

# Experimental Study on Stabilization of Black Cotton Soil with Lime, Plastic Waste & Red Mud

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**Abstract:** Soil stabilization is the process which altering the soil in different methods. The black cotton soil not suitable for construction process. So we can improve the strength by the plastic waste ,lime and red mud are mixed with black cotton soil at proportion of 3%, 5%, 7% and 9%. Basic soil sample tests and strength determining test like standard proctor test, CBR(California bearing ratio test), and unconfined compression test are conducted for the shear strength and bearing capacity. It was found that engineering properties of black cotton soil improved by addition of lime and plastic waste.

**Key words:** Black cotton soil, Lime, plastic waste, CBR test, red mud, unconfined compression test

## I. INTRODUCTION

This project is about stabilizing the strength of black cotton soil .Black cotton soil has low strength and high moisture absorption .So it cannot be used alone in construction technology and road development. So I have come up with a new practice to increase the stability .The strength of this black cotton soil can be increased with plastic waste, lime and red material .Because there is a lot of plastic waste in India, it can be recycled to increase the strength of this black soil .Also lime and red clay The experiment shows that black cotton absorbs soil moisture and brings its stability. Basic soil sample test are conducted to find the engineering properties of the soil, CBR test, SPT and UCC test are conducted for the soil sample first and then conducted for the soil mixed with medical waste powder at different proportion.

## II. MATERIALS USED

There are different materials used in the soil stabilization process

1. Black cotton soil
2. Lime
3. Plastic waste
4. Red mud

### 1. Black cotton soil

Black cotton soil is heavy clay soil, varying from clay to loam; it is generally light to dark grey in colour. Cotton grows in this kind of soil. The soil prevails generally in central and southern parts of India. Expansive nature of this soil negatively affects its bearing capacity. If black cotton soil stabilization is not applied, the damage will apparent usually several years after construction.

### 2. Lime

Lime is a chemical admixture Lime is a chemically reacting admixture reacts with composition of soil. It can be used for stabilizing in weak or expensive soils add in the black soil. These materials are still used in large quantities in building and engineering materials.

### 3. Plastic waste

Plastic waste is a improve properties of black soil. It has low shrinkage and high flexibility After proper cleaning and air drying, the plastic waste were shred into powder each of average thickness of 1mm. These plastic wastes are usually considered to be waste materials.

### 4. Red mud

Red mud, now more frequently termed bauxite residue, is an industrial waste generated during the processing of bauxite into alumina using the Bayer process. The main constituents of the residue after the extraction of the aluminium component are insoluble metallic oxides. The percentage of these oxides produced by a particular alumina refinery will depend on the quality and nature of the bauxite ore and the extraction conditions.

### III. LITERATURE REVIEW

1. Sivapullaiah, P et.al 2019– The Soil stabilisation is defined as the physical or chemical treatments applied to a soil in order to preserve or improve its stability as well as its engineering qualities. Soil stabilisation entails improving soil quality and softening water by increasing resistance via soil particle bonding. Technology offers a variety of options, but composition and drainage are the most fundamental. Other ways involve grading particle sizes and adding binders to expansive soil.
2. S. Andavan and V. K. Pagadala 2020- Increasing the additions of lime to the clay and is due to aggregation by lime Soil stability determines the qualities of the soil material. In order to create a combination that outperforms any of its constituents, two or more types of natural soils are combined in this project.
3. Sridevi, G et.al 2019 - To achieve the desired effect, the stabilisation relies on a chemical interaction between the stabiliser and the soil minerals. Portland cement, lime cement (fly ash), plastic, bitumen, lime, and other stabilisers are only a few examples. As this is the major topic of our study, it will be discussed in greater detail.
4. J. Premalatha et.al 2019 - Eco friendly the stability of the mix and durability of the roads can be increased while the plastic waste is added they are significantly stronger than soils that have not been stabilised. It helps you save time and money. Because the soil is already stabilising, site preparation time is minimised because the traditional "dig and dump" procedure is not required.

### IV. TEST AND RESULT

TABLE 1  
 PROPERTIES OF BLACK COTTON SOIL

properties	value
Dry density	1300 - 1800kg/m <sup>3</sup>
Liquid limit	40 - 120%
Plastic limit	20 - 60%
Specific gravity	2.65 - 2.70
Maximum dry density	20 - 35%

#### 1. Atterberg limits

##### A. Liquid limit



Casagrande apparatus

The liquid limit of black soil is found to be 45.6 % Inference Since the liquid limit comes out to be < 50%, therefore the soil is medium to high plastic.

*B. Plastic limit*

The average plastic limit of black soil was found to be 23.78%. so the plastic limit value has comes out in medium value

*C. Free swell index*

The results show that the differential free swell index of black cotton soil is 57%. After soil stabilization, the differential free swell index value for the final optimum mix reduced to a value of 18%

2. Specific gravity test

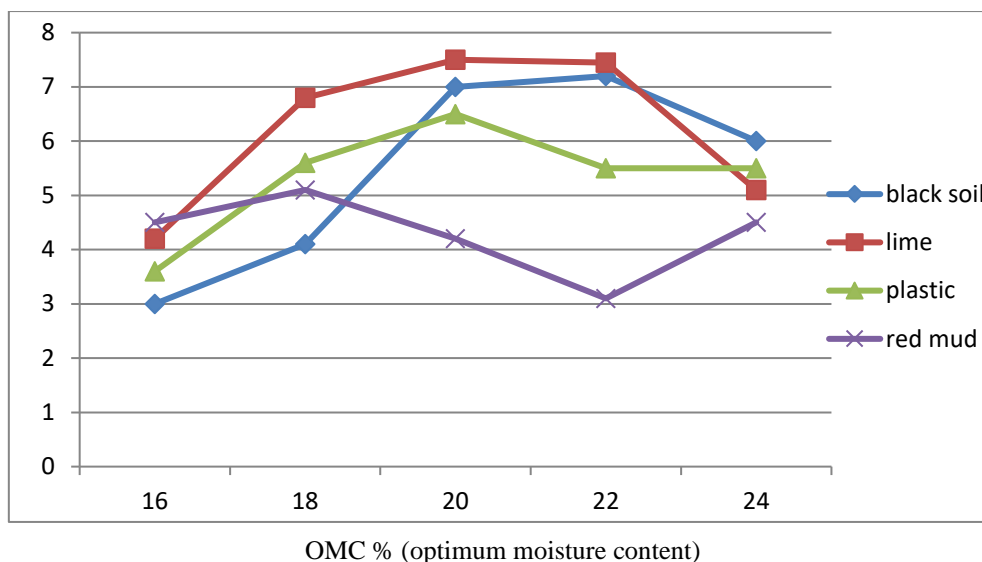
Table 2  
 Specific gravity test

sample	1	2
W1 = Weight of Empty Density bottle	30	29.2
W2 = Weight of Density bottle + oven dry soil	39.5	36.3
W3 = Weight of Density bottle + oven dry soil + water	83.5	84.4
W4 = Weight of Density bottle + water full	78.5	79.6
Specific gravity	2.63	2.73

3. STANDARD PROCTOR COMPACTION TEST

TABLE 3

SI.NO	% of Lime	% of Plastic waste	% of Red mud	OMC %	MDD (g/cc)
1	0	0	0	24	1.658
2	3	3	3	20.51	1.782
3	5	5	5	18.12	1.796
4	7	7	7	18.06	1.792
5	9	9	9	21.85	1.685



#### V. CONCLUSION

The Maximum dry density increases with increase in lime and plastic waste mix. But at 9% mix there is no increase in max dry density. The OMC strength maximum at 5% lime, plastic and red mud mix, after 5% it starts to decrease, the PCT value start decreasing after 7% of mix. As the result obtained from different soil test I have concluded that the plastic waste powder increasing the properties of black cotton soil. The maximum strength in properties obtained when the mix proportion is between 5% to 7%. The peak strength achieved in between this proportion. I will do the further research on this project in future by implementing these materials as soil cover in order to provide extra safety to the ground water. This project is suitable for highway projects. Using recycling plastic waste as filling and stabilizing material in safety methods helps to decompose the plastic waste and also economic. Plastic waste and red mud in mixed condition Observing its economic cost and quality of stabilization improvement, it is clear that this type of stabilization may be applicable in stabilization of black cotton soil in construction of road or in shoulder portion of highways

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