iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 8 **Issue:** II **Month of publication:** February 2020

DOI: http://doi.org/10.22214/ijraset.2020.2014

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.177
Volume 8 Issue II Feb 2020- Available at www.ijraset.com

A Study on Strengthening of Black Cotton Soil using Sisal Fiber and Coconut Fiber

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Abstract: ***The present study is aimed to compare the behaviour of black cotton soil reinforced with sisal and coconut fibre also referred as coir. The soil used is black cotton soil collected from Arera Colony Area of Bhopal District (M.P). Sisal fibre and coconut fibre 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 standard fibre-reinforced soil is defined as a soil mass that contains randomly distributed, discrete elements, i.e. fibres, which provide an improvement in the mechanical behaviour of the soil composite. Sisal fibre is one of the natural fibres that can be used for various industrial and construction purposes, the other fibres include bamboo, jute, coir etc. The test results indicate an improvement in the CBR value of soil due to the addition of sisal fibre and coconut fibre and the combination of above two shows better results. The optimum CBR value is obtained for 2 cm length for both the fibres i.e. for sisal fibre with 4% fibre content and for coconut fibre with 6%.***
Keywords – sisal fibre, coconut fibre, fibre-reinforced soil, CBR, black cotton soil.

I. INTRODUCTION

Fibres is a cost-effective solution to the ground/soil improvement problems. This experimental study deals with the use of sisal and coconut fibre for soil stability. The study includes the properties of sisal and coconut fibre and clay and experimental workouts such as California bearing ratio and unconfined compression test. A large part of Central India and a portion of India are covered with black cotton soils. These soils have high swelling and shrinkage attributes and amazingly low CBR esteem and shear quality. Hence, there is need for improvement of these properties. The act of utilizing strengthened earth has been settled in soil building calling. The concept of reinforcing soil masses with natural fibres like sisal fibre, coconut fibre, coir fibre, banana fibre, polypropylene fibre, etc. is a relatively new development to improve the properties of soil. The present study is aimed at determining the behaviour of black cotton soil reinforced with sisal and coconut fibre in a random manner. The soil used is a type of black cotton soil collected from Arera Colony Area of Bhopal District (M.P). The fibres are cut to a length 2 cm and mixed randomly with soil in varying percentages (2%, 4% and 6%) by dry weight of soil and compacted to maximum dry density at optimum moisture content. The test results indicate an improvement in the CBR value and Unconfined Compressive Strength of soil due to the addition of sisal and coconut fibre.

II. OBJECTIVE OF THE STUDY

Following are the objectives of this work-

A. To understand the behaviour of soil-fibre interaction of sisal fibre and coconut fibre and a combination of both fibre reinforced soils.
B. To study the strength, deformation characteristics of black cotton soil reinforced with Sisal and coconut fibre varying fibre content (2%, 4% and 6% of the dry weight of soil) and to determine the optimum fibre content.
C. To design a pavement with the help of CBR graph.

III. LITERATURE REVIEW

1) Tzetzis and Berketis (2014) studied shear strength behavior of polypropylene fibre reinforced cohesive soils. Authors observed that the shear strength of soils increases with the inclusion of fibres up to the optimum dose, beyond which it decreases or remains constant. The addition of the fibres results in a substantial increase of the friction angle. On the other hand, cohesion does not change considerably with the change of fibre content.
2) Estabragh et al. (2011) Studied Mechanical Behavior of a clay soil reinforced with nylon fibres. Author found that the reinforcement using fibres restrain the volumetric dilation of soil and this leads to an increase of the excess pore water pressure in undrained conditions. Increase in the effective shear strength of the soil with presence of fibres.

3) Maheshwari et al. (2011) Studied Application and modeling of fibre reinforced soil. Author observed that there is significant increase in the bearing capacity of highly compressible clayey soil with the inclusion of polyester fibres. The bearing capacity of unreinforced clayey soil is found to be 64 kPa. The bearing capacity is increased up to 250 kPa for fibre reinforced soil with optimum fibre content of 0.50% and optimum depth of placement of fibre reinforced soil is B/4. The bearing capacity obtained by model footing results are matched by full scale load test on the field. Thus, small scale laboratory results are verified. Though the soil is significantly affected for a depth of about 2 to 2.5 times the width of footing there is no need to putting the fibre reinforced soil through this depth. Only the depth equals to one fourth of size of footing is sufficient for placing the fibre reinforced soil for increasing bearing capacity.

4) Viswanadham (2009) concluded that the swelling tendency of the soil is reduced because of the efficacy of randomly distributed coconut coir fibres. The maximum dry density (MDD) of the soil decreases by adding coir fibres and the optimum moisture content (OMC) of the soil increases with an increase in percentage addition of coir to the soil. Up to 1% of coir fibres addition, the compressive strength increases and decreases thereafter. Increased percentage of coir fibres increases the tensile strength and water absorption of the soil. Soil stabilized with coir retains 75 to 80% of its tensile strength after 6 months of embedment in clay.

5) Shrithi S Badami (2017) discussed that Soil adjustment is the procedure for changing the designing properties of a soil. The principle saying of adjustment is to expand the quality of soil and furthermore to make the task efficient by making the best utilization of the locally accessible materials. India is secured with huge measure of sweeping soil which is otherwise called Black Cotton soil, which covers around 20% of aggregate land territory. These soils have less compressive quality, high swelling, high shrinkage qualities and low in CBR esteem. Consequently, in the present examination sisal fibre which is a normally happening fibre is influenced utilization of in balancing out the dark cotton to soil. The quality conduct, for example, compaction attributes, swelling conduct and unconfined compressive quality of sisal fibre strengthened dark cotton soil has been considered.

6) Abhay Kumar Jha (2017) as a rule, soils can't be utilized straightforwardly as street benefit layers, establishment layers and as a development material; thus the properties of those soils ought to be changed. Sweeping soils are one of those sorts of soils whose volume change happens while it interacts with water. It extends amid the stormy season because of admission of water and therapists amid summer season. The wetting and drying procedure of a subgrade layer made out of dark cotton (BC) soil result into disappointment of asphalts in type of settlement and breaking. Along these lines, preceding development of a street on such sub-level, it is critical either to expel the current soil and supplant it with a non-extensive soil or to enhance the building properties of the current soil by adjustment. There are number of soil change methods. These incorporate adjustment of soil by lime, bond, lime and concrete, bitumen, synthetic concoctions and so on. Rice husk fiery remains (RHA) is likewise used to settle the dark cotton soil. RHA is liberally accessible as modern and Agricultural squander and is dangerous if not arranged experimentally. Asphalt development is one of the real zone in which a substantial amount of RHA could be successfully used. The nearness of little measure of strands in soil upgrades soil quality and diminishes swell therapist conduct of soil. Utilizing filaments support in sub evaluations can build security coefficient of dike strength and furthermore diminish removals. Moreover, if the powerless sub review is balanced out or fortified, the outside layer thickness required will be less, which comes about in less repairs and general economy. The present work is intended to survey the change in the quality and solidness attributes in delicate Subgrade soil by utilizing the RHA for the adjustment and afterward Sisal fibre as strengthening material. Haphazardly appropriated fibre strengthened soil strategy is utilized to set up the fortified soil tests.

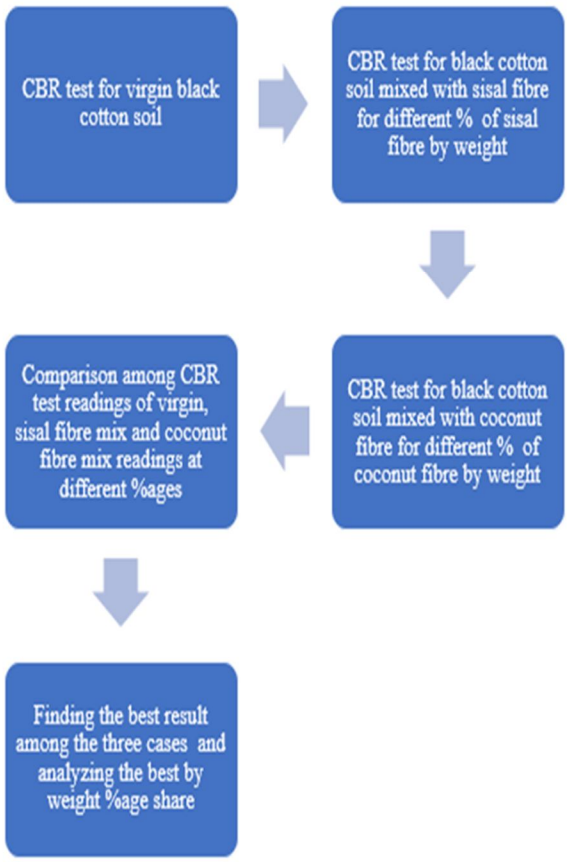
IV. METHODOLOGY

In this work, the analysis is based on experimental work which is used to investigate "A Study on Strengthening of Black Cotton soil using Sisal Fibre and Coconut Fibre" as per IS-standards.

California Bearing Ratio Test was performed which determines whether the soil sample is appropriate for pavement of subgrade soil. According to (IS 2720 Part 16 1980), CBR is the ratio of force per unit area required to penetrate as soil mass with a plunger of 50 mm dia. at 1.25 mm/minute.

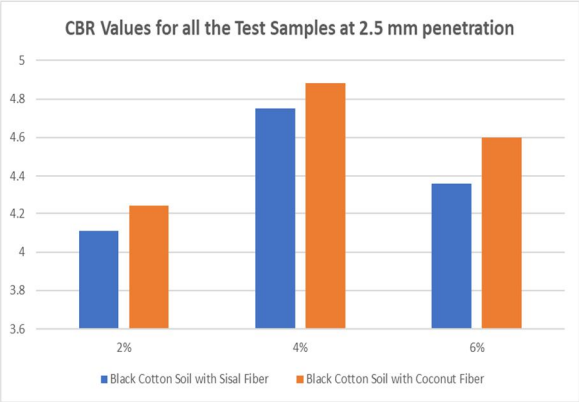
For the procedure 5kg of soil sample is taken mixed with water. Compaction is done by rammer at 56 blows. The value obtained at 2.5 mm is considered as the CBR value of the soil. The proving ring constant for this experimental apparatus was given to be 35.21 N.

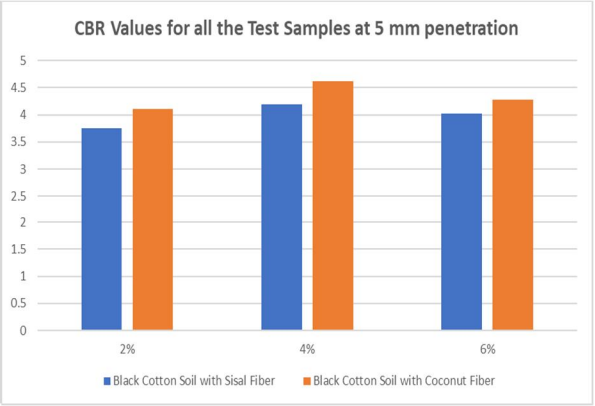
Lab view of CBR Apparatus



Flow Chart Diagram

V. RESULTS AND DISCUSSION





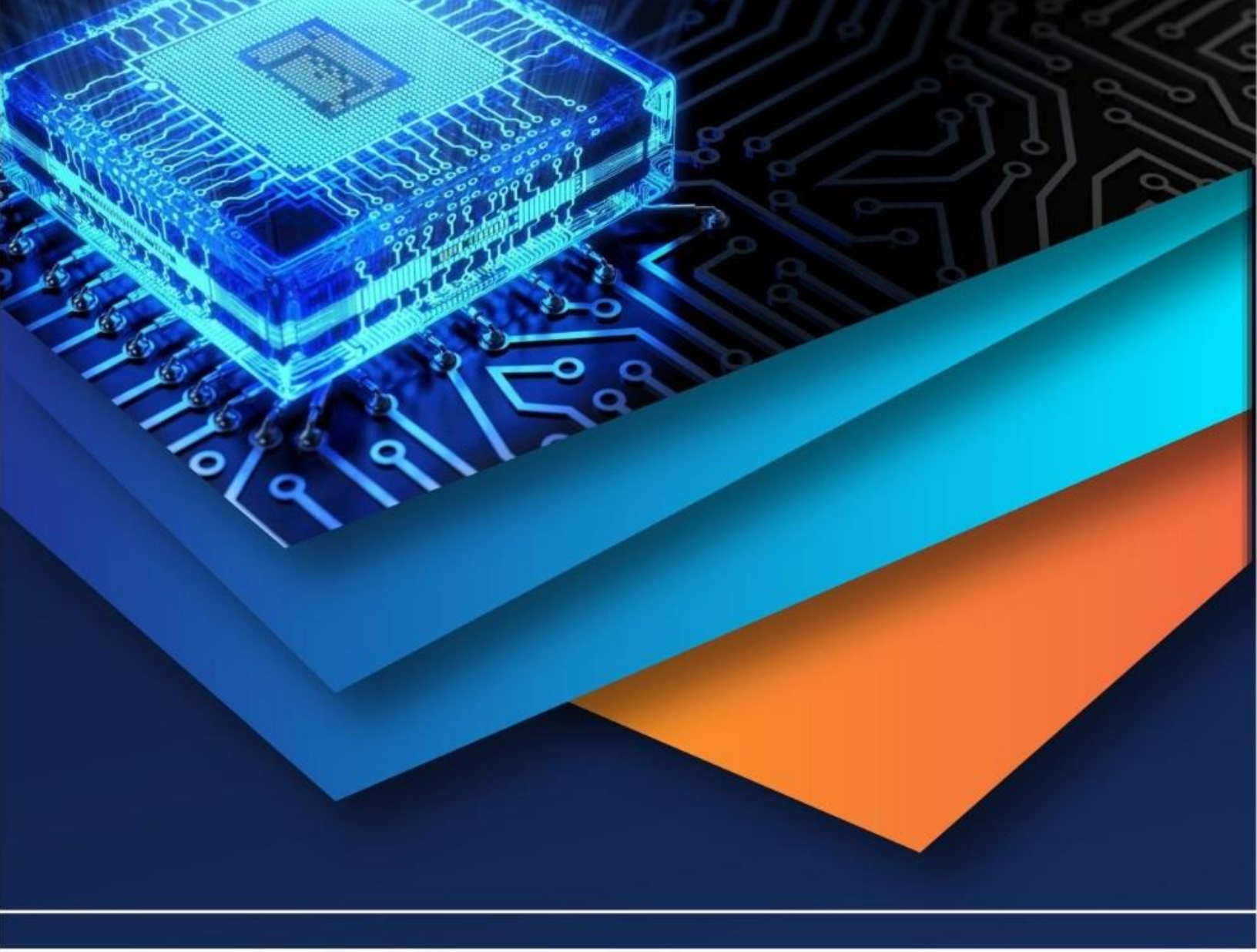
Percentage	Virgin Black Cotton Soil		Black Cotton Soil with Sisal Fibre		Black Cotton Soil with Coconut Fibre	
			2.5 mm	5 mm	2.5 mm	5 mm
2 %	3.85	3.42	4.11	3.76	4.24	4.11
4 %			4.75	4.19	4.88	4.62
6 %			4.36	4.02	4.60	4.28

VI. CONCLUSIONS

A. The CBR value of virgin black cotton soil obtained as 3.85 %. CBR value of black cotton soil increases with the addition of sisal fibre and coconut fibre.
B. The maximum CBR value is found to be 4.75 % by mixing 4% sisal fibre by weight in black cotton soil.
C. The maximum CBR value is found to be 4.88 % by mixing 4% coconut fibre by weight in black cotton soil.
D. 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 %.
E. Beyond 4 %, if we increase percentage of sisal fibre and coconut fibre in black cotton soil the CBR value reduces.
F. This stabilized black cotton soil can be used in the construction of some inferior works.
G. 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.

REFERENCES

[1] Vikas Kumar Shrivastava, Vikash Kumar Singh, Abhay Kumar jha, Parametric Study on performance Evaluation on Black Cotton Soil Stabilized with Rice Husk Ashand Randomly Distributed Sisal Fibres, International Journal of Science Technology & Engineering, Volume 3 | Issue 12 | June 2017.
[2] Pranjal Upadhyay, Pratiksha Malviya, Vikash Kumar Singh, Experimental Studies on Physico - Mechanical Properties of Vertisol Treated with SCBA, Reinforced SISAL Fibre, International Journal of Trend in Research and Development, Volume 4(5), Sep-Oct 2017.
[3] Mittal Shelly and Singh R. R. (2014). Improvement of local subgrade soil for road construction by the use of coconut coir fibre. IJRET: International Journal of Research in Engineering and Technology, Volume: 03 Issue: 05 | May.
[4] Anitha.S, Sangeetha.G, Sujitha.M , Gayathri.M , Banu.K, “Stabilization Of Black Cotton Soil By Using Coconut Coir Fibre And Lime”, IJARTET, 2018.
[5] IRC: 37: Guidelines for design of Flexible Pavements. Bureau of Indian Standards, New Delhi (2012).
[6] IS: 1498: Indian Standard for Classification and Identification of Soils for General Engineering Purposes. Bureau of Indian Standards, New Delhi (1970).
[7] IS: 2720 Part I: Preparation of Dry Soil Samples for Various Tests. Bureau of Indian Standards, New Delhi (1983).
[8] Karl Terzaghi, Ralph B. Peck and Gholamreza Mesri, Soil Mechanics in Engineering Practice, 2011.
[9] Steven L. Kramer, Geotechnical Earthquake Engineering, 2007.
[10] C. Venkatramaiah, Geotechnical Engineering, 2017.
[11] Gopal Ranjan, Basic and Applied Soil Mechanics, 2016.
[12] K. R. Arora, Soil Mechanics and Foundation Engineering, 2009.



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