Stabilization of Clay Soil using RBI Grade-81

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Abstract:

Soil stabilization is one of the processes used for improving engineering properties soil. There are various materials used as stabilizing agents. In this paper, RBI GRADE -81 mixed in different percentages with clay soil and its effect on engineering properties of clay soil is investigated after conducting California Bearing Ratio test and Proctor Test. Observations are made for the changes in the properties of the soil such as Maximum dry density (MDD), Optimum moisture content (OMC), California Bearing Ratio (CBR) values are determined on 0%, 2%, 4%, 6%, and 8% percentages of RBI. It has been find out that MDD goes on decreases with the increase in percentage of RBI Grade-81. The CBR value of soil goes on increases up to 6% and then decreases at 8% in case of RBI. So, the optimum value we got is 6% in CBR Test. From the analysis it is found that RBI Grade-81 may widely use as a stabilizing agent.

Keywords: *Soil stabilization, RBI Grade-81, Compaction and CBR*

I. INTRODUCTION

Soil is the basic construction material. It supports the sub structure of any structure and it is the sub-grade which supports the sub-base/base in the pavement. The improvement of soil at a site is indispensable due to rising cost of the land, and there is huge demand for high rise buildings. Soil Stabilization can be defined as any physical, chemical, biological method of changing the available natural soil in order to meet the engineering properties of soil. Soil stabilization is a technology which enhances the soil characteristics in order to improve mechanical & load bearing properties through technological methods like Soil improvement. Soil stabilization method is suitable for heavily soaked soils, which is not suitable for road or traffic construction since required rate of compaction cannot be achieved. The main resolution of soil stabilization is to progress the California bearing ratio of the available soil by four to six times & to improve on site materials which in turn creates a solid & a strong base & sub base courses.

There is a need to concentrate on improving properties of soils using cost-effective practices like treating with different materials those having cementations value. In this study, we are using RBI Grade-81 to improve geotechnical properties of a soil.

II. LITERATURE REVIEW

P. T. Ravichandran , K. Divya Krishnan, Manisha Gunturi, C. Sudha and P. R. Kannan Rajkumar(2016) conducted Study of RBI-81 in Stabilization of Soil. In this study an attempt is made to analyze the effect of soil stabilizer RBI grade 81 on two different soils treated with varying percentages of admixture for different curing periods. Use of RBI 81 in soil stabilization renders a better stabilizing agent making the soils capable of meeting the constructional requirements with improved engineering properties.

Raju Sarkar, Ankur Mudgal, Sandeep Bhaskar, Varun Gupta and Ritesh Kurar (2016) study on Waste materials can be used as geotechnical admixtures to improve geotechnical properties of black cotton soils as well as curb environmental degradation. Thorough comparative studies of the existing researches it can be inferred that the combinations of admixtures and expansive soil improve the CBR value, UCS and decrease swelling index of soft soils to an acceptable range and aid in achieving economic design of pavement.

T. Dhanasekar and P.Rajakumar (2016) In apparent, the RBI grade 81 of black cotton soil used in road construction and fuzzy model utilized for classification of road. The utilization of fuzzy logic is mentioned for classifying the road as pedestrian walk, light moving vehicles and heavy moving vehicles. By using fuzzy logic in road construction is to classify the output in which level the road has been used. Fuzzy outputs are classifying the road by minimization of error and finally in logic the three significant considerations are the light moving vehicles and heavy moving vehicles B. Vishnuvardhan Kumar, M. Teja, G. Kalyan Kumar (2015) In this study a new Proprietary Cementitious Stabilizer (Road Building International Grade 81) and Ground granulated blast furnace slag(GGBS) is being used to study the improvement in engineering properties of Black Cotton (BC) soil.

Mamta, Mallikarjun Honna (2014) conducted a study to improve the engineering properties of BC soil and lateritic (red soil) by using RBI Grade-81. This

study concluded that RBI-81 is effective stabilizer from enhancement of geotechnical properties of lateritic soil & Black cotton Soil.

Manisha Gunturi at. Al. (2014) carried out a study on CBR and swelling behavior of expansive soil when treated with RBI Grade-81. After the test investigation they were concluded that the UCS value was improved appreciably with the addition of RBI Grade-81 under the curing period of 3 days and 7 days with the increase in the percentage of RBI the rate of increase of UCS also increased. The UCS value of sample A1 and A2 increased by 425% and 430% respectively after 7 days of curing period with 6% RBI stabilizer.

Lekha B.M. and A.U. Ravi Shankar (2014) conducted a study on performance of RBI Grade-81 in laboratory to stabilize the soil for pavements. The soil and stabilizer RBI- 81 were mixed in different proportion and tested for atterberg's limit, OMC, MDD, UCS and CBR. The fatigue life of untreated soil was obtained 3 after 7 days curing and 5 after 28 days curing period at one third corresponding UCS strength values for 2% stabilizer.

Najia Nouf et al *(*2014) have made an modify engineering properties of a black cotton soil from Nagpur region, Maharashtra, India by stabilizing it with an eco friendly stabilizer RBI Grade 81 to make it suitable as a sub grade material. The stabilizer was added to the soil in different percentages (by dry weight) varying from 1% to 6%. The results indicate that RBI-81 was effective in improving engineering properties of black cotton

K.V. Madurwar, P.P. Dahale, A.N.Burile (2013) conducted a study on effect of sodium silicate and RBI Grade- 81 on black cotton soil to improve it's engineering properties. When the RBI Grade-81 was added to the soil the free swell index value was decreased but with the addition of sodium silicate it was increased.

Pankaj Modak et al (2012) have planned the adjustment of the Black cotton soil (BC soil) are profoundly clayey soils (Montmorillonite mud mineral). The dampness changes in BC soils with fly ash, compressibility and pliancy nature can be incredibly enhanced by the expansion of Lime and fly ash. Through the consequences, the application of lime and fly ash elevates the California Bearing Ratio values. In terms of material cost, the use of less costly fly ash can reduce the required amount of lime.

III. MATERIALS USED

A. Clay Soil

Clay soil is composed of tiny particles that are hard and able to become easily compacted. This compaction makes it difficult to plant or even shovel within the soil. When it is compacted, it is nearly impossible to break up using only physical strength. The variation in compaction characteristics, strength characteristics and CBR values are discussed in this paper.

B. RBI Grade-81

It is a road construction material patented worldwide. It modifies the engineering properties of soil by providing rapid infrastructure development. By adding RBI Grade 81 in the soil, there will be chemical reaction which takes place and is mainly of pozzolanic reaction. During the pozzolanic process, the Calcium Hydroxide released by additives will react with the clay mineral typically aluminous and siliceous which can induce the pozzolanic properties

The RBI Grade 81 is an inorganic soil stabilizer and pavement material. Some characteristic of RBI Grade 81 is given in the following.

- Patented worldwide including India.
- Cementitious powder.
- Non-toxic.
- Non inflameable.
- Grey color powder.

IV. RESEARCH METHODOLOGY

The objective of my dissertation is to investigate the engineering properties of clay soil after improving with RBI Grade-81. The clay samples were taken from a Braham Sarover in Kurukshetra (Haryana). Soil sample is collected from 0.5m below the ground surface. The liquid limit, plastic limit and specific gravity of soil have been determined in the laboratory. The standard Proctor Test, California Bearing Ratio test has been performed by adding at 0%, 2%, 4%, 6%, and 8% of RBI grade 81 in the clay soil.

A. Standard Proctor Compaction Test

Compaction test of soil also known as Proctor's test is done to understand compaction characteristics of different soils with change in moisture content.

B. California Bearing Ratio Test

This is a penetration test developed by the California division of highways as a method for evaluating the stability of soil sub Grade and other flexible pavement materials

V. RESULTS AND DISCUSSION

Utilization of RBI for soil improvement is a cost effective technique. The geotechnical properties studied in this investigation includes Index properties like liquid limit, plastic limit, Plasticity index, specific gravity and engineering properties like Standard proctor test (SPT), Unconfined Compressive Strength test, California Bearing Ratio test for Clay soil and RBI Grade 81 with variation in composition in quantity sample are prepared that are shown below:

Table 5.1 Index Properties of Soil

S. No.	SOIL PROPERTY	SOIL SAMPLE
1	Color of soil	Yellowish
2	Nature of soil	Clay type
3	Optimum Moisture Content (%)	17.9
4.	Maximum Dry Density (g/cc)	1.78
5	Specific gravity (G)	2.71
6	Liquid limit (%)	34.52
7	Plastic limit (%)	21.65
8	Plasticity Index PI=(LL-PL) %	12.87

A. Standard Proctor Analysis

Compaction test of soil also known as Proctor's test is done to understand compaction characteristics of different soils with change in moisture content. This test is performed to obtain the maximum dry density and optimum moisture content variation at different percentages of stabilizing agent used. The variation of dry density with varying water content has been found and is plotted on the graph to understand the behavior of variation of dry density with varying water content and varying percentage of clay soil and RBI.

1) Graphs for Proctor Test:-

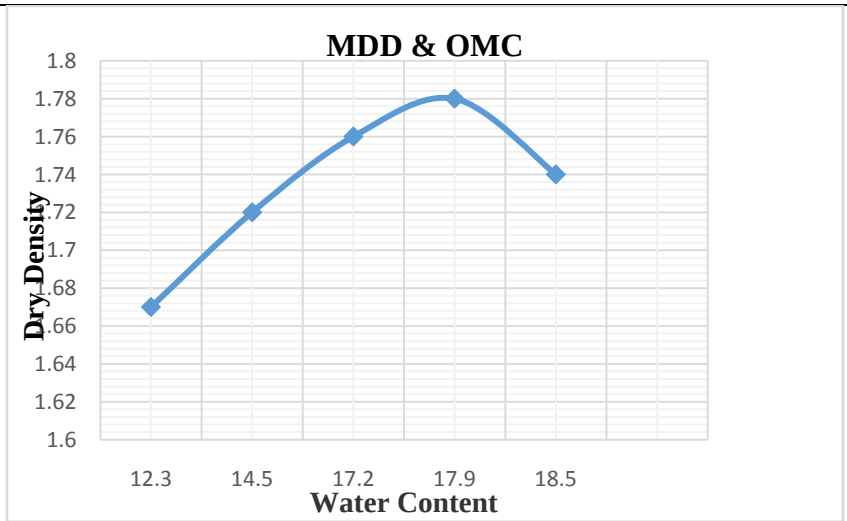

Fig 5.1 Variation of MDD Vs OMC with Parent Soil (Cl+ 0%RBI).

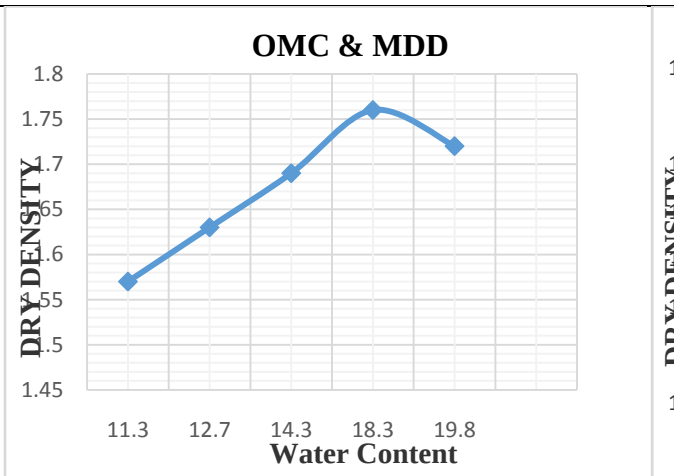

Fig 5.2 Variation of MDD Vs OMC with Admixture (Cl+ 2%RBI)

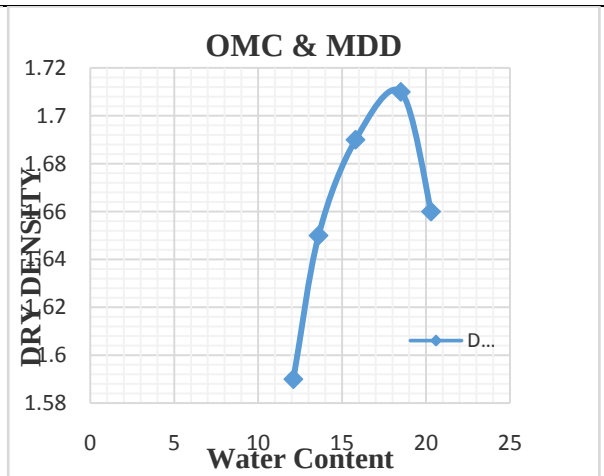

Fig 5.3 Variation of MDD Vs OMC with Admixture (Cl+ 4%RBI)

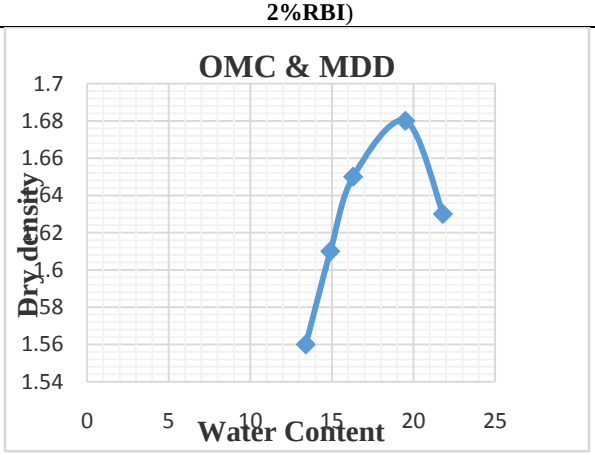

Fig 5.4 Variation of MDD Vs OMC with Admixture (Cl+6%RBI)

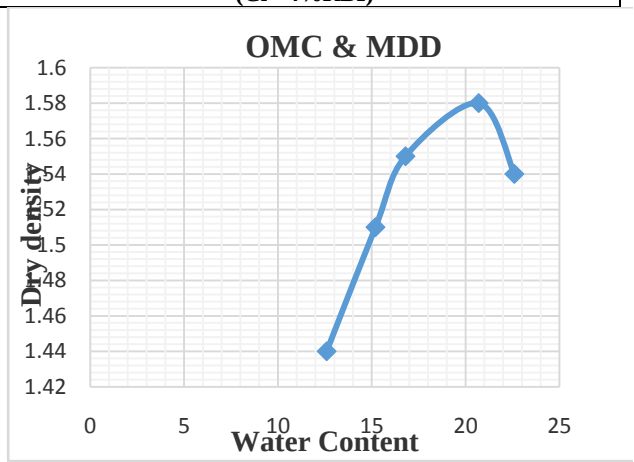

Fig 5.5 Variation of MDD Vs OMC with Admixture (Cl+8%RBI)

5.2 CALIFORNIA BEARING RATIO ANALYSIS :-

This is a penetration test developed by the California division of highways as a method for evaluating the stability of soil sub Grade and other flexible pavement materials. The load values are noted corresponding to penetration values of 0.0,05,1.0,1.5,2.0,2.5,3.0, 4.0, 5.0,7.5,10.0 and 12.5mm.The load corresponding to 2.5 and 5.0 mm penetration are values are noted. The CBR value is calculated using the relation:

$$\text{CBR\%} = \frac{\text{(Load sustained by the specimen at 2.5 or 5.0mm penetration)}}{100} \times \text{(Load sustained by standard aggregates at the corresponding Penetration level)}$$

*2) **Graphs for CBR Test:-***

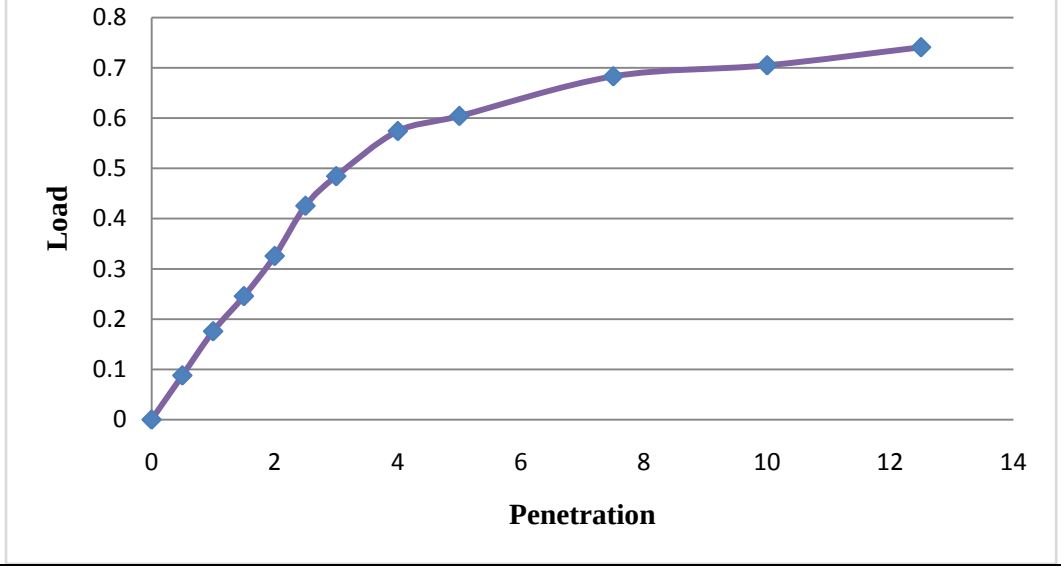

Fig 5.6 CBR Characteristics for Parent Soil i.e.(CI+0%RBI)

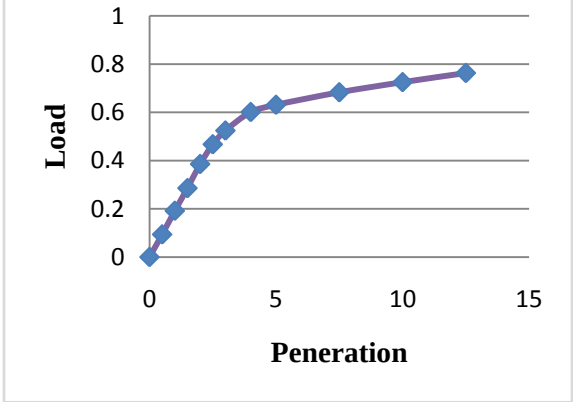

Fig 5.7 CBR Characteristics with Admixture i.e.(CI+2%RBI)

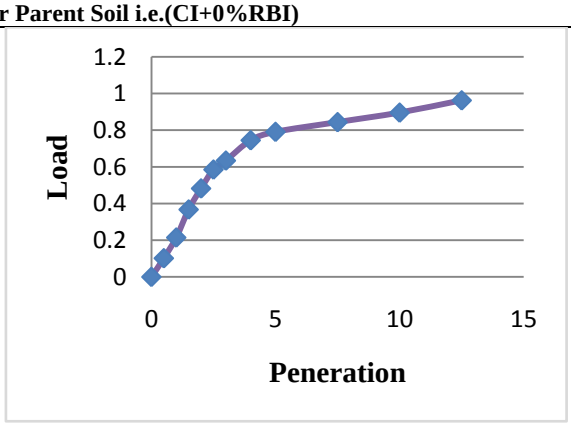

Fig 5.8 CBR Characteristics with Admixture i.e.(CI+4%RBI)

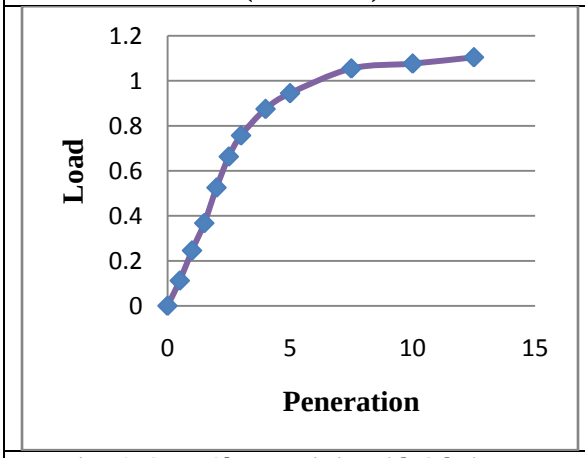

Fig 5.9 CBR Characteristics with Admixture i.e.(CI+6%RBI)

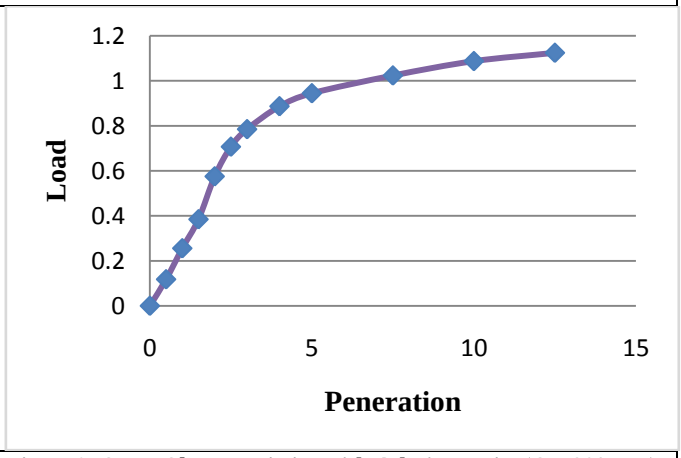

Fig 5.10 CBR Characteristics with Admixture i.e.(CI+8%RBI)

VI. CONCLUSION

A thorough laboratory investigation was carried out to study the improvement in geotechnical properties of an expensive soil stabilized with RBI. The following conclusions are drawn from this study.

The optimum percentage of RBI admixture are observed in between 0 to 8% respectively for improving the properties of expansive soil. Addition of RBI at different proportional to clay soil decreases the dry density and increases optimum moisture content. It is found that there is a maximum improvement in strength properties with the combination of RBI. This help to find applications to improve the properties of clay soil both in embankments and pavement construction.

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