Utilization of Jute Fibre in Soil reinforcement, A Review

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Abstract - The stability of any pavement depends upon the stability of its subgrade soil. Subgrade governs the performance, life span and effectiveness of the pavement. The entire load coming over the pavement is ultimately borne by the subgrade. Soil is a base of structure, which actually supports the structure from beneath and distributes the load effectively. If the stability of the soil is not adequate then failure of structure occurs in form of settlement, cracks etc. In this study the soil samples were prepared at its maximum dry density corresponding to optimum moisture content in the CBR mould with and without reinforcement. Standard size of moulds have been used. From the laboratory tests the effect of jute fiber content on density of soil (optimum moisture content and maximum dry density) was observed for each length and diameter of jute fiber. The California Bearing Ratio test was conducted on all the samples and the results have been presented.

Key-words - California Bearing Ratio, Subgrade, Jute fibre, SPT, Tri-axial etc.

Objective - To Study the effect of jute fiber in soil reinforcement.

Introduction

Subgrade is the lowest layer of the pavement. It takes all the loads of the pavement as well as the loads coming on the pavement. So, it should possess sufficient stability under adverse climatic and loading conditions. The defects in black top pavement surface like rutting, corrugation, etc. are generally attributed to poor subgrade. Thus the stability of the pavement depends upon the stability of the subgrade and it is done with soil stabilization. In order to enhance the engineering properties, soil can be reinforced using jute fibre. Jute fibre is preferable because of its better durability, high tensile strength and capacity to withstand rotting and heat, porous texture which gives it good drainage and filtration properties. Poor natural soils make them practically unsuitable for many civil engineering construction activities including road pavements. In such cases natural soils are being treated with different kinds of materials to improve their engineering properties. The fiber-reinforced soil behaves as a composite material. When loaded, the fibers mobilize tensile resistance, which in turn imparts greater strength to the soil. Use of natural or synthetic fibers in geotechnical engineering has been in the construction of pavement layers, road and railway embankments, and retaining walls as well as in the protection of slopes.

Materials and Tests:-

Jute:- Jute is economical and easily available in the market. Jute bags are locally available in the market. Jute bags were cut in desired shape with an average overall thickness of 2mm and about 0.4% and 0.8% by weight of soil for 2-layer and 4-layer jute reinforcement as shown below:

Jute-Fibre

California Bearing Test:- The California bearing ratio indicates the bearing resistance of soil. After knowing the OMC the optimum water quantity is mixed in oven-dried soil. The soil Is compacted in 5-layers with 56 blows on each layer. Sample is soaked in water for 96 hours for worst moisture condition. The soil is then tested on CBR machine in which load and penetration are recorded. The loads corresponding to 2.5mm and 5mm penetration is taken and CBR values are obtained. The same process is repeated on specimen reinforced with Jute reinforcement in 2-layers and 4-layers and corresponding change in values is noted.

Standard proctor test:-Standard proctor covers the determination of the relationship between the moisture content and density of soils. The standard proctor test was performed in accordance with IS 2720 (Part VII) on fine sand. In this test, a standard mould of

100 mm internal diameter and an effective height of 127.3 mm, with a capacity of 1000 ml are used. The mould had a detachable base plate and a removable collar of 50 mm height at its top. The soil was compacted in the mould in 3 equal layers; each layer was given 25 blows of 2.6 kg rammer falling through a height of 310 mm.

Review of Literature

Yagya Sharma(2017):- Determine the jute geo textile as soil reinforcement or soil stabilizer. This analysis discusses the potential of fine sand stabilization with jute is cut into approximately 20mm lengths as admixture.The varying percentage 0.5%, 1%, 1.5%, 2% of jute pieces of jute geotextile were mixed with fine sand of different densities and moisture content. All the Unconfined Compressive Strength Tests were conducted at different mix compositions of square pieces of plastic waste and fine sand of different dry densities as arrived from Standard Proctor Test.It is determined that the stabilization of fine sand using 20mm pieces of jute as admixture improves the strength characteristics of the fine sand so that it becomes usable as construction of embankment.

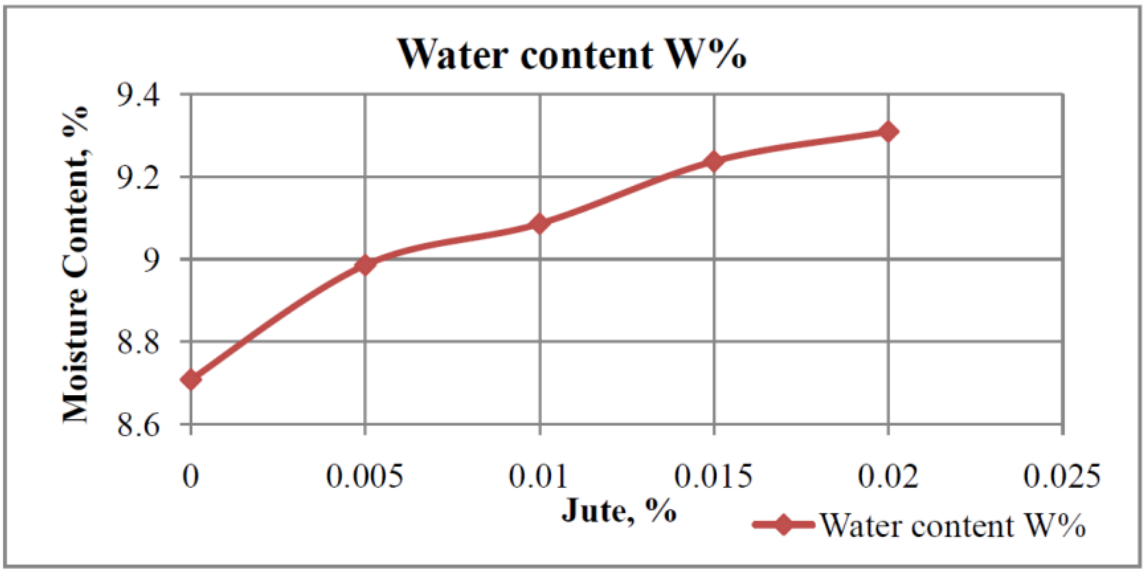

Figure 4: Moisture Content v/s Jute % Curve

Anzar Hamid(2017): Concluded that CBR value of soil increases with the inclusion of jute fibre. When the jute fibre content is increased, the CBR value of soil further increases and this increase is remarkable at fibre content of 0.75%. It is also concluded that there is significant effects of length of fiber on the CBR value of soil. The CBR value of soil also increases with the increase in length of fibre. The maximum increase in CBR value was found to be more than 200 % over that of plain soil at fiber content of 0.75% for fiber having diameter 2 mm and length 90 mm. It has been concluded that reinforcement of soil using jute-geotextile is economically advantageous as it is cheap and locally available material. Compared to existing methods of soil reinforcement which have practical difficulties in the field, the application of jute-geotextile is easier.

Bairagi, (2014): Studied the Effect of jute fibers on engineering characteristics of black cotton soil and gave result that CBR and UCS values of soil were increased significantly when mixed with jute fiber from 0% to 5%.

Jagan, (2016):- Conducted a case study on a critical review on applications of natural jute fibers and concluded that the cbr value of soil was increased after mixing the jute fiber in soil.

Amit Kumar(2016):- Determine the jute reinforcement is found to be very much effective for stabilizing the expansive soil as the CBR values of the soil were improved. The changes observed in the soil after reinforcement is remarkable. The OMC of the soil was decreased from 19.54% to 15.98%. The MDD was increased at 2-layer reinforcement from 1.698 g/cc to 1.74 g/cc and after the 4-layer reinforcement of jute layer, the MDD was seen to be reduced to 1.72 g/cc. The CBR values were enhanced as the CBR value of natural sample was 2.67% and after 2-layer reinforcement of jute layer the improvement in CBR value was improved to 6.07% and when the jute layer reinforcement was increased to 4-layers the tremendous CBR value of 11.85% was obtained. Thus it can be concluded that maximum improvement was seen in 4-layer reinforcement of jute layer in soil.

Md. Akhtar Hossain(2015): Determines the Jute fiber reinforcement reduces the maximum dry density and increases the optimum moisture content of the subgrade soil for each aspect ratio and The CBR value of soil increases when the aspect ratio decreases for same percentage of jute fiber.

Methodology

The soil sample is tested for different tests listed below:

- Sieve Analysis
- Pycnometer test for Specific Gravity
- Liquid Limit
- Plastic Limit
- Standard Proctor Test
- CBR test

Conclusion

On the basis of existing review of literature it can be concluded that the Jute fiber reinforcement reduces the maximum dry density and increases the optimum moisture content of the subgrade soil for each aspect ratio and the CBR value of soil increases when the aspect ratio decreases. The CBR value of soil also increases with the increase in length of fibre. The maximum increase in CBR value was found to be more than 200 % over that of plain soil at fiber content of 0.75% for fiber having diameter 2 mm and length 90 mm.

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