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Soil Stabilization by using Lime

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ABSTRACT

Lime is a calcium- containing inorganic mineral in which carbonates, oxides, and hydroxides predominate. In the strict sense of the term, lime is calcium oxide or calcium hydroxide. It is also the name of the natural mineral (native lime) CaO which occurs as a product of coal seam fires and in altered limestone xenoliths in volcanic ejecta. The word lime originates with its earliest use as building mortar and has the sense of sticking or adhering. These materials are still used in large quantities as building and engineering materials (including limestone product cement, concrete, mortar) as chemical feedstocks and for sugar refining, among other uses. Lime industries and the use of many of the resulting products date from prehistoric times in both the old world and the new world. Lime is used extensively for waste water treatment with ferrous sulphate made to observe the effectiveness of stabilizing agent lime in improving various engineering properties of soil like liquid lime, plastic limit, plasticity index Black cotton soil is a highly clayey soil. In general, all lime treated fine-grained soil exhibit decrease plasticity, improved workability and reduce volume change characteristics. However, not all soil exhibit improved strength characteristics. It should be emphasized that the properties of soil lime mixtures are dependent on many variables. Soil type, lime type, lime percentage and curing conditions (time, temperature) It has been observed that CBR values increased with lime content, for black cotton soil. It is observed that value increased significantly after addition of lime content. The stabilized soil can be used as subgrade, sub base and base course without aggregate. The test result indicates that lime may be used to save natural resources like aggregate and murum.

Keywords-- CaO, Soil, Plasticity

I. INTRODUCTION

Lime, in general, all lime treated fine-grained soils exhibit decreased plasticity, improved workability and reduced volume change characteristics. However, not all soils exhibit improved strength characteristics. It should be emphasized that the properties of soil lime mixtures are dependent on many variables. Soil type, lime type, lime percentage and curing conditions (time, temperature, and moisture) are the most important. Lime is a calcium-containing inorganic mineral in which carbonates, oxides, and hydroxides predominate. In the strict sense of the term, lime is calcium oxide or calcium hydroxide. It is also the name of the natural mineral (native lime) CaO which occurs as a product of coal seam fires and in altered limestone xenoliths in volcanic ejecta. The word lime originates with its earliest use as building mortar and has the sense of sticking or adhering. Abandoned sites due to undesirable soil bearing capacities dramatically increased, and the outcome of this was the scarcity of land and increased demand for natural resources. Affected areas include those which were susceptible to Liquefaction and those covered with soft clay and organic soils. Other areas were those in a landslide and contaminated land. However, in most geotechnical projects.

II. LIQUID LIMIT TEST (PLAIN SOIL)

DETERMINATION NO	NOTATION	I	II	III
Container Number		15	17	16

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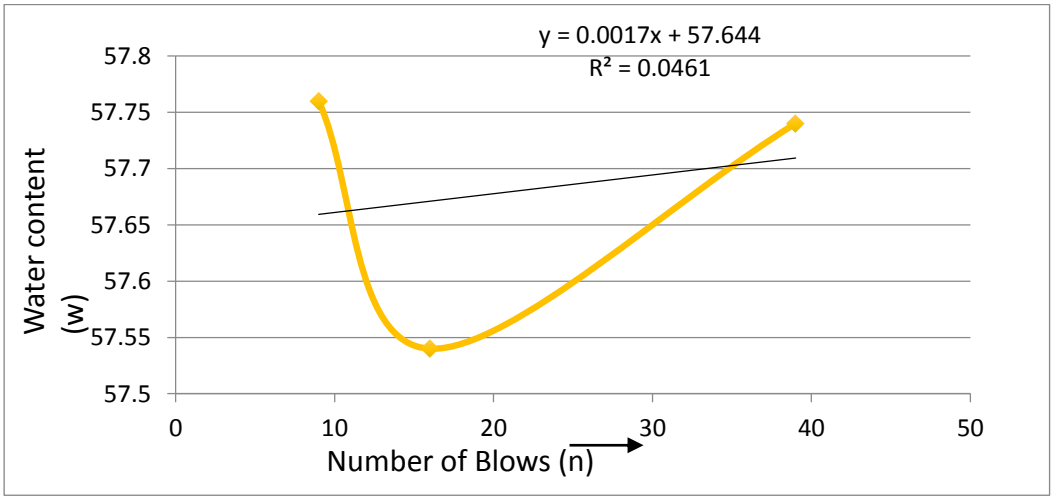
Number of Blows		09	16	23
Weight of Container	W_0 (grams)	12.18	11.84	12.34
Weight of Container + Wet Soil	W_1 (grams)	14.72	14.66	16.11
Weight Of 1Container + Oven-dry Soil	W_2 (grams)	13.79	13.63	14.73
Weight of Water	W_1-W_2 (grams)	0.93	1.03	1.38
Weight of Oven-dry soil	W_2-W_0 (grams)	1.61	1.79	2.39
Water Content (as a percentage)	$W = \left[\frac{W1 - W2}{W2 - W0}\right] X\ 100$	57.76	57.54	57.74



AVERAGE WATER CONTENT: W = 57.68 %

2.1 LIQUID LIMIT TEST (PLAIN SOIL+3% ASH)

DETERMINATION NO	NOTATION	I	II	III
Container Number		19	91	93
Number of Blows		24	31	39
Weight of Container	W_0 (grams)	11.86	11.90	12.25
Weight of Container + Wet Soil	W_1 (grams)	14.03	14.47	14.14
Weight Of 1Container + Oven-dry Soil	W_2 (grams)	13.28	13.58	13.51
Weight of Water	W_1-W_2 (grams)	0.75	0.89	0.63
Weight of Oven-dry soil	W_2-W_0 (grams)	1.42	1.68	1.26
Water Content (as a percentage)	$W = \left[\frac{W1 - W2}{W2 - W0}\right] X\ 100$	52.81	53.97	50.00

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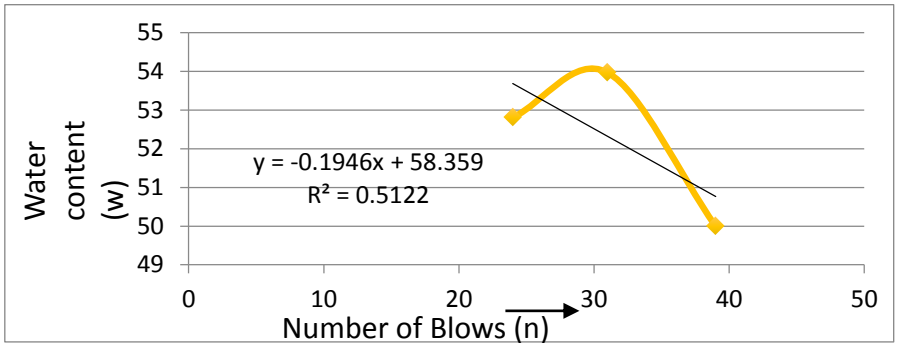

AVERAGE WATER CONTENT: W = 52.9 %

III. PLASTIC LIMIT TEST (PLAIN SOIL)

DETERMINATION NO	NOTATION	I	II
Container Number		89	90
Weight of Container	W_0 (grams)	11.66	12.17
Weight of Container + Wet Soil	W_1 (grams)	12.66	12.83
Weight of Container + Oven-dry Soil	W_2 (grams)	12.37	12.63
Weight of Water	W_1-W_2 (grams)	0.29	0.20
Weight of Oven-dry soil	W_2-W_0 (grams)	0.71	0.46
Water Content (as a percentage)	$W = \left[\frac{W1 - W2}{W2 - W0}\right] X\ 100$	40.84	43.47

PLASTIC LIMIT: W_P = 42.15 %

PLASTICITY INDEX:
PLASTICITY INDEX = LIQUID LIMIT – PLASTIC LIMIT
PLASTICITY INDEX = 15.53%

3.1 PLASTIC LIMIT TEST (PLAIN SOIL+3% LIME)

DETERMINATION NO	NOTATION	I	II
Container Number		13	05
Weight of Container	W_0 (grams)	11.96	11.66
Weight of Container + Wet Soil	W_1 (grams)	13.24	12.89
Weight of Container + Oven-dry Soil	W_2 (grams)	12.88	12.51
Weight of Water	W_1-W_2 (grams)	0.36	0.38
Weight of Oven-dry soil	W_2-W_0 (grams)	0.92	0.85

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Water Content (as a percentage)	$W = \left[\frac{W1 - W2}{W2 - W0}\right] X\ 100$	39.13	44.70

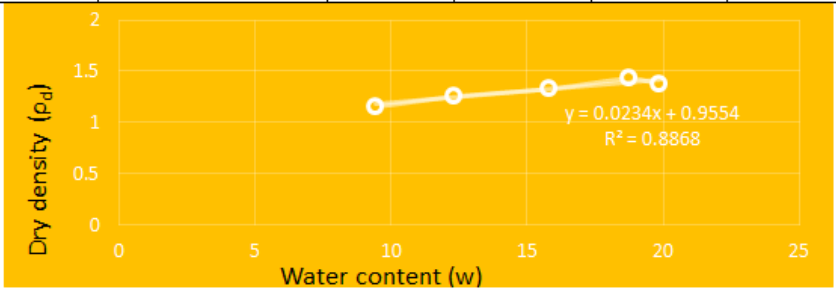
PLASTIC LIMIT: W_P = 41.91 %

PLASTICITY INDEX:
PLASTICITY INDEX = LIQUID LIMIT – PLASTIC LIMIT
PLASTICITY INDEX = 10.99 %

Trial Number	NOTATION	I	II	III	IV	V
Weight of Soil		2.5kg	2.5kg	2.5kg	2.5kg	2.5kg
Weight of mould (without collar)		3.675kg	3.675kg	3.675kg	3.675kg	3.675kg
Weight of mould +soil		5.916	6.485	7.130	7.805	7.508
Container Number		06	19	13	05	15
Weight of Container	W_0 (grams)	12.29	11.86	11.96	11.65	12.31
Weight of Container + Wet Soil	W_1 (grams)	36.82	38.9	38.53	39.69	39.47
Weight of Container + Oven-dry Soil	W_2 (grams)	34.71	35.94	34.9	35.36	34.97
Weight of Water	W_1-W_2 (grams)	2.11	2.96	3.63	4.33	4.50
Weight of Oven-dry soil	W_2-W_0 (grams)	22.42	24.08	22.94	23.11	22.66
Density		2.24	2.81	3.45	4.13	3.94

IV. STANDARD PROCTOR TEST OF SOIL SAMPLE

Water Content (%)	$W = \left[\frac{W1 - W2}{W2 - W0}\right] X\ 100$	9.41	12.30	15.83	18.74	19.86
DRY DENSITY	$\frac{M/V}{1+w}$	1.153	1.261	1.337	1.436	1.369



The maximum dry density of soil is 1.44 at 18.8 % of water content

4.1 STANDARD PROCTOR TEST OF SOIL SAMPLE WITH 3% LIME

Trial Number	NOTATION	I	II	III	IV	V
Weight of Soil		2.5kg	2.5kg	2.5kg	2.5kg	2.5kg
Weight of mould (without collar)		3.675kg	3.675kg	3.675kg	3.675kg	3.675kg
Weight of mould +soil		5.955	6.535	7.185	7.805	7.735
Container Number		03	06	07	17	04
Weight of	W_0 (grams)		12.32	11.85	12.43	12.21

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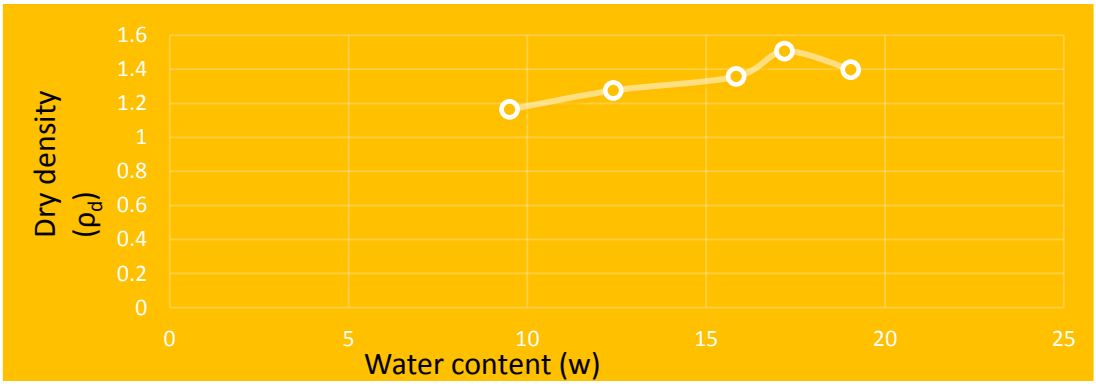
Container		11.82				
Weight of Container + Wet Soil	W_1 (grams)	36.80	38.7	38.52	39.81	39.28
Weight of Container + Oven-dry Soil	W_2 (grams)	34.73	35.92	34.8	35.75	34.95
Weight of Water	W_1-W_2 (grams)	2.05	2.67	3.54	4.03	4.40
Weight of Oven-dry soil	W_2-W_0 (grams)	21.81	22.7	22.85	23.32	22.48
Density		2.25	2.79	3.49	4.13	4.05
Water Content (%)	$W = \left[\frac{W1 - W2}{W2 - W0}\right] X\ 100$	9.51	12.41	15.85	17.2	19.05
DRY DENSITY	$\frac{M/V}{1+w}$	1.165	1.276	1.358	1.52	1.398



The maximum dry density of soil is 1.52 at 17.1 % of water content

V. CALIFORNIA BEARING RATIO TEST

5.1 SOIL SAMPLE (UNSOAKED)

1	0.5	1.0
2	1	2.4
3	1.5	4.1
4	2	6.2
5	**2.5**	**7.2**
6	3	8.3
7	4	8.9
8	**5**	**9.2**
9	7.5	9.6
10	10	10.2
11	12.5	14.3

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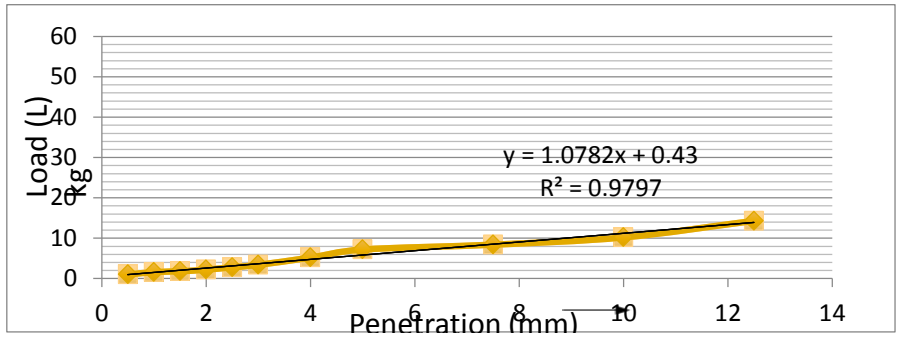

1. THE CBR VALUE AT 2.5 MM = 2.80 %
2. THE CBR VALUE AT 5 MM = 2.39 %

THE CBR VALUE OF SOIL IS = 2.80 %

5.2 SOIL SAMPLE + 3 % LIME (UNSOAKED)

Sr. No	PENETRATION(mm)	DIAL READING
1	0.5	1.5
2	1	2.1
3	1.5	4.3
4	2	6.2
5	**2.5**	**8.9**
6	3	10.1
7	4	11.8
8	**5**	**12.1**
9	7.5	15.8
10	10	19.9
11	12.5	23.7

1. THE CBR VALUE AT 2.5 MM = 3.47 %
2. THE CBR VALUE AT 5 MM = 3.15 %

THE CBR VALUE OF SOIL IS = 3.47 %

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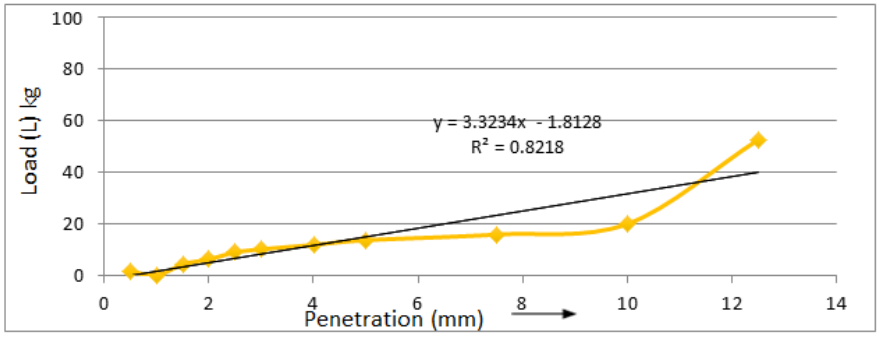
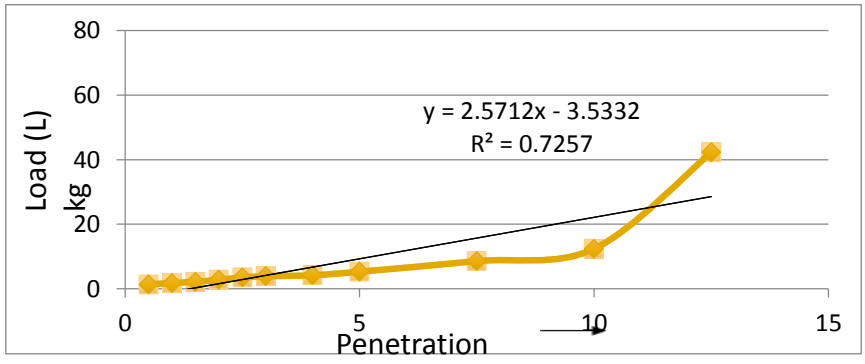


5.3 SOIL SAMPLE (SOAKED)

Sr. No	PENETRATION(mm)	DIAL READING
1	0.5	1.4
2	1	1.8
3	1.5	2.2
4	2	2.8
5	**2.5**	**3.5**
6	3	3.9
7	4	4.2
8	**5**	**4.5**
9	7.5	8.6
10	10	12.4
11	12.5	18.3



1. THE CBR VALUE AT 2.5 MM = 1.3 %
2. THE CBR VALUE AT 5 MM = 1.17 %

THE CBR VALUE OF SOIL IS = 1.3 %

5.4 SOIL SAMPLE + 3 % LIME (SOAKED)

Sr. No	PENETRATION(mm)	DIAL READING
1	0.5	2.5
2	1	3.3
3	1.5	3.9

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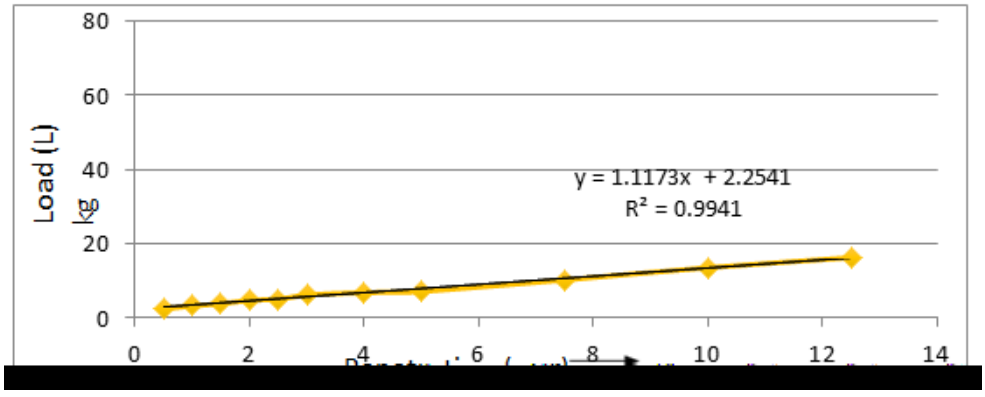
4	2	4.8
5	**2.5**	**5.1**
6	3	6.2
7	4	6.5
8	**5**	**7.2**
9	7.5	10.3
10	10	13.6
11	12.5	16.3



1. THE CBR VALUE AT 2.5 MM = 1.99%
2. THE CBR VALUE AT 5 MM = 1.87 %

THE CBR VALUE OF SOIL IS = 1.99%

VI. CONCLUSION

The CBR of the lime treated black cotton soil increased when compared to untreated black cotton soil.

It has been observed that CBR value increases with lime content 2%-3%, for black cotton soil.

Soil stabilization is the process in which improving the different type of engineering properties of black cotton soil and it is making for stable soil.

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