iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 10 Issue: III Month of publication: March 2022

DOI: https://doi.org/10.22214/ijraset.2022.40609

A Study of Black Cotton Soil by Using Sisal Fibre and Coconut Fibre

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Abstract: ***The present study is aimed to compare the behaviour of black cotton soil reinforced with sisal and coconut fiber also referred as coir. The soil used is black cotton soil collected from Arera Colony Area of Bhopal District (M.P). Sisal fiber and coconut fiber are mixed randomly with soil in varying percentages (2%, 4% and 6%) respectively by dry weight of soil and compacted to maximum dry density at optimum moisture content. The test results indicate a reduction in the maximum dry density and the optimum moisture content of soil due to the addition of sisal fiber. It also indicates an improvement in the CBR value of soil due to the addition of sisal fiber and coconutfiber and the combination of above two shows better results. The optimum CBR valueis obtained for 2 cm length for both the fibers i.e. for sisalfiber with 4% fiber content and for coconut fiber with 6%.***
Keywords: Black Cotton soil, Sisal fiber, Coconut fiber, Maximum Dry Density, Stabilization, CBR

I. INTRODUCTION

Expansive soil is one of its types, a regular fine-grained shake or soil material that consolidates at least one mud mineral with hints of metal oxides and natural problem. Depending on the composition of the material, the soil also has various properties. It is moderate to exhausted, solidifies quickly, and difficult to use for anything given its better molecular measurement. Black Cotton Soil is a kind of expansive soil in which it expands in volume when wet and shrinks when dry. In some situations, construction on clay soil is unavoidable so soil stabilization is one of the most commonly used methods to increase the technical properties of soil (earth), due to soil adjustment, the load-bearing limit of the establishment of the structure is widened and its quality, its watertightness, its protection against leaching. The basic methods of stabilization are cementation, bitumination, silicification, resinification, methods using electrochemical or thermal action and artificial freezing. These methods can have effects on the environment. In the context of sustainable development, of the natural environment, the use of natural fibers in geotechnical applications is desirable. Reinforcing soil with fiber is a cost-effective solution to soil problems/soil improvement. This experimental study focuses on the use of sisal and coconut fiber for soil stability. The study includes the properties of sisal, coir, and clay, as well as experimental workouts such as the California Rolling Ratio and the Unconfined Compression Test.

A. Properties of Black Cotton Soil

1) Black soil has a texture like clayey and is highly fertile.
2) Black soil structure is cloddish or sometimes friable.
3) Black soil when dry gets a contract and develops deep wide cracks.
4) Black soil expands when they are wet and they are hard to ploy.
5) Black soil contains almost 50% of clay and can hold water for a long time.

B. Methodology Considered

In this work, the analysis is based on an experimental work which is used to study
"A study on the reinforcement of black cotton soil using sisal fiber and coir fiber" according to IS standards.

II. LIQUID LIMIT

When water is added to dry soil, its state of consistency changes from hard to soft. If we add water to fine-grained soil, the water will change its consistency from hard to semi-hard. If we continue to add more water, the soil will again change its consistency state from semi-hard to plastic and eventually reach a liquid consistency stage. When the soil reaches the state of liquid consistency, it no longer has any cohesive force to maintain its shape under its own weight. It will begin to distort its shape. Thus, the amount of water that is responsible for this state of soil consistency is called liquid limit of soil. In other words, we can define the liquidity limit as
"It is the minimum water content at which the soil is still in a liquid state, but has a small shear resistance against flow."

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 10 Issue III Mar 2022- Available at www.ijraset.com

III. SOIL LIQUID LIMIT

Fig:1 CASAGRANDE APPARATUS

1) Liquid limit of soil is a very important property of fine-grained soil (or cohesive soil)
2) Liquid limit value is used to classify fine-grained soils.
3) It gives us information on the state of consistency of the soil on the site.
4) Soil liquid limit can be used to predict soil consolidation properties while calculating allowable bearing capacity and foundation settlement.
5) Soil liquid limit value is also used to calculate clay activity and soil toughness index.

A. Test Preparation

Place part of the paste in the cup of the liquid limiter. Level the mixture so as to have a maximum depth of 1 cm. Pass the grooving tool through the sample according to the axis of symmetry of the cup, holding the tool perpendicular to the cup. For normal, fine-grained soil. The Casagrande tool is used to cut a groove 2mm wide at the bottom, 11mm wide at the top and 8mm deep. For sandy soils: The ASTM tool is used to cut a groove 2mm wide at the bottom, 13.6mm wide at the top and 10mm deep.
After the earth has been cut by a suitable grooving tool, the handle is rotated at approximately 2 revolutions per second and the no. of counted counts, until the two parts of the soil sample come into contact over a length of about 10 mm.
Take about 10 g of soil near the closed groove and determine its water content. The earth from the cup is transferred to the dish containing the earth paste and mixed thoroughly after adding a little more water. Repeat the test.
By changing the water content of the soil and repeating the previous operations, obtain at least 5 readings between 15 and 35 counts. Do not mix dry soil to change the consistency. The liquidity limit is determined by plotting a "debit curve" on a semi-logarithmic graph, sans. counts on the abscissa (logarithmic scale) and the water content on the ordinate and by drawing the best straight line passing through the plotted points.

Fig:2 Liquid Limit Apparatus

IV. COMPACTION TEST

The Proctor compaction test is a laboratory method of experimentally determining the optimum moisture content at which a given type of soil will become densest and reach its maximum dry density.
The term Proctor is in honor of R.R. Proctor.

A. Device Required

Proctor mold with a capacity of 1000 cc with an internal diameter of 10 cm and a height of 12 cm. The mold should have a removable collar and a removable base plate.

1) Pestle: Mechanically operated metal pestle with a face diameter of 5.08 cm and a weight of 2.5 kg. The rammer must be equipped with a suitable device to control the height of fall up to a free fall of 30 cm.
2) Examples of extrusions.
3) A scale with a capacity of 15 kg.
4) Sensitive balance.
5) Blending tools

B. Procedure

1) Dry the soil sample by exposing it to air or sunlight (about 5 kg) in the given tray. Thoroughly mix the sample with enough water to moisten it about four to six percentage points below the optimum moisture content.
2) Weigh the proctor mold without base plate and collar. Attach the collar and the base plate. Place the earth in the Proctor mold and compact it in 3 layers giving 25 strokes per layer with the 2.5 kg pestle falling through.
3) Remove the collar, cut the compacted earth flush with the top of the mold using the ruler and weigh.
4) Divide the weight of the compacted sample by 1000 cc and record the result as the wet weight gwet in grams per cubic centimeter of compacted soil.
5) Remove the sample from the mold and slice it vertically and obtain a small sample for moisture determination.
6) Increase the moisture content of the soil sample by one or two percentage points and repeat the above procedure for each addition of water.

V. TEST RESULTS

Table 1:- CBR Test Result of Black Cotton Soil

S. No.	Penetration	Load	Load X Proving Ring Constant (35.21N)
1	0	0	0
2	0.5	7	246.47
3	1.0	9	316.89
4	1.5	11	387.31
5	2.0	13	457.73
6	2.5	15	528.15
7	3.0	15.5	545.75
8	3.5	16	563.36
9	4.0	17	598.57

VI. CONCLUSIONS

On the basis of experimental investigation & results obtained. In present dissertation work following conclusion can be drawn –

1) The CBR rate of virgin black cotton soil obtained as 3.85 %. CBR value of black cotton soil increases with the addition of sisal fibre and coconut fiber.
2) The maximum CBR value is found to be 4.75 % by mixing 4% sisal fibre by weight in black cotton soil.
3) The maximum CBR value is found to be 4.88 % by mixing 4% coconut fibre by weight in black cotton soil.
4) At 2 % addition of both sisal fibre and coconut fibre the black cotton soil mix shows slight increment in CBR values respectively 4.11 % and 4.24 %.

5) Beyond 4 %, if we raise percentage of sisal fibre and coconut fibre in black cotton soil the CBR value reduces
6) This stabilized black cotton soil can be used in the construction of some inferior works.
7) According to the study and work done, when comparing black cotton soil mixed with sisal fibre and coconut fibre, the coconut fibre is found superior than sisal fibre at 2 %, 4 % and 6 % by weight.

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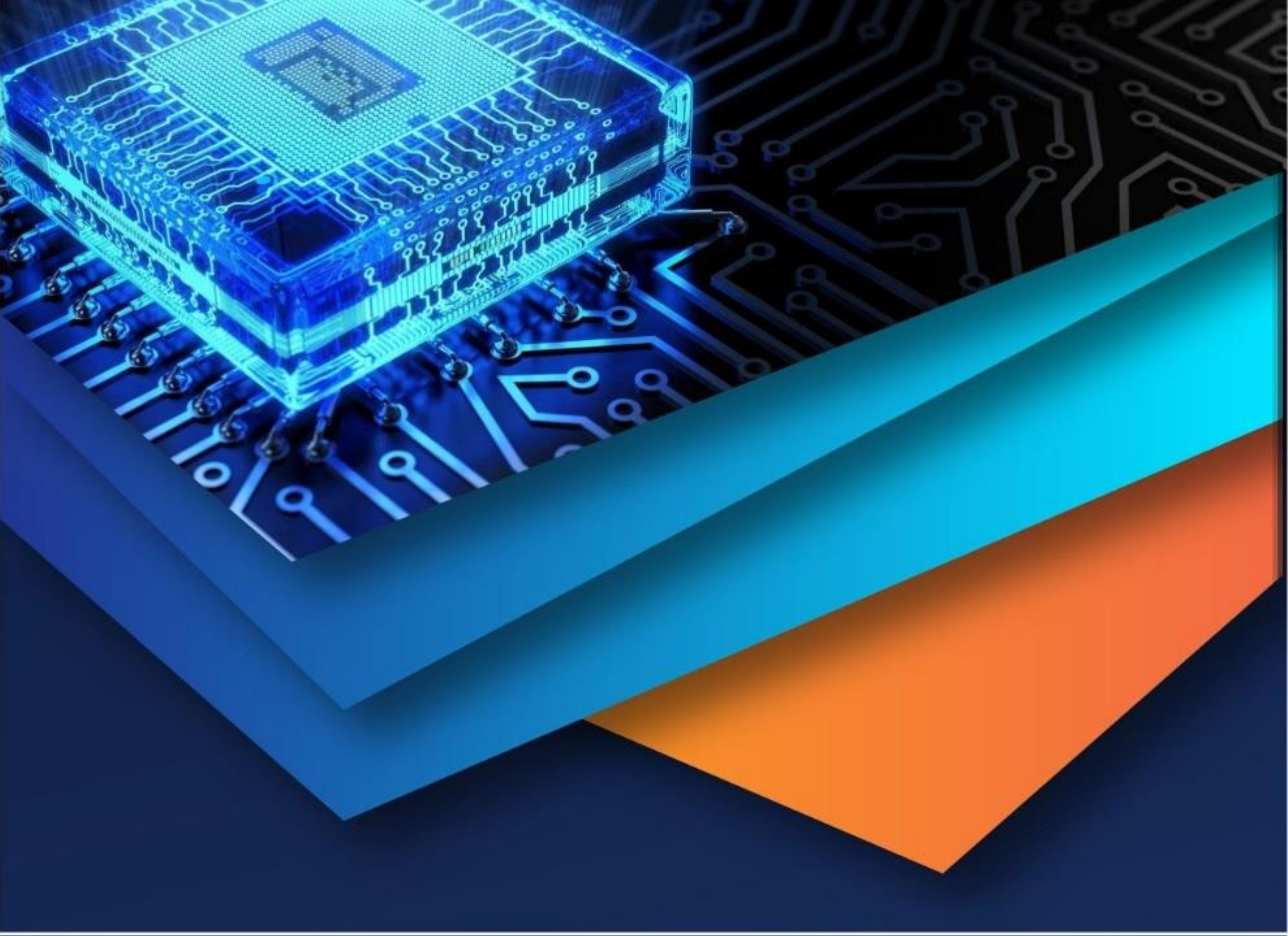

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