Assessment of CBR development of Black Cotton Soil Using Conventional & Non-Conventional Stabilizers

K.Chandraprakash[1], Vijeth U K [2], Dr. S.D. Venkataraja Mohan[3]

1. *Asst.Professor, School of Civil Engineering, REVA University, Bangalore*
2. *4th semester student (M.Tech, TE&M), School of civil engineering, Bangalore*
3. *Professor, Dept. of Civil Engineering, Dr AIT, Bangalore*

Abstract

Suitable soil for construction activity may not be available all along the alignment. It is therefore becomes necessary either to bring suitable soils from far off barrow areas or to stabilize locally available soils to improve their engineering properties. The stabilization of locally available soil always proves economical. In the present study, laboratory studies were carried out on black cotton soil blended with non-conventional stabilizers (stabling) and conventional stabilizer (lime).

Compaction, California bearing ratio test were carried out on native and soils blended with 2%, 4% and 6% dosages. It is found that there is no significant change in basic properties of soil when it is stabilized. The CBR value found at different proportions of admixtures.

***Key Words*:** Black cotton soil, non-conventional stabilizers (stabling), conventional stabilizer (lime), CBR, MDD

1. Introduction

The ground is an essential part of this nature. It is set for all in one way or another. The term land in basic construction is defined as a loose rock, compound produced by the decay of Felsen. Der blank space between particles can air out of solid particles, contain water or both. Solid particles can contain organic matter. There are extremely unpredictable bottom sediments in nature so they produce an infinite variety of combination possibilities to influence the soil resistance and procedures. So it is the special case of black cotton soil with a variety of challenges related to construction sites with black cotton soil.The present study considers two commercial patented stabilizers namely “Stabilig Material” and one conventional stabilizer i.e., Lime.

1.1 Necessity to replace

Stabilig can stabilize soil of any type sort, either very sandy, very clayey, through which necessary replacement of in – situ materials can be avoided. Through this soil exchange can be avoided and also reduction of the quantity of aggregate can be achieved, it also cuts down the expenditure during highway construction to a large extent when compared with other traditional ways.

1.2 Traditional Stabilizers

- Cement,
- Different Lime,
- Different classes in Fly ash,
- Bitumen materials.

1.3 Non-traditional Stabilisers

There are varieties of non-traditional soil stabilisation additives industry, such as polymer emulsions, acids, enzymes, lignin derivatives, wood resin emulsions and silicates. These additions can liquid or solid form, and often touted as applied to most soils. The market becomes more and more life in the stabilisation of non-traditional alternative products always. This is because a lot of time to improve your times and large quantizes of the desired to get a traditional stabilizing chemical, as well as related to the chemical reaction, a few traditional chemical stability (sulphate, taking soil cement, lime, and fly ash).
Non- traditional stabilisers are typically grouped in different types.

1.4 Scopes & Objectives

The scope of the present study is to study the index properties, strength and performance characteristics of BC soil stabilized with commercial patented stabilizers namely “Stabilig Material”. Also, to compare the properties obtained with same soil stabilized with Lime.

2. Materials & Methodology

The black cotton soil used for conducted experiments brought from Davanagere, Karnataka, India. All the tests carried on the soil are as per IS specifications. Ground control is used in the construction of new roads and the reconstruction tired and generally requires that then addition to the 2%, 4%& 6% by weight of the dry soil. Lime is used to improve the properties of the soil/aggregate mixtures "in the entire depth of the recycling.
“Stabilig an Australian patent product is a soil stabilizer designed to form to get an impervious bound flexible pavement. The percentage of Stabilig is adopted for different soil in different percentages. Basic lab tests were performed in the Geotechnical Lab on the BC soil to study the behavior of BC soil, when it is mixed with admixtures, Index properties – Specific gravity, Sieve analysis, Atterberg’s limits. Compaction tests- Optimum moisture content, maximum dry density. Strength tests-CBR & UCS.
All the above tests were conducted on the various combinations 2%, 4% & 6%.

Table No-2.1: Chemical properties of STABLIG

Sl No.	Constituent	Percentage(%)
1	Calcium	52-56
2	Silicon	15-19
3	Sulphur	09 to 11
4	Aluminium	05 to 07
5	Magnesium	0-1
6	Manganese, Potassium, Copper, Zinc.	0.1-0.3
7	Water	01 to 03
8	Fibres(Polypropylene)	0-1
9	Additives	0-4

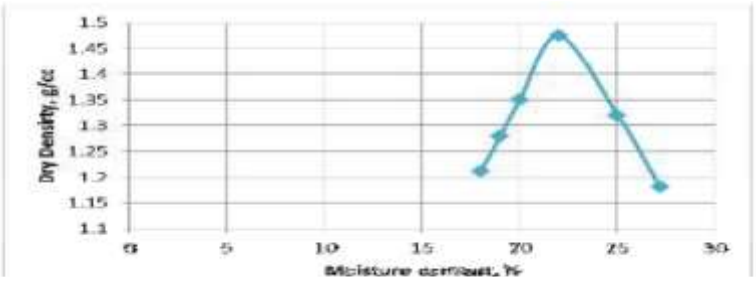
Table No-2.2: Physical properties of stabilig

Sl.No.	Physical Properties of STABLIG	
1	Odour	Odourless
2	pH	12.5 (Saturated Paste)
3	Specific Gravity	2.5
4	Solubility	Insoluble in water
5	Freezing Point	None, Solid
6	Flammability	Non-flammable
7	Self-Life	12 month(Dry Storage)
8	Storage	Dry Storage
9	Bulk Density	700 kg/ m3

3. Results and Discussion

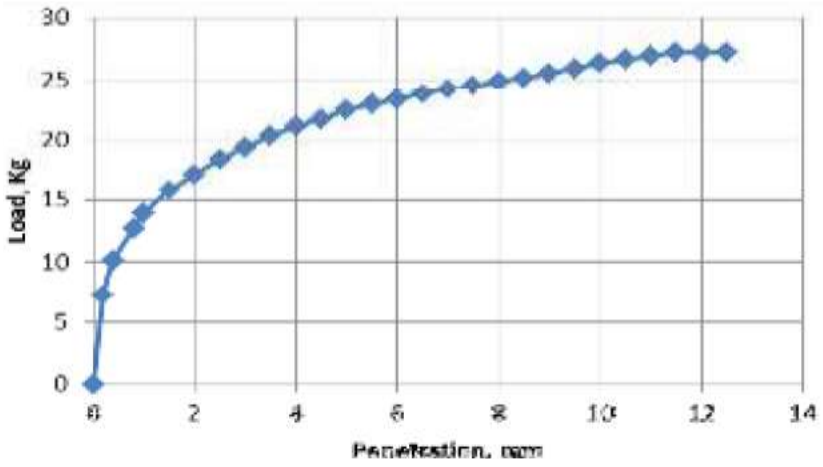
Without adding any admixture to the soil and the soil is treated with conventional stabilizer i.e. lime in various proportions of 2%, 4% and 6% by weight of soil.
The soil is treated with Non-conventional stabilizer i.e. Stabilig in various proportions of 2%, 4% and 6% by weight of soil.

Modified proctor compaction test was carried out as per IS 2720 (Part VIII) and obtained maximum dry density (MDD) is 1.475 g/cc and optimum moisture content (OMC) is 27.2%.



Graph-1: Compaction Curve of unstabilised BC Soil

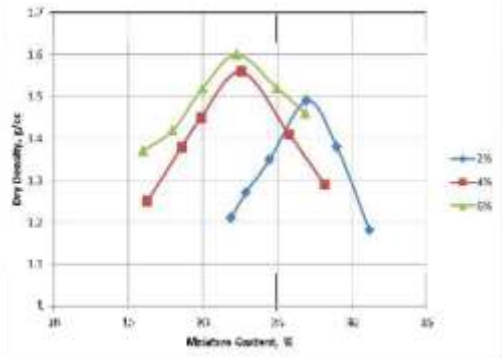
California bearing ratio test was carried out as per IS-2720 (Part XVI) and obtained CBR value is 2.55%.



Graph-2: CBR Curve of unstabilised BC Soil

Table 2.8 –Compaction characteristics of BC Soil treated with Lime

S.No.	Tests	BC soil treated with Lime		
		2%	4%	6%
1	MDD g/cc	1.49	1.52	1.55
2	OMC %	31.2	28.2	26.9

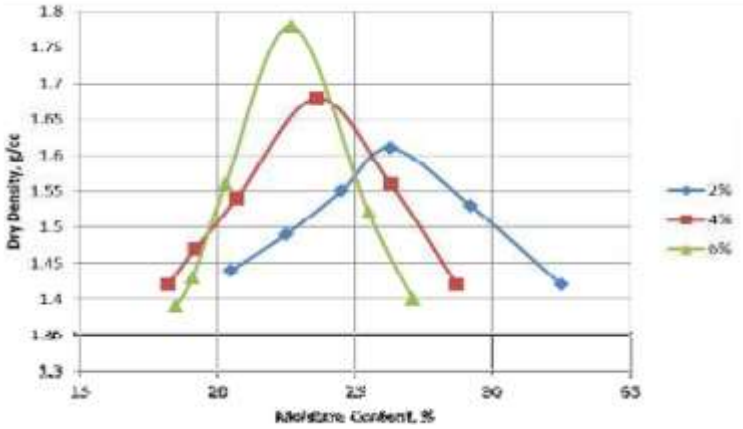


Graph-3: Compaction curve variation in BC Soil treated with lime

Table -Compaction values of BC Soil treated with Stabilig

S.No.	Tests	BC soil treated with Stabilig		
		2%	4%	6%
1	MDD g/cc	1.61	1.68	1.78
2	OMC %	32.5	28.7	27.1

Graph-4: Variation of Compaction of BC soil treated with Stabilig

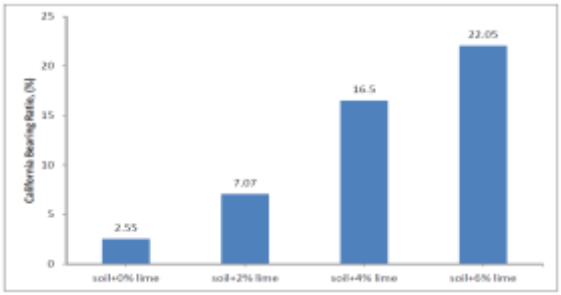


California bearing ratio test for soil treated with Lime was carried out as per IS 2720 (Part XVI) and the results are shown in table below.

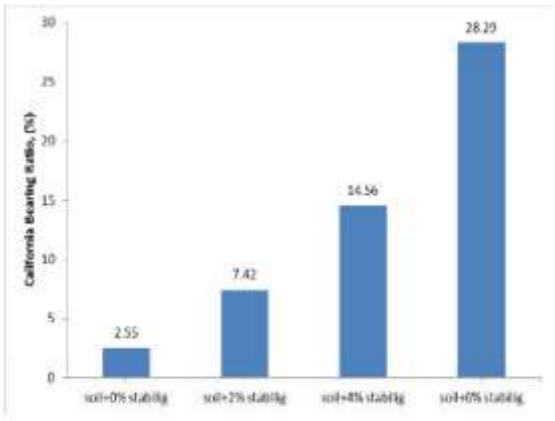
Table : CBR of BC Soil treated with Lime

Test	BC soil treated with Lime		
	2%	4%	6%
CBR (%)	7.04	16.53	22.02

Graph-5: CBR variation in BC Soil treated with lime



Test	BC soil treated with Stabilig		
	2%	4%	6%
CBR (%)	7.42	14.56	28.22



Graph-6: Variation in CBR values of BC soil treated with Stabilig

4. Conclusion

It was found that there were no significant changes in basic properties of black cotton soil when treated with lime, from CBR test it was found that there is significant increase in strength of soil when treated with Stabilig material.

References

[1] Dhawan, P.K., Bhantnagar O.P an swami R.K "Design of soil lime mixes and Durability Aspects". Highway Research Board, No.36, 1988, Soil Engineering.
[2] Dallas N. Little, Syam Nair, Recommended Practice for Stabilization of upgrade soils and base materials.
[3] DFID, Design of stabilized sub-bases for heavily trafficked roads, project references:R6027, R8010, TRL, UK
[4] ASTM Standards on Soil Stabilization with Admixtures, 2nd Edition. 1992. 126 pp.
[5] Baghdadi, Z.A., M.N. Fatani, N.A. Sabban, 1995. Soil modification by cement kiln dust. Journal of Materials in Civil Engineering, 7(4): 218-222.
[6] Bell, F.G., 1996. Lime stabilization of clay minerals and soils. Engineering Geology, 42: 223-237. Bell, F.G., R.R. Maud, 1944.
[7] Dispersive soils and earth dams with some experiences from South Africa. Bulletin of the Association of Engineering Geologists, 31(4): 433-446.
[8] Bergado, D., L. Anderson, N. Miura, A. Balasubramaniam, 1996. Soft ground improvement: in lawland and other environment. New York: American Society of Civil Engineers.
[9] Boschuk, J., 1991. Landfill covers - an engineering perspective. Geotech Fabrics Report, 9(4): 23-34. Chen, L., D.F. Lin, 2009. Stabilization treatment of soft subgrade soil by sewage sludge ash and cement. Journal of Hazardous Materials, 162: 321-327.
[10] Cristelo, N., S. Glendinning, L. Fernandes, A.T. Pinto, 2013. Effects of alkaline-activated fly ash and Portland cement on soft soil stabilisation. Acta Geotechnica.
[11] Cristelo, N., S. Glendinning, T. Miranda, D. Oliveira, R. Silva, 2012. Soil stabilisation using alkaline activation of fly ash for self compacting rammed earth construction. Construction and Building Materials, 36: 727-735.
[12] Diamond, S., E.B. Kinter, 1965. Mechanisms of soil-lime stabilization. Highway Research Record, 92: 83- 102.
[13] Duxson, P., J.L. Provis, G.C. Lukey, J.S.J.V. Devender, 2007. The role of inorganic polymer technology in the development of 'green concrete'. Cement and Concrete Research, 37(12): 1590-1597. Edil, T.B., H.A. Acosta, C.H. Benson, 2006.
[14] Stabilizing Soft Fine-Grained Soils with Fly Ash. Journal of Materials in Civil Engineering. Fauzi, A., W.M. Nazmi, U.J. Fauzi, 2010. Subgrade Stabilization of Kuantan Clay Using Fly Ash and Bottom Ash. The 8th International Conference on Geotechnical and Transportation Engineering Geotropika 2010. Ferguson, G., 1993.
[15] Use of self-cementing fly ashes as a soil stabilization agent. Fly ash for improvement, Geotechnical Special Publication No. 36, ASCE, New York, 1-14. FIPR (Florida Institute of Phosphate Research), 1988. Stabilization of phosphatic clay with lime. Florida Institute of Phosphate Research, Bortow-Florida 102 p.