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Performance of Flyash and Lime in Stabilization of Black Cotton Soil

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***Abstract**: Stabilization of Black Cotton Soil (BC soil) is studied by using Lime and Fly ash. 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 and Fly ash. This paper includes the evaluation of soils properties like liquid limit and plastic limit. Different quantities of Lime and Fly ash (% weight) are added to the BC soil and the experiments conducted on these soil mixes. The result shows that the use of Lime and Fly ash increases the soil stabilization.*

***Keywords**—Black cotton soil, lime, fly ash, liquid limit, plastic limit.*

1. INTRODUCTION

Black cotton soil is highly weakly because of the large changes in volume due to fluctuations in the moisture content. In monsoon seasons, soils absorb water, and swell soil , also capacity to bear is reduced. In drier seasons, these soils shrink or reduce in volume due to evaporation of
water and they become harder. Black cotton soil also known as expansive soil covers about 16% of total area of country. Designing and constructing of any structure on black cotton soil is quite challengeable and problematic for an engineer due to its property of volume change when comes in contact with water. The term soil improvement is used the technique which improve the index property and other engineering characteristic of weak soil in India expansive soil cover 0.8 x 106 Km2 which approximately 1/5 of its surface area. The common burnt clay brick is one of the oldest building materials, and is being extensively used even today as a leading construction material because of its strength, durability and low cost. Demand for this brick in our country is increasing day-by-day because of the aforesaid favorable characteristics and brisk construction activities. Black soil is one of the major soil deposits in India covering an area of about 5.4 lakh square kilometer. Black cotton soil having tremendous strength when it is dry but after getting wet it loses its strength of sub grade. BC soils shrink in volume and develop cracks during summer. They are characterized by extreme hardness and cracks when dry. The stability and performance of the pavements are greatly influenced by the sub grade and embankment as they serve as foundations for pavements. On such soils suitable construction practices and sophisticated methods of design are to be adopted. In the present paper, reasons for poor condition of roads in B.C soils and measures to be taken for construction and improvement of roads on BC soils are presented. It swells and shrinks excessively with change of water content. Such tendency of soil is due to the presence of fine clay particles which swell, when they come in contact with water, resulting in alternate swelling and shrinking of soil due to which differential settlement of structure takes place. Stabilization of black cotton soil has been done in this project work by using lime and Geo-grid as admixture.

The construction cost can be considerably decreased by selecting local materials including local soils for the construction of the lower layers of the pavement such as the sub-base course. If the stability of local soil is not adequate for supporting wheel loads, the properties are improved by soil stabilization technique. Stabilization of course-grained soils having little or no fines can often be accomplished by the use of LF combination. Lime and Fly ash in combination can often be used successfully in stabilizing granular materials. LF stabilization is often appropriate for base and sub-base course materials. The water content of the fly ash stabilized soil mixture affects the strength. The maximum strength realized in soil-fly ash mixtures generally occurs at moisture contents below optimum moisture content for density.

2.MATERIALS

Natural soil sample is taken from Utnal village near Vijayapur(Karnataka),from depth of 2.5 m from ground level. The soil was air dried and pulverized manually. Natural soil has the swelling and shrinkage properties in the present of moisture. This natural soil is grey and black in colour. Basic properties of the natural untreated soil used in experiment work are presented in table 1.

Table.I

S.No	Soil properties	Values
1.	Gravel	23.4%
2.	Sand	76%
3.	Silt& clay	0.60%
4.	Liquid limit	38.9%
5.	Plastic limit	14.4%
6.	Plastic index	24.5%
7.	OMC	15.73%
8.	MDD	1.76 gm/cm^3
9.	CBR	2.166

Fly ash

Class-F fly ash is taken from Thermal Power Plant Raichur (Karnataka). Fly ash is air dried and pulverized. Fly ash is waste by product of Thermal power plant. Fly ash by itself has little cementatious value but in the presence of moisture it reacts chemically and forms cementatious compounds and attributes to the improvement of strength and compressibility characteristics of soils. The basic constituents of fly ash are shown in table 2.

Table.II

S.NO.	Constituent of fly ash	Values
1	Silica (SiO 2)	60.00
2	Alumina (Al 2O3)	25.00
3	Ferric oxide (Fe 2O3)	8.12
4	Calcium oxide (CaO)	2.9
5	Magnesium oxide (MgO)	0.82
6	Titanium oxide (TiO 2)	0.24
7	Free lime content	2.75

Lime

Lime was generally used from Shastri market Vijayapur (Karnataka).
The basic constituents of lime are shown in table 3.

Table.III

S.NO.	Constituent of fly ash	Values
1	Silica (SiO 2)	60.00
2	Alumina (Al 2O3)	25.00
3	Ferric oxide (Fe 2O3)	8.12
4	Calcium oxide (CaO)	6.0
5	Magnesium oxide (MgO)	2.0
6	Titanium oxide (TiO 2)	85.0
7	CaCO3	2.75

3.SOIL PREPARATION & EXPERIMENT:

Fly ash is mixed in varying percentage of 10%,15%,20% ,25%and 30% with natural soil. lime are mixed in varying percentage of 10%, 15%, 20% ,25%and 30% with natural soil.
The fly ash, lime & black cotton soil are mixed fully on dry weight basis in the suitable required proportions. There are different test sieve analysis, liquid limit, plastic limit, compaction unconfined compression test were performed in laboratory as per IS code standards.

The following tests are conducted:
- Sieve analysis
- Liquid limits
- Plastic limit

Sieve analysis
The Grain size analysis on natural soil and the soil additive mixture were con- ducted according to I.S. 2720 (Part iv)-1975.

Atterberg's limits
The tests on the liquid limit (LL), plastic limit (PL), and plasticity index (PI) of the soil-additive mixture were conducted according to I.S. 2720 (Part v)-1970.

4.RESULT AND DISCUSSION

The tests results of varying % fly ash and lime with BC soil is shown in table 4.

Table. IV

S. No	TYPES OF SOIL	LIQUID LIMIT TEST	PLASTIC LIMIT TEST
1.	B.C. SOIL	60.20%	45%
2.	B.C. SOIL+ 10% FLY ASH	45.13%	42%
3.	B.C. SOIL +15% FLY ASH	40%	41.8%
4.	B.C. SOIL +20% FLY ASH	37%	40.4%
5.	B.C. SOIL +25% FLY ASH	35%	38.5%
6.	B.C. SOIL +30% FLY ASH	33%	37%
7.	B.C. SOIL+10% LIME	56%	40%
8.	B.C. SOIL+15% LIME	54%	38.5%
9.	B.C. SOIL+20% LIME	54.12%	37.4%
10.	B.C. SOIL+25% LIME	50%	35.2%
11.	B.C. SOIL+30% LIME	48.4%	34%

Liquid limit

Liquid limit of black soil is decreases with addition of fly ash content. The primary clay mineral present in the black cotton soil is montmorillonite. The variation of liquid limit on addition of fly ash to the black cotton soil is shown in fig.1

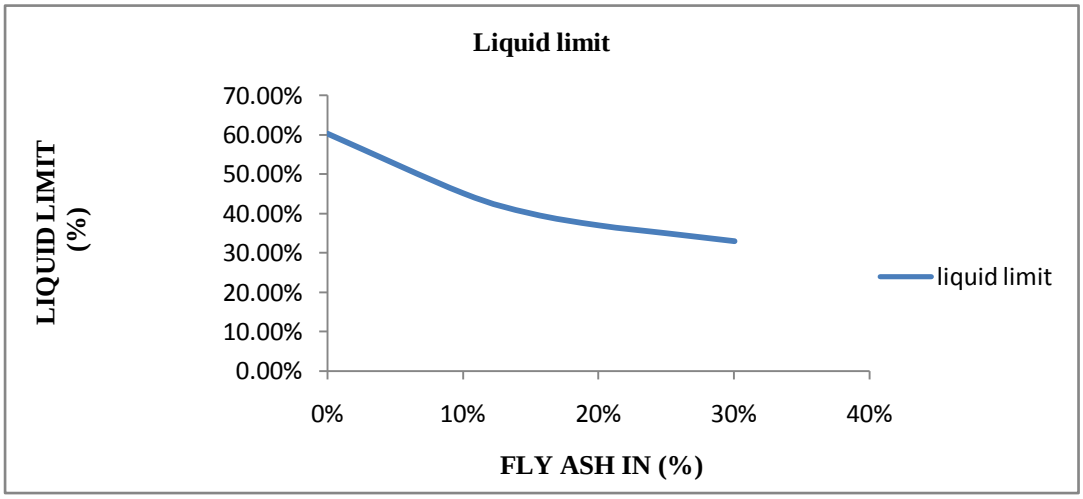

Figure 1. Liquid limit

Increased addition of fly ash with BC soil, the amount of soil to be flocculated decreases and the finer particles of fly ash may be incorporated in the voids of flocculated soil ; thereby decreasing the water held in the pores leading to the decrease in the plastic limit The variation of plastic limit on addition of fly ash to the black cotton soil is shown in fig. 2.

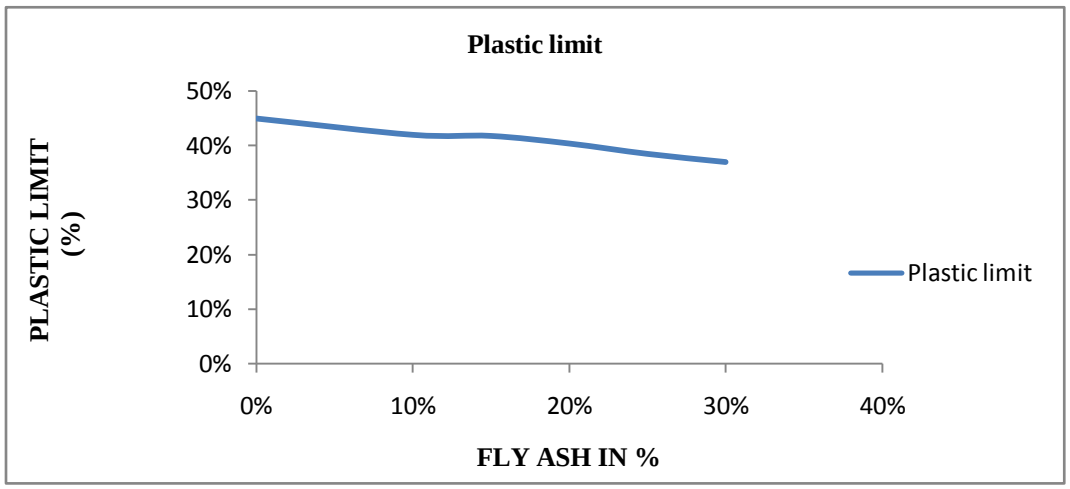

Figure 2. Plastic limit

Liquid limit

Liquid limit of black soil is increases with addition of lime content.
The variation of liquid limit on addition of lime with the black cotton soil is shown in fig.6.

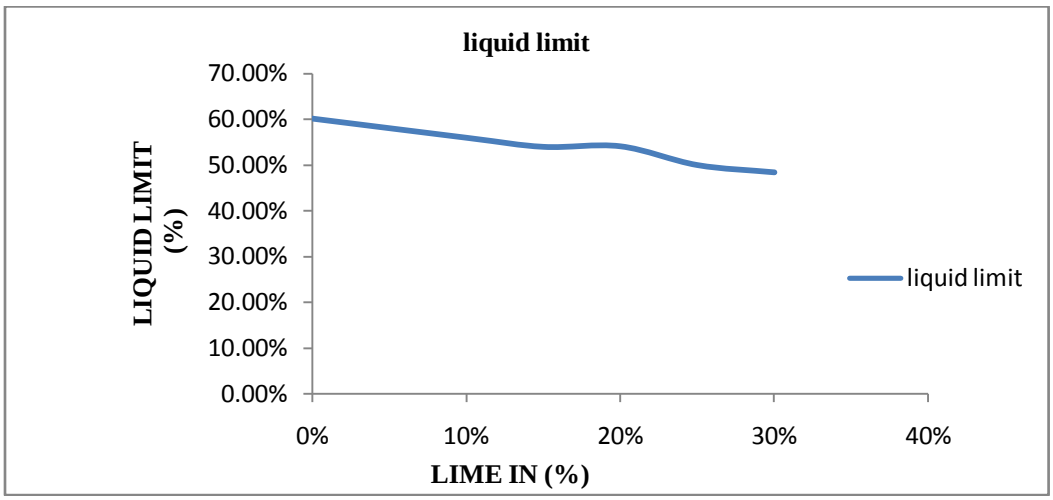

Figure 3. Liquid limit

Plastic limit

The variation of plastic limit on addition of lime with the black cotton soil is shown in fig. 4.

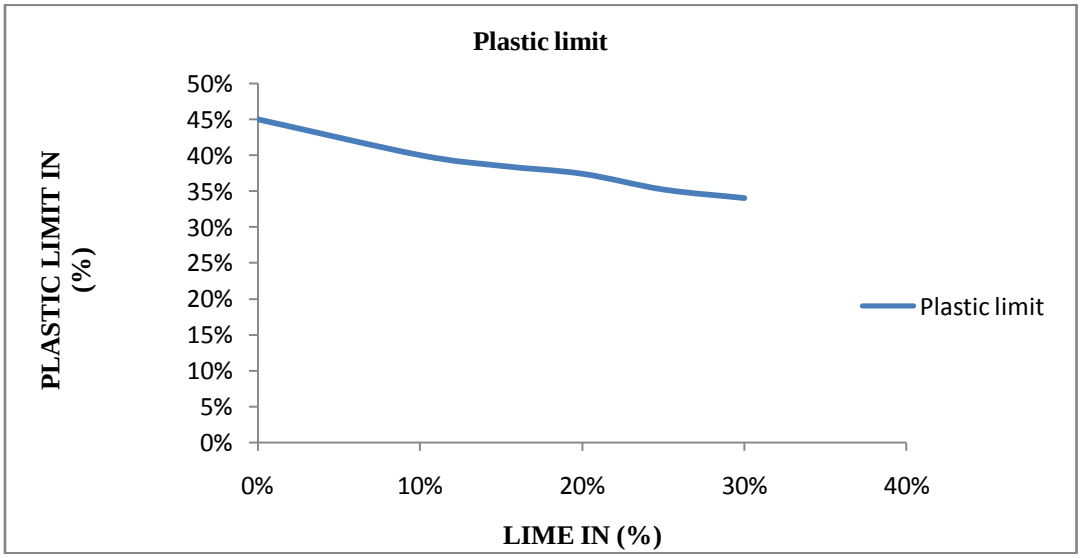

Figure 4.Plastic limit

5. CONCLUSIONS

The following conclusions are drawn from the present investigation:-

- In this project work it has been found that the properties of black cotton soil get effectively modified by varying proportions of lime and fly ash.
- In this experimental program stabilization of soil has been carried out by mixing lime and fly ash in varying percentages (10% to 30%). Liquid limit and plastic limit of BC soil decrease with increasing 10%,15%,20%,25%,30% fly ash. But Liquid limit and plastic limit of BC soil increase with increasing 10%,15%,20%,25%,30% lime.
- The index parameters of the study soils improve with the addition of flyash. The liquid limit decreases from 62% to 33% , plastic limit marginally decreases from 45% to 38%.

6. REFERENCES

[1] Phani Kumar, S.R., and Sharma, R.S (2004). "Effect of fly ash on engineering properties of expansive soils." J. Geotech. Geonviron. Eng., 131(7),914-924
[2] Determination of liquid limit and plastic limit. Indian standard methods for testing of soils-IS2720 (a) Indian standard Institution, New Delhi, India, part 5,pp 109-144,1985

