Soil Stabilization of Clayey Soil Using Coir Fibre and Lime

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Abstract— In India the soil mostly present is Clay, in which the construction of sub grade is problematic. In recent times the demands for sub grade materials has increased due to increased constructional activities in the road sector and due to paucity of available nearby lands to allow excavate fill materials for making sub grade. In this study coir fibre and lime is mixed with Parent Soil in various percentage (0%, 0.25%, 0.75, 1.0% and 5%, 10%, 15%). The main objective of this study is to evaluate shear strength characteristics, Unconfined Compression behaviour of untreated and stabilized soil with coir fibre and lime. Based on the results obtained from standard Proctor compaction test, the ideal MDD and OMC value used for further, unconfined compression test. The present investigation has therefore been carried out with materials such as coir fibre and lime which was mixed with soil to study improvement of weak sub grade in terms of compaction and strength characteristics.

Key words: MDD, OMC, UCS

I. INTRODUCTION

Clayey soil deposits occur in the arid and semi arid regions of the world and are problematic to engineering structures because of their tendency to heave during wet season and shrink during dry season. Clayey soils are a worldwide problem that poses several challenges for civil engineers. They are considered a potential natural hazard, which can cause extensive damage to structures if not adequately treated. Hence problematic soil like clayey soil must be adequately treated before the erection of structure. Wide range of soil modification method is available. Selection of appropriate method should be based on the type of soil and its characteristics, type of the construction, time available, associated cost. It has been observed that industrial by-products can cause drastic change in the soil properties in terms of strength characteristics, density, acidity etc. and also serves agricultural benefits by increasing crop yield. Moreover utilization of these products is a better solution to disposal than heaving them up on land.

II. OBJECTIVE OF THE STUDY

1) To check the ambit of reducing clayeyness and improving bearing capacity value by adding additives.
2) Also to establish the usage of coir fibre and lime as an additive, due to their cheap cost.

Moreover pavement on clayey soil requires a greater thickness of base and sub-base course which results increases the expenditure of project. To set right this problem it becomes mandatory to increase the strength of the soil which in-turn will help in lessening the thickness of the pavement layers and thus project cost.

III. MATERIAL COLLECTION

A. *Clayey Soil*

As a part of this investigation, the clayey soil was acquired from the site Kurukshetra, Haryana. The clayey soil thus obtained was carried to the laboratory in sacks. The soil was oven dried before determining any geotechnical properties. The various geotechnical properties of the procured soil are as follows:

S.No.	Parameters	Result
1.	Light Compaction Test MDD (gm/cc) OMC (%)	 1.61 24.2
2.	Liquid Limit (%)	49.67
3.	Plastic Limit (%)	20.69
4.	Plasticity Index (%)	28.98
5.	Specific Gravity	2.67
6.	Indian Soil Classification	CI

Table 1: Physical Properties Of Soil

B. *Coir Fibre*

Coir Fibres have been purchased from the market of Kurukshetra. The Fibres are cut into pieces of approximately 25mm lengths and are mixed in percentage of 0%, 0.25%, 0.5%, 0.75% and 1%, by dry weight of soil.

Property	Range/Value
Fibre length, mm	25 mm
Average Diameter, mm	0.25
Specific Gravity	1.15
Bulk Density, (Kg/m^3)	1300
Ultimate tensile strength, (MPa)	150
Young's Modulus (GPa)	72
Colour	Brown

Table 2: Properties Of Coir Fibre

C. *LIME*

Lime has been purchased from the market of Kurukshetra. The lime are mixed in percentage of 0%, 5%, 10% and 15%, by dry weight of soil. Lime is The oldest traditional chemical stabilizer used for soil stabilization The addition of lime to the soil water system produces and it increases the pH of the soil to above 10.5 which enables the clay particles to break down.

Basic characteristics	Data sheet of Lime
Physical appearance	White powder dries
Cao (%)	> 73.3
Mgo (%)	< 0.5
FeO(%)	< 2
AlO (%)	< 1.5
SiO (%)	< 2.5
SO (%)	< 0.5
NaO (%)	0.4 - 0.5
CO (%)	< 5
CaCO (%)	< 10
Specific density (gm/cc)	2
More than 90 micron (%)	< 10

Table 3: Physical Properties of lime

More than 630 micron (%)	0
Insoluble material (%)	< 1
Apparent density (gm/l)	600 - 900

Table 4:

IV. METHODOLOGY

A. Compaction Test

This Phase of Study involved a detailed investigation of the compaction characteristics of the parent soil and blended sample containing different length of coir and lime contents, in order to obtain the optimum moisture contents and maximum dry densities. The optimum moisture contents thus obtained is used in preparing samples for Unconfined Compressive Strength Test. This test confirms to IS: 2720 (Part 7)1980.

B. Unconfined Compressive Strength

After the compaction test the compressive strength of the sample is measured. Cylindrical specimen is compacted by static compaction in 3.8 cm diameter and 7.6 cm high mould. The inner surface of the mould is lubricated with mobile oil so as to extrude the sample from mould with minimum disturbance. The sample is placed inside the specimen mould in seven layers using spoon, leveled and gently compacted. Pressure pad will be inserted into the mould and the whole assembly will be statically compacted in loading frame to the desired density. The sample is to be kept under static load for not less than 10 minutes in order to account for any subsequent increase in height of sample due to swelling. The sample will then be removed from the mould with the help of sample extruder. Initial dimensions are measured.

V. RESULT AND DISCUSSION

A. Effect of Coir fibre and lime on MDD and OMC

The increase in coir fibre percentage the dry density increase upto 0.25% and after the MDD value has been decreasing trend. Though, a increase in OMC has been observed with increase in percentage of coir fibre. The comparison curve shows in Figure fig 1 and fig 2.

The increase in Lime percentage the dry density increase upto 10% and after that MDD value has been decreasing trend. Though, a marginal decrease in OMC upto 5% of lime and after that OMC has been Increasing trend. The comparison curve shows in Figure fig 3 and fig 4

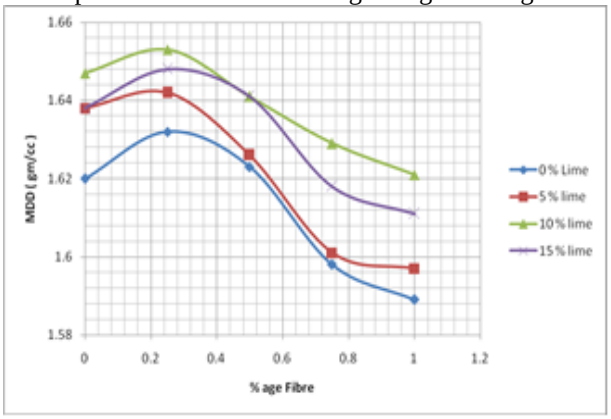

Fig. 1: Effect of coir fibre and lime with parent soil on MDD at different percentage.

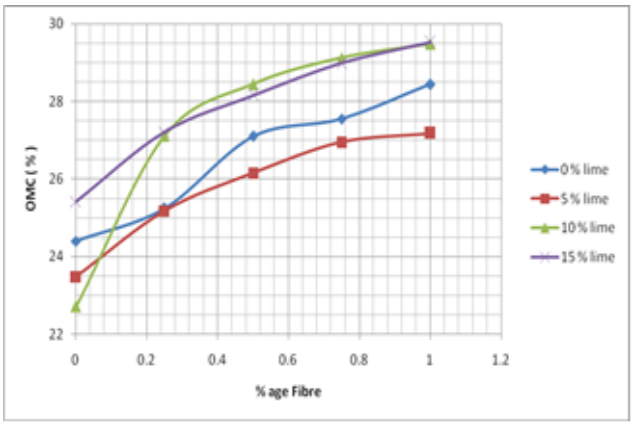

Fig. 2: Effect of coir fibre and lime with parent soil on OMC at different percentage

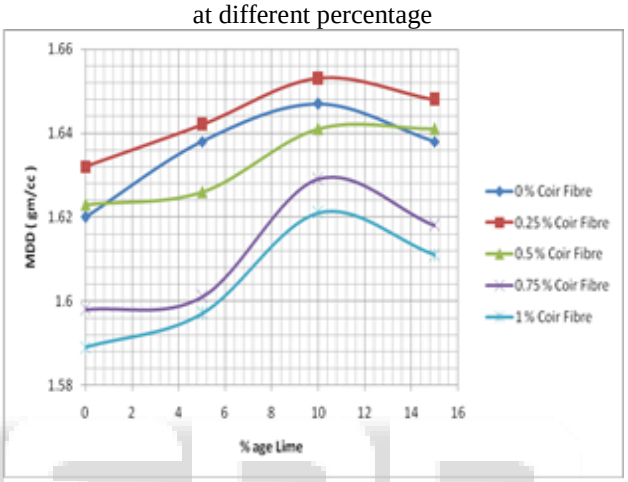

Fig. 3: Effect of lime and coir fibre with parent soil on MDD at different percentage

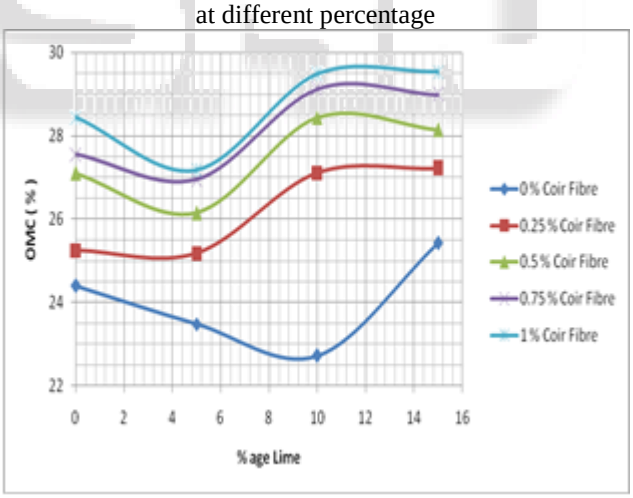

Fig. 4: Effect of lime and coir fibre with parent soil on OMC

B. Effect of coir fibre and lime on UCS

From UCS test conducted for the same sample as described in proctor test, the strength of samples shows increasing tendency for some samples with the increment of Coir fibre and lime percentage in the soil i.e.; for parent soil strength obtained 1.06 kg/cm2. For coir fibre-Soil mixture and lime-Soil mixture shows incremental results in the compressive strength as compared to the parent soil. The comparison of UCS for coir fibre and lime are given in Figure 5 and 6.

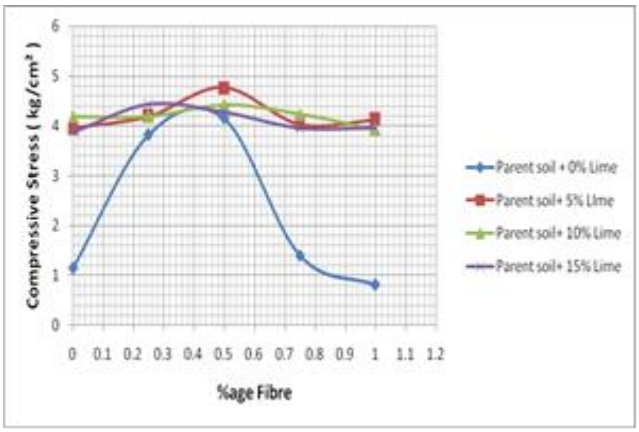

Fig. 5: Effect of coir fibre and lime with parent soil on unconfined compressive strength test with different percentage

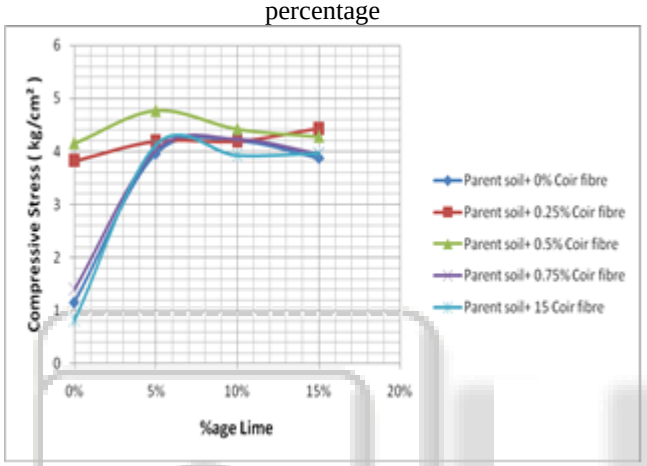

Fig. 6: Effect of lime and coir fibre with parent soil on Unconfined Compressive Strength with Different Percentage

VI. CONCLUSION

In This thesis, strength characteristics of Soil -Coir Fibre - Lime have been studied. The following conclusion can be made based on the test result obtained from Coir fibre- Lime stabilized clayey soil:-

1) In Standard Procter Test, the increase in coir fibre percentage the dry density increases upto 0.25% and after the MDD value has been decreasing trend. Though, a increase in OMC has been observed with increase in percentage of coir fibre..
2) In Standard Procter Test, the increase in Lime percentage the dry density increase upto 10% and after that MDD value has been decreasing trend. Though, a marginal decrease in OMC upto 5% of lime and after that OMC has been Increasing trend.
3) In UCS, Due to increase in coir fibre percentage the UCS value increases upto 0.5% and after the UCS value has been decreasing trend.
4) In UCS, Due to increase in Lime percentage the UCS value has been observed increasing trend for various percentage of lime.
5) Lime not only acts as a activator in this case but also reduces the plasticity of the soil.
6) Soil-Coir Fibre-Lime specimen fails by formation of vertical cracks.

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