

RBI Grade 81 as a Sub Grade Stabilizer in Sustainable Road Infrastructure

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Article Info

Volume 82

Page Number: 16683 - 16688

Publication Issue:

January - February 2020

Article History

Article Received: 18 May 2019

Revised: 14 July 2019

Accepted: 22 December 2019

Publication: 29 February 2020

Abstract

CBR value is directly proportioned to the strength of the soil to bear the stress and in case of road structures, strength is very important against the action of load of vehicles, in North region of the country, roads generally collapse in monsoon session due to penetration of excessive amount of water into the subgrade. To avoid this problem, soil stabilization is an important factor that can be done using many traditional methods but use of an updated method results in an effective output. In this study soil sample was taken from Chandigarh region and adding RBI Grade 81, various tests were conducted on the samples, the huge increase was reported in the CBR values of the sample after treating it with RBI Grade 81.

Keywords; RBI Grade 81, CBR, MDD, OMC, Soil stabilization.

I. INTRODUCTION

RBI grade 81 has already been used in north Indian states including Himachal Pradesh (Kufri), Haryana (bio-diversity park), Jammu and Kashmir (ReasiPauni, Budgam, Alamdhar colony near airport and Ladakh) and Delhi (Cant, Jasola, Srifort and Housing society, Dwarka). It has been already added in the Schedule of Rates of Karnataka and Puducherry. RBI Grade 81 (Road Building International Grade 81) is a patented material of Road Building International in India. It contains cement, lime, pozzolanas, and polypropylene. It increases the CBR, modulus of elasticity and UCS values of soil and reduces plasticity and swelling index values which results in the decrease in the required thickness of road and ultimately makes road economical.

There are many methods for the stabilization of soil but are traditional and every method has some shortcomings but the stabilization with RBI Grade 81 is the latest method being used by many countries including India.

Soil can be stabilized using mechanical methods, using geosynthetics and chemical admixtures. RBI grade 81 method is a chemical method where a powder of this admixture is mixed with soil, water is sprinkled over it and then compaction is done. This admixture reacts with the minerals present in the soil and makes a stronger bond. RBI Grade 81 can be used for the stabilization of any type of soil and for any construction project but it is specially made for road construction and used in the formation of the stabilized base, sub-base, and subgrade. It can also be used as a wearing course but with limited conditions only.

II. LITERATURE REVIEW

Ahmed et al conducted a study on expensive black soil to check its feasibility as a subgrade material using waste materials (fly ash, natural soil stabilizer) and RBI grade 81 soil stabilizer. The study area is the Maharashtra region. Atterberg's limits test and compaction test were conducted on the sample and it was found that LL, PL, and PI go on decreasing even after the addition of fly ash and LL of RBI

grade 81 was also decreasing on increasing its proportion in the sample and at the same time plastic limit was increasing. It was analyzed that fly ash up to 30% of addition gives good results.

Patil et al studied the design of flexible pavement on black cotton soil which is stabilized with RBI grade 81. A comparison study was done in between treated and untreated soil using soil experiments like Atterberg's limit test, compaction test, and CBR test. An increase in the value of CBR and PI was observed. Flexible pavement design was also done to analyze the saving in the cost of construction and to find an optimum proportion of stabilizer. The soil sample was taken from the Nashik region. Reduction in the thickness was noticed more in 4% and 6% proportion of the RBI Grade 81 and cost of construction was increased by 2% but on other proportions it was decreasing and the optimum cost was obtained at 4% proportion.

Patil BM & Patil KA studied the improvement in the properties of soil of the subgrade using moorum and RBI Grade 81 stabilizer. The use of moorum as an additive increases the strength as well as reduced the cost of construction of the road. In treated soil increase in the CBR value was found to be 476.56%. the soil sample was taken from Aurangabad region of Maharashtra. Standard Proctor Test was carried out on treated and untreated samples to get the values of MDD and OMC. CBR values were found out using different proportions of soil, Moorum and RBI Grade 81 and a huge increase in the values was seen after the treatment.

Madurwar et al conducted a comparative study for the stabilization of black cotton soil of Nagpur region in Maharashtra using RBI Grade 81 and sodium silicate. UCS, CBR and Atterberg's limits tests were conducted for comparison and proportion variation for RBI Grade 81 was 2% to 6% and for sodium silicate solution it was 3% to 6%. The free swell index was decreasing on the addition of RBI Grade 81 and it was increasing with an increase in sodium silicate. A decrease in the values of CBR

and UCS was also noticed with an increase in the amount of sodium silicate, which limits its use as a stabilizer and on another hand, RBI Grade 81 is reported as the best stabilizer.

Aaqib et al studied the effect of Bagasse Ash and RBI Grade-81 On Geotechnical Properties of Expansive Soil. The use of Bagasse ash increased the strength and reduced the swelling potential of the soil. The proportion of sugarcane Bagasse ash was in the range of 0% to 20% and increment was taken as 5%, and that for RBI Grade 81, the increment was taken as 2% up to 6% proportion. Using various proportions tests was conducted and an optimum proportion was found to be 86% clay, 10% SBA and 4% RBI Grade 81. After the treatment water penetration was noticed to be restricted and it became denser.

Majid et al studied the addition of geotextiles with RBI Grade 81 to strengthen the soil of subgrade in bitumen pavement. In this study, non-woven geotextiles were used at different layers of soil along with the addition of RBI Grade 81. And then series of CBR tests were conducted on these layers with the result of an increase in the CBR values. Pavement design was also done considering both fatigue and rutting life of the pavement and for the analysis, IITPAVE software was used.

Jain & Goliya studied the chemical stabilization of expensive soil for subgrade use. Various tests were conducted including Atterberg's limit test, Shrinkage limit test, Free Swelling Index test, Compaction test (OMC & MDD) and 4 day's soaked CBR value test. An increase in the CBR value was confirmed as 745.54% i.e. from 2.02% to 15.06%. moisture content reduction was found up to 6% addition of RBI Grade 81, further increase in the proportion does not show any change. At 4% addition of RBI Grade 81, reduction in the pavement depth was reported as 37.50% and that of cost reduction was 18.50%.

III.LITERATURE GAP

A lot of studies have been conducted on black cotton soil in the south region of the country and various additives were also introduced like fly ash, moorum, pond ash, and sugarcane ash, etc. but only limited studies are there on RBI Grade 81 for the north region. This study is focused on the use of RBI Grade 81 in the North Indian parts.

IV.OBJECTIVES

main objectives of the study are:

- To compare the results of experiments on untreated and treated soil samples.
- To find the optimum proportion of RBI Grade 81 and soil for maximum increase in the strength.
- Representation of variables relationship using graphs like MDD v/s sample, OMC v/s sample and for CBR.

V. METHODOLOGY

Atterberg's limits tests were conducted in accordance with IS 2720 Part V, for MDD and OMC calculations IS 2720 Part VIII guidelines were followed and for the CBR test, IS 2720 Part XVI guidelines were followed.

These tests were conducted to know the basic result values of important variables in the sample for considering the relationship among them.

VI. SAMPLING AND EXPERIMENTATION

6.1 The material used: RBI grade 81 and soil from Chandigarh region

6.2 Geotechnical properties:

A. RBI grade 81

Table 1.geotechnical properties of RBI Grade 81

Sr no.	particular	value
1	Specific gravity	2.5
2	The ph of the	12.5

	saturated paste	
3	Bulk density	700 kg/m ³
4	Storage life	12 months in moisture-proof condition
5	Other properties	Inflammable, odorless and non-toxic

Composition of RBI grade 81 include CaO (50-60%), SiO₂ (15-20%), SO₂ (10-15%), Al₂O₃ (5-10%), Fe₂O₃ (0-2%) and fibers (0-1%).

B. Soil:

it is taken from Chandigarh region and various tests conducted on this soil are as per the guidelines of Indian standard codes and results are as following:

6.3 Test procedure:

6.3.1 Atterberg's limits and compaction test:

The test was conducted on virgin soil as well as on stabilizer added soil. There was given an increment of 2% in RBI grade 81 and at every stage required test was conducted whose results are shown below:

- a) At 0% RBI grade 81 and 100% soil sample

Table 2.test results for 0% addition of RBI Grade 81

Sr. no.	Test name	Value obtained
1	Liquid limit	34.9%
2	Plastic limit	20%
3	Plasticity index	15.1%
4	MDD	18.95 KN/m ³
5	OMC	11.20%

- b) At 2% RBI grade 81 and 98% soil sample

Table 3.test results for 2% addition of RBI Grade 81

Sr. no.	Test name	Value obtained

1	Liquid limit	35.4%
2	Plastic limit	24.38%
3	Plasticity index	11.02%
4	MDD	18.5 KN/m ³
5	OMC	12.98%

c) At 4% RBI grade 81 and 96% soil sample

Table 4.test results for 4% addition of RBI Grade 81

Sr. no.	Test name	Value obtained
1	Liquid limit	42.2%
2	Plastic limit	27.8%
3	Plasticity index	14.4%
4	MDD	17.8 KN/m ³
5	OMC	18.1%

d) At 6% RBI grade 81 and 94% soil sample

Table 5.test results for 6% addition of RBI Grade 81

Sr. no.	Test name	Value obtained
1	Liquid limit	44.89%
2	Plastic limit	29%
3	Plasticity index	15.89%
4	MDD	16.2 KN/m ³
5	OMC	18.9%

e) At 8% RBI grade 81 and 92% soil sample

Table 6.test results for 8% addition of RBI Grade 81

Sr. no.	Test name	Value obtained
1	Liquid limit	47.8%
2	Plastic limit	31.76%
3	Plasticity index	16.04%
4	MDD	16.4 KN/m ³
5	OMC	18.84%

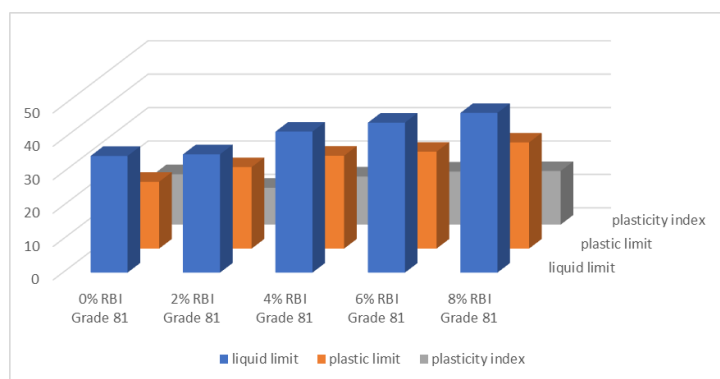


Fig. 1. Atterberg's limits relation with varying proportion of RBI Grade 81

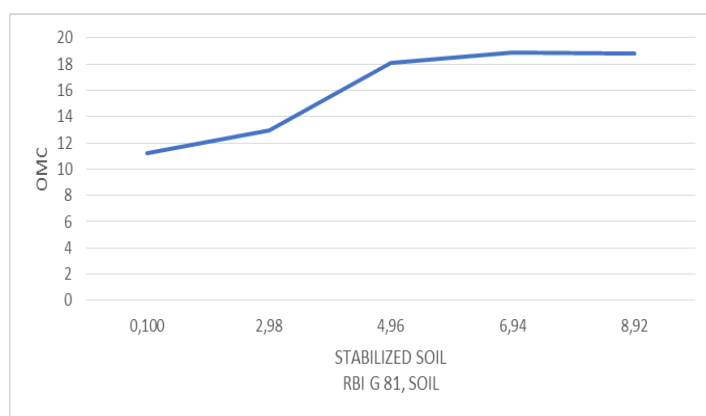


Fig. 2. the relation between OMC and varying proportion of RBI Grade 81

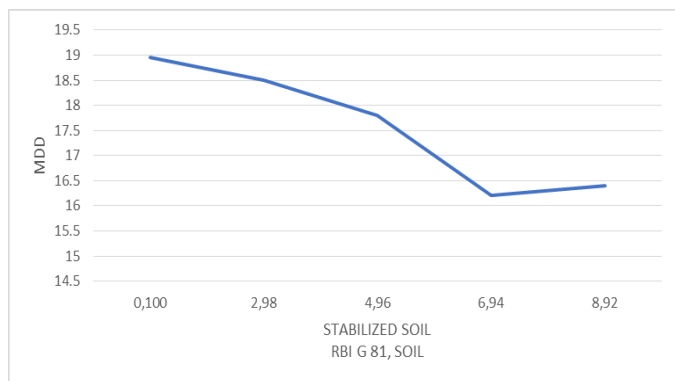


Fig. 3.the relation between MDD and varying proportion of RBI Grade 81

Table 7.test results for 2.5 and 5mm penetration and CBR%

Penetration (mm)	Test load at 0% RBI grade 81(kg)	Test load at 2% RBI grade 81(kg)	Test load at 4% RBI grade 81(kg)	Test load at 6% RBI grade 81(kg)	Test load at 8% RBI grade 81(kg)
2.5	46.58	89.05	291.8	443.8	682.2
5	69.87	133.6	437.7	665.8	1023.39
CBR %	3.4	6.5	21.3	32.4	49.8

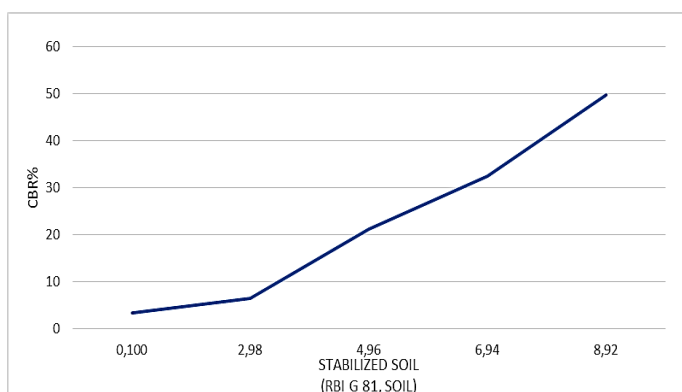


Fig. 4.the relation between CBR% and varying proportion of RBI Grade 81

VII. CONCLUSION AND FUTURE SCOPE

based on various experiments conducted above, the following points are concluded:

1. In Atterberg's limits test, there was observed a little fall in the value of plasticity index at 2,98 proportion of the sample and after that values were increased in order. And in compaction test, MDD

6.1.2 CBR TEST:

In this test, standard loads taken for 2.5 and 5mm penetration of plunger are 1370 and 2055 kg respectively. For this study 4 days soaked CBR test was conducted.

$$CBR\% = (Test\ load / standard\ load) \times 100$$

Values of load for 2.5mm and 5mm penetration of plunger and respective CBR values are given in below table:

was decreasing and OMC was increasing with an increase in the proportion of RBI grade 81, but for OMC at 2,98 proportion of the sample there was noticed a slight decrease.

2. In the CBR test, there is a huge increase in the CBR value of 0,100 proportion of the sample and 8,92 proportion of the sample which represents that RBI grade 81 is best stabilizer for increase in the strength of the soil and other properties like plasticity range and UCS.

3. For future work, soil from another region can be selected and other materials can also be used in addition, like fly ash, stone dust, etc.

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