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Effectiveness Study of RBI81 in Stabilisation of Soil

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Abstract

Background/Objectives: Problematic soils cause more damage to structures which are resting over it due to less strength to support the loads acting on them during the construction as well as in service periods. A proper treatment of the subgrade soil is required for providing a stable working area for the construction of structures. In geotechnical point of view, soil stabilization with suitable admixtures fulfils the improvement in the soil characteristics for construction of foundation for light structures and pavements. **Methods/Statistical Analysis**: In this study an attempt is made to analyse the effect of soil stabiliser RBI grade 81 on two different soils treated with varying percentages of admixture for different curing periods. The strength properties are studied by conducting the UCC and CBR test for treated soils with 2%, 4% and 6% of RBI for specific curing of 7, 28 and 60 days. Microstuctural studies by Scanning electron microscopy had done on untreated and treated soils shows the relevant structural changes which promotes the strength attainment with the addition of admixtures while curing period increases. **Findings:** This study shows a substantial improvement in problematic soils by treated with RBI grade 81 shows the increasing value of UCC ranging from 1.5 to 11 times and California Bearing Ratio values shows an increase of 65% and 41% from 2% and 2.19% for the both the soils with the addition of 6% RBI additives at the curing period of 60 days. **Improvement/Applications:** Use of RBI 81 in soil stabilisation renders a better stabilizing agent making the soils capable of meeting the constructional requirements with improved engineering properties.

Keywords: CBR, RBI 81, Soil Stabilisation, UCS

1. Introduction

Stabilization of soil is one of the ground improvement techniques for achieving adequate strength in a short period of time for subgrade soils. Among various soils, modification in expansive soils needs more attention; since it shows high volume changing characteristics depends on moisture variation. During soil stabilization, the admixture helps in physical as well as chemical changes by forming binding agents to makes a suitable construction platform. To facilitate the desired attainment of strength in the soil proper admixture should used as a stabilizer. As conventional method of stabilization, the use of cement, flyash and lime has proved excellent stabilizers in improving engineering characteristics of soil[1–4].

The investigations which were already conducted on soil stabilization, majorly have conducted on the mechanical performances and the microstructural improvement results in the remarkable changes in fine-grained soils. Except from these techniques, stabilization particularly on expansive soils with various waste products such as flyash[5,6], cement kiln dust[7], waste tyre[8] etc, as additives also meets the considerable success for the desired construction purposes.

In this work the experimental study on the influence of RBI on strength characteristic of clayey soils were considered. The Unconfined Compressive Strength and California Bearing Ratio tests were used as strength indicator to observe the strength development in treated and untreated soils. The micro-structural analyses were also performed in this study using a Scanning Electron Microscopy for analyzing the micro-structural development which contributes the gain in strength.

2. Materials and Testing Program

Two soil samples of expansive nature are used in these studies which were collected from Tamil Nadu.

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The soil samples are tested for various Geotechnical characteristics[9–12] and the results are shown in Table 1. Both the samples are showing high swelling potential, which have free swell index value is greater than 50 (110% and 105%). Based on the Atterbergs limits and the grain-size distribution, soil is classified as a CH as per IS classification system[13]. RBI grade 81 is the soil stabilizer used and its chemical composition identifies that it has high percentage of CaO, SiO_2 and Al_2O_3 initiates for pozzolanic reaction with the clayey soil.

3. Test Results and Discussions

3.1 Unconfined Compressive Strength Test

The samples are prepared for UCC is with the Optimum Moisture Content (OMC) and Maximum Dry Density (MDD) obtained from compaction test results and unconfined compressive strength test were conducted as per the guide line of IS:2720 (Part-10)[14] with different percentages of RBI grade 81 using static compaction. These samples were tested on under a constant strain rate of 1.2 mm/min at the end of each curing periods. Table 2 shows the observations made by conducted the UCC tests to study the performance of different percentages of admixture proportions with varying curing periods on both the samples.

Table 1. Geotechnical characteristics of soils

Properties		Sample G1	Sample G2
Specific Gravity		2.36	2.65
Particle Size Distribution	Sand	4	2
	Silt	26	32
	Clay	70	66
Liquid limit		75	72
Plastic limit		38	39
Shrinkage limit		7	6

Table 2. UCS values of samples G1 and G2 treated with RBI

Days	UCS Value, kPa							
	Sample G1 + RBI81				Sample G2 + RBI81			
	0	2%	4%	6%	0%	2%	4%	6%
7	138	217	366	794	122	157	339	541
28		302	579	1202		234	496	718
60		328	648	1559		276	600	856

Figures 1 to 2 shows the stress-strain behaviour of treated soils with 2%, 4% and 6% of RBI at different curing periods of 7, 28 and 60 days. From the plot, it is cleared that, the increase in percentage of RBI on both the soils improves the UCS value with increasing curing periods. It is also observed that the increase in percentages of RBI increases the peak stresses and the rate of increase at 28 days curing period was observed to be 369.6% and 392.1% in sample G1 and G2 respectively. Figure 3 shows the failure pattern of soil samplestreated with various proportion of admixture and it confirms a changes to brittle from the ductile nature of untreated soil samples.

3.2 California Bearing Ratio (CBR) Test

The California Bearing Ratio (CBR) test is the penetration test meant for the evaluation of soil strength. CBR tests was conducted as per IS: 2720 (Part-16)[15] for finding the strength of untreated and treated soil samples. The CBR values for virgin soils and soil with different percentages of RBI are determined after soaking condition at the end of respective curing periods, are shown in Table 3. From laboratory test results on samples, it was seen that the CBR values increases with the addition of RBI and increase in curing period. CBR values were increased to 65% and 41% from 2% and 2.19% at end of 60 days curing with 6% stabilizer for G1 and G2 respectively. The

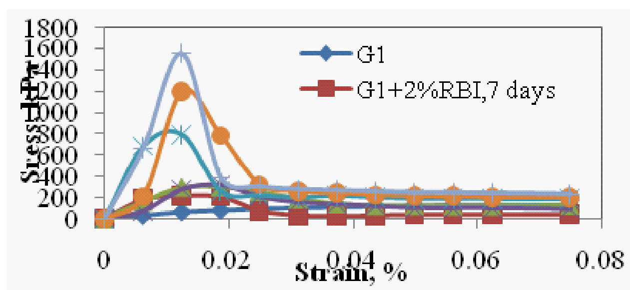

Figure 1. Stress – Strain characteristic curve of sample G1 with RBI for different percentages and curing periods.

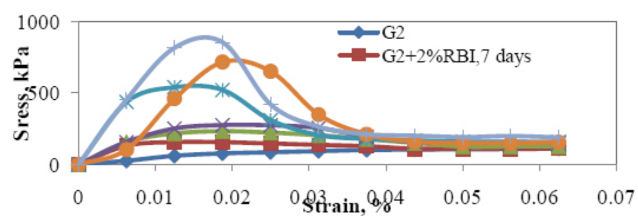

Figure 2. Stress – Strain characteristic curve of sample G2 with RBI for different percentages and curing periods.

Figure 3. Failure pattern of UCC soil specimens with RBI additives for different percentages.

Table 3. CBR values for sample G1 and G2 treated with RBI

Days	CBR Value							
	Sample G1 + RBI 81				Sample G2 + RBI81			
	0%	2%	4%	6%	0%	2%	4%	6%
7		9.93	22	34.96		10.6	20	25
28	2	11.5	31	60	2.19	12.7	27	36
60		12	34	65		14.38	31	41

load-penetration comparison curves of for both virgin and treated soils with RBI for G1 at different curing periods were presented in Figure 4.

The influence of curing period on the CBR value of the soil sample G1 and G2 were shown in Figure 5. From this curves it was clear that a tremendous increasing in the CBR value has been observed with increase in percentage of RBI and age of curing and that the rate of increase is more in the initial period and gradually decreases in later periods of curing.

4. Microstructural Analysis

The microstructural study were performed on the virgin and RBI treated soil samples to analyse the changes in microstructural behaviour and physical properties of soils. The improvement in treated soils are studied based on the results obtained from Scanning Electron Microscopy method.

SEM micrographs are observed on samples obtained by pulverising the tested UCC samples. Figure 6 shows the typical SEM micrographs of virgin samples, admixture and treated sample at a curing period of 60 days.

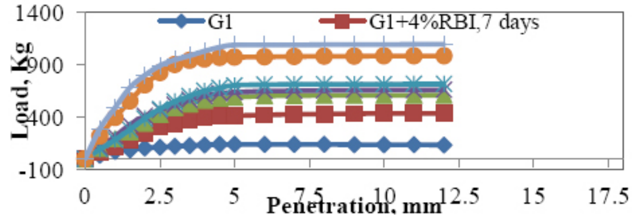

Figure 4. Load-penetration curve for soil sample G1treated with RBI for different curing periods and percentages.

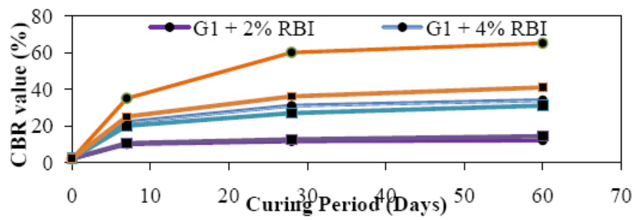

Figure 5. Effect of percentage of additive on CBR value for sample G1 and G2.

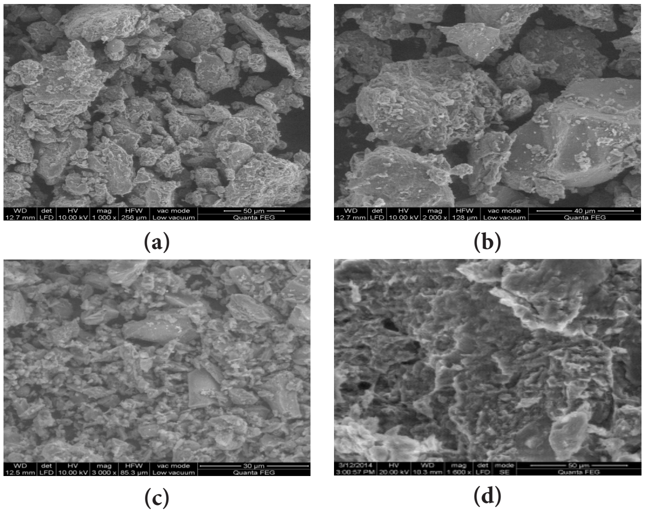

Figure 6. Typical SEM micrographs of virgin samples, admixture and treated sample. **(a)** Sample G1. **(b)** Sample G2. **(c)** RBI. **(d)** Sample G2+ 6% RBI for 60 days curing.

From the micrographs, it was noticed that the distribution of particle assemblies and pores in virgin samples are bonded by cementitious compounds when compared with the treated soil samples.

5. Conclusion

It is observed that the increase in percentages of RBI increases the peak stresses and the rate of increase at 28 days curing period was observed to be 369.6% and 392.1% in sample G1 and G2 respectively.

CBR value of soil also showing an increase of 65% and 41% from 2% and 2.19% on both the soils with the addition of 6% RBI additives at the curing period of 60 days.

Microstructural studies revealed the improvement in microstructure of the treated soil sample with the enrichment of cementitious compounds which contributes the compactness in soil structure.

6. Acknowledgment

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