Effect of Untreated and Treated Oil Palm Fibre on Compaction and Shear Strength Characteristics of Soil

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Abstract:- **As the land requirements increases, the ground improvement becomes necessary. Many studies have been held to improve the ground using natural as well as synthetic fibres. Industrial as well as agricultural waste is been used to stabilise the soil due to its availability and less cost. Also, it reduces the pollution. Here, in this study, palm fibre is used to stabilise the soil. Since, the natural fibre doesn't much improve the shear strength of the soil; a chemical treatment should be applied before mixing it with the soil. This paper deals with the compaction as well as the shear strength characteristics of the soil mixed with untreated and treated palm fibre in varying percentages of 0% to 1% by an increment of 0.2%. It shows a slight reduction in the dry density and an increase in water content when increasing percent of palm fibre. When treated palm fibre is used, dry density increases and water content decreases. The treated palm fibre mixed soil shows 36.9% increase in shear strength than the untreated fibre mixed soil.**

Keywords: - Silt, palm fibre, compaction, UCC

I. INTRODUCTION

Nowadays, ground improvement becomes necessary since the soil available in the construction site is weak. As the land requirements increases due to population and many other reasons, the improvement of ground also increases.Many studies have been held to improve the ground using natural as well as synthetic fibres. But sometimes, it may be costly. Therefore, researches have been carried out to use the wastes available such as industrial waste and agricultural waste to stabilize the soils. The dumping of these wastes is a serious problem in the environment. By stabilizing these wastes in the soil improves the ground as well as decreases the pollution in the environment. Stabilisation of soils causes changes in the characteristics of the soil.

Silty soils are most abundant in most parts of Kerala. Some of such soils are easily susceptible to settlement and shear failure. To stabilize such soils, palm fibre is used in the present study. It is the waste product from palm oil factory. Usually, the natural fibre doesn't much improve the shear strength of the soil. Hence, a chemical treatment should be applied before mixing it with the soil. The change in the compaction and shear strength characteristics of the soil after mixing untreated and treated palm fibre is been studied.

II. MATERIALS

A. Soil

Soil used in the present study is a clayey silt soil obtained from Alappuzha. It was collected from a depth of 1m. It was partially air dried and powdered to a fraction less than 4.75 mm. The physical properties of soil obtained are shown in the table 1.

TABLE 1. PHYSICAL PROPERTIES OF SOIL

Insitu water content	163%
Specific gravity	2.53
Colour	Brown
Plastic limit	26.98%
Liquid limit	66%
Shrinkage limit	36.84%
Optimum moisture content	38.75%
Dry density	1.17 g/cc
Soil classification	MH

B. Palm fibre

Palm fibre waste is obtained from Oil palm India Ltd, Bharathipuram, Kollam. It consists of mainly cellulose 65.5%, hemicellulose 11.8 %, lignin 10 %, pectin 0.7% and small amounts of wax 0.7%.The specific gravity of palm fibre is 0.7953 and the average length of the fibre is 1cm.

III. METHODOLOGY

The compaction and UCC tests were performed on each soil palm fibre mix. The coir pith was varied from 0% to 1% in the increments of 0.2% by weight of the soil. These tests were performed to determine the maximum dry density as well as the shear strength. For chemical treatment, NaOH at 5% concentration is used. Palmfibres are soaked in 5% concentration of NaOH solution for 1 hour room temperature followed by washing with water. Then, oven dried at 110^0C for 2 hours. Then, again the tests were performed.

IV. Results And Discussions

A. *Compaction characteristics*

Proctor compaction tests were conducted with different percentages of palm fibre. The tests were conducted as per IS-2720-part 8 (1980).

1) *Variation of dry density*

a) Untreated palm fibre

It is found that dry density decreases with increase in the palm fibre content. When 1% fibre is added, the maximum dry density decreases to 1.138 g/cc.Fig 1 represents the variation of dry density with the fibre content.

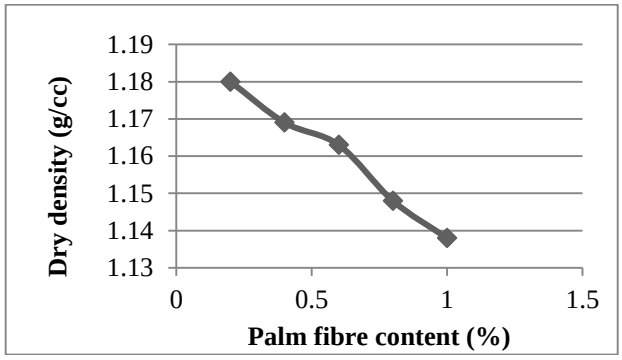

Fig 1. Variation of dry density with varying palm fibre content

b) Treated palm fibre

For a treated palm fibre soil mixture, it is observed that the dry density increases with the increase in fibre content and reaches its maximum at 1%. Fig 2. shows the variation of dry density with varying treated palm fibre content.

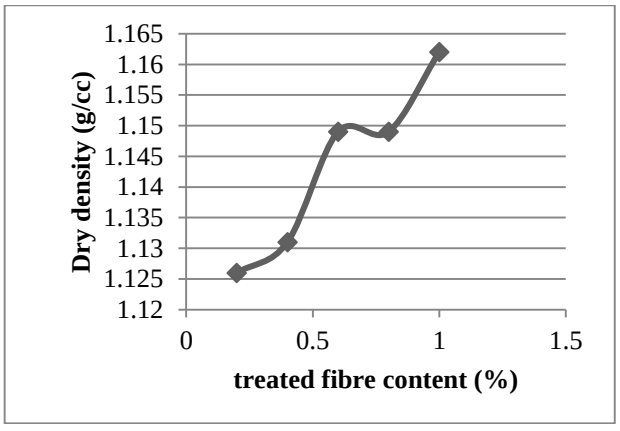

Fig 2. Variation of dry density with varying palm fibre content

2) *Variation in OMC*

a) Untreated palm fibre

Fig 3 shows the variation of optimum moisture content with different percentage of palm fibre. It is found that optimum moisture content decreases as the fibre content increases and reaches to 40.588%.

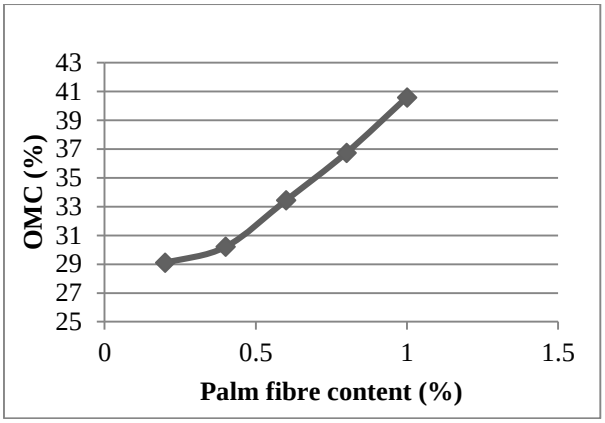

Fig 3. Variation of OMC with the varying percent of palm fibre

b) Treated palm fibre

After the chemical treatment of fibre, it is been observed that the OMC of the palm fibre soil mix reduces as the fibre content increases. Fig 4 shows the variation of OMC with the addition of varying palm fibre content.

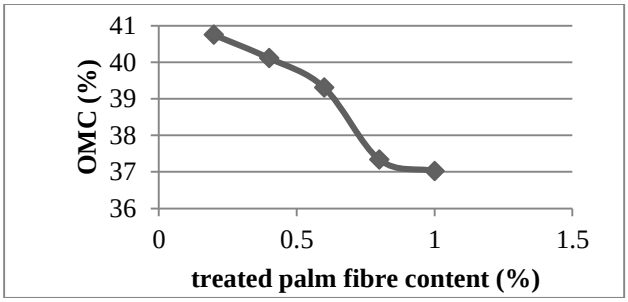

Fig 4. Variation of OMC with the varying percent of treated palm fibre

B. *Shear strength characteristics*

The unconfined shear strength was carried out as per IS-2720 – part 10 (1973) and unconfined compressive strength of each soil- palm fibre mix is obtained from the load- deflection graph.

1) *Untreated palm fibre*

Fig5 represents the variation of the shear strength due to the varying percentages of palm fibre. It shows that the UCC strength of the plain soil is 11.4 kN/m^2 and increased to 35.06kN/m^{2}by the addition of 0.8% palm fibre. And then it decreases to 28.2kN/m^{2}by the addition of 1% palm fibre to the soil. The maximum shear strength obtained is 17.5 kN/m^2 where as the shear strength of soil alone is found to be 5.7 kN/m^2.

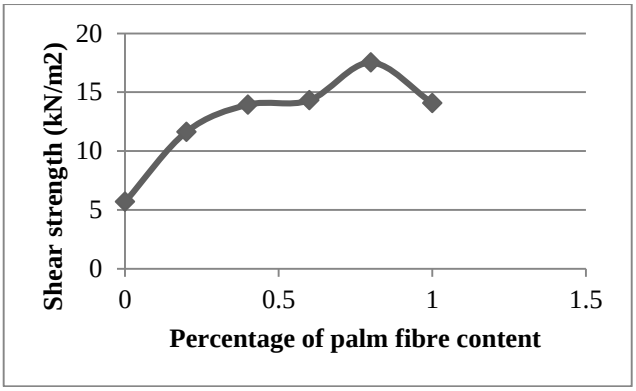

Fig 5. Shear strength variation with varying percentages of palm fibre

2) Treated palm fibre

It is found that the UCC strength increases upto 0.8% and then decreases as the palm fibre content increases, i.e., 48 kN/m^2. The maximum shear streangth obtained is 24 kN/m^2. Fig 6 shows the variation of shear strength with varying percentages of treated palm fibre.

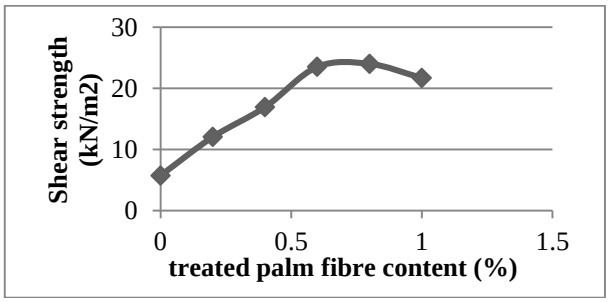

Fig 6. Shear strength variation with varying percentages of treated palm fibre

C. Comparison of shear strength

The soil treated palm fibre mix shows higher shear strength than the soil untreated fibre mix. The shear strength of soil-treated palm fibre mix shows 36.9% increase than untreated one. Fig 7 shows thecomparison of shear strength of treated and untreated palm fibre soil mix.

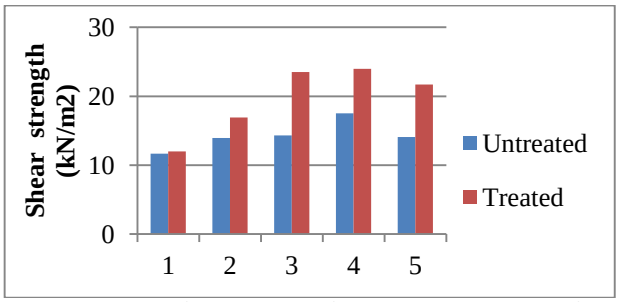

Fig 7. Comparison of shear strength of treated and untreated palm fibre soil mix.

V. CONCLUSIONS

- It is found that the maximum dry density decreases with increase in the palm fibre content. This is due to the replacement of soil with palm fibre of lower specific gravity than the soil. Whereas the maximum dry density increases with increase in the treated palm fibre content.
- The OMC of soil specimen mixed with untreated palm fibre increases and reaches 40.588%. This is due to the water absorbing capacity of the fibre added. But the soil specimen mixed with untreated palm fibre shows a reduction in OMC as the fibre content increases.
- The UCC strength varies and reach its maximum at 0.8% of untreated fibre content, i.e., 35.06 kN/m^2. The maximum shear strength obtained is 17.53kN/m^2.The maximum shear strength obtained for soil-treated palm fibre mix is at 0.8%, i.e., 24 kN/m^{2}and the UCS value is 48 kN/m^2.

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