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AN EXPERIMENTAL STUDY ON SOME GEOTECHNICAL PROPERTIES OF STABILIZED SOIL WITH RECRON-3S FIBRE

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Abstract: The growth of the population has created a need for better and economical vehicular operation which requires good highway having proper geometric design, pavement condition and maintenance. There are various infrastructure projects which are used in different highways, railways, water reservoir etc. which requires earth material in very large quantity. The highways have to be maintained so that comfort, convenience and safety are provided to the travelling public. The pavements along national and state highways in the Gujarat and many other states are damaged due to the poor strength of the soil used and low permeability. Soil stabilization is the process in which engineering properties of the different type soil is improved. It can be done by the use of controlled compaction, proportioning and addition of suitable different type of admixtures and stabilizers. Soil stabilization is very necessary for various construction works like road pavement and foundation because it improves the engineering properties of different soil. This project represents a study of the Recron-3s Fibre as the admixtures or stabilizers in improving some engineering properties soil. This experiment evaluates the effect of the Recron-3s on the some basic engineering properties of these soils such as California Bearing Ratio (CBR) value and Unconfined Compressive Strength (UCS). The different values adopted in the present study for the percentage of fiber reinforcement are 0.75%, 1.5 %, 2.25 % and 3 %.

Keywords: Recron-3S Fibre, Soil Stabilization, Unconfined Compressive strength.

1.0 INTRODUCTION

Transport is a vital infrastructure facility for the foundation development in India. Development of a country depends on the connectivity of various places with adequate road network. Roads are very vital for better and economical vehicle operation which requires good highway having proper geometric design, pavement and maintenance. The road has been maintained so that safety, comfort and convenience are provided to the traveling people. The movement of men and materials i.e. transport, trade, commerce, service sector which depend on heavy commercial vehicle loads and repetitive applications of it thereby producing heavier stresses on clayey soil ranges are known as bed condition and unpredictable conduct of the clayey contributing to fail of road. Owing to the engines of infrastructure growth of foundation development in India, a great many new road kilometers are expected to extend the system of activity veins in the booming economy to be sturdy and maintaining the quick extension in loaded weight of vehicles on pavement with changing atmospheric environment. It is the fundamental destination of pavement engineers and contractors is to build the quality or security of soil and to decrease the development cost by making best utilization of the provincially accessible materials. In developing countries like India, the biggest handicap to provide a complete network of road system is the limited finances available to build roads. Use of local materials, including local soils, can considerably lower down the construction cost. If the stability of the local soil is not adequate for supporting wheel loads, the properties can be improved by soil stabilization techniques. The stabilization of soil for use in subgrade for pavement is an economical substitute of costly paving materials. There are many techniques for soil stabilization either mechanical or chemical, but all of them require skilled manpower and equipment to ensure adequate performance. Randomly distributed fibre, when used as insertion in highway subgrade, can produce a high performance stabilized subgrade. Many investigators have used various types of fibres under different test conditions. The most important findings of the previous research work is that the use of certain fibre, such as synthetic and natural, in road construction can significantly increase pavement resistance to rutting, as compared to the resistance of non-stabilized pavement over a weak subgrade. Permanent deformation in each layer is the indicator of rut formation at the road surface. Consequently this is used as a criterion of pavement performance. However, it is difficult to comprehensively include permanent deformation in structural design procedure. There are problems in assessing the contribution made by each individual layer to the total rut depth visible at the pavement surface. Hence, the deformation that appears at the surface of a pavement is the sum of deformation of each of the pavement layers, together with that in the subgrade.

The concept of reinforcing soil masses by including some kind of fiber was practiced by early civilizations which used soil mixed with straw or other available fiber to improve durability and strength of the dried brick used as building materials. They found that fibrous soil works better than natural soil. Reinforced soils can be obtained by either incorporating continuous reinforcement inclusions (e.g., sheet, strip or bar) within a soil mass in a defined pattern (i.e., systematically reinforced soils) or mixing discrete fibers randomly with a soil fill (i.e., randomly reinforced soils). However, randomly distributed fiber reinforced soils have recently attracted increasing attention in geotechnical engineering. In comparison with systematically reinforced soils, randomly distributed fiber reinforced soils exhibit some advantages. Preparation of randomly distributed fiber reinforced soils mimics' soil stabilization by admixture. Randomly distributed fibers offer strength isotropy and limit potential planes of weakness that can develop parallel to oriented reinforcement. The process of soil stabilization helps to achieve the required properties in a soil needed for the pavement construction work. As needs be a literature audit was completed on the subject that was trailed by research facility tests and field tests. This paper portrays the properties of regular soil and settled it with differing rate of Recron-3s fiber as added substance material correspondingly the test properties are resolved.

1.1 NEEDS & ADVANTAGES OF SOIL STABILIZATION

Soil properties vary a great deal and construction of structures depends a lot on the bearing capacity of the soil, hence, we need to stabilize the soil which makes it easier to predict the load bearing capacity of the soil and even improve the load bearing capacity. The gradation of the soil is also a very important property to keep in mind while working with soils. The soils may be well-graded which is desirable as it has less number of voids or uniformly graded which though sounds stable but has more voids. Thus, it is better to mix different types of soils together to improve the soil strength properties. It is very expensive to replace the inferior soil entirely soil and hence, soil stabilization is the thing to look for in these cases.

- It improves the strength of the soil, thus, increasing the soil bearing capacity.
- It is more economical both in terms of cost and energy to increase the bearing capacity of the soil rather than going for deep foundation or raft foundation.
- It is also used to provide more stability to the soil in slopes or other such places.
- Sometimes soil stabilization is also used to prevent soil erosion or formation of dust, which is very useful especially in dry and arid weather.
- Stabilization is also done for soil water-proofing; this prevents water from entering into the soil and hence helps the soil from losing its strength.
- It helps in reducing the soil volume change due to change in temperature or moisture content.
- Stabilization improves the workability and the durability of the soil.

1.2 RECRON FIBRE

Recron 3S is changed polyester. It is by and large utilized as execution. Polyester (Recron) fiber utilized for the test having diverse sizes 6mm and 12mm. These filaments were produced using polymerization of unadulterated teraphthalic corrosive and Mono Ethylene Glycol utilizing an impetus. These strands were observed to be generally utilized as a part of solid innovation which has an uncommon triangular cross area and proportional width of fiber was around 32 µm– 55 µm.

Roles of Recron-3S

- Controls cracking
- Reduce water permeability
- Increases flexibility
- Easy to use

Figure 1: Recron Fibre

2.0 LITERATURE ON RECRON-3 S

Haricharan T S et al investigated the expansive soil stabilized with natural inorganic stabilizer. Soil stabilization has proven to be one of the oldest techniques to improve the soil properties. Literature review conducted revealed that uses of natural inorganic stabilizers are found to be one of the best options for soil stabilization. In this regard an attempt has been made to evaluate the influence of RBI-81 stabilizer on properties of black cotton soil through laboratory investigations. Black cotton soil with varying percentages of RBI-81 viz., 0, 0.5, 1, 1.5, 2, and 2.5 percent were studied for moisture density relationships and strength behaviour of soils. Also the effect of curing period was evaluated as literature review clearly emphasized the strength gain of soils stabilized with RBI-81 over a period of time. The results obtained shows that the unconfined compressive strength of specimens treated with RBI-81 increased approximately by 250% for a curing period of 28 days as compared to virgin soil. Further the CBR value improved approximately by 400%. The studies indicated an increasing trend for soil strength behaviour with increasing percentage of RBI-81 suggesting its potential applications in soil stabilization.

Kameshwar Rao Tallapragada et al investigated the use of synthetic fibers to minimize swell in expansive subgrades. This work is undertaken to evaluate the benefits of fiber reinforced subgrade soil in flexible pavements. Two types of fibers 1) Monofilament, 2) Nylon Thread are selected for study. An attempt was made to investigate the strength behaviour of locally available Black Cotton soil reinforced with randomly mixed (1) Monofilament and (2) Nylon Thread. The main purpose of this investigation is to study the variation in CBR, *C*–f, UCS and Swelling pressure of Black Cotton soil due to randomly distributed fibers in different concentrations and aspect ratio. Results showed that there was a decrease in value of cohesion and increase in value of f with addition of 0.75%, 1.5% and 2.25% of these fibers in Black Cotton soil. CBR value of Black Cotton soil also increases considerably due to addition of the fibers in soil. From UCS test it was found that Maximum Stress value of soil increases with increasing aspect ratio and fiber content. Swelling pressure of soil also decreases with addition some percentage of fibers in soil.

P. Rajendra Kumar et al studied the Effect of CBR of Black Cotton Soil Reinforced with Recron Fiber. Most of the soil available are such that they have good compressive strength adequate shear strength but weak in tension/ poor tensile strength. To overcome the same many researchers have concentrated their studies on soil improvement techniques by developing new such materials, through the elaboration of composites. The main objective of this study is to investigate the effect of fibers in geotechnical applications and to evaluate the strength of unsaturated soil by carrying out compaction test and CBR tests on soil sample. The fibers are cut in length of 6mm and 12 mm and mix randomly in varying percentages (0.50%, 1.0%, 2.0%, and 4.0%) 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 optimum moisture content of soil due to the addition of Recron fiber. It also indicates an improvement in the CBR value.

M. T. S. Lakshmayya et al studied the stabilization of expansive subgrade of pavement by usage of vitrified polish waste and geogrid provision. Black cotton soils or expansive soils which are vastly found in India are known for their susceptibility to varying moisture condition. This causes severe problem for pavement construction in areas where black cotton soils are predominantly present. To cope up with this problem in many sites, soil replacement technique is adapted which is very costly. In present investigation a study area from Samalkot to Uppada in Andhra Pradesh, India is selected having similar problem. Experiments are carried out to stabilize the soil with Vitrified Polish Waste (VPW) as an admixture and geogrid provision. The VPW is mixed in proportions of 5%, 10%, 15%, 20% to virgin soil and the engineering and index properties of soil are evaluated after stabilization. The subgrade soil is also tested for simulated traffic loading condition by providing geogrid membrane in the laboratory and result analysis proved that VPW has a good potential to be used as an additive for black cotton soil stabilization.

Dr.M.D.Subham explained that soil reinforcement is defined as a technique to improve the engineering characteristics of soil. In this way, using natural fibers to reinforce soil is an old and ancient idea. The effect of randomly distributed polypropylene fibers on Maximum dry density (MDD),Optimum moisture content (OMC), unconfined compressive strength (UCS),soaked California bearing ratio (CBR), hydraulic conductivity and swelling pressure of an expansive soil stabilized with rice husk ash and lime has studied. Following conclusions are drawn from this study: (i) the addition of rice husk ash and lime decrease the MDD and increase the OMC of the expansive soil. MDD goes on decreasing and OMC goes on increasing, with increase in percentage of poly propylene fiber in the rice husk ash-lime stabilized expansive soil. (ii) The addition of rice husk ash and lime increases the UCS and soaked CBR of the expansive soil. With the addition of polypropylene fiber to rice husk ash-lime stabilized expansive soil, the UCS and soaked CBR increases, up to 1.5 % addition of polypropylene fiber and decreases with further increase in polypropylene fiber content. The UCS and soaked CBR increases with increase in curing period irrespective of the percentage of addition of polypropylene fiber in rice husk ash Lime stabilized expansive soil

Arpansenet al.st studied Soil stabilization using waste fiber materials. This study investigate the use of waste fiber materials in geotechnical applications and to evaluate the effects of waste polypropylene fibers on shear strength of unsaturated soil by carrying out direct shear tests and unconfined compression tests on two different soil samples. The results obtained were compared for the two samples and inferences are drawn towards the usability and effectiveness of fiber reinforcement as a replacement for deep foundation or raft foundation, as a cost effective approach.

3.0 PREPARATION OF REINFORCED SOIL SAMPLES.

Following steps are carried out while mixing the Recron-3S to the soil.

1. All the soil samples are compacted at their respective maximum dry density (MDD) and optimum moisture content (OMC), corresponding to the standard proctor compaction tests.
2. Content of fiber in the soils is herein decided by the following equation:

$$\rho_f = \frac{W_f}{W}$$

Where, ρf= ratio of fiber content
Wf = weight of the fiber
W = weight of the air-dried soil

3. The different values adopted in the present study for the percentage of fiber reinforcement are 0.75%, 1.5 %, 2.25 % and 3 %.
4. In the preparation of samples, if fiber is not used then, the air-dried soil was mixed with an amount of water that depends on the OMC of the soil.

If fiber reinforcement was used, the adopted content of fibers was first mixed into the air-dried soil in small increments by hand, making sure that all the fibers were mixed thoroughly, so that a fairly homogenous mixture is obtained, and then the required water was added.

4.0 UNCONFINED COMPRESSION TEST

The unconfined compressive strength is the load per unit area at which the cylindrical specimen of a cohesive soil falls in compression and by plotting the axial stress and strain in the graph, following unconfined strengths are computed as per reinforcement.

Table 1: Unconfined compression test

Sample	**Unconfined Compression strength**
0	0.0584
0.75	0.0847
1.5	0.0958
2.25	0.1087
3.0	0.1234

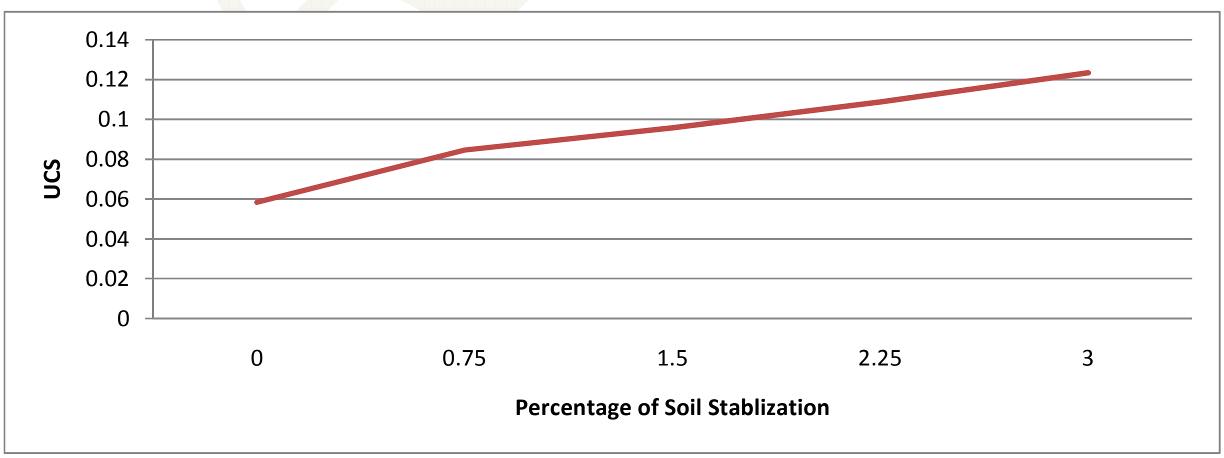

Fig 2: Relationship between UCS and Fibre content

CONCLUSION

The effect of Recron Fibre on soil samples were studied by conducting tests with various percentages of Recron Fibre and the following conclusions were drawn.

1. Strength of soil can be increased to the certain extent by using additive materials in soil. Especially Recron 3s, when mixed with soil gives a wonderful result.
2. Fiber absorbs everything and keeps the road surface intact and many problems can be solved like potholes, cracking & failure of pavement.
3. From the arrangement of standard delegate tests directed, we found that the OMC of the strengthen soil increments with the pickup of the fiber content.
4. There is considerable decrease in cohesion of soil with Recron Fibre thread. Though F value increase with addition of both the reinforcing materials.
5. Unconfined compressive strength of the soil increases with the addition of Recron Fibre.
6. From the series of standard proctor tests conducted, we found that the OMC of the reinforce soil increases with the gain of the fiber content.
7. The new technique of soil stabilization can be effectively used to meet the new challenges of society, producing useful material from non-useful waste materials.
8. The variation of the friction angle of clayey soil with percentage of Recron Fibre is a nonlinear variation and similar trend is found in sandy soil.
9. The Recron Fibre decreases the maximum dry unit weight of the soil and optimum moisture content. The variation of optimum water content and maximum dry unit weight with Recron Fibre content is linear, the shape of the compaction curves are similar to those of unreinforced samples.

REFERENCES

1. Kolla Aswani Chandh, "A Study on Effect of Fibre on Non Swelling Sub Grade Layer", International Journal of Engineering Science and Computing, September 2016, Volume 6 Issue No. 9.
2. R.V.Giridhar, "An structured teaching program on geotechnical application and soil treated", Scientific Journal of India, ISSN: 2456-5644 (Online) ,Vol. 01
3. P.Sowmya Ratna, "Performance of Recron-3s Fiber with Lime in Expansive Soil Stabilization", IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684.
4. Hussain, M. and Dash, S. K. (2009), "Influence of Lime on Compaction Behaviour of Soils", Geotides, Indian Geotechnical Conference, Guntur, India, IGC-2009.
5. B.R. Phanikumar, C. Amshumalini and R. Karthika(2009)"Effect of Lime on Engineering Behavior of Expansive Clays", IGC-2009,Guntur,pp.80-82.
6. Siddique, A. M. and Hossain, A. (2011), "Effects of Lime Stabilization on Engineering Properties of an Expansive Soil for Use in Road Construction." Journal of Society for Transportation and Traffic Studies, 2(4).
7. Ankit Singh Negi, Mohammed Faizan, Devashish Pandey Siddharth, Rehanjot singh ,(2013)"Soil Stabilization Using Lime", International Journal of Innovative Research in Science, Engineering and Technology Vol. 2, Issue 2, pp.448-453.
8. Sunilakumar Biradar, Shivaraj Biradar and A.D Kotagond (2014), "Stabilization Stabilization of Black Cotton Soil by Using Lime and Recron Fibers", IJREAT International Journal of Research in Engineering & Advanced Technology, Volume 2, Issue 4, Aug-Sept, 2014,pp.1-4.
9. IS: 2720 (Part V) – 1985, Determination of Liquid and Plastic Limit.
10. IS: 2720 (Part VIII) – 1987, Determination of Water Content – Dry Density Relation Using Light Compaction.
11. ASTM D422 (2002), (Standard Test Method for Particles Size Analysis of Soil).
12. ASTM D854 (2002), (Standard Test Method for Specific Gravity of Soil Solids by Water Pycnometer).
13. ASTM D4253 (2000), (Standard Test Method for Maximum Index Density and Unit Weight of Soils and Calculation of Relative Density).
14. ASTM D4254 (2000), (Standard Test Method for Minimum Index Density and Unit Weight of Soils Using Vibrated Table).
15. ASTM D3080 (2000), (Standard Test Method for Direct Shear Test of Soils under Consolidated Drained Conditions).
16. ASTM 4318 (2000), (Standard Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils
17. ASTM 698 (2000), (Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort).
18. ASTM 2487 (2000), (Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)).