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Improving Efficiency of Compressible Clay as a Subgrade

Susan Sunny Kocheril[1]
[1]P.G Student JBCMET, Arackappady, Perumbavoor

Arya Vimal [2]
[2]Asst. Prof. Of CE, Dept. Of JBCMET Arackapaddy, Perumbavoor

***Abstract*—Natural and synthetic fibers can be used in combination for improving the properties of compressible clay in order to make it efficient for use as a subgrade. The economical aspect of a road construction depends on the subgrade layer. Natural fibers such as roots of water hyacinth and jute are used in combination with sand and geogrid. The use of different types of fibers reduces the overall percentage of fiber required. Natural fibers were used tested at different percentages such as 0.25% ,0.5%, 0.75%, 1% and 1.25%. Determining the optimum percentage of reinforcement for the water logged areas as a subgrade is keen interest of the project. On the basis of this subgrade layer can be strengthened which results in reduced pavement thickeness and overall economy of road construction. Compaction test, unconfined compression test and CBR test were carried out to determine optimum percentage required.**

Keywords*— *Water Logged*, *Subgrade, Optimum Percentage, Tensile Strength, Dry Density

I. INTRODUCTION

Reclamation of water logged areas for pavement is increasingly popular nowadays .The water logged areas such as paddy fields which are not usable and have been unused for the past 5-8 years are increasingly rising in large plots. Water hyacinth a weed is risingly increasing in such unused paddy fields. As a result of these while cleaning large amount of these water hyacinth is obtained which creates a serious concern regarding its dumping. Now a road network through these areas is matter of concern as large amount of waste is generated in the form of water hyacinths. Through economical pavement design it helps in meeting the budgets for the road network. The quality of sub gradeis plays a crucial role in pavement design. Higher pavement thickness is been demanded in case of highways if the subgrade is of poor quality or weak and thus higher pavement construction cost. Soil stabilization is a process by which we can improve the soil characteristics & its economy. Stabilization, in a broad sense, incorporates the various methods implement for modifying the properties of a soil and improves the engineering properties and performance of soil. The pavement construction cost can be reduced to a large extent by enhancing the properties o subgrade.Using different kinds of naturally available fibers this requirement can be met to a large extent. These materials can be of wide range such as from the naturally available to synthetic.

II. SCOPE AND OBJECTIVE

In the present study, an attempt is made to study how water hyacinth, jute fibers and geogrid can be effectively utilized in combination to enhance the properties of paddy field clay.Determination of an optimum percentage of combination of different types of fiber reinorcement is the main real of the research. The limitations of roots of water hyacinth as a soil reinforcement has been overcomed by treating with bitumen. Reducing the pavement thickness in waterlogged areas also form another shade of this project as well as trying to provide a solution to the problem faced while encountering with pavements constructed over waterlogged areas.

III. MATERIALS USED

Roots of water hyacinth, bitmen, jute fiber, sand and geogrid were used or carrying out this project . Water Hyacinth root fibre used in this study has been collected from paddy field field from kizhakkambalam. The water hyacinth roots are air-dried to remove moisture from it. These fibres are coated with bitumen to protect it from the degradation. The roots of the fibres are dipped in bitumen and dried off for one day.. Jute fibers were also treated using bitumen to protect it rom being degraded. The geogrid of biaxial type was used and it was obtained from banglore.Soil Index properties of the soil are determined (Table – 1) and classification of soil is done as per Indian standard that is *IS: 1498 & IS: 2720.*

TABLE 1 INDEX PROPERTIES OF SOIL

Colour	brown
Liquid limit	48 %
Plastic limit	38 %
Plasticity index	10 %
Soil type	CI
Specific gravity	2.3
Dry density	17 kn/m^3
Optimum moisture content	20 %

IV. TEST PROCEDURE

Inorder to obtain Maximum dry density, optimum moisture content, unconfined compressive strength and cbr value proctor compaction test,unconfined compression test and CBR test were carried out. Soil samples for both reinforced and unreinforced types were carried out to differentiate and to draw results.

A.Proctor Compaction Test

Modify Proctor compaction test is performed to find out the optimum moisture content (OMC) and maximum dry density (MDD) as per ASTMD-1557.The test were conducted for water hyacinth and jute fibres at different percentages with 0.25% ,0.5%, 0.75%,1% and 1.25%. Initially the test is been carried out for water hyacinth roots as fibers and the optimum percentage required is found out. Further with the optimum percentge of water hyacinth roots fiber compaction test was carried out for different percentages of jute fiber with 0.25%, 0.5%, 0.75%, 1%and 1.25%. For any fiber content percentage above 1.25% is not physically possible to carry out as there is a difficulty faced during the mixing of soil-fiber as well as these fibers forms lumps together resulting in pockets of low density.

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B. California Bearing Ratio Test

CBR test were carried as per the standard procedure IS: 2720-XVI.Soaked test were conducted to test for subgrade properties and 4 days soaking was adopted.Corresponding to the plunger penetration of 2.5mm and 5mm CBR values were noted down. The test were carried out for first with different percentage of water hyacinth roots as fiber followed. After attaining the optimum percentage of water hyacinth root fiber , with this optimum percentage of water hyacinth roots fiber as constant further test was carried out on different percentage of jute fibers. Once the optimum percentage required for the combination of fiber is obtained the CBR test is carried out with soil mixed with the optimum percentage of water hyacinth and jute fibers and it is compacted in cbr mould and beore testing a layer of sand of 10mm is placed followed by layer of geogrid on top .

C. UCC Test

Unconfined compressive test were conducted according to (IS 2720 Part X-1919) in paddy clay with the corresponding fiber percentages to determine the unconfined compressive strength. Clay sample is prepared with the corresponding OMC of the particular fiber percentage. Prepared clay sample is first put in the mould to 3/ 4th length of the mould and the fiber weighing to the corresponding percent is placed and the rest of the sample is put in the mould. The load is applied and the undrained strength is obtained.

V . TEST RESULTS AND DISCUSSIONS

Based on the test conducted jute,water hyacinth and geogrid following inferences can be drawn with respect to each of the cases considered.

A. Effect of water hyacinth root fibres on MDD

The maximum dry density is found to increase with the increasing percentage of fiber content up to 0.25 %. There is a gradual fall in maximum dry density thereafter. It has been observed that even with a sigle fiber being added itself increased the maximum dry density to about 2.35% with respect to unreinforced.

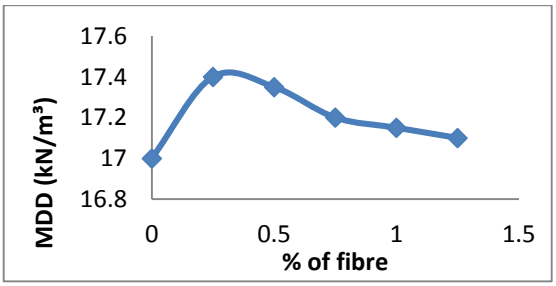

Fig. 1 MDD variation of Paddy clay

B. Influence of water hyacinth root fibres on ucc strength

The axial stress is found to increase till 0.5% of the fiber after that there is a gradual fall. Unconfined compressive strength on soil is found to increase to 25% when compared to unreinforced.

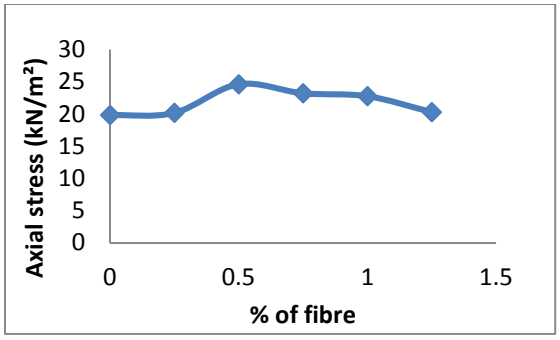

Fig. 2 % of fiber versus axial stress

C. Influence of water hyacinth root fibres on cbr test

The soil is tested for different percentage of fiber content , from which it was founded that 0.75% as optimum percentage of combination of fiber content. The cbr value obtained at optimum percentage is 56% greater than that o unreinforced .

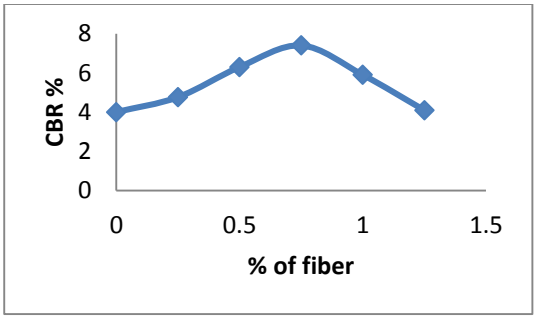

Fig. 3 % of fiber versus CBR value

D. Effect of water hyacinth root and jute fibres on mdd

With increase in the combination of fibers the maximum dry density is found to increase with increase in fiber percentage up to 0.25% and thereafter a gradual decease in maximum dry density. For the combination of fibers 0.25% is the optimum percentage.

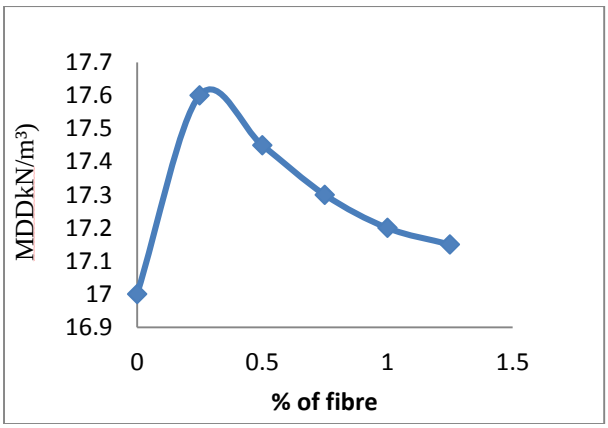

Fig. 4 MDD variation of Paddy clay

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E. Influence of water hyacinth root and jute fibres on ucc strength

The UCC strength of soil is found to be increased with the increase in percentage of fiber up to 0.75%. Therefore from this the optimum percentage can be taken for the combination as 0.75%.

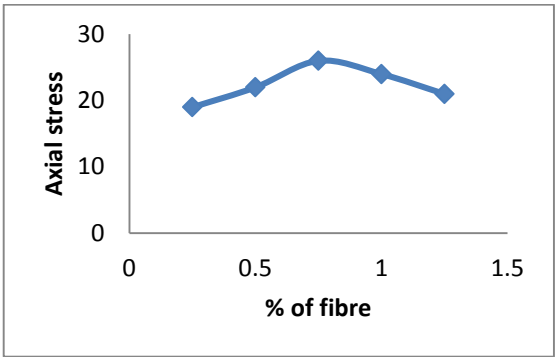

Fig. 5 % of fiber versus axial stress

F. Influence of water hyacinth root and jute fibres on cbr test

The optimum percentage of fiber is about 0.5% where there is a maximum increase in the CBR value . There is an overall increase of 75 % in cbr value for soil reinforced with 0.5% with respect to unreinforced soil.

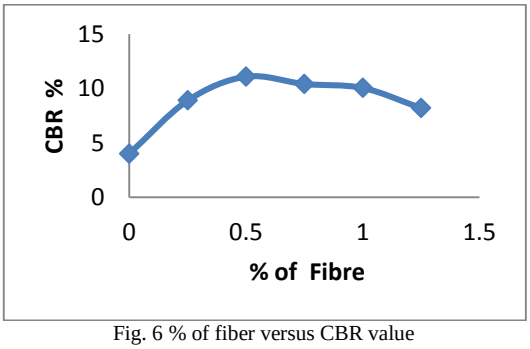

Fig. 6 % of fiber versus CBR value

G. Influence of water hyacinth root, jute fibres and geogrid on cbr test

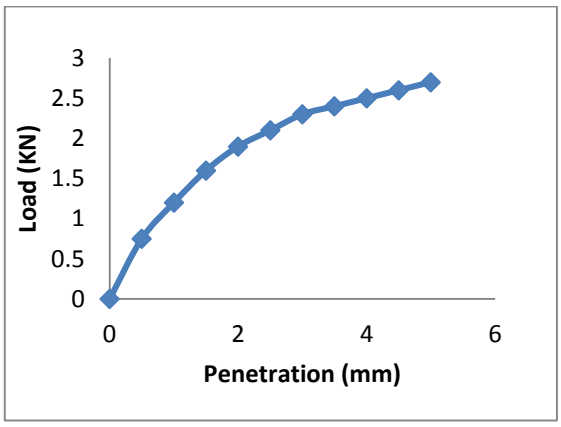

Fig.7 Load- penetration graph

From the cbr test conducted it has been found that the cbr value increased by 145% when it was reinforced using geogrid inaddition to water hyacinth and jute fibers.

V I.CONCLUSIONS

It can be inferred that with the addition of different types of fibre the overall percentage required in reinforcement is less. Using a combination of reinforcements helps in minimising the drawbacks of each fiber type and the dependence on a particular type of fiber. With the combination of water hyacinth roots and jute as fiber the MDD was observed to be maximum at 0.25% of fiber content jute and 0.25% water hyacinth roots as fiber so total of 0.5 % fiber content the MDD is maximum. The unconined compressive strength was observed to be at maximum at 0.5% water hyacinthroots as fiber content. In case of ucc test results of water hyacinth and jute as combined fiber showed 0.75% fiber content as optimum percentage.CBR value increased by 144%with the addition of geogrid when placed as asingle layer. It can be drawn that 0.75% of water hyacinth and jute fiber as optimum percentage of natural fiber reinforcement with a single layer of geogrid placed on top.

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