Notable improvements were also observed in the MDD, UCS, OMC and CBR values of stabilized soil therefore coconut waste ash can be used to stabilize lateritic soil. Hence, the use coconut waste ash (CWA) should be encouraged in the construction industry to reduce the cost

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INTRODUCTION

PROBLEMS OF CLAY AS CONSTRUCTIONMATERIALS

Damage Caused to Pavements over Clay Subgrade:

Among the various damages, the damage caused by expansive soils to pavements is more predominant. Majority of the pavement failures is attributed to the poor sub-grade conditions. It is a well-known fact that water is the worst enemy of road pavement, particularly in expansive soil areas. Water penetrates into the road pavement from three sides' viz. top surface, side berms and from sub grade due to capillary action. It has been found during handling of various road investigation project assignments for assessing causes of road failures that water has got easy access into the pavement. It saturates the sub grade soil and thus lowers its bearing capacity, ultimately resulting in heavy depressions and settlement. In expansive soil areas, unpaved berms pose the maximum problem as they become slushy during rains, as they are most neglected lot. Premature failures are common in flexible pavements over clay subgrade. In rainy seasons, the subgrade soil gets softened and intrusion of subsoil into sub base will take place resulting in failure of the flexible pavement. The types of failures in clayey subgrades are as follows

Longitudinal cracks and frost heaving

This is due to differential volume changes that occur in expansive soils. The alternate swelling and shrinkage characteristics possessed by expansive soils results in tracking through the full pavement thickness. When temperature fails to lesser degrees heaving of pavement may occur due to frosting of water in voids of expansive soils. Due to frost action volume of voids increases, there by forming a localized heaving up portion in pavements.

Fig-1 longitudinal cracking

MATERIALS:

Coconut Husk Ash:

Coconut husk ash is an excellent mineral fertilizer for immature **coconut** hybrids to provide potassium. In addition to the plant based materials, other potential organic waste also provide high nutrient which are useful to formulate high-quality organic liquid fertilizers. Cocos Nucifera trees, otherwise known as coconut palm trees, grow abundantly along the coast line of countries within 15oof the equator. They prosper in sandy, saline soil and in tropical climates. A healthy coconut tree will produce approximately 120 watermelon-sized husks per year, each with a coconut imbedded inside. There are three constituents of the Cocos Nucifera that can be used for fuel: the husk, the coconut shell, and the coconut oil that is in the white coconut "meat" or copra as it is usually called. Thus, the coconut tree is a very abundant, renewable resource of energy. When coconuts are harvested, the husks are removed, thereby leaving the shell and the copra. Plate 1 shows the coconut with the husk being removed whereas plate 2 shows the different layers of the coconut fruit. These husks are considered as waste materials and are usually dumped into refuse bin. When consumers buy the coconut, they buy it with the shell and when it is to be consumed it is broken and the shell is removed. Large quantities of the shells can be obtained in places where coconut meat is used in food processing. The husk and the shell are both regarded as waste materials. These materials are then burnt into ashes in a furnace at a very high temperature to produce the coconut shell and husk ash. The coconut shell when dried contains cellulose, lignin, pentosans and ash in varying percentage

Plate 1 Coconut with the husk being removed

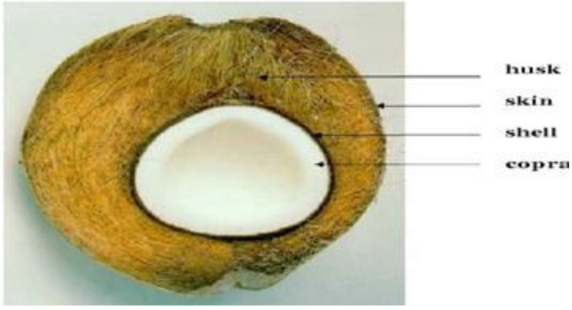

Fig-2 coconut husk ash

Table-1 Chemical Properties of CHA

IS Sieve	Weight Retained	Percentage Retained	Cumulative Percentage	Percentage of Finer
	(g)	(%)	(%)	(%)
4.75	372	37.2	37.2	62.8
2.36	162	16.2	53.4	46.6
2	98	9.8	63.2	36.8
1	146	14.6	77.8	22.2
0.6	80	8	85.8	14.2
0.425	56	5.6	91.4	8.6
0.3	32	3.2	94.6	5.4
0.15	22	2.2	96.8	3.2
0.09	14	1.4	98.2	1.8
0.075	10	1	99.2	0.8
PAN	4	0.4	99.6	0.4

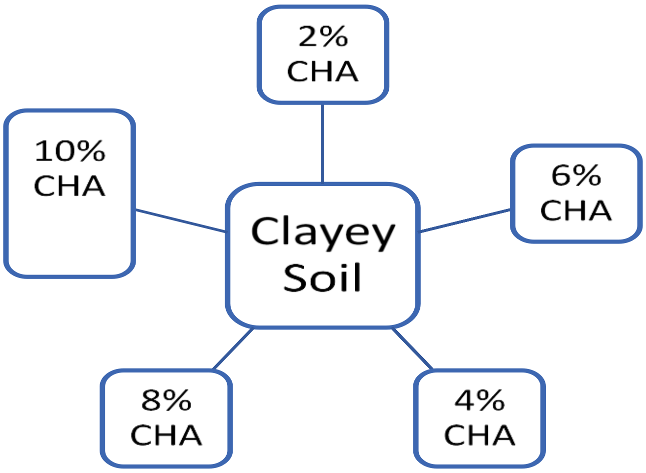

Fig-3 Schematic Representation of Compaction Test Sample prepared with variation of CHA

Table -2 Sieve analysis:

Oxide	Percentage composition (%)	
	CSA	OPC
SiO_2	37.97	20.70
Al_2O_3	24.12	5.75
Fe_2O_3	15.48	2.50
CaO	4.98	64.0
MgO	1.89	1.00
MnO	0.81	0.20
Na_2O	0.95	0.60
K_2O	0.83	0.15
P_2O_5	0.32	0.05
SO_3	0.71	2.75
LOI	11.94	2.30

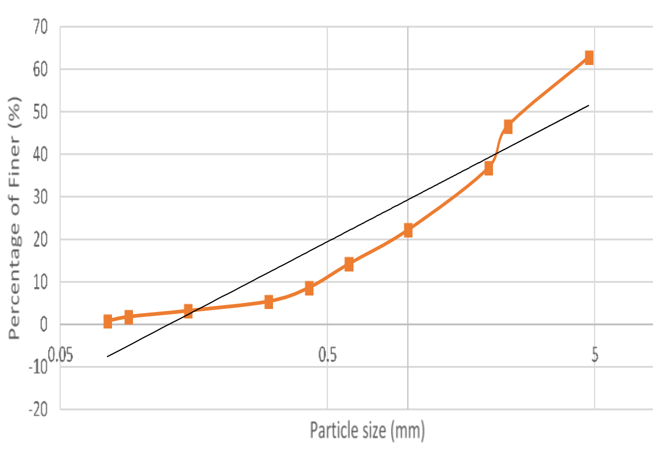

Fig-3: Sieve Analysis Graph

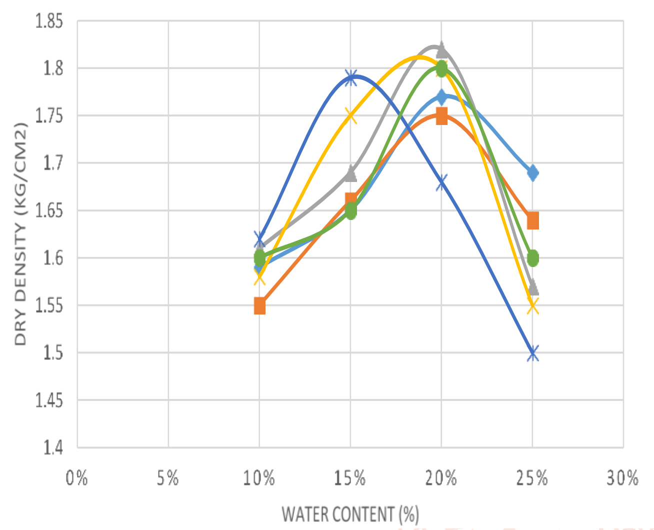

Fig-4Compaction curves for soil samples with & different percentages of jute fiber

Table-3 OMC and MDD values of clay soil + CHA%

S. no	Sample	OMC (%)	MDD (g/cc)
1	CLAYEY	20	1.77
2	CLAYEY +2% CHA	20	1.82
3	CLAYEY+ 4% CHA	20	1.8
4	CLAYEY + 6% CHA	20	1.68
5	CLAYEY + 8% CHA	20	1.8

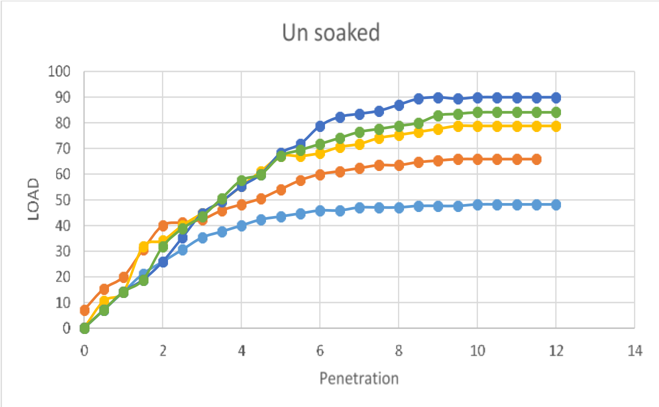

Fig-5: Load Vs Penetration graphs of Unsoaked CBR at different percentages of CHA

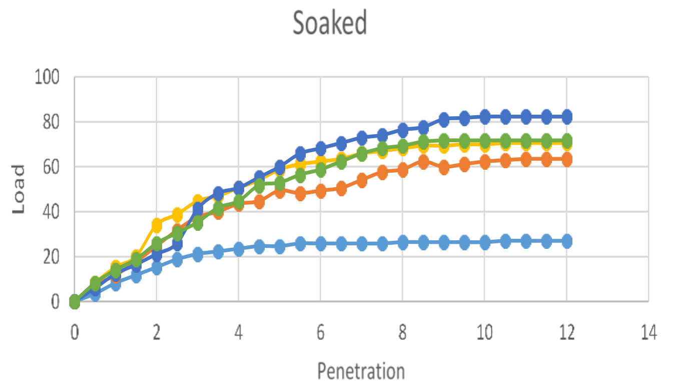

Fig-6: Load Vs Penetration graphs of Unsoaked CBR at different percentages of CHA

CONCLUSIONS

In this study, the major properties studied are OMC, MDD, CBR, UCS, and Consolidation. Based on the all investigations on all samples and when compared with normal soil, following conclusions were made

Compaction Test and CBR Test:

- In Standard Procter Test, the increase in CHA percentage the dry density increases upto 0.75% and after the MDD value has been decreasing trend. Though, a decrease in OMC has been observed with increase in CHA %
- Maximum dry density was increased with the addition CHA
- When 2%,4%,6%,8% & 10% added, higher MDD observed for 8% CHA
- Both the Unsoaked and soaked condition of CBR were studied and Peak value was obtained at 8% CHA in both conditions.

Unconfined compressive strength:

- In UCS, Due to increase in CHA percentage the UCS value having increasing trend with respect to the parent soil.
- In UCS, Due to increase in CHA percentage the UCS value has been observed increasing trend up to 8% after that having decreasing trend.
- The Curing period of mix is a governing parameter as the chemical reaction of stabilizers is depends on it.so it can be concluded that the strength will increase with increase in curing period.
- UCS of treated soils was higher than that of untreated soils.
- UCS value of sample is Increased from 0.97 to 4.3 kg/cm^2

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