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Influence in CBR of Expansive Soil with Jute Fiber Reinforcement

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Abstract: ***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. Expansive soil also known as black cotton soil is more responsible for such situations and this is due to presence of montmorillonite mineral in it, which has ability to undergo large swelling and shrinkage. To overcome this, properties of soil must be improved by artificial means. Soil reinforcement technique is one of the most populartechniques used for improvement of poor soils. The improvement of sub-grade has always been significant aspect in highway and geotechnical engineering fields. To strengthen the subgrade soil, the use of natural Jute fiber is advantageous because they are cheap, locally available, and biodegradable. In this paper the soil sample was compacted at its maximum dry density corresponding to its optimum moisture content in the Laboratory California Bearing Ratio (CBR) mould with and without natural Jute fiber. Natural Jute fiber sheets equal to the plan of CBR mould diameter were placed at various layers to investigate its behaviour on CBR value.***

Keywords: Jute Geotextile Sheet, Geotextile Reinforcement, Expansive soil, Stabilization, CBR, Strength of soil

1. Introduction

Soil improvement is of major concern in the construction activities due to rapid growth of urbanization and industrialization. The term soil improvement is used for the techniques which improve the index properties and other engineering characteristic of weak and soft soils. Infrastructure development roads, bridges etc on expansive soil is a challenging job for Civil engineers due to its swelling and shrinkage nature in wet and dry conditions respectively. 25 percent of total area in India is covered by black cotton soils. Due to changes in moisture content, these types of soils exhibit much variation in swelling, compressibility and result in failure of structure. Hence, there is a need for soil improvement by using Jute Geotextile, in which we can use locally available weaker soil. The primary purpose of reinforcing a soil mass is to improve its stability by increasing its bearing capacity, and by reducing settlement and lateral deformation. 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.

2. Literature Review

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%. **Choudhary et al, (2012)** studied the improvement in CBR of expansive soil with a single Jute reinforcement layer and gave results that reinforcement in layer controls swelling and enhances CBR value. **Singh, (2013)** conducted work on strength and stiffness of soil reinforced with jute geotextile sheets and concluded that there is increase in shear strength of soil with inclusion of jute in soil. **Pandit et al, (2016)** conducted experimental work on Effects of Jute Fiber on Compaction Test and concluded that OMC of soil increases upto 1.25% of jute fibres and then decreases for 1.50%. MDD decreases upto 1.25 % of jute fibre and then increases for 1.50%. **Hamid (2017),** Subgrade Soil Stabilization Using Jute Fibre as a Reinforcing Material.

3. Materials Used

- Soil
- Jute fibres

Soil

The soil used in the investigation was the natural soil collected from Pushpak Nagar area of Bhilai. The soil sample was collected from a depth of 70 cm after removing the top surface soil from natural ground surface.

Jute Fibres

The Jute fiber sheets (woven type) taken from the Jute bag, were procured from the local market. The average thickness of the sheet was 2.0 mm. Figure shows a view photograph of the Jute fiber sheet.

4. Methodology

The soil sample is tested for different tests listed below:

- SieveAnalysis
- Pycnometer test for SpecificGravity

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- LiquidLimit
- PlasticLimit
- DFS
- Modified ProctorTest
- CBRtest

The sample was tested as listed above and values obtained are shown in table-1. After the tests on Natural Soil Specimen Modified Proctor Test and CBR test were again conducted on soil specimen reinforced with 2-Layer and 4-Layer respectively

A series of proctor compaction tests and California Bearing Ratio tests have been carried out on soil mixed with jute fiber. The detailed procedure and results are as under.

A. Proctor Compaction Test:

To assess maximum dry density (MDD) and optimum moisture content (OMC) Standard Proctor compaction test is performed as per IS 2720: Part VII: 1980. The soil sample is oven-dried at 105oC for 24 hours. Soil passing from 4.75mm sieve is taken and kept in the mould having volume 2250 cc. The MDD is determined and water content corresponding to MDD is taken as OMC. The test is again repeated on 2-layer and 4- layer reinforced sample to observe the change in corresponding values.

B. California Bearing Ratio Test

A series of California bearing ratio (CBR) tests were performed on the soil without jute fiber reinforcement and with different proportion of jute fiber based on the standard proctor test results. It is the ratio of force per unit area required to penetrate in to a soil mass with a circular plunger of 50mm diameter at the rate of 1.25mm /min.

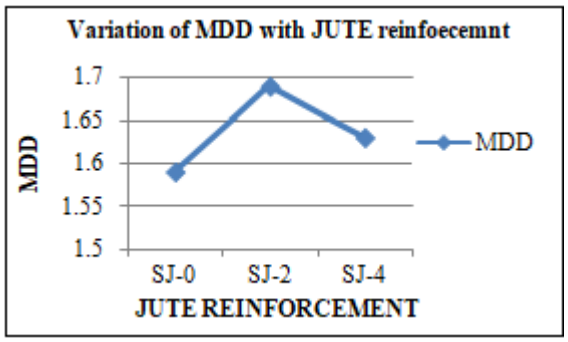
5. Results and Discussion

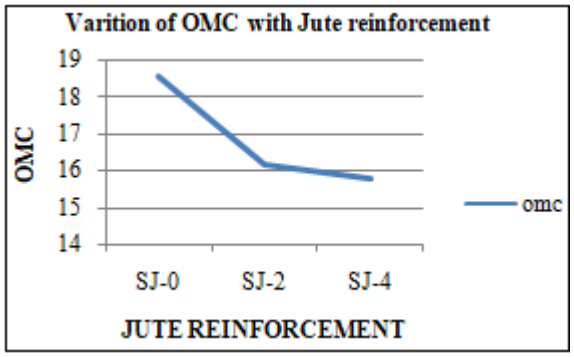
The dry density and CBR properties of soil are improved. The maximum improvement is seen in 4- layers of reinforcement. The results are tabulated below:

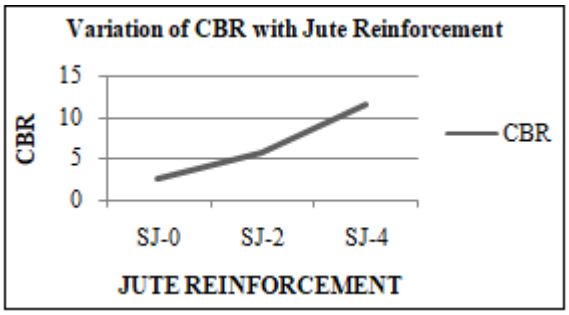
Sno.	Experiment	SJ-0	SJ-2	SJ-4
1	MDD (g/cc)	1.59	1.69	1.72
2	OMC (%)	18.54	16.14	15.78
3	CBR (%)	2.5	5.65	11.70

SJ-0 = Soil sample with no reinforcement
SJ-2= Soil sample with 2-layer jute reinforcement
SJ-4= Soil sample with 4-Layer jute reinforcement

The above results indicate that the MDD (Maximum Dry Density) of the soil is maximum in 2-Layer reinforcement and there is a slight decrease in 4- layer sample. The OMC (Optimum Moisture Content) is reduced from 18.54% to 15.78%. The CBR (California Bearing Ratio) is improved from 2.5% to 11.7%. The CBR value obtained is maximum in 4- Layer reinforcement in soil sample.







6. Conclusions

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 18.54% to 15.78%. The MDD was increased at 2- layer reinforcement from 1.59 g/cc to 1.69 g/cc and after the 4-layer reinforcement of jute layer, the MDD was seen to be reduced to 1.63 g/cc. The CBR values were enhanced as the CBR value of natural sample was 2.5% and after 2-layer reinforcement of jute layer the improvement in CBR value was improved to 5.65% and when the jute layer reinforcement was increased to 4-layers the tremendous CBR value of 11.7% was obtained. Thus it can be concluded that maximum improvement was seen in 4-layer reinforcement of jute layer in soil.

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