IJARSCT

ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

Impact Factor: 5.731

Volume 10, Issue 1, October 2021

Ground Improvement By Using Coir Geo-Textile

R. A. Joshia Issac[1], A. Bharathu[2] and Dr. K. Ramadevi[3]

First Year PG Students, Department of Construction Management[1,2]

Assistant Professor, Department of Construction Management[3]

Kumaraguru College of Technology, Coimbatore, Tamil Nadu, India

Abstract: *For the design of pavement structure the subgrade soil and its properties are important as it gives adequate support to the pavement. To increase the life of pavement the subgrade must be able to support loads transmitted from pavement structure without excessive deformation under adverse climatic and traffic conditions. For using the soil as a good quality pavement material, it is a well-known fact that all soils do not possess all the desirable qualities. The subgrade performance of such soils should be increased by several modification techniques, when such soils cannot be replaced. Among that providing reinforcement to improve subgrade soil nowadays is widely adopted. Nowadays many reinforcing techniques are used to reinforce the soil, among that coir geotextile is most widely used. As it is a natural geotextile it needs treatment to improve the durability. In this study woven coir geotextile are used as soil reinforcement to improve the subgrade soil. The improvement in CBR value when coir geotextile placed at different depth in CBR mould is studied. The coir geocells with an aspect ratio of 0.75, 1 and 1.33 is used. The maximum improvement in CBR value is obtained when geotextile is placed at 1/3H. The CBR value improved when treated coir geotextile is used and the percentage improvement is 66.8% for coir geotextiles placed 1/3H and the percentage increase for treated coir geocells when placed at 1/3H is 37.5%. The optimum height of coir geocells is obtained at an aspect ratio of 1.*

Keywords: Subgrade, Ground Improvement, Coir Geo-Textile, CBR Test

I. INTRODUCTION

Coir geotextile, a natural geotextile manufactures out of coir fibres, has been recognized as a feasible alternative to geosynthetics for reinforcement applications, due to its longevity and excellent engineering properties. It is best suited for low-cost applications in developing countries due to its availability at low prices compared to its synthetic counterparts. The results indicate that bearing characteristics clearly depend on the form in which reinforcements are applied. Coir helps in slope stabilization and also in embankment and stream bank stabilization. It acts as effective erosion and sediment control.

India has one of the largest road networks in the world, aggregating to about 33 lakh km at present. However, many of the existing roads are becoming structurally inadequate because of the rapid growth in traffic volume and axle loading. At locations with adequate subgrade bearing capacity/CBR value, a layer of suitable granular material can improve the bearing capacity to carry the expected traffic load. But at sites with CBR less than 2% problems of shear failure and excessive rutting are often encountered. The ground improvement alternatives such as excavation and replacement of unsuitable material, deep compaction, chemical stabilization, preloading and polymeric geosynthetics etc are often used at such sites. The cost of these processes as well as virgin material involved is usually high and as such they are yet to be commonly used in developing nations like India.

In this context natural fibre products hold promise for rural road construction over soft clay. India is the first largest country, producing coir fibre from the husk of coconut fruit. The coir fiber (50 to 150 mm long and 0.2 to 0.6 mm diameter) till recently were spun into coir yarn and then woven to obtain woven nettings. The fibers are now a days being needle punched or adhesive bonded to obtain non-woven products or blankets. Geotextiles are proving to be cost effective alternative to traditional road construction method. Studies have indicated that the biodegradability of coir can be used to advantage, and the coir-based geotextile have the potential of being used for rural road construction over soft clay.

In paved and unpaved road construction, geosynthetic reinforcement has been applied to improve their overall strength and service life. The stabilization of pavements on soft ground with geotextiles is primarily attributed to the basic functions of separation of base course layer from subgrade soil, reinforcement of composite system etc. But these synthetic products are biodegradable and cause environment problems, whereas natural geotextile like coir is biodegradable. The report presents the results of CBR and The results of the test in the laboratory. The details of the test stretches, and the results of tests conducted in the laboratory are described in this report. Geosynthetics are Synthesized Polymeric or natural materials used to solve Coir Engineering problem. The problem of rural roads on soft soil can be solved to some extent using Geosynthetics.

Polymeric materials are polypropylene, polyethylene, nylon, polyester etc. Natural geosynthetics are produced from natural materials like coir, jute, sisal etc. The manufacturing process of geotextiles defines two key terms, the machine direction (MD) and the cross-machine direction (XD). The MD is parallel to the longitudinal (unrolled roll length) direction, likewise XD corresponds to the shorter length and transverse direction. A geotextile is similar to a fabric. It is manufactured by interweaving together numerous yarns in a close-knit pattern. The pattern is tight enough to filter sand/aggregate particles, thus an apparent opening size (AOS) typically characterizes the openings of a geotextile. A geosynthetic is affected by its surroundings or Environment. Environmental factors that contribute to the degradation of geosynthetics include UV radiation (sunlight), mechanical/physical wear, long duration loads, and temperature. For instance a polypropylene textile or grid, will creep when exposed to tensile loads. Creep is also enhanced by an increase in temperature and additionally, UV radiation in sunlight can cause serious degradation and weakening of polymer bonds. There are many applications of geosynthetics. Even within the highway application of geosynthetics, further division is necessary for clarity. Geosynthetic highway applications can be split into two areas, which are unpaved and paved roads. It is important to distinguish between the two, since different theories, physical mechanisms, design methodologies and failure criteria are utilized for each.

The coarse aggregate may be uncrushed, crushed or partially crushed gravel or stone most of which is retained on 4.75mm IS sieve. They should be hard, strong, dense, durable, clear, and free from veins and adherent coatings and free from injurious amounts of disintegrated pieces, alkali, organic matter and other deleterious substances. Flaky, coriaceous, and elongated aggregate should be avoided. The main functions of the coarse aggregate are almost same as that of fine aggregate.

II. METHODOLOGY

2.1 Material Collection

Generally in the construction of pavement the major requirement is considered for bitumen since it binds with aggregate and form a protective coat from pat holes and other effects on pavement. The common materials that have been used in the construction of pavement can be given by bitumen, coarse aggregate, and proper soil. In the coarse aggregate there are wide variety that is has been used in pavement. Normally, in the top layer chips is required for the good binding particle with the bitumen. The size of chips may be of 10mm to 12mm. In the pavement and in construction the strength usually depends upon the aggregate. The aggregate acts as a filling material as improves of the density in the construction. For improvement of pavement here by using geotextile material which will increase the CBR value and provide less thickness in layer. The geotextile that has going to be used in pavement is polyester. This polyester fabric has stiffness while laying it to the pavement. This polyester fabric is a Non-Woven type of geotextile material.

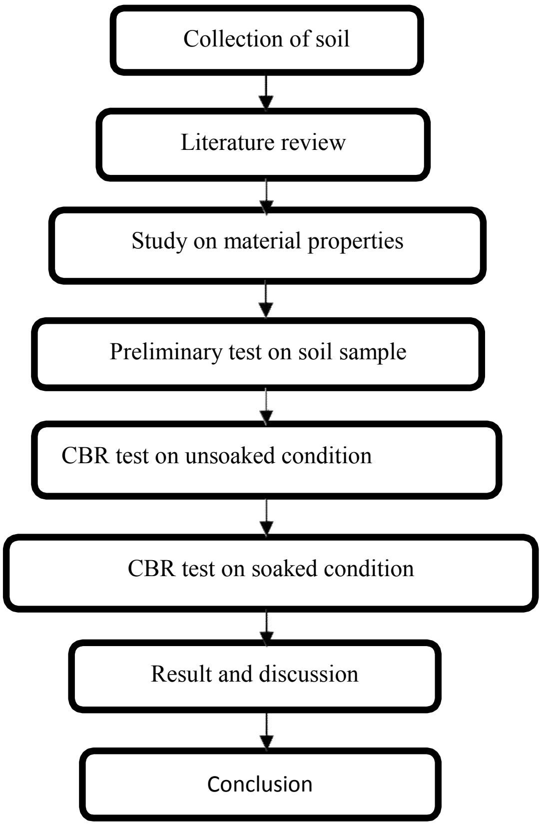
IJARSCT

ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

IJARSCT
Impact Factor: 5.731

Volume 10, Issue 1, October 2021



2.2 Material Properties

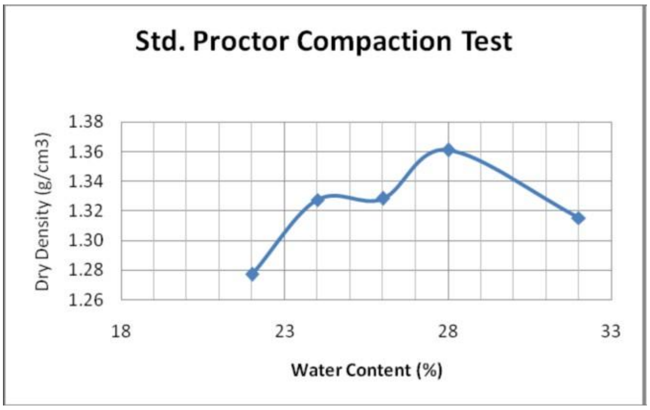
The coarse aggregate may be uncrushed, crushed or partially crushed gravel or stone most of which is retained on 4.75mm IS sieve. They should be hard, strong, dense, durable, clear, and free from veins and adherent coatings and free from injurious amounts of disintegrated pieces, alkali, organic matter and other deleterious substances. Flaky, coriaceous, and elongated aggregate should be avoided. The main functions of the coarse aggregate are almost same as that of fine aggregate.

Of all-natural fibres coir possesses the greatest tearing strength, even in very wet Conditions. Unlike most synthetic fibres, coir fibres are non-thermoplastic – that is, they do not soften when heat is applied. Coir fibre show little sensitivity to dry heat, and there is no shrinkage or high extensibility upon heating. The fibre is hygroscopic, with moisture content of 10 to 12% at 65% relative humidity and 22 to 55% at 95% relative humidity. Coir can withstand huge amount of weight and rubbing and recovers, as soon as the weight is removed from it. They are porous having a lot of air pockets to act as good insulators. Coir fibre is in demand for its toughness, strength, resistance to dampness, rot resistance, durability and natural resilience, porous, hygroscopic and biodegradable properties. They have excellent

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 10, Issue 1, October 2021
Impact Factor: 5.731

acoustic properties by virtue of its rough and rugged surface. They do not require anti UV treatment during field applications. They do not become brittle if cooled to below temperature. Their thermal recycling is also possible. Coir is renewable, recyclable and versatile. It absorbs less water. Long lasting without affected by moth, bacteria and other insects. High durable product in respect of location suitability relating to heavy duty contract. Rigid natural fibre, capable to withstand higher compressive strength.

Sample No.	Optimum Moisture content (%)	Dry Density (γd max), g/cc
sample1(bottom layer)	21	1.52
sample2 (top layer)	21	1.50
sample3	30	1.34



III. Result And Discussion

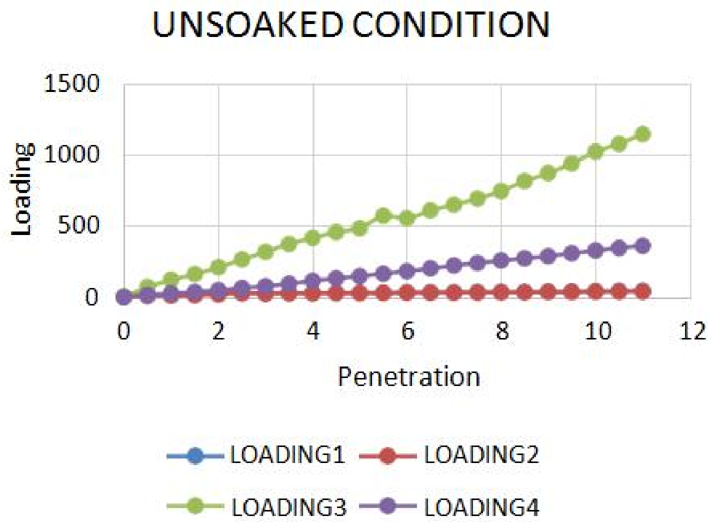
California Bearing Ratio (CBR) Test (Unsoaked Condition) was conducted for three samples. The mould was cleaned and the spacer disc was placed.

S. No	Penetration	Load1	Load2	Load3	Load4
1	0	0	0	0	0
2	0.5	12	6	69.25	12.742
3	1	15	9	119.11	23.268
4	1.5	18	12	160.66	34.902
5	2	21	18	207.75	47.644
6	2.5	24.6	30	263.15	62.602
7	3	25.2	22.8	318.55	75.898
8	3.5	26.4	24.6	373.95	92.518
9	4	27	25.2	415.5	113.57
10	4.5	27	26.4	457.05	130.19
11	5	27.6	27	484.75	146.81
12	5.5	28.8	27.6	572.45	163.984
13	6	31.2	28.2	554	181.158
14	6.5	32.4	28.8	609.4	199.994
15	7	33	30	650.95	221.6
16	7.5	33.6	30.6	692.5	239.882
17	8	34.2	31.8	747.9	255.948
18	8.5	34.8	33	817.15	272.014
19	9	36.6	33.6	872.55	288.08

IJARSCT
ISSN (Online) 2581-9429
IJARSCT
Impact Factor: 5.731
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
Volume 10, Issue 1, October 2021

20	9.5	37.8	34.8	941.8	308.024
21	10	39	36	1024.9	326.86
22	10.5	40.8	36.6	1080.3	346.25
23	11	42	37.2	1149.55	360.1

5kg of Soil sample was taken and then the water was added (OMC value from Standard proctor test). Prepared soil samples were placed in CBR mould as 5 layers and each layer was compacted with 25 blows. The mould was placed under the CBR Testing machine and then load was applied and the corresponding Penetration values were obtained.



California Bearing Ratio (CBR) Test (Soaked Condition) was conducted for three samples. The mould was cleaned and the spacer disc was placed. 5kg of Soil sample was taken and then the water was added (OMC value from Standard proctor test). Prepared soil samples were placed in CBR mould as 5 layers and each layer was compacted with 25 blows. The Sample thus prepared is kept soaked under water for 4 days. After 4 days, the mould was placed under the CBR Testing machine and then load was applied and the corresponding Penetration values were obtained. It will show the Load Vs penetration observed for the sample.

S. No	Penetration	Load 1	Load 2	Load3	Load4
1	0	0	0	0	0
2	0.5	0.5	12	5.54	18
3	1	1.5	15	11.08	32.4
4	1.5	2	18	20.775	48
5	2	2.5	21	38.78	66
6	2.5	18	24	60.94	80.4
7	3	21	24	86.424	112.8
8	3.5	24	24	114.124	139.2
9	4	27	27	146.81	174
10	4.5	30	27	182.82	216
11	5	30	27	231.018	260.4
12	5.5	33	30	274.23	306
13	6	36	30	315.78	360
14	6.5	39	33	360.1	411.6

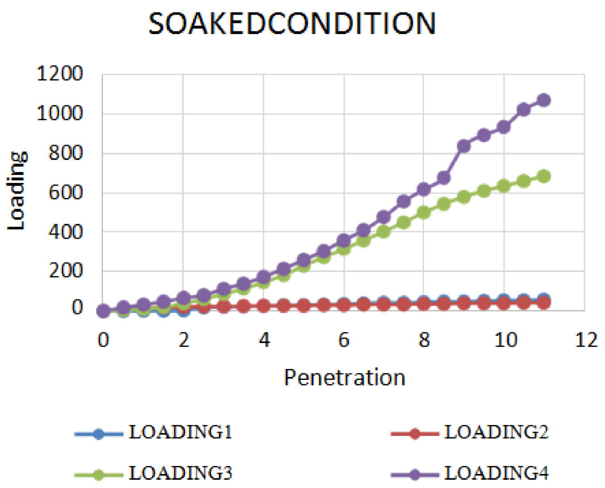
IJARSCT

ISSN (Online) 2581-9429

International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)

Impact Factor: 5.731

Volume 10, Issue 1, October 2021



			CBR TEST		
CBR TYPE	PENETRATION IN (mm)	WITHOUT G.T	ONE LAYER G.T	TWO LAYER G.T	THREE LAYER G.T
SOAKED CBR	2.5 - 5 -	1.31 1.45	0.90 1.01	4.44 11.24	2.70 5.85
UNSOAKED CBR	2.5 - 5 -	1.75 1.31	1.01 2.02	19.2 23.5	4.56 7.14

The above tabulation shows the comparison of CBR test under soaked and unsoaked condition. The CBR value of soil is found to increase with the inclusion of Geo textiles. The CBR value for reinforced soil (soaked) is found to be lower than the unreinforced Soil. There is considerable increase in the CBR value when Geo textile is anchored to the soil in two layers. The CBR value of soil with anchored Geo textile is observed to vary from 19.2% to 23.5% (un soaked) and 4.44% to 11.24% (soaked). Hence it can be concluded that there is improvement in CBR value when coir geo textile is used. It is also found that coir geo textile roads are structurally strong compared to unreinforced roads and it remains stable. Pavement design can be formulated when two layers of Coir G.T is introduced.

IV. Conclusion

The CBR value of soil is found to increase with the inclusion of Geo textiles. The CBR value for reinforced soil (soaked) is found to be lower than the unreinforced Soil. There is considerable increase in the CBR value when Geo textile is anchored to the soil in two layers. The CBR value of soil with anchored Geo textile is observed to vary from 19.2% to 23.5% (un soaked) and 4.44% to 11.24% (soaked). Hence it can be concluded that there is improvement in CBR value when coir geo textile is used. It is also found that coir geo textile roads are structurally strong compared to unreinforced roads and it remains stable. Pavement design can be formulated when two layers of Coir G.T is introduced.

4.1 Scope for further development

1. The expiry period for coir geo-textile ranges upto 5 years or more.
2. This can be increased when coir geo-textile is treated with chemicals.
3. And also, by observing the performance of it.

REFERENCES

[1]. Ajitha, B., Jayadeep, T., 1997. . "Interfacial frictional properties of geotextiles and biomats"., in: Proceedings of Indian Geotechnical Conference, Vadodara, India, Vol.1, pp. 287-290.

[2]. Anderson, P., Killeavy, M., 1989. "Geotextiles and geogrids-cost effective alternate materials for pavement design and construction" In: Geosynthetics'89, San Diego, USA, vol. 2, 353-364

[3]. Babu, K.K., Beena, K.S., Raji, A.K., 2008."Design of Coir Geotextile reinforced Road using IRC method". Highway Research Journal, Special Issue

[4]. Cancelli, A., Montanelli, F., 1999. "In-ground test for geosynthetic reinforced flexible paved roads". Proceedings of Geosynthetics '99, Vol. 2, Boston, USA, pp. 863-879.

[5]. Chauhan, M.S., Mittal, S., Mohanty, B., 2008. Performance evaluation of silty sand subgrade reinforced with fly ash and fibre. Geotextiles and Geomembranes 26 (5),429-435.

[6]. Datye. K. R, Gore. V. N., (1994) "Application of natural geotextiles and related products" Geotextiles and Geomembrance 13,371-388

[7]. Fannin, R.J., Sigurdsson, O., 1996 " Field observations on stabilization of unpaved roads with geotextiles" Journal of Geotechnical Engineering, ASCE. 26(7): 544-553.

[8]. Giroud, J.P, Noiray, L, 1981. "Geotextile reinforced unpaved road design" Journal of Geotechnical Engineering ASCE 107 (9), 1233–1254.

[9]. IRC: 81-1997 Guidelines for Strengthening of Flexible Road Pavements using Benkelman Beam Deflection technique.

[10]. IRC : SP 72 – 2007 Guidelines for the design of flexible pavements for Low volume Rural Roads.

[11]. IS: 2720(Part 16) – 1979, Methods of Test for Soils: Determination of California Bearing Ratio.

[12]. IS 2720 (Part 5)-1985, Methods of Test for Soils: Determination of Atterberg Limits.

[13]. IS 2720 (Part 8)- 1983, Methods of Test for Soils: Determination of Water Content – Dry Density Relation using Heavy Compaction.

[14]. IS: 15868 (Parts 1 to 6) – 2010. Methods of test natural fibre geotextiles (Jute geotextile and coir Bhoovastra)

[15]. Khanna,S.K, Justo. C.E.G, "Highway Engineering", published by New Chand and Bros., Roorkee, Eighth Edition, 2009.

[16]. M.V.L.R..Anjaneyulu,"Evaluation of Pavement Performance"

[17]. Perkins, S.W., 1999a. Geosynthetic reinforcement of flexible pavements: laboratory based pavement test sections. Final Report FHWA/MT-99-001/8138, State of Montana Department of Transportation, MT, USA, 140 p.

[18]. Perkins, S.W., 1999b. Mechanical response of geosynthetic-reinforced flexible pavements. Geosynthetics International 6 (5), 347-382

[19]. Rao. G. V, Balan. K, (2000) "coir geotextiles Emerging trends". The Kerala state coir corporation LTD (publishers) Alappuzha, Kerala.

[20]. Rawal, A., Anandjiwala, R., 2007. Comparative study between needle punched nonwoven geotextile structures made from flax and polyester fibres. Geotextiles and Geomembranes 25 (1), 61-65.