International Journal of Research in Engineering, Science and Management
Volume-2, Issue-1, January-2019
www.ijresm.com | ISSN (Online): 2581-5792

To Enhance Properties of Soil using Waste Coconut Coir Fiber

Rajesh Kumar[1], Akash Batra[2]
[1]*M. Tech. Student, Department of Civil Engineering, Indus Institute of Engineering and Technology, Jind, India*
[2]*Assistant Professor, Dept. of Civil Engineering, Indus Institute of Engineering and Technology, Jind, India*

***Abstract*: This study was accompanied to decide the effect of coconut coir fiber on the density of the soil, the California Bearing Ratio (CBR) value and the bearing capacity generated in locally loose soil. Tests accompanied on the soil involved testing the physical properties (sieve analysis test, moisture content and specific gravity test) and mechanical properties (compaction test, un-soaked and soaked CBR test). The testing of coconut coir fiber are density test and tensile strength test. The length variation of coir fiber used are 3.0-4.0 cm and 4.0- 5.0 cm with the addition of coir fiber percentage of 0%, 0.5%, 1% and 1.5%. The result showed that the addition of coir fiber can be increase CBR value and bearing capacity of loose soil. At un-soaked condition, the highest CBR value was about 52.88% and bearing capacity was 10.75 which are reached at 1.5% percentage of coir fiber and 3.0-4.0 cm of coir fiber long. While in soaked condition, the highest CBR value was about 39.46% and bearing capacity was 9.88 which are reached at 0.5-1% percentage of coir fiber and 3.0- 4.0 cm of coir fiber long. It is concluded that proportion of 0.85% coir fiber and 4.0-5.0 cm of length in a soil is optimum percentage of materials having maximum soaked CBR value. Hence, this proportion sample economically used in road projects and embankments. The road pavement is placed on the ground floor, thus the overall quality and durability of a pavement construction cannot be separated from the properties possessed by a foundation. Compaction is a basic method of soil stability, where the amount of poor compaction will outcome in decreased soil stability in road works. Compacted base soils to optimum masses have good carrying capacity and have the ability to tolerate volume changes during the capability life. Soil properties are subjective by soil type, texture, density, water content, environmental conditions, and so forth. Land transport capacity for roads can be expected using CBR checks. Earlier studies related to soil synthetic, essentially with coconut coir fiber has been widely practiced. The mechanical things of fiber (synthetic and natural) reinforced soil have been investigated by various researchers. All previous studies have shown that addition of fiber reinforcement causes important improvement in strength of the soil and increases its stiffness. The current study is set out to figure out performance of locally loos soil as road subgrade with coconut coir fiber strengthening.**

***Keywords*: Coconut Coir Fiber, California Bearing Ratio (CBR), Soaked or Un-Soaked Sample, Shear Strength, Maximum Dry Density (MDD), Optimum Moisture Content (OMC).**

1. Introduction

A. Soil

Soil is a term used in engineering applications, which includes all deposits of loose material on the earth's crust that are created by weathering and erosion of essential rocks. Though weathering follows on a geologic scale, the process is continuous and keeps the soil in constant transition. The physical, chemical, and biological processes that form soils vary generally with time, location and environmental conditions and result in a wide range of soil properties. Physical weathering occurs due to temperature changes, erosion, alternate freezing and thawing and due to plant and animal activities causing disintegration of underlying rock strata whereas chemical weathering crumbles rock minerals by oxidation, reduction, hydrolysis, chelation, and carbonation. These weathering processes, individual or in combination.

B. Components of strengthen soil

Soil Strengthen involves the use of mixing agents (binder materials) in weak soils to improve its geotechnical properties such as compressibility, strength, permeability and durability. The components of Strengthen technology include soils and or soil minerals and mixing agent or binders.

1) Various techniques for soil strength improvement

There are various techniques used for the development of the soil based on the construction work and type of soil. The soil development techniques are,

- Surface Compaction
- Drainage Techniques
- Vibration Methods
- Density and consolidation
- Filling and Injection
- Biochemical Stabilization
- Soil Reinforcement
- Geo textiles and Geo casings
- Other Approaches

These are various technique which are researched from different author we discussed about it .Such as improving CBR value, bearing capacity of soil, by adding Geo-synthetic material (textile, yarn, fiber plastic and any other waste material).

2) We use coconut coir fiber as a geo- synthetic material

Fibers were composed from the local temples, cleaned, sun dried, removed dust to explore its properties. Coconut fibers require no pre-treatment, except for water treatment. Coconut

Fiber Coconut has high water absorption. Due to this property, the coconut fibers were presoaked in water for 24 hours. Soil being the cheapest and freely available Highway Pavement construction material, has been Popular used by the civil Engineers, even still it being poor properties. It has been the constant effort of research workers innovative ideas to improve its chemical properties to ensemble the requirements of engineering students.

Table 1
Properties of Coconut Coir Fiber

SR.NO.	Depiction	Significance
1	Diameter	0.3mm
2	Length	2cm to 4cm
3	Specific gravity	1.34

2. Literature review

Use of unwanted material and natural fiber for improving soil property is advantageous because they are cheap, locally available and eco-friendly. In this study, the become stable effect of Natural fiber (coconut coir) on soil properties has been studied. Above the last time the use of unwanted material and fiber has recorded a tremendous increase. Keeping this in view an investigational study is accompanied on locally available i.e. clayey soil diverse with variable percentage of coir fiber. Soil examples for unconfined compression strength (UCS) and California bearing ratio (CBR) tests are ready at its maximum dry density corresponding to its optimum moisture content in the CBR mold without and with coir fiber. The percentage of coir fiber by dry weight of soil is taken as 0%, 0.50%, 1.0% and 1.5% and consistent to each coir fiber content un-soaked and soaked CBR and UCS tests are accompanied in the laboratory. Tests result designates that both un-soaked and soaked CBR value of soil increases with the increase in fiber content. Soaked CBR value increases from 4.75% to 9.52% and un-soaked CBR value increases from 8.72% to 13.55% of soil mixed with 1% coir fiber. UCS of the soil increases from 2.75 kg/cm2 to 6.33 kg/cm2 upon addition of 1% accidentally dispersed coconut fiber. Adding of coconut coir fiber results in less thickness of pavement due to increase in CBR of mix and decrease the cost of construction and hence economy of the construction of highway will be realized. This is because of compound effect of natural fiber changes the stiff behavior of the soil to elastic behavior

R.R Singh (2014) In these results soil is added with dissimilar ratios of coconut coir. The main parameters that are studied include unconfined compression strong point and C.B.R. The numbers of curves are located from the test results of U.C.S. and C.B.R. tests are accomplished on the soil and soil mix with different percentage of coir fiber. Coir increases the U.C.S and C.B.R values in this research. The investigational results are carried out in the ensuing laboratory works.

V. Sai Uday (2017) Coconut fiber being low in density reduces the weight of the fiber reinforced concrete. The compressive strength and Split Tensile Strength of the concrete gets the maximum value at the mixture of coconut fiber. Then in addition of fibers in the concrete the strengths of the specimens get decreasing and it can be accomplish that the fiber should not be used beyond 1%

Renu Bala (2018) The Journal Published by International Journal of Current Research shows that the shear strength of the soil is maximum 1% (of soil) of Coconut fibers is additional to it. Hence in order to obtain higher shear resistance 1% of fibers (of soil) can be considered as the optimum fiber content.

3. Research methodology

A. *Methodology used*

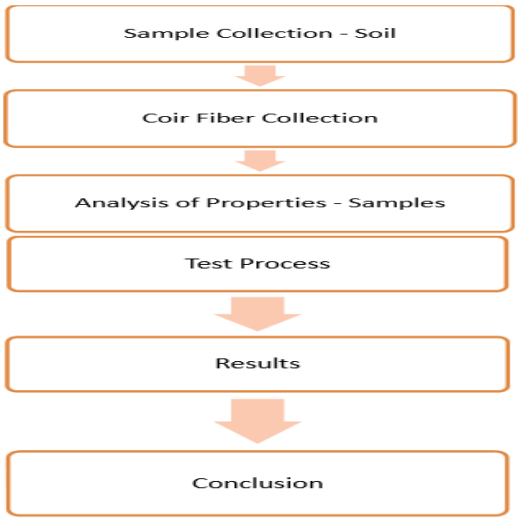

Fig. 1. Flow chart of methodology

B. *Sample received*

I received total amount of soil was about of 40 kg. This soil was free from debris, plastics, canker and other unwanted materials. The composed soil sample.

C. *Different tests are performed on the soil sample*

- Natural moisture content test.
  Optimum moisture content & Maximum Dry Density test. (Maximum Dry Density)
  Tri-axial Test [Unconsolidated Undrain (UU) Condition] Water Content in Soil by Oven Drying Method. When the soil has dried, eliminate the plate from the oven, using tongs.
- Find the weight 'S3 'of the dish with the lid and the dry soil sample.

$$W = S2\text{-}S3/S3\text{-}S1\times100$$

S1= Mass of empty container with lid.
S2 = mass of the container with wet soil and lid.
S3 = mass of container with dry soil and liquid.

Determine the OMC and MDD through standard proctor test. In this method, the maximum dry density and optimum moisture content of soils is obtained by using the results of standard proctor curve to enter a family of curves from which

the maximum dry compactness and optimum moisture content can be determined Process of optimum moisture content. Take about 25 kg of air dry soil .sieves it through 20 mm and 4.75mm IS sieves. calculate the %age retain on 20 mm sieves, and 4.75 mm sieves ,and the % age passing 4.75mm sieves. Don't use the soil retain on 20 mm sieve.

4. Test results

Table 2
Sieve Analysis Result Sheet

Observations			Calculations	
Size of opening sieve	Weight of soil retained	% Weight retained	Cumulative % retained	% finer
Coarse sieve Fraction				
80	60	6%	6%	94%
40	140	14%	20%	80%
20	400	40%	60%	40%
10	250	25%	85%	15%
4.75	150	15%	100%	0%
		100%	Total=1000gm	

Table 3
CBR Analysis Result Sheet

Fiber length variations(cm)	Variation of fiber (%)	Average CBR value (%)	
		Un-soaked	Soaked
3.0-4.0	0	39.47	31.12
	0.5	46.22	38.84
	1.0	51.12	38.97
	1.5	53.52	39.11
4.0-5.0	0	39.64	31.52
	0.5	43.51	36.32
	1.0	44.85	37.24
	1.5	45.66	32.35

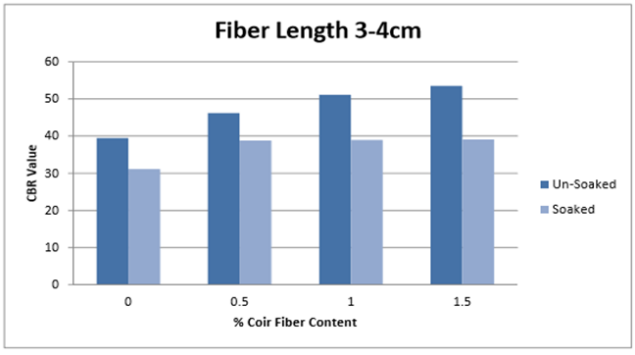

Fig. 2. Graphical view CBR value and % of coconut coir fiber

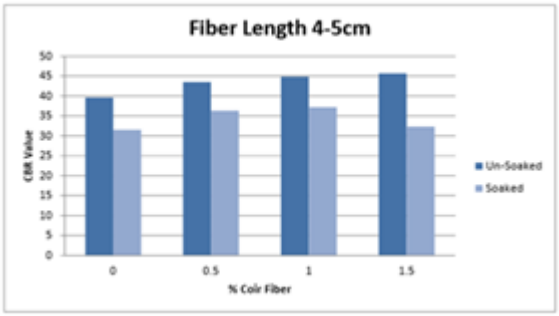

Fig. 3. Graphical view CBR value and % of coconut coir fiber

Table 3
Bearing capacity of soil sample

Fiber length variations	Variation of fiber (%)	Average CBR value (%)	
		Un-soaked	Soaked
3.0-4.0	0	8.7	8.18
	0.5	9.92	9.51
	1.0	10.53	9.55
	1.5	10.77	9.21
4.0-5.0	0	8.78	8.14
	0.5	9.96	9.29
	1.0	9.88	9.53
	1.5	9.87	9.56

Table 4
Unconfined compression test results (UCT)

Soil Sample	Fiber Content (%) of Soil Mass	UCS
Sample 1	0.0	0.751
	0.5	0.184
	1.0	0.173
	1.5	0.349
Sample 2	0.0	0.019
	0.5	0.066
	1.0	0.179
	1.5	0.157

Table 5
Results obtained from proctor test

Soil Sample	Mass of Soil	Fiber Content (%) of soil mass	Optimum Moisture Content (%)	Maximum Dry Density (gm/cc)
Sample 1	Without fiber	-	10.5	1.91
	With fiber	0.5	11.5	1.90
		1.0	11.5	1.94
		1.5	11.9	1.82
Sample 2	Without fiber	-	8.8	1.91
	With fiber	0.5	9.4	1.89
		1.0	13.5	1.83
		1.5	13.9	1.79

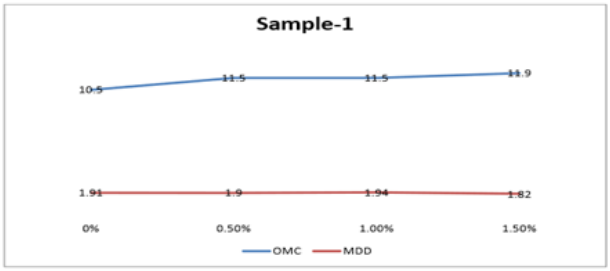

Fig. 4. Sample 1

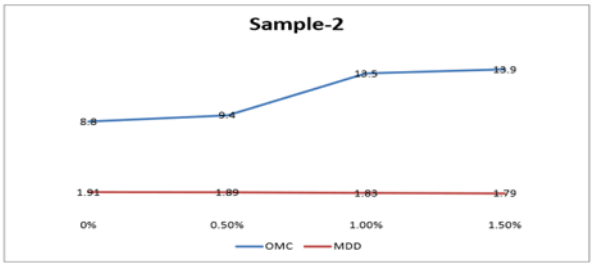

Fig. 5. Sample 2

5. Conclusion

The percentage increase in CBR value after mixing with optimal percentage of fibers is 12.35% (For un-soaked test).The California bearing ratio (CBR) of the only soil obtained as 4.28 and there durable increase in CBR value with addition of fibers. The California bearing ratio (CBR) of the only soil is obtained as 1.92% and it increased to 7.41% (For soaked) after combined with optimum percentage of coconut fibers. There is substantial decrease in OMC with increase in addition of fibers. In unconfined compression test it was observed that the shear strength of the soil has decreased with the increase in percentage of Coconut fibers, when related to that of shear strength of soil tested without fiber. The shear strength of the soil is maximum 1% (of soil) of Coconut fibers is additional to it. Hence in order to obtain higher shear resistance 1% of fibers (of soil) can be considered as the optimum fiber content.

References

[1] V. Sai Uday (2017), Concrete Reinforced with Coconut Fibers, 2017 IJESC
[2] Pooja Upadhyay (2017), Soil stabilization using natural fiber coir.
[3] Hema Rani (2017), A review: effect of coir fiber on Engineering properties of Cohesive soil
[4] R. R. Singh, Shelly mittal, importance of local subgrade soil for road construction by the use of coconut coir fiber, International journal of research in engineering and technology., vol. 3, no. 5, 2014
[5] Shukla Devdatt, and Rajan Shikha, “Soil Stabilization Using Coconut coir fiber,” IJRASET, vol. 3 no. 9, September 2015.
[6] Gopal Ranjan, “Soil Mechanics and Foundation Engineering.”