International Journal of Advance Research in Science and Engineering
Vol. No.6, Issue No. 03 , March 2017
www.ijarse.com
IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

SUBGRADE IMPROVEMENT OF CLAYEY SOIL WITH THE USE OF GEOTEXTILES

[1]Soma Prashanth Kumar, [2]Mohammed Asif T L,
[3]Mane S R Rohith

[1] Assistant Professor, Department of Civil Engineering, JBIET, Moinabad, (India)
[2] Assistant Professor, Department of Civil Engineering, JBIET, Moinabad, (India)
[3] Assistant Professor, Department of Civil Engineering, ASTRA Bandlaguda (India)

ABSTRACT

Poor sub grade soil conditions can result in inadequate pavement support, reduce pavement life and araises different pavement distresses especially expansive soil (Black cotton soil) is very weak and does not have enough stability for any type of construction work. This is accomplished by ground improvement methods, which are employed to improve the quality of soil incompetent in their natural state. To make the subgrade soil stable, by improving its engineering properties is very essential. This paper examined the basic engineering and geotechnical properties of poor subgrade soils using geosynthetics like geo-textiles to improve its strength. A geotextile inserted between the base material and sub grade can function as reinforcement having specific tensile strength, a filter medium, a water permeability, a separation layer and as a drainage medium.

The tests conducted for identification and classification of selected soil sample are Particle size distribution by wet sieve analysis, Consistency limits, Proctor compaction test, Free swell index, specific gravity test. An extensive field investigation was carried out to determine the properties of subgrade soils treated with geotextiles in pavements. The performance of two different types of geotextiles (H2M8, H2M9) placed at a depth of 0.2H from top of soil reinforced subgrade was studied by conducting California Bearing Ratio (CBR) tests to evaluate strength properties. It is found that H2M8 showed higher CBR value than.This paper will give tha advance method how to improve the strength of subgrade by using geotextiles. It improves the CBR value and thus reduces the pavement thickness.

Index Terms-Subgrade strength, Geosynthetics, Reinforcement, Geotextiles, CBR test, Aggregate.

I. INTRODUCTION

The main function of soils in transportation infrastructure is to form the construction material for the subgrade built on top of the natural ground. The long-term performance of a pavement depends to a very large extent on the properties of the subgrade soil. Unstable and weak soils especially black cotton soil may cause significant problems to the overlying pavement. Many usual forms of pavement distresses like cracking, depression, transverse and longitudinal unevenness, lane/shoulder dropoff, permanent deformation are due to the

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

inadequacy of subgrade strength, which may not meet the design requirements. There are typically two mechanisms to improve the subgrade. One simply consists of the replacement of weak soil by stronge adequate subgrade soil, and the other one is ground improvement techniques of the soil. One of the innovative ground improvement techniques practised all over the world is the use of geosynthetics, which include geotextiles, geomembranes, geogrids, etc. They offer the advantages such as space saving, enviromnental sensitivity, material availability, technical superiority, higher cost savings, less construction time, etc.

Geosynthetics have been found to be a cost effective alternative to improve poor sub-soils in adverse locations, especially in situations where there may be non-uniform quality and/or non-availability of desired soils with applications in almost all geotechnical engineering projects such as airport and highway pavements. Though polymeric geotextiles are used in abundant quantities due to their properties like environmental friendly and ecologically compatible as it gets degraded with the soil, the use of natural geotextiles (like coir, jute, etc.) especially Coir geotextiles are best suited for low cost applications because of its availability at low prices compared to its synthetic counterparts. Geotextiles must have the ability to provide reinforcement action and thus increases the subgrade soil strength. Also the geotextiles improves the CBR value and thus reduces the pavement thickness. This paper highlights the improvement in CBR properties of subgrade soil with using of coir geotextiles. Black cotton soils having high swelling and shrinkage properties as subgrade are showing lesser strength when they are immersed/flooded. This problem can be addressed by reinforcing the subgrade with proper coir geotextile at proper depth. The objectives of present paper are to develop a methodology of using coir as geotextile for the protection of subgrade and soil structures in low lying areas with soft clay and under water logged conditions. And to Compare the performance of H2M8 and H2M9 coir geotextile as a soil stabilizing material by Placing the optimum position (i.e., 0.2H depth) of coir geotextile in a soil subgrade.

II LITERATURE REVIEW

Moayed and Nazari (2011) investigated the effect of geogrid and geotextile in reduction of the required thickness of subbase layer in unpaved roads is studied. The properties of the non-woven geotextile namely F-300 and the geogrid namely CE-161. The size of the geotextile and the geogrid used was 152.4 mm in diameter. To study the behavior of two layered soil (granular subbase overlying cohesive subgrade), with geosynthetic reinforcing at the interface, and to investigate the different performance of geotextile and geogrid inclusion on reducing the required subbase layer thickness to achieve to a satisfactory bearing ratio, a series of bearing ratio tests conducted in both unreinforced and reinforced conditions. Three different thicknesses (40 mm, 55 mm and 70 mm) spotted for subbase layer in this study according to subbase layer thickness at full scale field.

Babu (2008) carried out various test by means of using three varieties of coir two woven type and one non-woven type are placed subgrade of two types red earth and silty soil. The plate load tests were done as per Indian standard test procedure. For type one red soil it is found that the control section without coir Geotextile reinforcement can sustain a load of 7.7 kN for a deformation of 20 mm. But when coir reinforcements were introduced at the interface of subgrade and subbase, this load was increased to 10.5 kN, 13.0 kN, and 13.50 kN respectively for H2M6, Non Woven and H2M8. At greater deformations the percentage increases are still

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

higher. Also, it is to be noted that the variations in load carrying capacity of unpaved sections are almost identical for H2M8 and Non-Woven coir geotextile reinforcements.

Michael and Vinod (2009) investigated the beneficial use of different varieties of coir geotextiles as reinforcing material in subgrade. Soaked California Bearing Ratio tests were conducted on reinforced and unreinforced soil and the effects of placement position and stiffness of geotextile on the performance of reinforced sections were examined, by using five different types of geotextiles. CBR tests were conducted on samples reinforced with varieties of coir geotextiles. The properties of the materials used for the experimental investigation are Lateritic soil and Coir geotextiles. Three varieties of woven coir geotextile and two varieties of knotted coir geotextile were used. Strength of each soil layer of a pavement and to investigate effectiveness of coir geotextile in improving the CBR value of the subgrade, a series of CBR tests were done. CBR tests were done for five different types of geotextiles by placing the coir geotextile at various depths of 0.2H, 0.4H, 0.6H and 0.8H, where H is the height of the specimen (=12.5cm). He found that the inclusion of coir geotextile in soils improves the California Bearing Ratio of lateritic soils. The geotextiles-reinforced soils in unpaved roads will perform better than unreinforced ones and therefore increase load carrying capacity of soils.

III METHODOLOGY

TENSILE STRENGTH TEST ON COIR GEOTEXTILE

Tensile strength test was carried out in the laboratory for the two grades (H2M8, H2M9) of untreated coir geotextiles results showed below.

H2M8	9.13 KN/m
H2M9	10.94 KN/m

The following tests were conducted to determine the physical properties of the soil sample as per BIS specifications.

The following tests conducted for identification and classification of soil.

- Particle size distribution by wet sieve analysis
- Consistency limits
- Proctor compaction test
- Free swell index
- Specific gravity test

TABLE 1 Physical properties of soil sample

The results of the test were shown in the Table 1.

soil	Grain size analysis (%)			Consistency limits (%)			Procter compaction test		Free swell index (%)	Specific gravity
	clay	Silt	sand	WL	PL	PI	OMC (%)	MDD (kg/m3)		
Black cotton	61	26	13	49	27	22	16	1450	21	2.48

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

CBR TESTS

CBR tests were done for two different grades of coir geotextiles by placing the coir geotextile at a depth of 0.2H where H is the height of the specimen (12.5cm) Required quantity of water i.e., OMC is added to the dry soil and compacted in layers upto 0.8H over the compacted soil,coir mats were placed and remaining soil was added to make up till the height prior to compaction. After compaction, place the four different moulds for different curing periods and test the mould on each day. After soaking the specimens, they were placed under the plunger CBR test frame. Results of CBR values of unreinforced and reinforced with geotextiles at a depth of 0.8H are summerised in table 2.

Soaking time	CBR (%)		
	Unreinforced soil	Soil reinforced with geotextiles at a depth of 0.2H from top	
		H2M8	H2M9
Day 1	1.62	1.84	1.79
Day 2	1.48	1.62	1.16
Day 3	1.31	1.48	1.17
Day 4	0.85	0.97	0.72

TABLE 2 CBR values of unreinforced and reinforced with geotextiles placing at a depth of 0.2H from top.

From the above Table 2, it was observed that among the two grades of coir geotextile, H2M8 shows maximum value of 1.84% compared to the H2M9 value of 1.79% and there is a decrease in the CBR value with increasing soaking time from 1 to 4 days for both grades of coir as well as unreinforced soil.

IV RESULTS AND DISCUSSION

Figure1 shows the variation in CBR values of unreinforced and reinforced with two grades of coir geotextiles (H2M8, H2M9) placed at a depth of 0.2H from top of subgrade soil after soaking periods of 1, 2, 3, and 4 days. Figure1 showing soaking period on X axis and CBR values on Y axis.

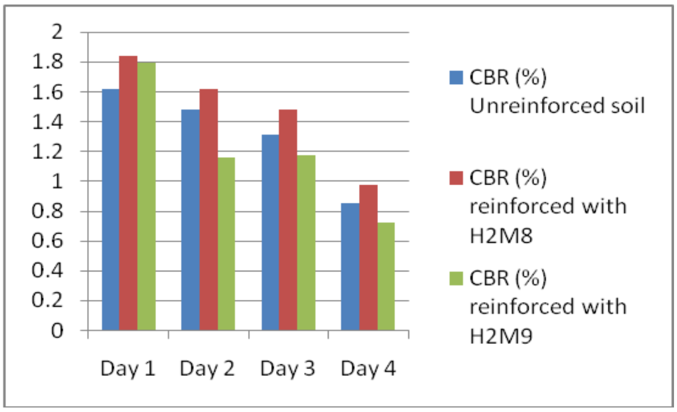

FIGURE1: variation in CBR values of unreinforced and reinforced with two grades of coir geotextiles (H2M8, H2M9) placed at a depth of 0.2H from top

IJARSE
ISSN (O) 2319 - 8354
ISSN (P) 2319 - 8346

From the Figure1, it was observed that on first day the CBR value shows a maximum value of 1.62%, 1.84%, and 1.79% for untreated and trated with H2M8 and H2M9 respectively. But there is a gradual decrease in the CBR values with increasing soaking time resulting a minimum value of 0.85%, 0.97%, 0.72% on the 4th days. The decreasing in CBR strength values for BC soils due to increasing soaking time is due to continuous swelling of BC soils.

This paper shows the results obtained from the tensile strength test, CBR tests and the effect of coir geotextile in the reinforcement of subgrade. It also brings out the comparison between the two grades of coir geotextile and its strength characteristics. Finally it comes to know that H2M8 grade of coir geotextile occupies more CBR value compared to the H2M9 grade of coir geotextile.

V CONCLUSIONS AND RECOMMENDATIONS

The study investigated the application of geotextiles to subgrade material as a form of reinforcement to road construction. The inclusion of the geo-textiles considerably increases the strength of poor soils, which is reflected in the higher CBR values. The study shows that the strength of the subgrade is significantly altered positively.

The selected Black Cotton soil exhibits 21% swelling Index, the maximum dry density is 1450 kg/m3 and the OMC is 16 %. The subgrade strength is decreasing with increasing soaking periods due to the swelling property of Black cotton soils for unreinforced and reinforced soils. Black cotton soils reinforced with H2M8 coir geotextile yield higher CBR values as compared the soils reinforced with H2M9 coir mats. The maximum CBR improved from 1.62% to 1.84% by using H2M8 geotextiles placing at a depth of 0.2H from top of soil. The maximum CBR improved from 1.62% to 1.79% by using H2M9 geotextiles placing at a depth of 0.2H from top of soil.

The use of geotextiles as reinforcement to poor soils improves its strength. It is non-bio degradable and therefore durable; it also increases the ultimate service life of the pavement. The use of Geotextiles should therefore be encouraged as an effective and modern form of improving road construction on poor sub grade materials. Further research should be analyzed in ascertaining the effect of geotextiles on subgrade soils under under soaked condition.

REFERENCES

[1] ASTM D1777 and D3776, (2001). "*Standard Test Method for Thickness of Textile Materials, fabric, thickness, Mass per unit area".*

[2] Ramanatha Ayyar, T. S. (2002), "*Comprehensive Reference Book on Coir Geotextiles"*, Centre for Development of Coir Technology.

[3] Sarsby, R.W., 2007. *"Use of „Limited Life Geotextiles" (LLGs) for basal reinforcement of embankments built on soft clay"*. Geotextiles and Geomembranes 25 (4–5), 302 310.

[4] Schurholz, H., "*Use of woven coir geotextiles in Europe"*, Coir, 35(2), 18-25, 1991.

[5] T.S. Ayyar, C. G. Ramachandran Nair and N. Balakrishnan Nair (2002), "*Comprehensive Reference Book on Coir Geotextiles"*, Centre for Development of Coir Technology (CDOCT).

[6] Venkatappa Rao, G and Dutta, R.K.,*"Coir products in unpaved roads –a comparative study"* Proc. International Conference on Structural and Road Transportation Engineering, Kharagpur, 2005, pg 533-541.

[7] Giroud, J.P. and Noiray, L. (1981) "Geotextile reinforced unpaved road design", *Journal of Geotechnical Engineering Division,* ASCE, 107, 1233 - 1254.