

Soil Stabilization Using Coconut Coir Fiber Waste

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Abstract: The soil above which a civil engineering structure rests must have adequate shear strength and bearing capacity if it is to be secure and stable. When the soil on the site is unsuitable, it can be improved using the soil stabilization method. The primary goal of this review paper is to examine the method of soil stabilization using data from previous studies. The engineering properties of permeability, shear strength, shrinkage, and swelling are all improved by soil stabilization.

All soil stabilization techniques are divided into two groups: chemical stabilization and mechanical stabilization. The process of mechanical stabilization involves adding various admixtures to the soil to change its chemical makeup, change its gradation, and stabilize the soil. Fly ash, lime, cement, coconut coir fiber, and other materials are used as soil stabilizers.

Key words: Soil stabilization, Coconut coir fiber, waste management, improving soil properties

1. INTRODUCTION

In order to improve soil quality, bearing capacity, and durability in the face of challenging dampness and strain conditions, soil adjustment is a technique. It mostly alludes to the mixing of distinct soil with different soil, concrete, lime, bituminous items, silicates, and specific chemical compounds rather than uncommon or engineered, herbal, or inorganic materials prevailing fashions. For the replacement and adjustment of insufficient soil, superior imaginative structures for using naturally available ecological and modern waste cloth have been developed. Most likely only minor improvements were achieved. Secure disposal of agricultural and local wastes between those times presents engineers with a testing task. As a result, a project has been created with the help of analysts to use agrarian and local wastes of coconut fiber/cutting-edge wastes as soil stabilizers. Processing of a large volume of cutting-edge waste products anywhere in the economy reactivates huge treatment and switch issues.

1. SOIL STABILIZATION METHODS

1.1 MECHANICAL STABILIZATION

Mechanical Stabilization is the process of improving the properties of the soil by changing its gradation. This process includes soil compaction and densification by application of mechanical energy using various sorts of rollers, rammers, vibration techniques and sometime blasting. The stability of the soil in this method relies on the inherent properties of the soil material.

Two or more types of natural soils are mixed to obtain a composite material which is superior to any of its components. Mechanical stabilization is accomplished by mixing or blending soils of two or more gradations to obtain a material meeting the required specification.

STABILIZATION BY USING ADMIXTURES

- A. Lime stabilization
- B. Cement stabilization
- C. Chemical stabilization
- D. Fly Ash stabilization
- E. Thermal stabilization

2. MATERIAL USED FOR STABILIZATION

2.1 COCONUT COIR FIBER



Fig. 1 Coconut Coir Fiber

- a) It is both a renewable resource and a CO₂ neutral material.
- b) The fiber is rich in micronutrients and has a high

capacity to hold water.

The fiber is readily available, naturally non-toxic, biodegradable, low density, and very affordable.

Table 1: Physical properties of coir fiber

Density (g/cc)	1.40
Diameter in mm	0.1-0.5
Length in inches	6-8
Tenacity (g/Tex)	10.0
Rigidity of Modulus	1.8924 dyne/cm ²
Breaking Elongation%	30%

Scope of Work

This study will contribute in improvement of soil properties by using coconut coir fiber. As soil and waste is variable material in characteristics from place to place, this experimental research work will be applicable for particular region soil with particular type of soil. For different area's soil, we can have different Optimum percentage of coconut coir fiber which will enhance soil properties. Use of coconut coir fiber as stabilizing material, is cheap as well as eco-friendly method of soil stabilization, which will solve the economic problems as well as enhances soil properties.

Experimental Results

General

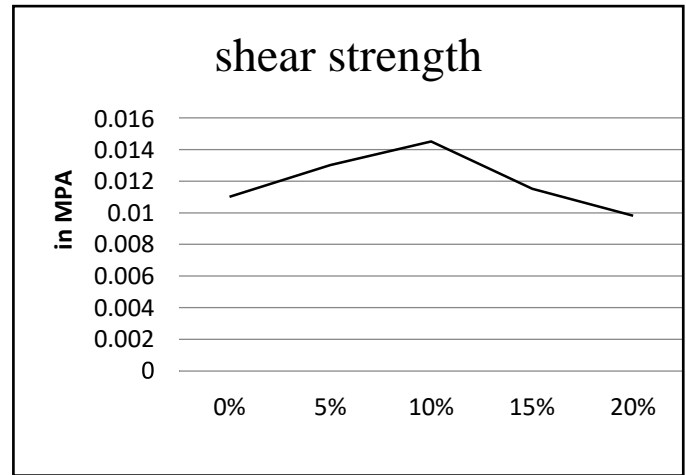
Soil with different amount percentage of Coconut Coir Fiber is used for soil stabilization. Here we are discussing test results of shear test, permeability and compaction test on soil with 0%, 5%, 10%, 15% and 20% of Coconut Coir Fiber. As Coconut Coir Fiber is varying in percentage, properties of soil are also varying. Here we are discussing results of shear strength, permeability and compaction of soil with different percentage of Coconut Coir Fiber through test reading and graphs plotted for comparison of results.

Vane Shear Test:

Observation No.	% of coconut coir	Shear Strength (N/mm ²)
1.	0%	0.011
2.		
3.	5%	0.013
4.		
5.		

6.	10%	0.0145
7.	15%	0.0115
8.		
9.	20%	0.0098
10.		

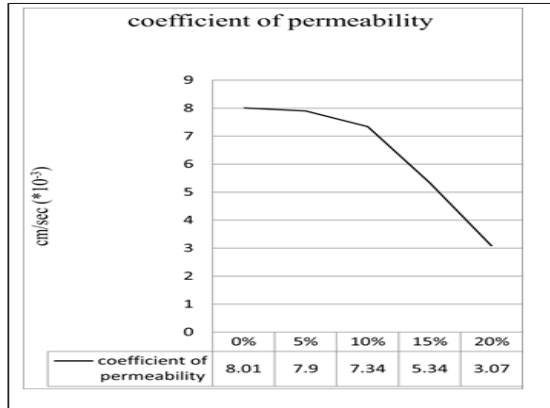
Shear test is carried out on soil with varying percentage of soil check shear effect of different amount of Coconut Coir Fiber the given Table shows percentage used and shear strength achieved.



At 0% of coconut coir addition i.e. soil without coconut coir gives shear strength as 0.011 N/mm² (11 kN/m²) As coconut coir content increases in soil, shear strength of soil also increases as 0.0145 N/mm² but up to 10% only. After 10% addition of coconut coir doesn't improve shear strength of soil

Permeability Test

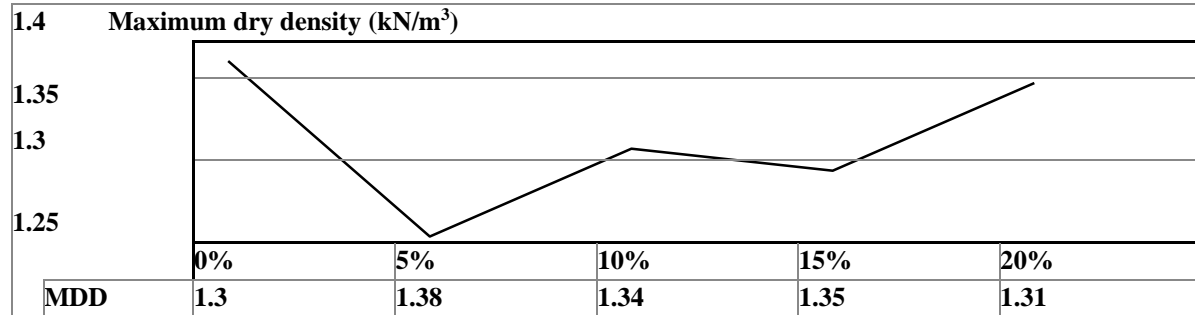
Observation	% of coconut coir	Coefficient of Permeability (K) cm/sec
No. 1.	0%	0.00801
No. 2.		
No. 3.	5%	0.00790
No. 4.		
No. 5.	10%	0.00734
No. 6.		
No. 7.	15%	0.00534
No. 8.		
No. 9.	20%	0.00307



At 0% of coconut coir addition i.e. soil without coconut coir gives Permeability as 0.00801 cm/sec. As coconut coir content increases in soil, permeability of soil decreases as 0.00734 cm/sec at 10%. After 10% addition of coconut coir, permeability of soil continues to decrease.

Compaction test

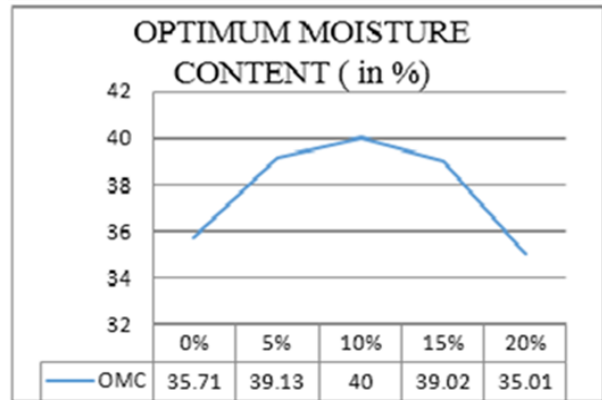
MDD (Maximum Dry Density)



Observation No.	% of coconut coir	Maximum Dry Density (in kN/m)
1.		
2.	0%	1.30
3.		
4.	5%	1.38
5.		
6.	10%	1.34
7.		
8.	15%	1.35
9.		
10.	20%	1.31

At 0% of coconut coir addition i.e. soil without coconut coir gives maximum dry density as 13.0 kN/m³. As coconut coir content increases in soil, permeability of soil also increases as 13.8 kN/m³ but upto 5% only. After 5%, addition of coconut coir doesn't improve density of soil.

4.2.2OMC (Optimum Moisture Content)



Observation No.	% of coconut coir	Optimum Moisture Content (in %)
1.		
2.	0%	35.71
3.		
4.	5%	39.13
5.		
6.	10%	40.00
7.		
8.	15%	39.02
9.		
10.	20%	35.01

At 0% of Coconut coir addition i.e. soil without Coconut coir gives optimum moisture content as 35.71%. As Coconut coir content increases in soil, optimum moisture content of soil also increases as 40% but up to 10% only. After 10%, addition of Coconut coir doesn't improve permeability of soil. Coconut coir absorbs moisture from soil which results in less moisture content at higher percentage.

5.3 Cost Analysis

The cost estimating tool is intended to be used to develop a preliminary project scoping cost estimate. This preliminary estimate can be based on the typical cost of item involved in stabilization process. In this work, Cost involved in soil stabilization with lime is compared with Coconut Coir Fiber for soil stabilization is given below.

Conventional Stabilization	Coconut Coir Stabilization
813/m ³	326/ m ³

CONCLUSION

1. Experimental study of soil stabilization with Coconut Coir Fiber shows 10% with soil enhances soil properties viz. Shear strength, permeability and compaction.
2. This study shows instead of using lime as a stabilizer, which is not economical to improve the soil property so that, we can improve soil properties by using Coconut Coir Fiber.
3. As soil and coir is variable material in characteristics from place to place, this experimental work is only applicable to our Miraroad region soil with particular type of clayey soil. For different area's soil, we can have different Optimum percentage of coconut coir fiber which will enhance soil properties.
4. Using Coconut Coir Fiber as stabilizing material is cheap as well as eco-friendly method of soil stabilization, which improves the soil properties.

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