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COMPARATIVE STUDY OF SOIL STRENGTH BY MIXING SOIL WITH RECRON 3S AND SISAL FIBRE

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Abstract - Soil reinforcement has been introduced into the field of geotechnical engineering for many years in order to improve the properties of ground soil in specific engineering projects. It is one of the most popular techniques used for the improvement of poor soil. Further, soil reinforcement causes significant improvement in tensile strength, shears strength, bearing capacity, as well as economy.

The main objective of the present project is to check the usefulness of Recron 3S fibre and sisal fibre in improving soil subgrade strength of low strength soil (Davanagere & Haveri soil). For this purpose a series of experiments were conducted which include Modified Proctor Compaction and Unconfined Compressive Strength (UCS) tests. A total of four samples of soil - fibre mixture were made with fiber content as 0.25%, 0.50%, 0.75% and 01% of dry weight of soil. Other tests for index and physical properties like Atterberg limits, Specific gravity and sieve analysis of parent soil were also carried out. Experimental results revealed that addition of Recron 3S & sisal fibre increases the UCS value of the soil.

From the results, it is also observed that to compare the strength in terms of UCS value adding different dosage of both Recron 3S & Sisal fibre. In this study to find the optimum dosage of Recron 3S & Sisal fibre to achieve maximum strength.

Key Words: Soil, Recron 3S, Sisal, Compaction test, Unconfined compression strength test.

1. INTRODUCTION

The term soil has sundry denouements, depending upon the general professional field in which it is being considered. To an agriculturist, soil is the substance subsisting on the earth's surface, which grows and develops plant life. To geologist additionally, soil is the material in the relatively thin surface zone within which roots occur, and all the rest of the crust is grouped under the term rock irrespective of its hardness. To an engineer, soil is the unaggregated or uncemented deposits of mineral and/or organic particles boulders covering sizably voluminous portion of the earth crust. Indian terrain is composed by sundry type of soil deposition. Some of the soil formations exhibit quandaries for designed and construction of civil engineering structures.

Low shear strength soils are the main cause of damages to civil engineering structures such as spread footings, roads, highways, airport runways, and earth dams constructed with dispersive soils. Stabilization by chemical additives, Overloading, dihydrogen monoxide content obviation are general ground amendment methods that are habituated to mitigate swelling quandaries. There has been a growing interest in recent years in the influence of chemical modification of soils which upgrades and enhances the engineering properties. The transformation of soil index properties by integrating Recron-3s fibre and Sisal fibre often alter to have a great potential as an economical method for ameliorating the geotechnical properties of expansive soils Recently there is a growing attention to soil reinforcement with variants of fibre.

2. OBJECTIVES

1. To evaluate physical properties of existing soil in laboratory and compare the property of various(2district) soil.
2. To determine the properties of soil and soil stabilized with recron 3s and sisal fibre with different percentage individually.
3. To find out the improvements in soil by the addition of optimum dose of Recron 3S fibers and sisal fibers mixes in terms of UCS value.
4. To determine the Effect of recron 3s and sisal fibre on shear parameters of soil.

3. LITERATURE REVIEW

Amrutha Mathew, Dr.Raneesh K.Y (2016): "Effects on strength characteristics of expensive soil using Sisal fibre and waste materials" says Sisal fibre, bagasse and glass powder waste can be utilized for improvement of strength properties of soil. Increasing maximum dry density and decreases the optimum moisture content with increase in percentage replacement of Sisal fibre, bagasse and glass powder. The optimum dosage of sisal fibre, bagasse ash and glass powder is 0.3%, 7% and 14% respectively

Krishna K Santhis, Sayida M K (2015) : "Behaviour of Black Cotton Soil Reinforced with Sisal Fibre". This soil has a high swelling and shrinkage properties. Hence in order to reduce these properties, addition of sisal fibres to the soil is required. Varying quantity of sisal fibre is added to the soil like (0.25%, 0.50%, 0.75% and 1.00%) by the dry weight of

the soil. Strength of the soil increases by addition of sisal fibre.

Muhammad Nawazish Husain, Praveen Aggarwal (2015):"Application of Recron 3S Fibre in Improving Soil Behaviour". He is concluded from present experimental work to evaluate performance and strength characteristics of local silty soil mixing with Recron -3s fibre.Varying quantity of Recron 3S fibre is added to soil like 0.15%,0.3%,0.45%,0.6%. Recron 3S fibre helps in improving soil subgrade strength of silty soil. In case of unconfined compressive strength testing Recron 3S fibre is showing an increasing trend in UCS value of treated soil. From the results it is also observed that further increase in the quantity of Recron 3S fibre (0.30%, 0.45% and 0.60% of dry soil) increases the UCS value but to a lesser extent.

Nandan.A.Patel,C.B Mishra (2015):"The improvement of soil strength using recron-3s fibres" explains in there paper on use of recron 3s as a additive material. Varying percentage of Recron-3s fibre added to dry soil is 0.5%, 1%, 1.5% and 2%. optimum dose of Recron-3s is found to be 1% of dry weight of soil. In this study shows the using Recron-3s the thickness of pavement can be reduced which will prove more economical and will also increase load carrying capacity.

4. METHODOLOGY

4.1 Materials

4.1.1 Recron 3S Fibre

Recron 3S is a modified polyester synthetic fibre. It is generally utilized as secondary reinforcing material in concrete and soil to increment their performance. Recron 3S sample utilized in experiment was of 12mm length and manufactured by Reliance Industries limited.

Utilization of Recron-3S as a reinforcing material is to increment the in sundry applications like cement predicated precast products, filtration fabrics etc. It withal provides resistance to impact, abrasion and greatly ameliorates the quality of construction during substratum, retaining wall design etc. Recron-3S fibre is the most widely used includes laboratory testing of soil reinforcement. Currently Recron-3S fibre is utilized to enhance the soil strength properties, to decrease the shrinkage properties and to surmount chemical and biological degradation.

4.1.2 Sisal Fibre

Sisal fibre is one of the most widely used natural fibre and is very facilely cultivated. It is obtain from sisal plant. The plant, kenned formally as Agave sisalana. These plants engender rosettes of sword-shaped leaves which start out toothed, and gradually lose their teeth with maturity. Each leaf contains a number of long, straight fibres which can be abstracted in a process kenned as decortication. During decortication, the leaves are beaten to abstract the pulp and plant material, leaving the tough fibres behind. The fibres can be spun into thread for twine and textile engenderment, or pulped to make paper products.

In this study sisal fibre is added different dosage (0.25%, 0.5%, 0.75%, 1%) by dry weight of soil.

4.1.3 Black cotton soil

The soil used for present study has been obtained from Haveri in Karnataka state India. This soil has been procured from a depth of 0.5 m below the natural ground level. This soil collected in a dry season

Physical Properties of Soil after Testing

Specific gravity: 2.5

Liquid limit: 38.1 %

Plastic limit: 27.57 %

Optimum Moisture Content: 17.2 %

Maximum Dry Density: 1.73 g/cc

UCC kN/m^2: 64.10

4.1.4 Red soil

A soil sample used for this study is collected from Davanagere Karnataka state India. This soil has been procured From a depth of 0.5m below the natural ground level. This soil collected in a dry season.

Physical Properties of Soil after Testing

Specific gravity: 2.53

Liquid limit: 26.4 %

Plastic limit: 15.41 %

Optimum Moisture Content: 11.6 %

Maximum Dry Density: 1.92 g/cc

UCC kN/m²: 38.3

5. RESULTS AND DISCUSSION

5.1 Proctor Compaction Test

This experiment was performed to obtain a relationship between the dry density of the soil and the moisture content of the soil. The experimental setup consists of a cylindrical metal mould, detachable base plate, collar, and hammer (2.5Kg). Compaction process helped in increasing the bulk density by driving out the air from the voids. The concept used in the experiment is that for any compactive effort, the dry density depends upon the moisture content in the soil. The maximum dry density (MDD) is achieved when the soil is compacted at relatively high moisture content and almost all the air is driven out, this moisture content is called optimum moisture content (OMC). The data obtained from experiment helped in plotting the curve with water content as the abscissa and dry density as the ordinate. From this curve, the OMC and MDD were obtained.

Table No 1 : Compaction Properties of Davanagere soil with Recron 3S fibre

Mixture	OMC %	MDD g/cc
Davanagere soil alone	11.6	1.92
DS+0.25% Recron 3S	12	1.86
DS+0.5% Recron 3S	12.9	1.84
DS+0.75% Recron 3S	13	1.81

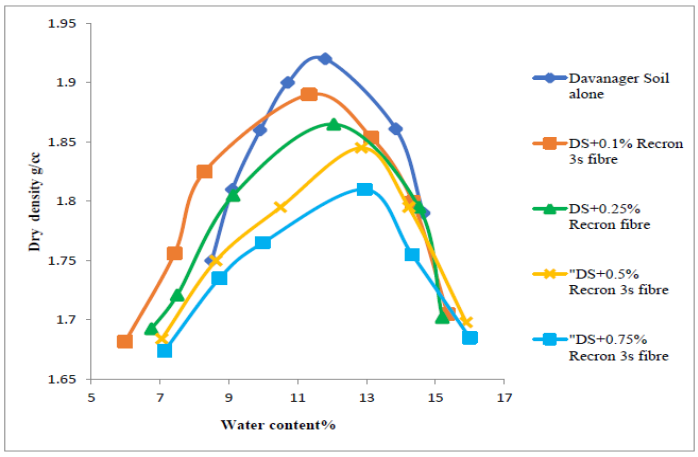

Figure 1 Compaction curve of Davanagere soil with Recron 3S

Table No 2 : Compaction Properties of Haveri soil with Sisal fibre

Mixture	OMC %	MDD g/cc
Haveri soil alone	17.2	1.73
HS+0.25% Sisal fibre	18.40	1.71
HS+0.5% Sisal fibre	18.50	1.67
HS+0.75% Sisal fibre	16.2	1.64

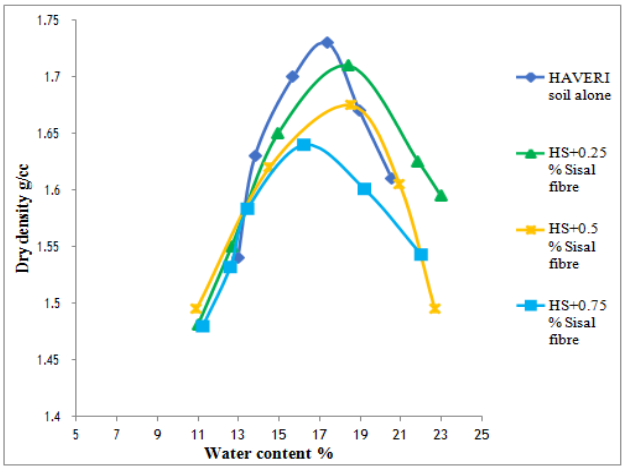

Figure 2 Compaction curve of Haveri soil with sisal fibre

5.2 Unconfined Compression Test

This test is usually performed on clayey soil to get their sensitivity values. It is used rapidly to assess clay consistency in field. The test helps in quickly evaluate the undrain cohesion. An undisturbed cylindrical specimen of dimensions 40 Diameter and 75 mm length was used in the test. In this study, both sample 1 and sample 2 possess negligible UCS which can't be determined despite of repetitive efforts. The graph of stress versus strain plotted with the help of results obtained.

Table No 3 : Variation of peak Shear Strength of Davanagere soil Reinforeced with varying percentage of Recron 3S fibre

Mixture	Peak Shear stress(KN/m²)
Davangere soil alone	38.3
DS+0.1% Recron 3S	85.9
DS+0.25% Recron 3S	110.5
DS+0.5% Recron 3S	128.5
DS+0.75% Recron 3S	154.2
DS+1% Recron 3S	161.1
DS+1.255% Recron 3S	155

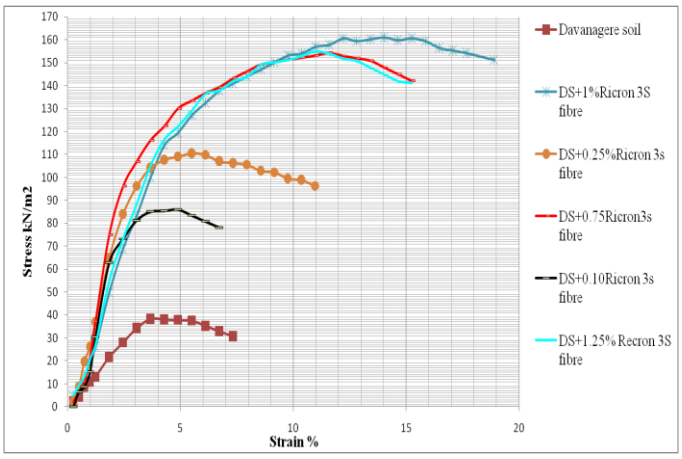

Figure 3 UCS variation curve Davanagere soil with Recron 3S fibre

Table no 3 and Fig 3, it is observed that, on compare to Davanagere soil alone, addition of randomly distribute Recron 3S fibre to Davanagere soil increases the strength up to 1% and beyond 1% fibre content in the matrix reduces strength. increase in strength mainly due to increase in the surface area of Recron 3S fibre. However the increased surface area of Recron 3S fibre in matrix leads to increase in strength as the friction developed between soil particles and the surface area of the fiber in mixture up to 1%. Beyond 1%, There will be fibre to fibre interaction develops and leads to decrease in strength. From Above discussion, Davanagere soil reinforced with 1% randomly distributed Recron 3S fibre (by weight of soil) is found to be optimum.

Table No 4: Variation of Peak Strength of Haveri soil Reinforced with varying Percentage of sisal fibre

Mixture	Peak Shear stress(KN/m²)
Haveri soil alone	64.10
HS+0.25% sisal fibre	90.70
HS+0.5% sisal fibre	92.10
HS+0.75% sisal fibre	106.4
HS+1% sisal fibre	102.8

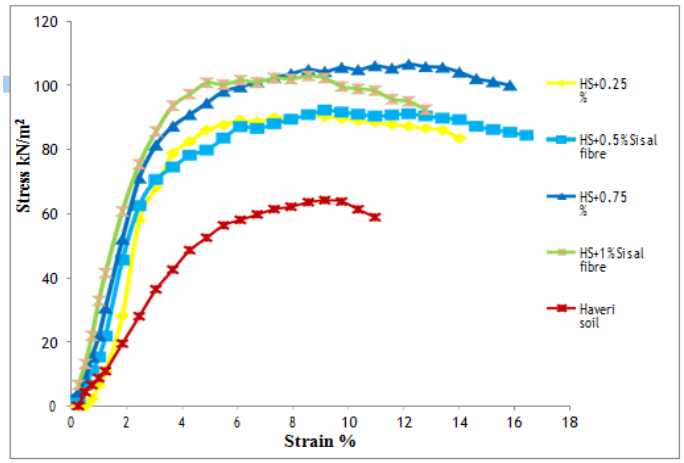

Figure 4 UCS variation curve Haveri soil with Sisal fibre

Table no 4 and Fig 4, it is observed that, on compare to Haveri soil alone, addition of randomly distribute Sisal fibre to Haveri soil increases the strength up to 0.75% and beyond 0.75% fibre content in the matrix reduces strength. increase in strength mainly due to increase in the surface area of Sisal fibre. However the increased surface area of Sisal fibre in matrix leads to increase in strength as the friction developed between soil particles and the surface area of the fibre in mixture up to 0.75%. Beyond 0.75%, There will be fibre to fibre interaction develops and leads to decrease in strength. From Above discussion, Haveri soil reinforced with 0.75% randomly distributed Sisal fibre (by weight of soil) is found to be optimum.

6. CONCLUSION

The following conclusion can be drawn based on the studies made.

- In this case of soil – fibre mixture as the content of fibre is increasing; its dry density goes on reducing. This may be because of the reason, as fibre content increases, soil- fibre packing becomes loose and it's become difficult to make samples even or decrease in maximum dry density may be due to the replacement of higher density soil by lower density Recron 3S & Sisal fibre in soil-fibre mixture. No trend of Optimum moisture content was observed while conducting experiments in laboratory. The probable reason for this could be the difficulty in maintain a constant temperature and humidity while conducting experiments in laboratory.

- Recron 3S fibre helps in improving soil subgrade strength of soil. It is evident from the UCS test results that UCS value of Davanagere soil increases from 38.3kN/m² to 85.9kN/m² (more than 50%) with addition of 0.10% Recron 3S fibre. From the results it is also observed that further increase in the quantity of Recron 3S fibre (0.25%, 0.5%,0.75%, 1% and 1.25% of dry soil) increases the UCS value but to a lesser extent. . From Above discussion, Davanagere soil reinforced with 1% Recron 3S fibre (by weight of soil) is found to be optimum.

- Sisal fibre is most widely used natural fibre improving subgrade soil. The UCS value of Haveri soil increases from 64.10kN/m2 to 90.73kN/m2 with addition of 0.25% Sisal fibre. From the results it is also observed that further increase in the quantity of Sisal fibre (0.25%, 0.5%,0.75% and 1% of dry soil) increases the UCS value but to a lesser extent. From Above discussion, Haveri soil reinforced with 0.75% Sisal fibre (by weight of soil) is found to be optimum.

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