

Behaviour of Black Cotton Soil by using Lime as Admixture

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Abstract - Black cotton soil is one of the major soil deposits of India. They exhibit high swelling and shrinking when exposed to changes in moisture content and hence have been found to be most troublesome from engineering considerations. Behaviour of Black Cotton Soil is studied by using Lime. BC soils are highly clayey soils (Montmorillonite clay mineral). The moisture changes in BC soils, compressibility and plasticity nature can be greatly improved with the addition of Lime. Soil proportion changes depending upon their constituents, i.e. water content, density, bulk density, angle of friction, shear strength etc. This paper includes the evaluation of soil properties like Optimum moisture content, dry density, and shear parameter. Different quantities of Lime (% by weight) is added to the BC soil and the experiments conducted on these soil mixes. Experimental work has been carried out with 3 %, 6% and 9 % of lime content. The experimental work is based on different percentages of lime content in soil on tests for soil Liquid limit, Plastic limit, O.M.C., M.D.D, Bulk density and Dry density and Grain size analysis. The aim is to improve the engineering properties of the black cotton soil such that the structure built on this soil can be efficiently withstanding applied loads. It was found that the engineering properties of black cotton soil substantially improved by addition of lime

Key Words: , swelling, lime, Montmorillonite, Black cotton soil, angle of friction etc.

1. INTRODUCTION

Soil is defined as sediments on other accumulation of mineral particle produced by the physical or chemical disintegration of rocks plus the air, water organic matter and other substances that may be included Soil is typically a non-homogeneous, porous, earthen material whose engineering behaviour is influenced by changes on moisture content and destiny. In India expansive soils are called as Black cotton soil. The name "BLACK COTTON " as an agricultural origin. Most of these soils are black in colour and are good for growing cotton. All the black soils are not expansive soils and all the expansive soils are not black in colour. This soil passed high strength in summer and decreased rapidly in winter. The soil has as swelling property due to the presence of montmorillonite material. The swelling soils of India have their origin in subaqueous decomposition of basalt rocks. It is very necessary to discuss about the Engineering behaviour of soils. From this information civil structures can be prevented from the damages causing Expensive soils. Black soils are highly argillaceous and are relatively rich in CaCO₃.

Lime stabilization has been used extensively in block cotton soil stabilization. The addition of lime results in several stabilizing reactions. The solubility of silica increases in alkaline environment and silica becomes available as a cementing agent. The lime also provides a divalent cation which forms calcium silicates and calcium alumina hydrates that increase soil strength. However, if soil contains organics, sulphates and some iron compounds, lime stabilizations reactions can be inhibited.

1.1 ADVANTAGES

1. The enrich agro-friendly contents make black cotton soil fertile.
2. These soil are highly moisture-retentive, thus responding well to irrigation.
3. These are enriched with calcium carbonate, magnesium, potash and lime which are all nutrients.
4. These soils are the best option for farmers who like to produce plenty of crops.
5. Poor phosphoric contents renders rich production of corps like cotton.

1.2 OBJECTIVES

1. To study the behavior of black cotton soil by conducting grain size analysis, Liquid limit, Plastic limit.
2. Determination of field density of soil by core cutter method (Standard compaction).
3. Determination of density of soil by light compaction method (Modified compaction method.)
4. Behavior of soil with varying percentage of lime(i.e. 3%, 6%and 9%), Comparative statement of soil with and without admixture.

2. METHADODOLOGY

Materials:

2.1)Black Cotton Soil

- Black Cotton soil which is expansive in nature was collected near magod cross, Ranebennur, Karnataka. The top surface of the soil was cleared

with all the organic wastes and other waste materials.



Figure 2.1 Natural soil

2.1 LIME

Lime is a white caustic alkaline substance consisting of calcium oxide, which is obtained by heating limestone and which combines with water with the production of much heat. This was procured from the local market, Davanagere.



Figure 2.2 LIME

PROPOSED METHADODOGY

ITEM	PROPERTIES
Identification of black cotton soil	Soil will collected from available area
Grain size analysis	To find the fines modulus of soil
Liquid limit	It is defined as minimum water content at which the soil is still in liquid state but as the small sitting strength against flowing which can be measured by standard procedure.
Plastic limit	It is defined as minimum water content at which soil will just begin to crumble when rolled into a thread approximately

	3mm in diameter
Field density by core cutter method	To find the field density and optimum moisture content
Light compaction method	To find out the maximum dry density and optimum moisture content without admixtures
Comparative statement	Comparison of different index properties of black cotton soil with and without admixture

3. EXPIREMENTAL OBSERVATION

STANDARD COMPACTION TEST

Apparatus –Cylindrical mould, 1000cc capacity rammer of 2.6 kg drop 310mm balance, graduated jar, water soil sample, spatula and container for water content determination.

PROCEDURE

- Take about 3kg of air dried soil sieve the soil through 4.75mm sieve. Take the soil that passes through the sieve for testing.
- Clean, dry and grease the mould and base plate. Weight the mould with base plate. Fit the collar.
- Compact the wet soil in 3 equal layers by the rammer with 25 evenly distributed blows in each layer.
- Remove the collar and trim off the soil flush with the top of the mould. In removing the collar rotate it to break the bond between it and the soil before lifting it off the mould.
- Enter all the observation in the table and calculate the wet density.
- Calculate the dry density by using the equation.



Figure 3.1 Standard compaction test

RESULTS AND DISCUSSION

Table 3.1 Comparison values of results

Percentage of lime added	0%	3%	6%	9%
Sieve analysis	3.81%			
Liquid limit in %	67	61	58	58
Plastic limit in %	33.33	37.75	37.94	42.74
Plasticity index in %	33.67	23.25	20.06	15.26
OMC in %	16.66	13.33	14.28	13.04
MDD in g/cc	1.171	1.798	2.534	1.745
Unconfined test 1 ©	0.925	0.436	0.146	
2.φ	30	50	70	

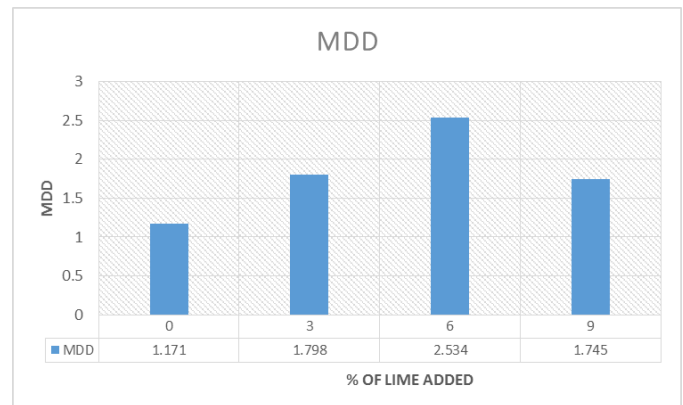


Table 3.4 MDD Comparison

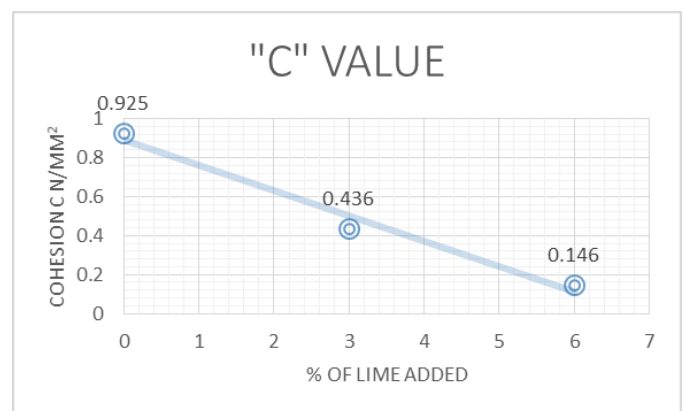


Table 3.5 Unconfined values comparison

4. CONCLUSIONS

- As the lime content goes on increasing the engineering properties like plastic limit goes on increasing their by plasticity index will gets a low.
- The Optimum moisture content and maximum dry density seems to be increasing as the lime percentage goes on increasing up to a limit of 6% lime.
- Thus by the use of above properties we can conclude that 6% is the limiting dosage of lime to stabilize to improve the behavior of black cotton soil.

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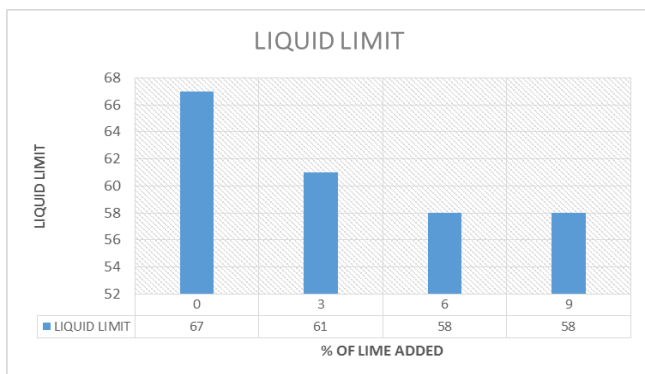


Table 3.2 liquid limit comparison

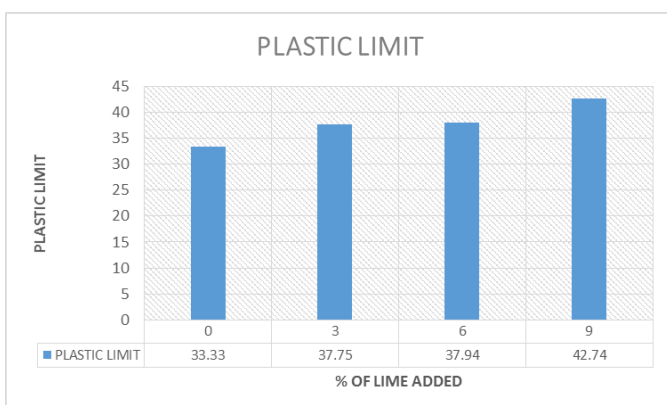


Table 3.3 plastic limit comparison

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