INFLUENCE OF NYLON FIBER ON THE ENGINEERING BEHAVIOR OF KUTTANAD CLAY

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Abstract -*Reinforced earth technique is considered as an effective ground improvement method because of its cost effectiveness, easy adaptability. In this paper an attempt is made to study the influence of nylon fiber reinforcement on shear strength properties of kuttanad clayey soil. Addition of nylon fiber (0.5-2.0 %.) to the kuttanad clay indicates that there is an appreciable improvement in shear strength properties of the soil*

Key Words: **Nylon Fiber, Triaxial test, Clay Soil**

1. INTRODUCTION

Constructing structures on a weak soil is achieved either by replacing the soil itself or by improving the engineering properties of soil. Former method being a costly one, most feasible and economical solution will be soil improvement techniques. Soil reinforcement is one of the soil improvement techniques where natural or synthesized materials are used to improve the properties of weak soil. The primary purpose of reinforcing soil mass is to improve its stability, to increase its bearing capacity, to reduce settlements and lateral deformations. These reinforcements resist tensile stress developed within the soil mass there by restricting shear failure. Reinforcement interacts with the soil through friction and adhesion. These techniques are employed for stabilization of thin soil layers, repairing failed slopes, soil strengthen around the footings and earth retaining structures. Soil reinforcement is procedure.

Kuttanad clayey soil is dark brown color medium sensitive alluvial deposits spread over the Kuttanad region in the state of Kerala in India. This area lies 0.6-2.2 m below mean sea level and a major portion of the region is in submerged condition during the monsoon season in every year. In the case of Kuttanad soil it exhibit generally undesirable engineering properties. These clays are characterized by high compressibility, low shear strength and high percentage of organic matter, which are unfavorable from the geotechnical point of view. They can be plastic and compressible and they expand when wetted and shrink when dried. A large number of embankment failures and foundation failures have been reported in this soil due to its poor shear strength and compressibility characteristics.

Use of fiber in civil engineering for improving soil properties is advantageous because they are cheap, locally available, and eco-friendly. Fiber selected must not be hazardous to the environment, and it should be easily available and less expensive. Here study is conducting on effect of addition of nylon fiber on the shear behavior of clay.

2. MATERIALS

2.1 Kuttanad Clay

The soil used in this study was collected from pandarakullam, region of Kuttanad in Alappuzha district, Kerala, India. The index and engineering property of the soil was studied in the laboratory and the results are as given in Table 1.

Table -1: Basic Properties of clayey soil

Property	Value
Field moisture content	113%
Specific gravity	2.6
Liquid limit	114%
Plasticity index	62%
Optimum moisture content	45%
Dry density	1.16g/cc
Percentage of sand	7%
Percentage of silt	19%
Percentage of clay	74%
Soil classification	CH
Shear strength(kN/m^2)	29.3

2.2 Nylon Fiber

Following table shows the basic properties of Nylon fiber used for the study

Table -2: Basic Properties of Nylon fiber

Properties	Values
Specific gravity	1.14
Tensile strength(MPa)	300
Diameter(mm)	0.3
Length(mm)	10

3. METHODOLOGY OF EXPERIMENT

To study the influence of nylon fiber on Kuttanad clay, the clay was initially air dried and then reinforced with varying percentages of Nylon fibers from 0.5% to 2% by weight at an increment of 0.5%. Fibers were randomly mixed in soil to form a homogenous mixture. A total of 5 mixes were prepared. Liquid limit, plastic limit, modified proctor compaction and Triaxial tests were conducted on these mixes as per Indian Standard codes.

4. TEST RESULTS AND DISCUSSION

The Compaction, Liquid limit, Triaxial test values of soil and soil reinforced with different combinations of nylon fiber determined in the laboratory.

4.1 Effect of Fiber content on OMC and MDD

The Proctor's tests results obtained from the tests conducted on the soil sample "with nylon fiber reinforcement and without nylon fiber reinforcement" are as shown in chart 1. The optimum moisture content decreases from 44% at 0% nylon fiber to 38.2% at 1.5% nylon fiber addition. The maximum dry density increases from 1.16 g/cc to 2g/cc by the addition of nylon fiber from 0% to 1.5%. Thus the addition of nylon fiber to the mix decreases the optimum moisture content and increases the maximum dry density. The increase in strength due to addition of nylon fiber is because of reduction of the plastic characteristics of the kuttanad clay.

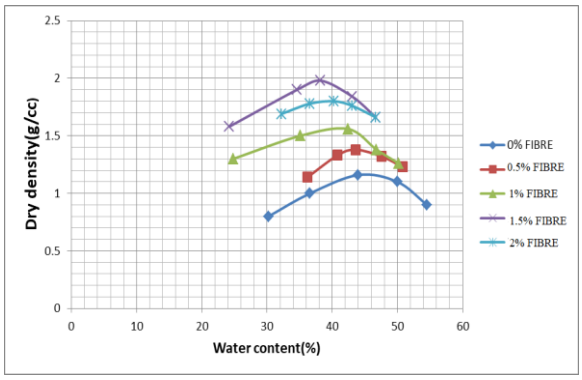

Chart-1: Compaction Curve for Soil with different Percentage of Nylon fiber

4.2 Effect of Fiber content on Liquid limit

Addition of nylon fiber to the kuttanad clay resulted in the decrease in the liquid limit of the soil. The Liquid limit decreases from 114 at 0% nylon fiber to 79 at 2% nylon fiber addition. The addition of nylon fiber increases the fiber content thereby decreasing the clay proportion needed for the bonding of resulting particle. The addition of nylon fiber decrease the water content of the mix and thereby increasing the workability which enhances the physical properties of soil

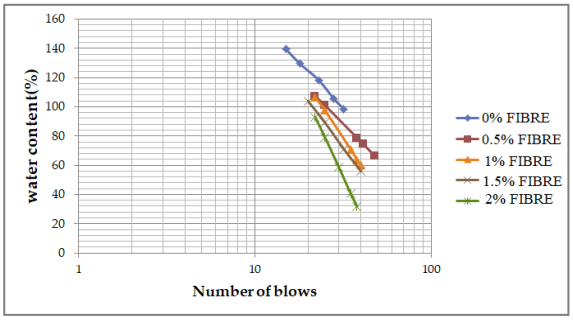

Chart-2: Flow Curve for Soil with different Percentage of Nylon fiber

4.3 Effect of Fiber content on Shear strength

The shear strength values appreciably increased from 29 kN/m²at 0% nylon fiber to 46kN/m² at 1.5% Nylon fiber addition .Thus nylon fiber addition improved the strength performance of kuttanad clay. From the test results it is seen that the shear strength value increases significantly with the nylon fiber addition from 0%nylon fiber to 1.5% nylon fiber and then decreases at 2% nylon fiber. The increase in the strength of the clay by the addition of nylon is due to the increasing the frictional strength between soil particle and nylon fiber.

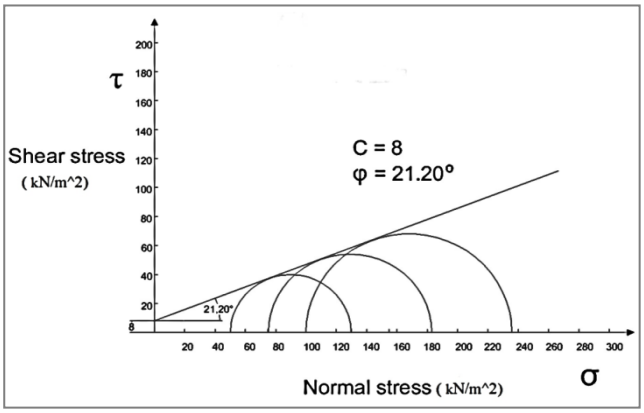

Chart-3: Normal and shear stress graph of 0.5% nylon fiber

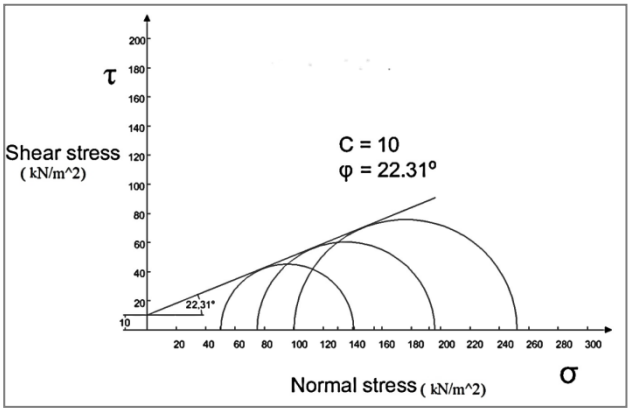

Chart-4: Normal and shear stress graph of 1% nylon fiber

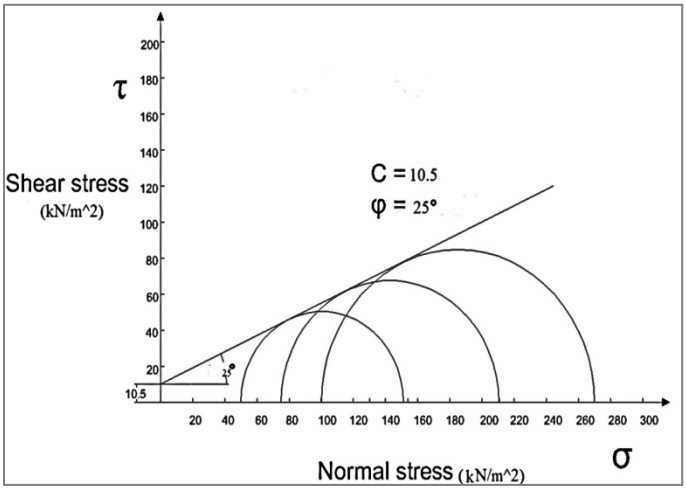

Chart-5: Normal and shear stress graph of 1.5% nylon fiber

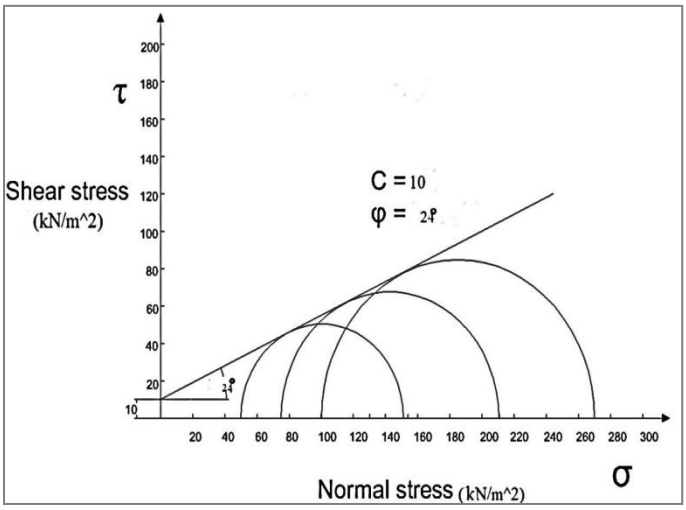

Chart-6: Normal and shear stress graph of 2% nylon fiber

5. CONCLUSIONS

Following major conclusions drawn from the study

- From the experimental observations 1.5% of nylon fiber is found to be the optimum percentage for to improving properties of Kuttanad clay.
- Addition of 1.5% of nylon fibers has improved the maximum dry density from 1.16 g/cc to 2g/cc to and decreased the corresponding optimum moisture content from 44 % to 38.2%.
- There is decrease in liquid limit with the addition of nylon fiber.
- Shear strength of soil increased from 29 kN/m^2 to 46kN/m^2 at 1.5% Nylon fiber addition.

Thus we can conclude that nylon fiber can be promising material for improving the properties of Kuttanad clayey soils.

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