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Stabilization of Black Cotton Soil using Lime, Coir Fiber & Rice Husk

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ABSTRACT

Because of their low bearing capacity, the expansive black cotton soils' high swelling and shrinking characteristics have posed numerous challenges to construction projects. When subjected to varying levels of moisture, black cotton soil expands and contracts rapidly. As a result, stabilising the soil is necessary to address these issues. Rice Husk Ash (RHA), Cori Fiber, and Lime are being tested in this study to see if they can act as a stabilising material in the expansive black cotton soil. The impact of RHA, CF, and LIME on the expansive soil's index and engineering properties was studied in the lab. Coir fibre concentration is 1.5 percent, lime is 5 percent by weight of dry soil, and RHA is mixed in at a ratio of 20 percent. The virgin soil sample is first tested for specific gravity and grain size distribution. With and without these admixtures soil's index properties like its plastic limit, liquid limit and shrinkage limit and its strength properties like its California Bearing Ratio, Unconfined Compressive Strength tests are discovered. According to the test results, a combination of 5 percent lime and 1.5 percent coir fibre yielded the strongest soil and best index properties.

***Keywords*—** Rice Husk, Ash, RHA, Coir Fiber, Lime

I. INTRODUCTION

The foundation of a building is critical in any construction project because it must support all of the structure's weight on the ground. In order to build a strong foundation, the soil around the structure is essential. Since the structure resting on expansive soils such as black cotton soil can crack at any time without warning, engineers have always had a difficult time with the foundation. When exposed to moisture, black cotton soils have high swelling and shrinkage characteristics, making them expansive soils. The mineral montmorillonite is responsible for this peculiar behaviour. Structural failure is commonplace when structures built on top of eroding soil experience cyclic swelling and shrinking. Due to their low strength, high compressibility, and volumetric changes, these soils are not suitable for construction activities. There are a number of ways to address these issues, including soil modification and soil stabilisation. In order to address the issues raised by these soils, a wide range of innovative techniques must be considered in order to improve soil stability. It is generally the alteration of soil properties in order to improve the soil's performance. Improved soil bearing capacity and weathering process and soil permeability are the primary goals of soil stabilisation. For any construction project, the longevity of the underlying soils plays a major role. Structures have a lot of trouble when the soil is unstable. Soil stabilisation techniques are therefore essential to ensure the stability of the soil in order to successfully support the weight of the superstructure, especially in the case of expansive soil.. There are many ways to improve the quality of the soil for construction projects, but chemical stabilisation of clay using lime is one of the most universal methods.

II. LITERATURE REVIEW

K.SURESH, APSAR SULTANA [2009]

Due to the rapid growth of urbanisation and industrialization, soil improvement is a major concern in construction activities. Techniques that improve the index properties and other engineering characteristics of expansive soils are referred to as soil improvement. High-plastic clay is found in expansive soils. Montmorillonite is the primary clay mineral in them. A large amount of

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shrinkage and swelling occurs in the soils. The soils are extremely weak when it comes to severing. To put it another way, the soils are extremely compressible. Working in such soils is a near-impossible task. Remaining deposits of basalt or trap rocks are the source of these soils. The structure resting on the soil resists the tendency of expansive soil to increase in volume as a result of water infiltration, resulting in vertical swelling pressure on the structure. If the soil isn't allowed to expand naturally, swelling pressure will build. Swelling pressure is proportional to how much expansion is allowed. If the soil's swell pressure is not properly controlled, it can lead to uplift and instability. Black cotton soil stabilisation with stone and fibre distress in structure was studied in an experimental manner Black cotton soil is being tested to see how index properties and engineering characteristics are affected by the addition of jute fibres in various proportions (up to 5% by weight of dry soil). 3 The unconfined compressive strength and bearing ratio in California have both increased significantly. From 1.8 percent to 4.1 percent, the California bearing ratio and the unconfined compressive strength increase. 4 Swelling of black cotton soil was reduced and its C.B.R. and unconfined compressive strength properties were increased by adding jute fibres to the soil, as demonstrated by the test results.

SK. MEHRUDDIN .P. RANGA RAMESH [2017]

There have been reports of black cotton soils on igneous rocks, sedimentary rocks, and metamorphic rocks, among others. Basalt, norite, andesite, diabasics, dolerites, gabbros, and volcanic rocks (e.g. gneisses) with calcium-rich feldspar and dark minerals at the top of the weathering order are the primary sources of these mainly chemically weathered mafic (basic) igneous rocks, as well as their metamorphic derivatives (e.g. gneisses). If conditions are right, clay minerals can form from any of the constituent elements. Quartz-free soils tend to have fine-grained, mostly clay-sized plastic particles that are less permeable and more susceptible to flooding. Black cotton soil may also form because of the abundance of magnesium and calcium in this rock, which can lead to swells (Ola, 1983). Sedimentary materials such as shales, lime stones, slates, etc. have also accumulated over the black cotton soils. When weathering occurs, clay residue is left behind in the form of feldspar and ferromagnesian minerals in the parent materials, which Ahmad (1983) found to be a common feature in all of the parent materials. Additional alkali earth elements can also be added by seepage or flooding waters in rocks that are not mafic (basic). Securing the Black Cotton Soil Using With 2 percent plastic waste replacement in a standard proctor test, it has been found that OMC values initially decrease. OMC, on the other hand, increased up to 5 percent plastic before decreasing below the 2 percent threshold. OMC values were nearly identical at 2% and 4% plastic. All tests showed a significant rise of 1.47 g/cc MDD value when 2 percent plastic was used in place of other materials. Thus, it can be concluded that the ideal plastic content for the plastic strips considered in this study is 2%.. It went from 14% at 0% plastic to 26% at 2% plastic in terms of CBR value gain. The CBR value begins to decline at about 2% plastic content. Plastic strip reinforcement increases soil strength, it can be inferred. As a result, it can be concluded that the ideal percentage of plastic for increasing CBR is 2 percent. The maximum compressive strength of the soil was found to be 2 percent plastic in the unconfined compression test, based on the results. The unconfined compressive strength was 2.36 kg/cm2 without any plastic replacement, and at 2% plastic, it nearly doubled to 4.96 kg/cm2. As a result of this research, it can be said that plastic waste from stationery items can be used to enhance the strength characteristics of black cotton soil. Using plastic in this way helps to protect the environment as well.

III. LOCATION DETAILS

The village of Eruthempathy in Kerala's Palakkad district is part of the ChitturTaluk. It is located 15 kilometres from Chittur, the sub-district headquarter, and 30 kilometres from Palakkad, the district headquarter. Eruthempathy is the grammepanchayat of Eruthempathy village, according to the 2009 census. The village has a total land area of 1986 hectares. The total population of Eruthempathy is 9,469 people. About 2,542 homes can be found in the Eruthempathy neighbourhood. Eruthempathy's nearest town, Chittur, is about 15 kilometres away.

Figure 1 location map

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IV. EXPERIMENT & RESULTS

Various laboratory experiments were carried out to determine the engineering properties of the black cotton soil sample, such as the water content, specific gravity, liquid limit, plastic limit, plasticity index, optimal moisture content, and maximum dry density.

Specific gravity

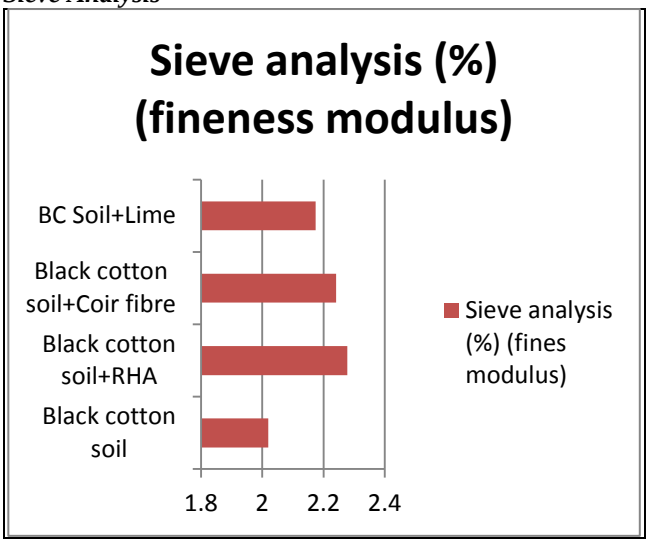
Black cotton	Black cotton + Rice husk ash	Black cotton + Coir fiber	Black cotton + Lime
2.36	2.00	1.85	1.83

Figure 2: Specific gravity test

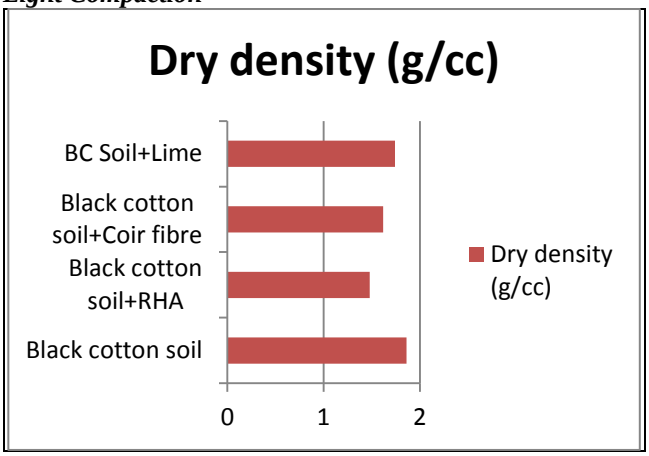
Atterberg's Limit

Tests	Black cotton	Black cotton + Rice husk ash	Black cotton + Coir fiber	Black cotton + Lime
Liquid limit %	27.5	47.2	41.43	34.52
OMC %	15	23	36.5	13
Plastic limit %	20.54	26.65	37.5	0.65
Plasticity index	7	20.55	3.925	33.87

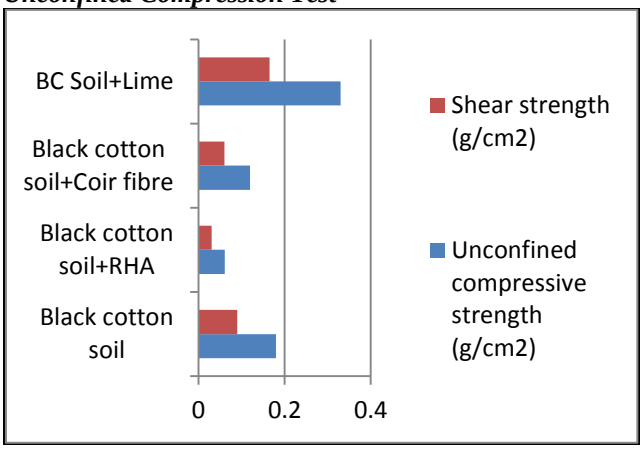
Sieve Analysis



Light Compaction



Unconfined Compression Test



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CBR Values

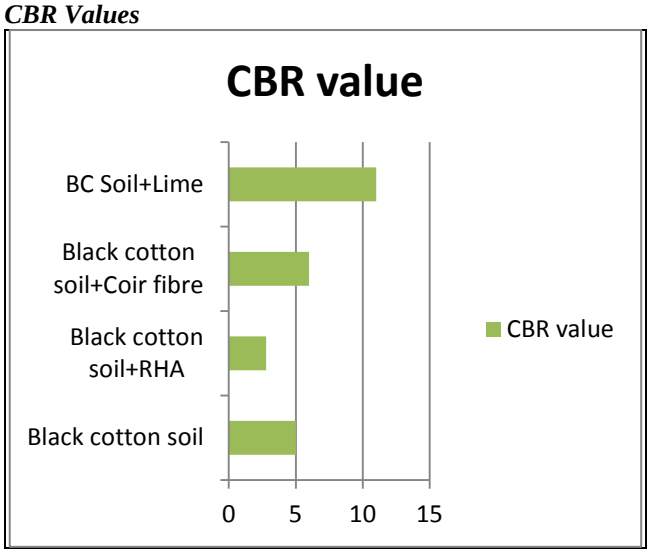

Figure 3: CBR test

V. CONCLUSION

It is critical to stabilise the problem clay in black cotton soil because of its high expansion. When these admixtures are used (20 percent RHA, 1.5% Coir fibre, and 5% LIME), it is stabilised. Soil and admixtures were tested in a laboratory. Studies like grain size distribution, specific gravity, elongation at break, Atterberg limits, UCC, and CBR are all examples of these. Soil indices, OMCs, dry densities, and strengths can all be measured with these techniques. In order to ensure the soil's stability and to improve its engineering properties, various admixtures are added to it and tests are run on it.

REFERENCES

[1] Ankit Singh Negi et.al. (2013). Soil stabilization using lime. *International Journal of Innovative Research in Science, Engineering and Technology*, *2*(2), 448-453.
[2] Aparna Roy. (2014). Soil stabilization using rice husk ash and cement. *International Journal of Civil Engineering Research*, *5*(1), 49-54.
[3] Asma Muhmed & Dariusz Wanatowski. (2013). Effect of lime stabilisation on the strength and microstructure of clay. *IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE)*, *6*(3), 87-94.
[4] B.Suneel Kumar & T.V.Preethi. (2014). Behaviour of clayey soil stabilized with rice husk ash & lime. *International Journal of Engineering Trends and Technology(IJETT)*, *11*(1), 44-48.
[5] C.Cherianet.al. (2016). Reappraisal of optimum lime contentdetermination for lime stabilization of fine-grained soils. *6th Asian Regional Conference on Geosynthetics-Geosynthetics for Infrastructure Development*, pp. 260-275.
[6] Dr. D. KoteswaraRao, G.V.V. RameswaraRao & P.R.T. Pranav. (2012). A laboratory study on the affect of rice husk ash & lime on the properties of marine clay. *International Journal of Engineering and Innovative Technology*, *2*(1), 345-353.