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A Comparative Study on Stabilization of Expansive Soil with RBI Grade 81 and Lime

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ABSTRACT*—Soil stabilization is of great importance in road construction. Soil stabilization implies in strength and stiffness of a soil layer can be improved through the use of additives to permit a reduction in design thickness of the stabilized material compared with an unstabilized or unbound material. Stabilization with admixtures, such as lime, cement, and asphalt, have been mixed with sub grade soils used for controlling the swelling and frost heave of soils and improving the strength characteristics of unsuitable soils.*

Stabilization of subgrade with lime is considered to be the most effective method of stabilizing highly plastic soil. In this paper, a comparative study is made with RBI Grade 81 and lime to understand their effectiveness as a suitable admixture.The changes brought by the admixtures in plasticity Index and CBR value of soil was evaluated and compared.

KEYWORDS—Lime, RBI Grade 81, Plasticity Index , CBR.

INTRODUCTION

The term soil stabilization means improving the properties of soil to make it suitable to serve as a sub grade. Stabilization of sub grade is of great importance in road constructions as ultimately the entire load is taken by it and hence the performance of pavement depends on the performance of sub grade.

Black cotton soil or expansive soil is one of the most problematic soil as sub grade and needs to be stabilized for effective functioning of pavement constructed over it. The swelling and shrinking character of soil due to presence of montmorillonite mineral and low CBR value ,makes it unstable and unfit as a sub grade.

RBI Grade 81 is insoluble in water, non UV degradable, inert and chemically stable. It forms a dust free surface and is simple to apply and hardens fast. It is durable and permanent. It is environmental friendly and aesthetically pleasing. Strength of soil treated with RBI Grade 81 increases with age. RBI Grade 81 converts clay irreversibly into cementations calcium silicate and aluminum hydrates. RBI Grade 81 creates a volume stable layer with very small capillary spaces. Application of RBI Grade 81 was carried out by researchers in the past and observations of investigation program are summarized below.

LIME is a widely used chemical compound. It is a white, caustic and alkaline crystalline solid at room temperature. As a commercial product, lime often also contains magnesium oxide, silicon oxide and smaller amounts of aluminum oxide and iron oxide.

Lime in the form of quicklime (calcium oxide – CaO), hydrated lime (calcium hydroxide-$Ca[OH]_2$)Quicklime is manufactured by chemically transforming calcium carbonate (limestone – CaCO3) into calcium oxide. Hydrated lime is created when quicklime chemically reacts with water. It is hydrated lime that reacts with clay particles and permanently transforms them into a strong cementations matrix.

EXPERIMENTAL STUDY

Basic Properties of Black Cotton Soil were determined by conducting laboratory tests as per IS code specifications, results are tabulated in Table 1. Further, soil was stabilized with lime and RBI Grade-81 and

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the strength parameters like MDD, CBR and UCS are determined by conducting compaction, CBR (California bearing ratio) and UCS (unconfined compressive stress) tests respectively.

Following laboratory tests have been carried out as per IS: 2720. The tests were carried out both on natural soil and stabilized soil with lime and RBI.

- Grain size distribution
- Specific gravity
- Liquid limit and Plastic Limit
- Standard Proctor compaction test
- Unconfined compression strength
- California bearing ratio [CBR].

The percentages of stabilizers RBI and LIME added to expansive soil were (2%, 4%, 6%) and (2%, 4%, 6%) respectively by dry weight of the soil to decide the respective optimum contents. The variations in plasticity index and CBR value was also evaluated with same varying percentage.

RESULTS AND DISCUSSIONS

Materials used for the study were soil, RBI and hydrated lime. The Soil was taken fromBasanthnagar street road near Ramagundam, Karimnagar district was used.

Experimental program was conducted on virgin soil to identify the atterberg's limits, compaction characteristics, CBR and UCS. This soil was then stabilized with RBI and Lime in varying percentages. The changes in the soil properties are discussed below.

The original soil properties of black cotton soil are as follows:

Table 1.Virgin soil properties

Sl. No	Laboratory Test	Result	Relevant IS codes
1	Grain size distribution(%)		IS 2720 Part IV
	Gravel	8.9	
	Sand	20.2	
	Clay	70.9	
2	Specific gravity(G)	2.71	IS 2720 Part III
3	Liquid limit(%)	42.46	IS 2720 Part V
4	Plastic limit(%)	19.04	IS 2720 Part V
5	Plasticity index	23.42	IS 2720 Part V
6	Water content (%)	10.5	IS 2720 Part II
7	Optimum moisture content (%)	18.09	IS 2720 Part VIII
8	Maximum dry density(g/cc)	1.57	IS 2720 Part VIII
9	California bearing ratio(soaked)	2.33	IS 2720 Part XVI
10	Unconfined compression strength (Kg/cm^2)	2.69	IS 2720 Part X

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A. Consistency Characteristics of soil treated with RBI

Variation of liquid limit, plastic limit and plasticity index of expansive soil with varying percentages of lime.

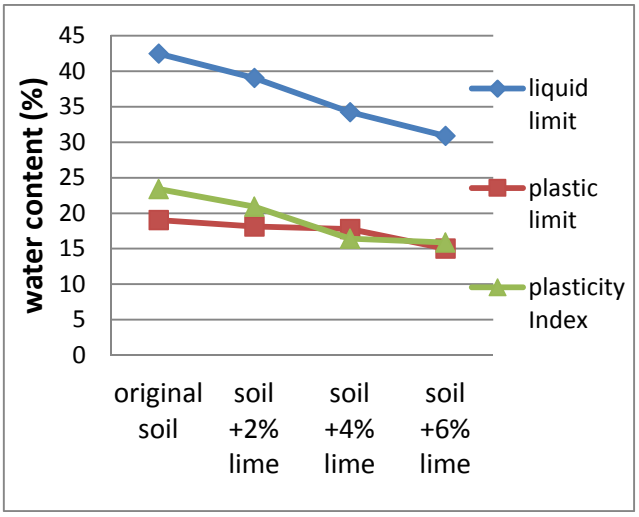

Fig.1 plastic characteristic of virgin soil and lime stabilized soil.

Variation of liquid limit, plastic limit and plasticity index of expansive soil with varying percentages of RBI stabilizer.

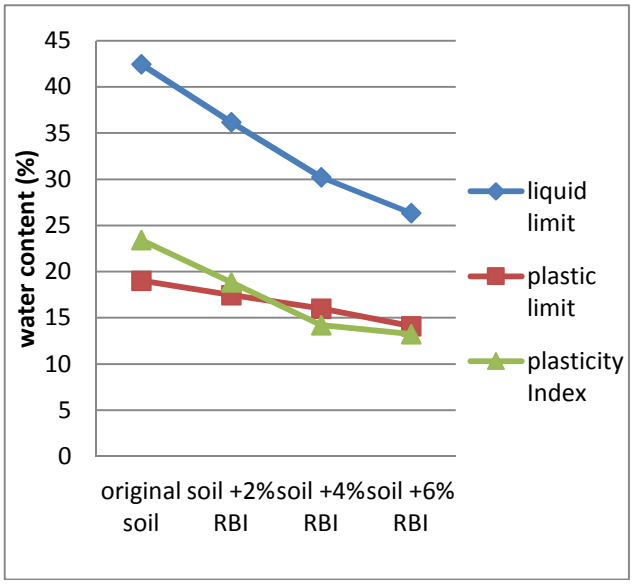

Fig.2 plastic characteristic of untreated and treated soil with RBI

From the above figures, it is seen that liquid limit and plasticity index of the soil decreases upon addition of stabilizer. Generally characteristic changes in plasticity of treated soil are attributed to cat-ion exchange, flocculation or agglomeration. Liquid limit and plasticity Index decrease is more when the soil is treated with RBI

B. Unconfined compressive strength of soil

UCC Test was conducted on samples prepared at their MDD and OMC with different percentages of stabilizers (2%, 4% and 6%).From fig 6.13, When compared, the unconfined compressive strength of soil treated with 6 % of RBI is almost double the value of 6 % of Lime.

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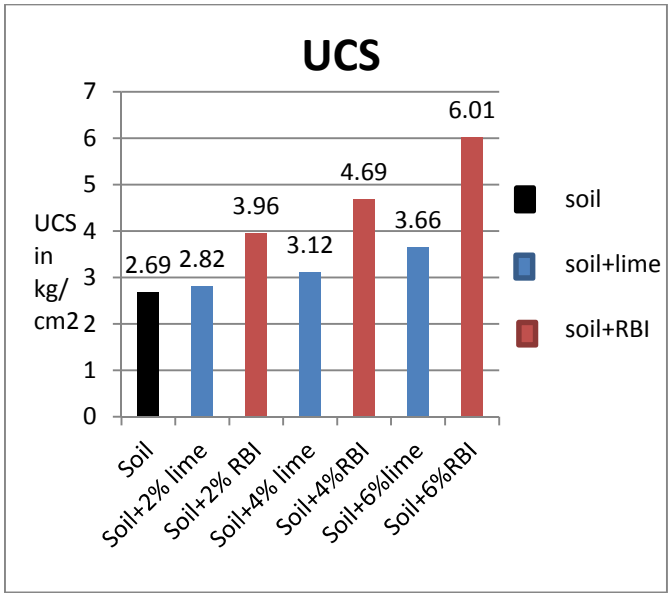

Fig.3 UCS of Soil with Varying % of RBI & Lime

C. CBR strength of BC soil

Soaked CBR test was conducted on both untreated and treated expansive soil. The test was performed on soil samples with, 2%, 4%, and 6% of lime and RBI stabilizer.

The CBR values at 2.5mm penetration were found to be higher than the CBR value at 5 mm penetration. Hence the CBR is taken as penetration at 2.5 mm only.

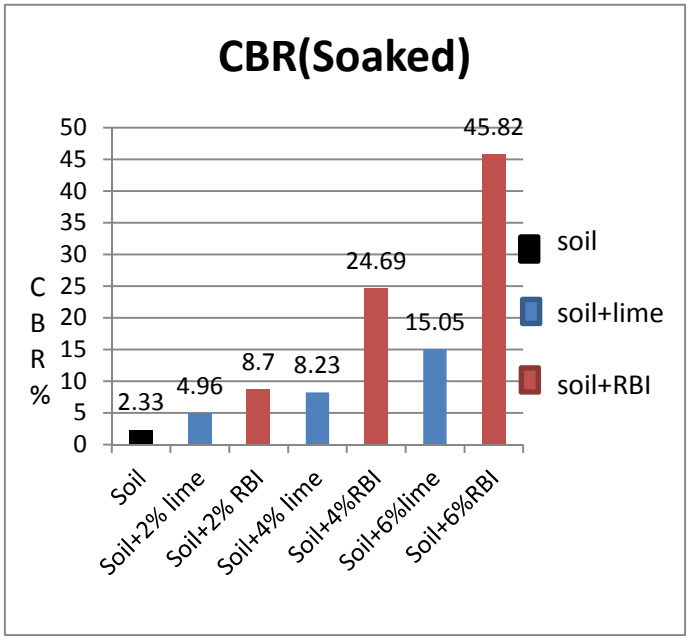

Fig. 4 CBR % of Soil with Varying % of RBI & Lime

From Fig 4, it is observed that as the percentage addition of RBI-81 increases, the CBR value increases. The minimum desired CBR for a subgrade as per IRC 37, is 10%. From Fig 4, its clear that CBR more than 10 % is possible when soil is treated with 6% of lime where as in Case of RBI, CBR value drastically increases at 4% dosage. Hence addition of 4% and 6% of RBI-81 is desirable for soil stabilization.

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CONCLUSION

Based on the findings of the present investigations, the following conclusion can be drawn.

- Treatment of soil with admixture like lime and RBI Grade 81 have resulted in change in atterberg's limit. Liquid limit of RBI Grade 81 mixed Soil decreases with the increasing proportions of the admixture.
- It is observed that plastic limit of RBI Grade 81 mixed soil increases with increasing proportions of admixture.
- Addition of lime with soil increases both CBR and UCS value substantially. But addition of RBI further improves CBR and UCS value.
- Both RBI and lime has high potential to improve the engineering properties of soil of expansive soil but RBI has marked more influence on strength characteristics of soil.
- Hence stabilisation with RBI is better when compared with lime stabilisation of soil.

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