

# STRENGTHENING AND EVALUATING OF BLACK COTTON SOIL BY USING RBI GRADE 81 AND LIME

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## ABSTRACT

*It is the era of reformation, low bearing capacity and high settlement behaviour of black cotton soil is the challenge for the engineers to work on it. To overcome this problem various techniques are used to increase the strength and durability of black cotton soil. Stabilization is the best technique which reduces the consistency limits of the soil. In this present study, experimental investigation are conducted to find out the improvement in the various engineering properties of soil after the addition of Lime and RBI grade 81 into the Black cotton soil. From the LL, PL, and PI tests on optimum mixes arrived, it has been found that the Liquid limit as well as plastic index decreases and Plastic limit increases by increasing the proportions of RBI grade 81, and Lime. The CBR and Standard Compaction tests were conducted on the optimum mix for Comparatively with normal black cotton soil, optimum mix.*

**Keywords:** Soil stabilization, RBI Grade 81, Lime, Compaction Test, CBR Test.

## 1. INTRODUCTION

- RBI Grade 81 meets the necessity for an all around demonstrated, solid and very savvy technique by making a solid and irreversible impermeable layer impervious to unfriendly climatic conditions, from extremely high temperatures to permafrost conditions, and obliging every single vehicular burden. RBI Grade 81 is naturally benevolent and accentuates the utilization of reused material, perceiving the absence of promptly accessible assets. Some trait of RBI Grade 81 is given in the accompanying. Patented worldwide including India.
- Cementitious powder
- Non-toxic
- Non inflammable
- Gray color powder

## 2. PROPERTIES OF RBI Grade 81

**Table 1. Physical Properties of RBI Grade 81**

Physical Properties	RBI Grade -81
Odour	Odourless
Ph	12.5
Freezing point	None
Flammability	Non-flammable
Shelf life	12 months
Storage	Dry storage
Bulk density	700 kg/m <sup>3</sup>

**Table 2. Chemical Properties of RBI Grade 81**

PROPERTIES	% BY MASS
Ca	CaO 52-56%
Si	SiO <sub>2</sub> 15-19%
S	SO <sub>3</sub> 9-11%
Al	Al <sub>2</sub> O <sub>3</sub> 5-7%
Fe	Fe <sub>2</sub> O <sub>3</sub> 0-2%
Mg	MgO 0-1%
Mn, K, Cu, Zn	0.1-0.3%
H <sub>2</sub> O	1-3%
Fibers	0-1%
Additives	0-4%

### 3. Lime

Lime is one of the basic building material used mainly as lime mortar in construction. Properties of building lime, advantages, and uses in construction is discussed. The broad category of lime is non-hydraulic and hydraulic lime. The non-hydraulic lime is called as quick lime, fat lime or white lime or as lump lime. Hydraulic lime sets under water and non-hydraulic lime do not set under water. Quick Lime is a form of lime is manufactured by the burning of stone that has calcium carbonate within it. The burning temperature varies, say 900 degree Celsius and above for several hours. This process is called as calcination. The solid product that remain after the removal of carbon dioxide in the calcium carbonate is called as the quicklime.

**Table 3.1. Physical Properties of Lime**

S.NO	CHARACTERISTICS	VALUE
1.	Water Absorptipn	0.6%
2.	Specific Gravity	2.75
3.	Fineness by wet sieving retain on 12.5 micron	0.59%

**Table 3.2. Chemical Properties of Lime**

S.NO	CHARACTERISTICS	VALUE
1.	Lime	38-42%
2.	Silica	15-18%
3.	Alumunium	3-5%
4.	Mgo	0.5-3%
5.	Feo	1-1.5%
6.	Loss on ignition	3.-32%

### 4. PERFORMED ON SOIL:

- **Liquid Limit Test:**

Preparation of Samples:

- Air dry soil sample and break the clots. Remove the organic matter like tree roots pieces of bark, etc.
- About 100g of specimen passing through 425µm IS sieve is mixed thoroughly with distilled water in the evaporating dish and left for 24 hours for soaking.

- **Plastic Limit Test:**

Preparation of sample:

- Take out 50 gm of air dried soil from a thoroughly mixed sample of soil passing through 4.25 µ m IS sieve. Mix the soil with the distilled water in an evaporating dish and leave the soil mass for nurturing. This period may be up to 24 hrs.

- **Standard Compaction Test (IS2720 Part VIII )**

➤ The test consists in compacting soil at various water contents in the mould, in three equal layers, each layer being given 25 blows of the 2.5 kg rammer dropped from a height of 310 mm. The dry density obtained in each test is determined by knowing the mass of the compacted soil and its water content. The compactive energy used for this test is 5880 kg cm per 2250 ml of soil.

• **California Bearing Ratio Test (CBR 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. The load values are noted corresponding to penetration values of 0.0,0.5,1.0,1.5,2.0,2.5,3.0,4.0,5.0,7.5,10.0 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:

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

- Normally the CBR value at 2.5 mm penetration which is higher than that 5.0mm .Reported as the CBR value of test material .However, if the CBR value obtained from the test at 5.0mm penetration is higher than 2.5 mm then the test is to be repeated for checking if it comes at 5mm it is reported as CBR value of test material.

**Table3. Characteristic Value of Soil**

S.NO	CHARACTERISTICS	VALUE
1.	Optimum Moisture content	18%
2.	Maximum dry density	2.1gm/cm <sup>3</sup>
3.	Plasticity limit	9.32
4.	Liquid limit	32%

**5. TEST RESULT**

A. *The Liquid Limit ,Plastic Limit & Plasticity Index using RBI Grade-81 and Lime*

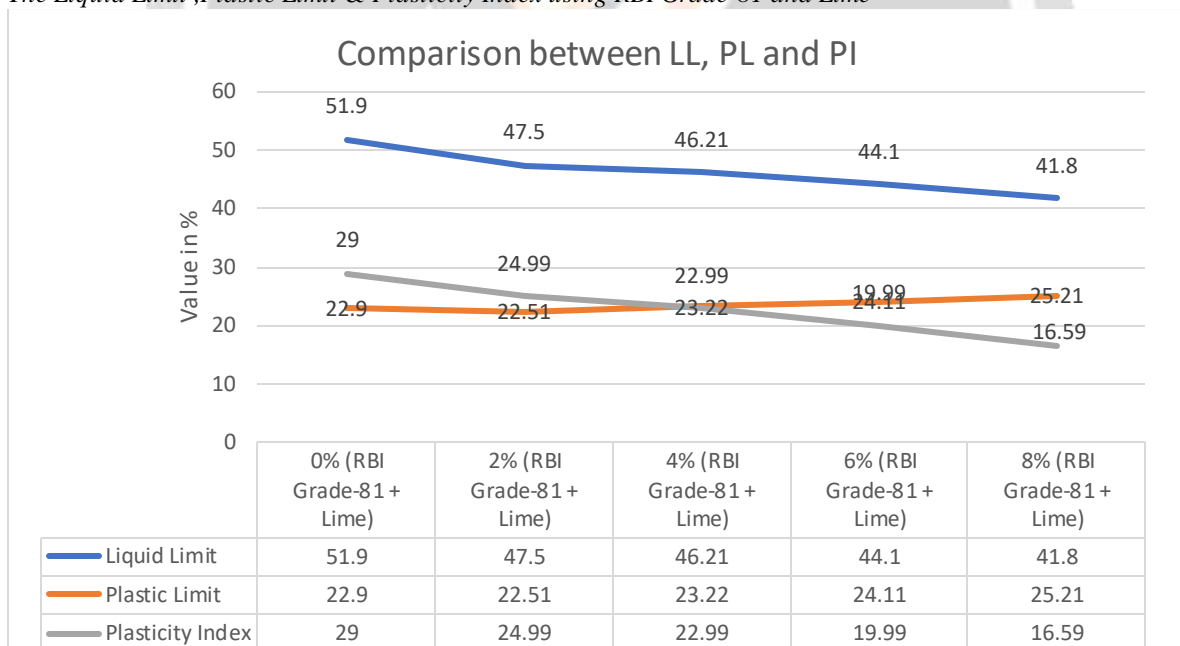


Fig. 1: The Liquid Limit, Plastic Limit & Plasticity Index using RBI Grade- 81 and Lime.

B *The Optimum Moisture Content & Maximum Dry Density using RBI Grade-81 and Lime*

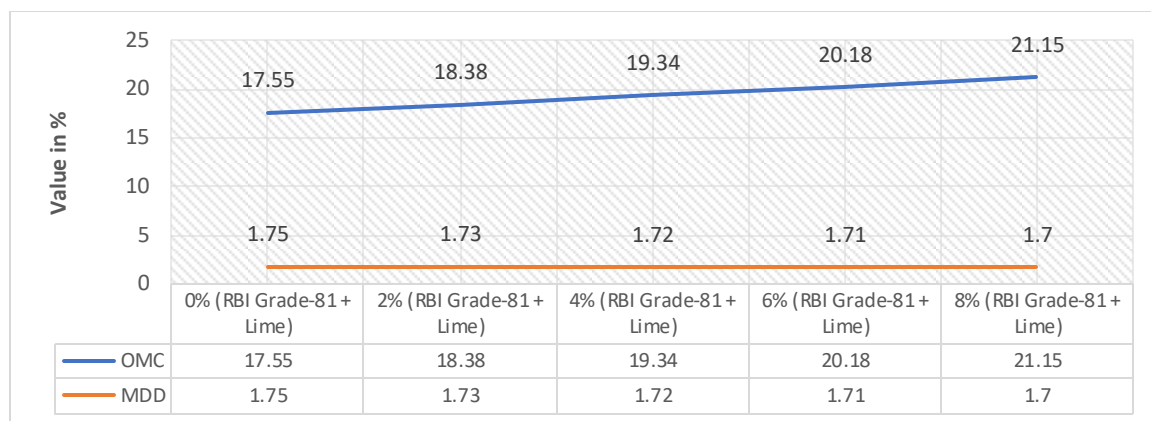


Fig. 2: The Optimum Moisture Content & Maximum Dry Density using RBI Grade-81 and Lime

C. 4 Day UN Soaked CBR Test Result

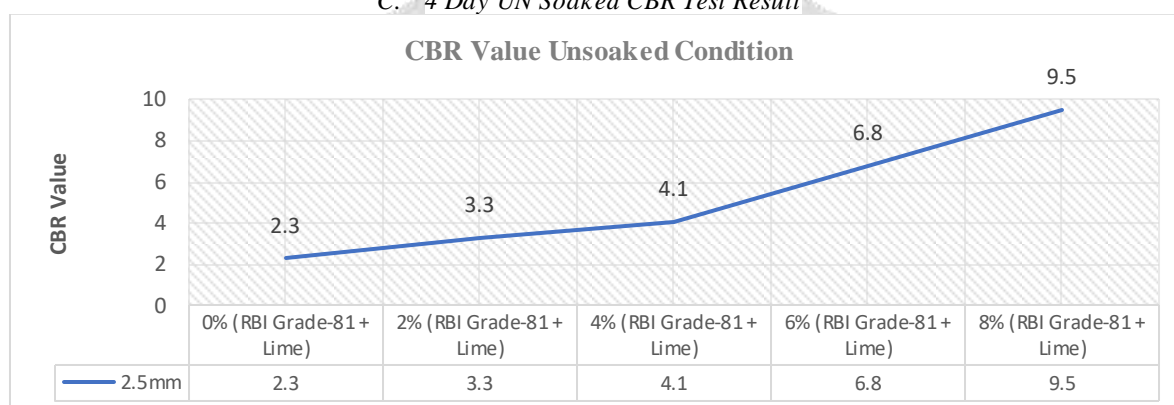


Fig. 3: 4 Day UN Soaked CBR Test Result

D. 4 Day Soaked CBR Test Result

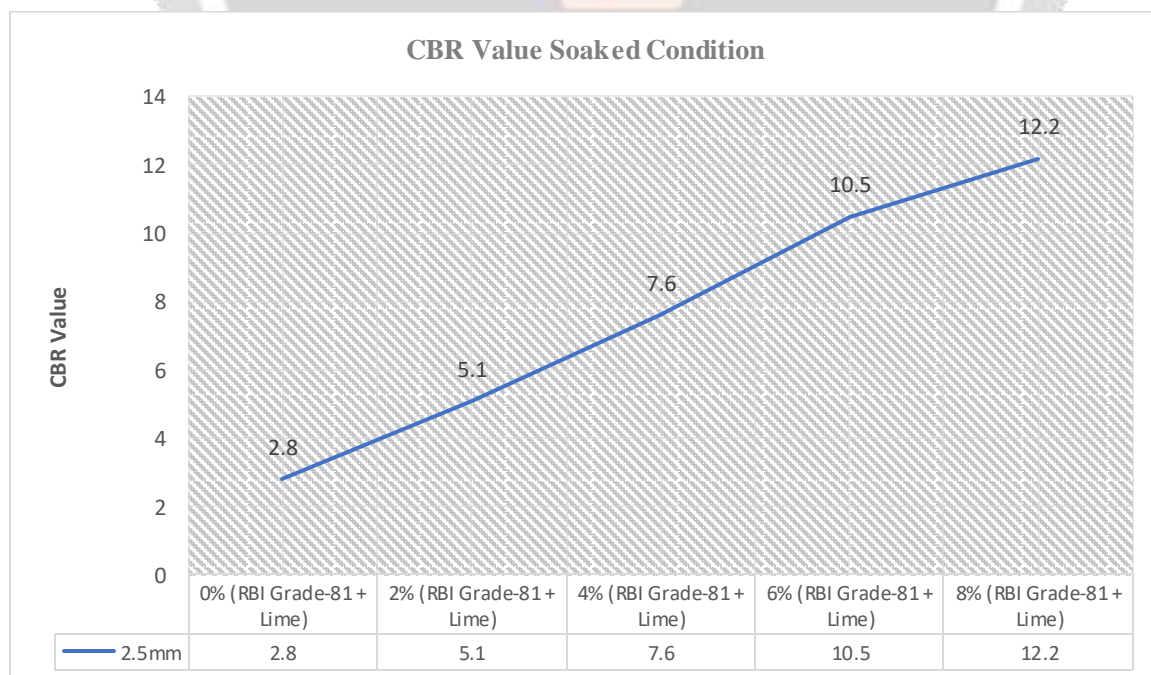


Fig. 4: 4 Day UN Soaked CBR Test Result

#### 4. CONCLUSION

Based on the results of this study the following conclusions may be drawn:

- Liquid Limit of the Black cotton Soil decrease with increase in percent of RBI Grade 81 and Lime.
- Plastic Limit of Black Cotton Soil increases with increase in percent of RBI Grade 81 and Lime.
- Plasticity Index of the Black Cotton Soil decreases with increase in percent of RBI Grade 81 and Lime
- The result implies that when sub-grade is reinforced with RBI Grade 81 and Lime it's CBR increases as for virgin soil CBR is 2.3 and it increases to 9.5 with RBI Grade 81 and Lime under un-soaked condition.
- For soaked condition CBR of RBI Grade 81 and Lime as 12.2 which is higher than virgin soil CBR of 2.8 under soaked condition.

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