

# Effect of RBI grade 81 on index properties and compaction characteristics of fine grained soil

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**Abstract** - The main objectives of the soil stabilization are to increase the bearing capacity of the soil, its resistance to weathering process and soil permeability. The long-term performance of any construction project depends on the soundness of the underlying soils. Unstable soils can create significant problems for structures and can lead to its failure and the structure is not able to fulfill the requirements for which it is designed. Therefore soil stabilization techniques are necessary to ensure the good stability of soil so that it can successfully sustain the load of the superstructure. The paper presents the effect of RBI grade 81 material on compaction characteristics and index properties of fine grained soils. The soil samples was collected locally from Jabalpur city. The outcome helps in looking at the change in liquid limit, plastic limit, optimum moisture content (OMC) and maximum dry density (MDD). The following tests were carried out on the untreated and stabilizer treated clayey soil and silty soil with varying RBI grade 81 % as 0%, 2%, 4% and 6%.

**Key Words:** (Clayey soil, Silty soil, RBI grade 81, Maximum dry density, Optimum moisture content.

## 1. INTRODUCTION

Soil Stabilization can be defined as any physical, chemical, biological or a combined method of changing the available natural soil in order to meet the engineering properties & fulfill the necessity. Soil stabilization is a group of earth work technology which enhances the soil characteristics in order to improve mechanical & load bearing properties through technological methods like Soil improvement & Soil Consolidation 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. RBI Grade 81 can be expanded as Road Building International Grade 81. It is a major material which was created for altering the various types of soil through an inexpensive approach. RBI Grade 81 is an ecofriendly, inorganic, hydration activated powder based stabilizer which combines along with the soil particles to create layers that are interconnected through a complex bury atom structure. It is a road construction material patented worldwide & in India. It is a Cementitious power stabilizer which is grey in color, non-flammable & also acts as waste binding. It modifies the engineering properties of soil by providing rapid infrastructure development. A Company called Legend Developers in New Delhi supplies RBI Grade 81 (Road Building International Grade 81). The company has the license to manufacture it and has patented it. This

product has recently been accredited by Central Road Research Institute, New Delhi. A combination of naturally occurring compounds form RBI Grade 81. Developed Countries like Germany, South Africa, Italy, Spain etc makes use of RBI Grade 81 to a great extent. Hence "It is defined as an inorganic chemical stabilizer which modifies the engineering properties of soil."

## 1.2 Literature review

Vinay et. al. (2011) investigated the strength properties for two types of soils. A local loamy soil and clayey soil were stabilized with RBI-81. Durability test, flexural strength, permeability test were carried out on untreated soils and soils treated with 1, 2, 4% RBI-81. A considerable increase in the strength values of CBR, UCS was reported.

Madurwar et al. (2013) made an attempt to modify engineering properties of black cotton soil by using RBI-81 and sodium silicate. After then Atterberg limit, CBR and UCS test were conducted out on the sample of soil with RBI-81 in proportion of 2% & 6% with curing period of 7, 14 & 28 days. Which finally made them to come to the conclusion that the normal soil which was having 2.33% CBR & 2.69% UCS has been increased to 10.03% & 3.62% at 14 days curing by adding 2% RBI-81 & 8.03% & 2.97% with 7 days curing. After then authors increased the percentage of RBI-81 from 2% to 4% which gave them result of 18.87% & 4.44% with 14 days curing and 16.24 % & 3.96% with 7 days curing. Overall the final conclusion which has been made by them was that the UCS & CBR value increases with increase in RBI 81.

Sushant et. al (2010) carried out an investigation to study the influence of RBI Grade 81 and lime on the stabilization of blast furnace slag and fly ash. Standard proctor test and unconfined compressive strength test for different combinations of the stabilizing agents were conducted. It was concluded that UCS of stabilized sample increases with increase in the period of curing. But the percentage of increase in strength was more upon lime addition compared to addition of RBI-81. Application of RBI Grade 81 chemical stabilizer causes the liquid limit to decrease and the plastic limit to increase, thereby decreasing the plasticity index of red soil under investigation. The most significant influence occurs mainly in the expansive soil than in the red clay soil studied by YOTAM Engineering Limited.

B.M.Patil[14] Manages the change in properties of sub grade soil by using soil stabilizer and provincially available poor materials. Where they completed standard proctor test on treated and untreated soil test and estimation of MDD and OMC were discover. The soil was treated with moorum and RBI 81 with distinctive extents tried for drenched CBR quality, MDD and OMC which came about for blend of soil: RBI Grade 81 in the extent of 100:0, 98:2, 96:4 the soaked CBR values are observed to be 2.56%, 4.89%, and 8.79% and for blend of soil: moorum: RBI Grade 81 in the extent of 100:0:0, 90:10:0, 80:20:0, the soaked CBR qualities are observed to be 2.56%, 2.41% and 2.84% and for blend of soil: moorum: RBI Grade 81, the extent of 78:20:2, 76:20:4 the splashed CBR qualities are observed to be 4.56%, 14.76% separately. This shows that the CBR value of sub grade soil can improved by using moorum along RBI 81 and development expense can be reduced to definite limit.

Anitha.K.R. et al. (2009) investigates the effect of using a new stabilization product, RB1-81 on kaolinite, red soil, & Lateritic soil. This study revealed that both soaked and un-soaked CBR increased significantly with the addition of RB1-81 for kaolinite, Red soil & lateritic soil. During this experiment the CBR specimen were prepared with different percentage RB181 i.e. (0%, 2%, 4%, 6%, & 8%) water content of 1% + OMC was added for preparation of specimen. CBR test were done at 0, 7 & 11 days of curing. CBR test at 11 days was done after soaking for 4 days, for the sample which has been cured for 7 days. After all experiment the author came to the conclusion that un-soaked CBR did not vary much for red soil and lateritic but it increased 16 times for kaolinite. It has also been found that soaked CBR increased 16, 14 & 4 folds with the addition of optimum percentage of RB1-81 recommended for red soil, lateritic and kaolinite respectively.

Haricharan T.S et al.(2013)evaluated the influence of RBI-81 stabilizers on properties of black cotton soil through laboratory investigation. Black cotton soil with varying percentages of RBI -81 that is 0, 0.5, 1, 1.5, 2 & 2.5 percent were studied for moisture density relationship and strength behavior of soil. In this experiment many several tests & analysis were made like Liquid Limit, Plastic Limit along with UCS & CBR. After conducting all the tests the author gets the result that UCS which treated with RBI-81 has increased up to 1032 KN/m<sup>2</sup> which was earlier 208 KN/m<sup>2</sup> after 28 days curing i.e. about 250% as compared to virgin soil. Further the CBR value improved approximately by 400% as the CBR value of virgin soil was 1.34% which has increased up to 14% after mixing 2.5% RB1-81 and 7 days curing period. Overall the plasticity index of the RB1-81 treated soil was found to be encouraging.

**1.3 Objectives**

1. To evaluate the effect of RBI grade 81 material on index properties and compaction characteristics of clayey soil.

2. To evaluate the effect of RBI grade 81 material on index properties and compaction characteristics of silty soil.

**2. MATERIALS**

After collecting soil samples, laboratory testing was done to assess the type of soil by evaluating its basic properties. Initially soil classification tests such as grain size analysis, liquid limit, plastic limit, plasticity Index were performed, followed by assessment of strength parameters such as compaction.

**Table -1:** Basic Properties of Soil

Property	Clayey soil	Silty soil
Liquid Limit	58%	40%
Plastic Limit	28.6 %	26%
Plasticity Index	29.4%	14%
Optimum Moisture Content	25%	16%
Maximum Dry Density	1.551 g/cc	1.61 g/cc
% Passing 75 micron sieve	96.68%	92.35%
Engineering classification	CH	MI

Similarly, the properties of stabilizer used here that is RBI grade 81 were studied as given in the manual provided by the Alchemist technology limited (2010),New Delhi. The properties are given in table 2.

**Table-2 :** Basic properties of RBI grade 81

Properties	Values
color	Grey powder
Odour	Odorless
Specific Gravity	2.5
Self Life	12 Months
Propylene Fibre%(By Mass)	1

**3. RESULT AND DISCUSSION**

Clayey soil +RBI 81	Sam ples	Liquid limit	Plastic limit	Plasticity index	OMC	MDD
Clayey soil +0%	C0R	58	28.6	29.4	25	1.551
Clayey soil +2%	C2R	55	29.2	25.8	24.2	1.585

Clayey soil +4%	C4R	51	30.6	20.4	23	1.61
Clayey soil+6%	C6R	48	32.4	15.6	22.3	1.63

Silty Soil + RBI 81	Samples	Liquid limit	Plastic limit	Plasticity index	OM C	MDD
Silty soil +0%	S0R	40	26	14	16	1.61
Silty soil +2%	S2R	38	26.4	11.6	15.5	1.65
Silty soil +4%	S4R	35.5	27.2	8.3	13.9	1.68
Silty soil +6%	S6R	33.2	28	5.2	12.3	1.72

**3.1 Atterberg limits :** The Atterberg limits of untreated soil and the soil+ RBI 81 mixtures have been performed in accordance to IS 2720: Part 5. The results are summarized in table-4. The tests indicated an decrease in liquid limit and increase on plastic limit which resulted in marginal reduction in plasticity index showing a significant improvement in soils.

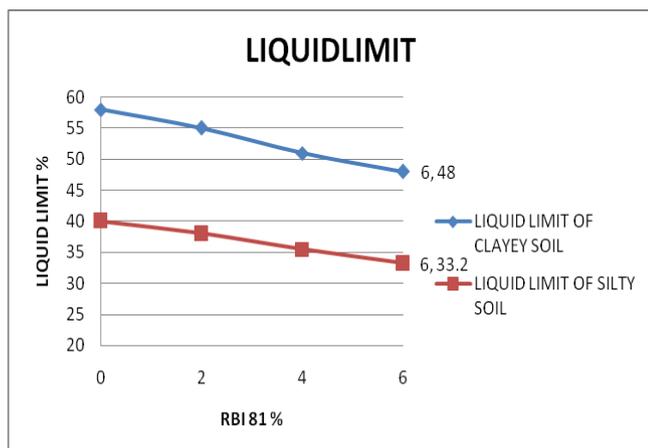


CHART 1- Effect of RBI 81% on Liquid limit of clayey soil and silty soil

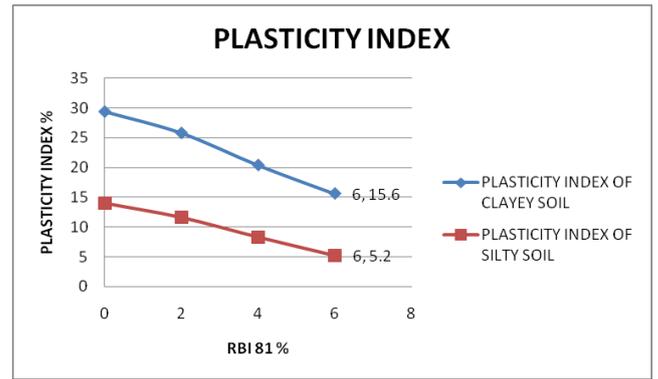


CHART 2- Effect of RBI 81% on Plasticity index of clayey and silty soil

**3.2 Optimum moisture content :** The Optimum moisture content of soil is the water content at which a maximum dry unit weight can be achieved after a given compaction effort .

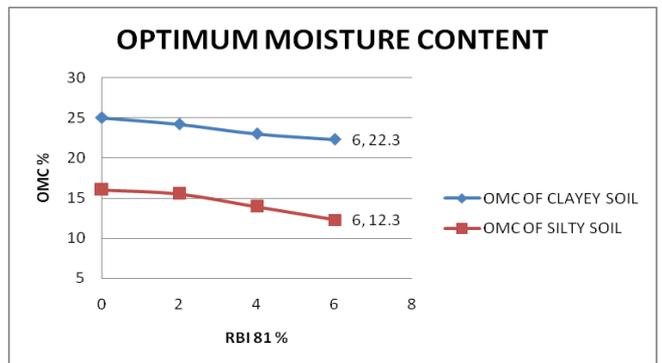


CHART 3- Effect of RBI 81% on OMC of clayey and silty soil

**3.3 Maximum dry density :** This laboratory test is performed to determine the relationship between the moisture content and the dry density of a soil for a specified compactive effort . This laboratory will employ the tamping or impact compaction method using the type of equipment and methodology developed by R. R. Proctor in1933.The test indicated an decrease in optimum moisture content and increase in Maximum dry density for clayey as well as silty soil mass.

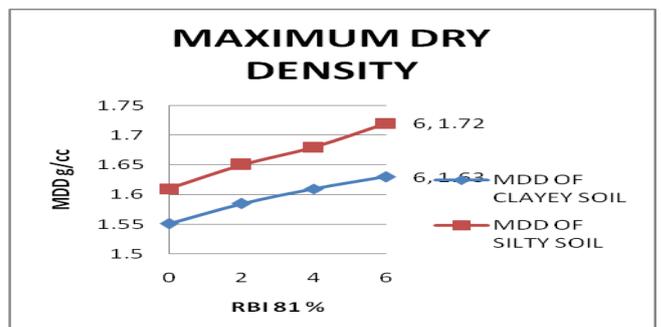


CHART 4 – Effect of RBI grade 81 % on MDD of clayey soil and silty soil .

#### 4. CONCLUSION

From this experimental study, it was found that with the increase of RBI 81 content in soil sample, the values of liquid limit reduces considerably and plastic limit increases. Hence, decrease occur in plasticity index of the treated soil. Maximum dry density increases while optimum moisture content decreases and hence compaction ability of soil increases and making the soil dense and more stabilized as compared to untreated soil.

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