International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 03 Issue: 11 | Nov -2016 www.irjet.net p-ISSN: 2395-0072

EFFECT OF LIME ON INDEX PROPERTIES OF BLACK COTTON SOIL

Ankit Jain (M.E. Geotechnical Engg.) R. K. Yadav (Associate Professor)

Civil Engineering Department, Jabalpur Engineering College (JEC), Jabalpur, (M.P.) India

ABSTRACT:

Black cotton soil is one of the major soil deposits of India. The Black cotton Soils are very hard when dry, but lose its strength when in wet condition. Black cotton soil exhibit high swelling and shrinkage when exposed to changes in moisture content and hence have been found to be most troublesome from engineering considerations. The properties of black cotton soil can be modified by stabilizing the soil with the use of additives or by mechanical means. In this study, lime is used as a stabilizing material to stabilize the black cotton soil. The experimental work has been carried out to check the improvement in the index properties and swelling property of expansive soil with lime in varying percentages. Lime is added in 2%, 4%, 6%, 8%, and 10% by weight of dry soil and the change in index properties and swelling property examined. Test results indicated that liquid limit, plasticity index and DFS of expansive soil decreased with increase in lime percentage. The optimum quantity of lime was found as 8% by weight of dry soil.

KEYWORDS:

Expansive Soil, Lime, Index Properties, DFS

INTRODUCTION:

Expansive soils, well-known as Black Cotton Soils in India, occupy about one-fifth of land area of the country. Black Cotton Soils are residual deposits formed from basalt rocks. They contain significant amount of montmorillonite mineral. 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, so the stabilization of black cotton soil has been done in this project work by using lime as an admixture. Experimental work has been carried out with 2,4,6,8 and 10% of lime content by weight of dry soil. The experimental work is based on different percentages of lime content in soil tests for Liquid limit, Plastic limit, Plasticity Index and DFS.

LITERATURE REVIEW:

Singh and Vasikar (2013) studied stabilization of Black cotton soil using lime. They concluded that an addition of 4% lime decreases the liquid limit by 12.1%, while addition of 6 % lime show a decrease of only 17.1%. Swelling pressure of Black cotton soil mixed with 4% and 6% lime decreased by 40% and 80% respectively.

Kumari Pratima et al. (2015) investigated swelling behavior of expansive soil mixed with lime and fly ash as admixture. They found that liquid limit of stabilize samples initially decrease with the addition of lime up to 6% and then increases. Free swell index of samples decreases with increasing lime content and the value of F.S.I becomes 0 at 8% of lime addition.

Nadgouda and Hegde (2010) studied the Effect of Lime Stabilization on Properties of Black Cotton Soil. The results of their work indicated that liquid limit of soil decreased from 59.8% to 53.2% with increase in lime content up to 4.5% after that it goes on increasing with increase in lime content. Plasticity index of soil decreased from 25.9% to 15.1%. DFS decreases gradually with increase in lime content.

MATERIALS:

BLACK COTTON SOIL:

Black cotton soil sample used in this project was collected from JASUJA CITY near Dhanwantri Nagar Jabalpur (M.P.).

Geotechnical properties of black cotton soil are given in Table- 1

TABLE-1

Geotechnical properties of black cotton soil

S.NO.	Properties	Values
1.	Soil Classification	CH(clay of high Plasticity)
2.	Liquid Limit (LL)	67.49%
3.	Plastic Limit (PL)	30.33%
4.	Plasticity Index (PI)	37.16%
5.	Specific Gravity	2.40
6.	Differential Free Swell (DFS)	60%
7.	Optimum Moisture Content (OMC)	18.74%
8.	Maximum Dry Density (MDD)	1.69 g/cc
9.	California Bearing Ratio (CBR)	2.82%

LIME: Lime used in this investigation was purchased from local market.

METHODOLOGY:

A series of laboratory tests were conducted on black cotton soil mixed with different proportion of lime i.e. 0%, 2%, 4%, 6% 8% and 10% by weight of dry soil. The following tests were conducted on black cotton soil and lime mixes as per relevant IS codes of practice:

- Specific gravity test
- Liquid limit
- Plastic limit
- Plasticity index
- Differential free swell (DFS) Test
- Wet Sieve Analysis

MIX PREPARATION:

Following mix has been prepared with different percentage of Lime.

- Soil Sample + 0% Lime (CL_0)
- Soil Sample + 2% Lime (CL_2)
- Soil Sample + 4% Lime (CL_4)
- Soil Sample + 6% Lime (CL_6)
- Soil Sample + 8% Lime (CL_8)
- Soil Sample + 10% Lime (CL_{10})

RESULTS AND DISCUSSION:

Test results are summarized in Table-2. Variation of LL, PI and DFS of Black Cotton Soil mixed with different proportion of lime as shown in the figure 1 to 3. The liquid limit and plasticity index of soil decreases with increase in lime content up to 8% after that further increase in lime content there is no significant changes in liquid limit and plasticity index. Thus the optimum quantity of lime is 8% for maximum effect on liquid limit and plasticity index and DFS decreases gradually with increase in lime content.

Table-2

Test results of Black Cotton Soil with Lime (%)

S.NO	SAMPLE TYPE	LL (%)	PI (%)	DFS (%)
1	CL_0	67.49	37.16	60
2	CL_2	62.73	21.46	55
3	CL_4	56.85	16.6	40
4	CL_6	55.65	15.97	25
5	CL_8	52.01	10.43	14
6	CL_{10}	52.78	11.09	14

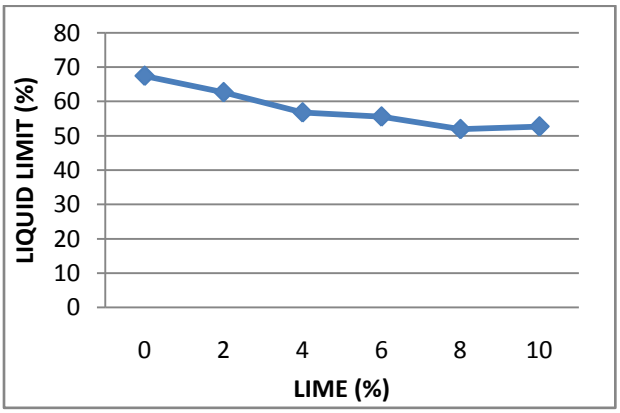

Fig 1: Variation of LL with increasing % of Lime

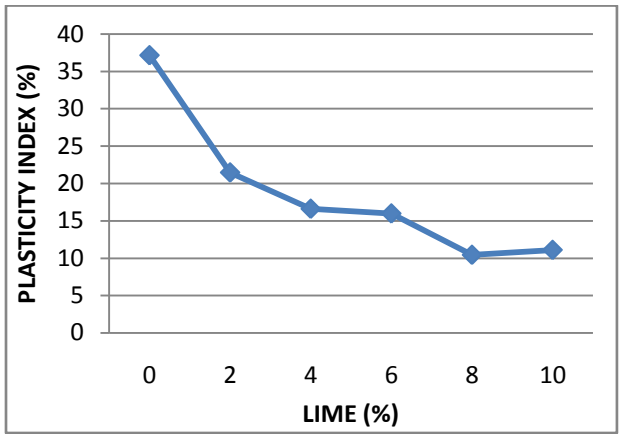

Fig 2: Variation of PI with increasing % of Lime

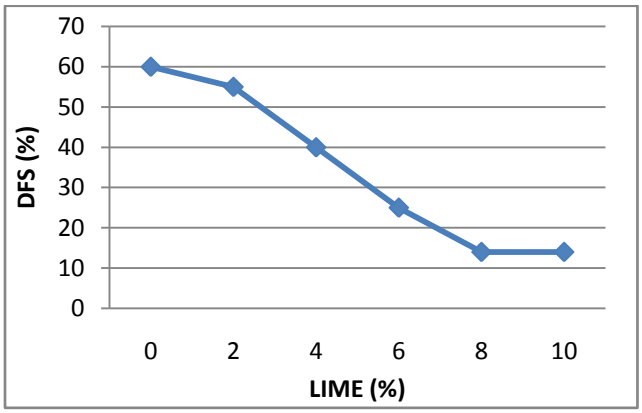

Fig 3: Variation of DFS with increasing % of Lime

CONCLUSIONS:

From the results of investigation following conclusions can be drawn.

1. Liquid limit of soil decreases from 67.49% to 52.01% with increase in lime content up to 8% after that there is no significant change with increase in lime content.
2. Plasticity index of soil decreases from 37.16% to 10.43% with increases in lime content up to 8% after that slight change is observed with increase in lime content.
3. Differential free swell decreases from 60% to 14% with increasing lime content.

Above results indicates that the swelling characteristics of soil is reduced and optimum quantity of lime required for reducing liquid limit and plasticity index of soil is 8%.

REFERENCES:

[1] Arora K.R. (2002); **Soil mechanics and foundation Engineering,** second edition, standard publication, New Delhi.

[2] Gati sri Utami (2014); **"Clay soil Stabilization with Lime effect the value CBR and Swelling"** ARPN Journal of Engineering and Applied Sciences volume 9, NO. 10, PP 1744- 1748

[3] IS 2720 (Part 2)-(1973); **"Determination of Water Content"**, BIS New Delhi.

[4] IS 2720 (Part 3)-(1980); **"Determination of Specific gravity"**, BIS New Delhi.

[5] IS 2720 (Part 5)-(1985); **"Determination of Liquid Limit and plastic Limit"**, BIS New Delhi.

[6] IS 2720 (Part XL)-(1977); **"Determination of Free Swell Index of Soils"**. BIS New Delhi.

[7] Kumari Pratima, Sharma Prafull and Singh J.P. (2015); **"Swelling Behaviour of Expansive Soil Mixed with Lime and Fly Ash as Admixture"** International Journal of Innovative Research in Science Engineering and Technology, Volume 4 Issue 6, pp 4364-4372.

[8] Nadgouda K.A. and Hegde R.A. (2010); **"The Effect of Lime Stabilization on Properties of Black Cotton Soil"** Indian Geotechnical Conference 2010, IGS Mumbai Chapter & IIT Bombay, pp 511-514.

[9] Punmia B.C (2011); **Soil mechanics and foundation Engineering**, 16th Edition, New Delhi.

[10] Ramesh H.N., Krishnaiah A.J. and Shet S. Shilpa (2014); **"Effect of Lime on the Index Properties of Black Cotton Soil and Mine tailings mixtures"** IOSR Journal of Engineering Vol. 3, Issue 4, pp 01-07.

[11] Singh Shailendra and Vasaikar B. Hemant (2015); **"Stabilization of Black Cotton Soil using Lime"** International Journal of Science and Research, Volume 4, Issue 5, pp 2090-2094.