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Stabilisation of Red Soil By using Coconut Coir Fibre and Rice Husk Ash

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Abstract: ***The focus of this report is to study the feasibility of stabilizing the soil by using rice husk ash and coconut coir fibre, thus re-using the waste materials and providing an economical and eco-friendly method of soil stabilization. Soil stabilisation is a system to treat the soil to improve the performance of the soil. The capacity, rice husk ash as stabilizing additive to expansive soil is evaluated for the enhancing engineering properties of expansive soil. The Assessment includes the dedication of the swelling capacity, plastic limit, liquid limit, plasticity index, cohesion & compaction characteristics of the expansive soil. For the soil which lacks enough stability, various stabilization techniques can be adopted. Various percentage of rice husk ash and coconut coir Fibre (5% to 25%). the practices were executed on 5 proportions 5% ,10%,15%, 20% and 25% with the sample. The optimum value of the assessment is found at the proportion of 15% in table 3i.e.the value of unconfined compressive strength is 142kN/m2. Expansive clays are very problematic soils and not suitable for construction. Because of the change in volume when it exposes to water. Usually in rainy season, they absorb water and swells and in summer it shrinks.***

Keywords**: Coconut coir fibre, Red soil, Rice husk ash, Soil stabilization**

I. INTRODUCTION

For any land-based structure, the foundation is very important and has to be strong to support the entire structure. In order for the foundation to be strong, the soil around it plays a very critical role. So work with soils, proper knowledge about their properties and factors which affect their behaviour is necessary. Stabilization contains the systems used for enhancing the properties of soil. In this study, an attempt has been made the investigation of Rice Husk Ash (RHA)and Coconut Coir Fibre to stabilize the red soil.

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Different proportions of Rice husk ash and coconut coir fibre was added to determine the basic geotechnical properties of red soil such as specific gravity, compaction, unconfined compressive strength, and maximum dry density.

It has been observed that the addition of rice husk ash (RHA) and coconut coir fibre did not changed the plasticity characteristics of the soil. Compaction tests showed that maximum dry density and optimum moisture content increases after adding these two admixtures. At one point the maximum dry density and optimum moisture content decrease by adding of rice husk ash and coconut coir fibre. In order to decrease such volume of waste, rice husk is seared either in open stores or as a fuel in stoves for rice drying, control age, etc. The expending volatilizes the regular blends and water of the rice husk, and about 20% of the mass remains as rice husk flotsam and jetsam (RHA). In case all rice husks had been seared, it would each year produce around 20 countless gigantic measures of RHA around the globe. To regard this development is an alternative as opposed to its last air with natural preferred position. Auxiliary structure adventures arranged in domains with fragile or weak soils have usually combined improvement of soil properties by using various procedures. Soil Change is being used for a combination of planning works, the most generally perceived application being in the advancement of road and pavements, where the standard target is to grow the quality or quality of soil and to decrease the advancement cost by using the locally available materials. Over the events, bond and lime are the two essential materials used for offsetting soils. These materials have rapidly extended in cost in view of the sharp augmentation in the cost of imperativeness. As such the usage of rustic waste, (for instance, rice husk trash - RHA) will astonishingly diminish the cost of advancement and too reducing the regular risks they cause. Rice husk is a provincial waste gained from preparing rice. Around 108 tremendous measures of rice husk are delivered each year on the planet. In this manner, usage of RHA for refreshing of soil should be encouraged.

II. OBJECTIVE

The objective of this paper is to study the stabilization of red soil by using ad-mixtures like Rice husk ash (RHA) and Coconut coir fibre. Rice husk ash is used as partial cement in different percentages of performance and strength. The demand for producing the rice husk ash as durable construction material results in the environmental pollution. Coir fibre is obtained naturally from the coconut husk and situated in between the hard-internal shell and external coat of the coconut. Coconut coir fibre is a fibrous material and researched as an alternative material in the construction site.

The bonding behaviour of the coir fibre is high with the hardening materials like cement.

- Order to find physical properties and Engineering properties of Red soil.
- Studying interaction behaviour of Red soil with admixtures.
- Order to develop various strength characteristics of Red soil using a different percentage of admixtures.

III. METHODOLOGY

Collecting the sample of soil from different areas and performing the physical properties of the soil with the collected sample, it gives the safe bearing capacity of the soil. And stabilizing the soil by using the admixtures and recording the optimum values of geotechnical properties such as physical properties and engineering properties of the Red Soil.

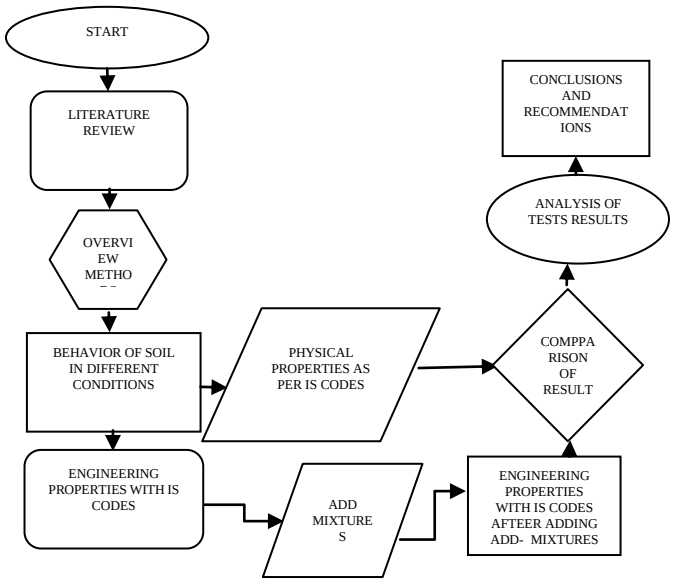

Fig.1.Step by step methodology

Fig.2.Sieve setup

Fig.3.Standard proctor setup

Fig.4. Unconfined Compressive Strength

A. Materials Used

As we all know very well that red soil is available everywhere all over India. To stabilize the red soil we use various techniques in the laboratory. Along with the red soil, we are using the various admixtures to stabilize the red soil.

B. Red soil

The soil is formed when rocks are broken down by the action of wind, water and climate. This process is called weathering. The red soils are formed due to weathering process by wind, water and nature due to weathering of the igneous rock. The feel of red soil is varied from sand to clay. In the red soil lime, kankar and free carbonates are absent and these soils are rich in lime, magnesia, phosphates, nitrogen, humus, and potash. The water holding or water-absorbing capacity of these soils is less. They can produce excellent crops like cotton, wheat, pulses and fruits. The red soil required for the experiments is collected from the village vaddeswaram to KL University. The red soil is carried out to the laboratory in bag.

Fig.5. Red soil sample

C. Rice Husk Ash (RHA)

Rice husk is a material obtained from the rice milling plants after the rice is isolated. It is a natural material and by-product of the agriculture, the cheapest and pollution-free material. The properties of RHA is depended on burning conditions (rate of heating, temperature, and duration of heating). It improves the compressive strength and the bearing capacity of the soil. RHA is a good reactive material to cement in construction and known as alternate cement.

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Fig.6. RHA sample

D. Coconut Coir Fiber

This fibrous material is naturally obtained from the environment. It is relatively a waterproof material and, is one of the few natural fibres which can resist the damage of saltwater. Coconut coir Fiber is separated from the husk of coconut and utilized in items example, Ground mats and Doormats. Coir Fiber is the fibrous material found in the middle of the hard, inner shell and the external layer of coconut. the physical property of the coir fibre is, the length of the fibre is 6-8 inches. The diameter of the fibre I 0.1 to 0.5mm and swelling in water is 5%.

Fig.7. Coir fibre sample

IV. EXPERIMENTAL PROCEDURES

Sieve Analysis: After the collection of the soil sample from the selected area first we performed the sieve analysis with practice code of (IS code (IS: 2720 (Part-IV), 1965). First, we have taken the soil sample of 1000 gm and sieved in the laboratory with standard set of sieves with the sizes 4.75mm, 2.36 mm, 1.18 mm, 0.6 mm, 0.25 mm, 0.15 mm, 0.075 mm, pan. Place the required soil sample on the top sieve, close the lid and transfer stack of sieve set to a mechanical sieve shaker. Shake the soil sample for a period of 10 minutes. Remove the stack of sieves on the shaker and record the mass of the material retained on each sieve. Compute the percentage retained on each sieve by dividing the weight retained on each sieve to the original mass of the sample. Compute the per cent finer by 100% and subtract the per cent retained on each sieve as cumulative procedure. The results of the sieve analysis are given in table 1.

After the performance of the sieve analysis we have done the specific gravity(As per IS (IS: 2720 (Part-HQ, 1964) for the soil sample with the sieved soil sample. After washing the density bottle record the weight of the density bottle with stopper. Take the soil sample of 50g which is passing through2mm IS sieve. Remove the entrapped air by connecting it to the vacuum pump and shake it thoroughly to remove the air bubbles in the density bottle. Immerse the bottle in the constant temperature up to the neck of the bottle. Record the temp. And mass of density bottle with water soil sample and stopper. After the completion of the specific gravity with the practise code mentioned in the above lines. The result of specific gravity is mentioned in table 1.

Later we proposed to the next experiment named as Determination of the consistency limits (Liquid limit, plastic limit, shrinkage limit) as per IS code (2720-(PART-5)-1985). Take 200g of soil sample which is passing through the 425-micron sieve and add water to the desired amount of distilled water to the soil until the paste becomes homogenous. Apply the grease to the Casagrande's apparatus for smooth running. Using ASTM grooving tool make a particular through the soil pat this divides the soil into two symmetric parts. Rotate the handle the 2revolutions minute and count the no of blows, blown. Take 25g of the soil sample from the above soil paste and determine the water content by oven dry method. Take 20g of air-dried soil passing through 425-micron sieve. Take soil of 10g and roll it into soil threads of 3mm diameter between the palm and glass plate. If the thread is 3mm without any cracks that indicates that the water is added more than its plastic limit. Take the 2 or 3 samples and repeat the process and record the average of the soil samples. Up to here the physical properties of the soil is determined. The results of the liquid limit, plastic limit and shrinkage limit is mentioned in table 1.

In engineering properties of soil first we are going to determine about the standard proctor test As per IS (IS: 2720 (Part VII-1980) practise code, measure the internal diameter of the mould and calculate the volume. Record the empty mass of the mould with base plate and insert the collar on the top of it. Take 3000g of soil sample passing through 4.75 mm in a wide-mouthed tray and mix thoroughly in its dry state. Apply the oil to the inner layer of the mould and compact the soil in three layers with compaction mould by imparting 25 blows for each layer using proctor hammer. Carefully remove the collar without disturbing the soil and cut the soil up to the top level of the mould with a knife. The results of standard proctor test are mentioned in table 2. After performing the standard proctor test we have proceeded to unconfined compressive test with the practice IS code (IS 2720 (Part -10): 1991) In this test the specimen is prepared either undisturbed remoulded or compacted. Place the specimen in the bottom plate of the compression machine and adjust the upper plate in contact with the specimen. Select an axial strain rate between 0.5% to 2.0% per minute and apply a compression load. Record the load and displacement readings at every 20 to 50 divisions of displacement gauge. Compress the specimen till the load peaks or till the vertical deformation reaches 20% of the specimen length. Take the specimen and collect 2 or 3 samples from the sample for water content determination. At last, we have performed the free swell index according to the laboratory schedule with the practice IS code(IS: 2720 part –XI) take two specimens of 10 each which are passing through 425-micron sieve and oven-dried. Pour each sample in two glass tubes separately. Pour the distilled water in one glass tube and kerosene in another glass tube of 100ml capacity and up to the mark on the cylinder; remove the entrapped air by shaking it thoroughly or stirring with the glass rod. Finally, the volume of each cylinder should be readout. The results of unconfined compressive strength are mentioned.

V. RESULTS

The strength of the soil is increased according to the per cent of rice husk ash added to the soil. We got the optimum value at 15% of rice husk ash and 5% of coconut coir fibre and after 15% the strength of the soil is getting decreased.

A. Geotechnical Properties of the Soil

Select the soil sample in nearby the college and collect the selected the soil sample, the selected soil is transported to laboratory in sacks. The soil sample that we have selected from the area is named as Undavalli. Later with the disturbed soil sample, we have performed all the physical properties of red soil in the laboratory and the results that are obtained, i.e. Specific gravity (2.69)As per IS (IS: 2720 (Part-HQ, 1964), I S Sieve analysis (reddish clay)As per IS code (IS: 2720 (Part-IV), 1965), Moisture content(19.68%)As per IS code (IS-2720-PART-2-1973), Liquid limit(43.28%)As per IS (IS: 2720 (Part 5) - 1985), plastic limit(28%)As per IS (IS: 2720-(PART-5)-1985), and Free Swell index(50%).

All over the completion of the physical properties, the project is further processed to the engineering properties. After the performing the engineering properties in the laboratory, the values obtained are Standard maximum dry proctor test density(1.67g/cc)As per IS (IS: 2720 (Part VII-1980), optimum moisture content(12%)As per IS code (IS-2720-PART-2-1973), unconfined compressive strength test(125kN/m2)As per IS code (IS 2720 (Part 10): 1991), and Cohesion(62.5kN/m^2)As per IS code (IS: 2720 (Part 13) - 1986)these are the values of the soil sample without adding the admixtures. After the addition of coconut coir fibre and rice husk ash with 5% proportion the results are varied from the above results i.e. Standard proctor test maximum dry density (1.72g/cc)As per IS (IS: 2720 (Part VII-1980), optimum moisture content (12.4%)As per IS code (IS-2720-PART-2-1973) (unconfined compressive strength test (128kN/m^2)As per IS (IS: 2720 (Part VII-1980, and Cohesion (64kN/m^2)As per IS code (IS: 2720 (Part 13) - 1986). After the 5% proportion, the percentage of rice husk ash is increased to 10% and the percentage of coir fibre remains constant throughout the project. The results obtained are Standard proctor test maximum dry density (1.78g/cc)As per IS (IS: 2720 (Part VII-1980) optimum moisture content (12.6%)As per IS (IS: 2720 (Part VII-1980), unconfined compressive strength test (130kN/m^2)As per IS (IS: 2720 (Part VII-1980), and Cohesion (65kN/m^2) As per IS code (IS: 2720 (Part 13) - 1986) Again, the percentage of rice husk ash is increased to 15%. At 15% proportion we got the optimum values of engineering properties (table 1), Standard proctor test maximum dry density (1.86g/cc)As per IS (IS: 2720 (Part VII-1980) optimum moisture content (11.6%)As per IS code (IS-2720-PART-2-1973), unconfined compressive strength test (142kN/m^2)As per IS (IS: 2720 (Part VII-1980), and Cohesion (71kN/m^2)As per IS code (IS: 2720 (Part 13) - 1986) Again, the proportion of rice husk ash is increased to 20%. At 20% the strength of the soil is observed decreasing compared with the above proportion (15%). At last, the percentage of rice husk ash is increased to 25% it results in decreasing the strength of the soil, the values obtained at higher proportion are Standard proctor test maximum dry density (1.56g/cc)As per IS (IS: 2720 (Part VII-1980), optimum moisture content (15.6%)As per IS code (IS-2720-PART-2-1973), unconfined compressive strength test (104kN/m2). As per IS (IS: 2720 (Part VII-1980), and Cohesion (52kN/m^2)As per IS code (IS: 2720 (Part 13) - 1986).

Soil classification: Reddish Clay.

Cu (Coefficient of uniformity) = 1.56

Cc (Coefficient of curvature) = 3.24

Liquid Limit:

Mass of soil =300 grams

Passing sieve =425-micron sieve

Liquid limit = 43.8%

Plastic Limit:

Empty weight of Bottle (w_1) =22.48g

Weight of bottle and wet soil(w_2) =24.26g

Weight of dry soil (w_3) =23.86g

Plastic Limit =28 %

Specific Gravity =2.69

Standard Proctor:

MDD (maximum dry density) = 1.67 g/cc

OMC(optimum moisture content) =12%

Free Swell Index:

Free Swell Index = (V_d- V_k) / V_k = 50%

UCC (unconfined compressive strength)= 125 kN/m^2

Cohesion(C) = 62.5 kN/m^2

Moisture Content= 19.68%

Table No.1 Red Soil + 5 % Coconut Coir Fibre + 15 % Rice Husk Ash

Test	Results
MDD	1.89 g/cc
OMC	11.60%
q_u	142 kN/m^2
Cohesion	71 kN/m^2

VI. CONCLUSION AND DISCUSSION

After the study of several experiments that are being performed in the laboratory, we found following significance in Rice Husk Ash (RHA)and Coconut Coir Fibres good stabilizing agents of Red soil.

I. Determined the natural and engineering properties of Red soil.

II. In our experiments, the adding of RHA and coconut coir fibre increases soil strength and we got optimum value at 15%. Keep on increasing the percentage of RHA, after 15% the strength of soil decreases.

III. In UCC test we got maximum compression strength at 15% of RHA and 5% of coconut coir fibre. Keep on increasing the percentage of RHA, after 15% the strength of the soil reduces.

IV. Largest cohesion value of soil sample is 71 kN/m2 at 15% of RHA and 5% of coconut coir fibre mixed with the soil.

V. So, we have concluded that, by adding 15% of RHA and coconut coir fibre to the red soil, it gives optimum values.

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