LABORATORY INVESTIGATION OF SOIL STABILIZATION USING TERRASIL WITH CEMENT

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ABSTRACT

This research work presented the efficacy of a nano technology based chemical named Terrasil as a modifier in improving the engineering properties of Black Cotton soil. Expansive soils are a worldwide problem that possess several challenges for civil Engineers. Various methods are adopted to improve the engineering characteristics of expansive soils. The problematic soils are either removed and replaced by good and better quality material or treated using additive. The effectiveness of Terrasil is tested by conducting various test like CBR , proctor test etc. on Black Cotton soil samples treated with different percentages of Terrasil 0.8%, 1% and 1.2%. The high strength of the above three ratio adding with 1% of cement. In this paper deals with the complete analysis of the improvement soil properties and its stabilization using Terrasil with cement

Key words: Stabilization, Laboratory investigation, Black cotton soil, Terrasil, Cement

1. INTRODUCTION

Urbanization and development in the India have led to the a great increase in the construction activities and has necessitated the implementation of infrastructure projects such as highways, railways, air strips, water tanks, reclamation etc. These projects required a good quality earth in massive quantity. In urban areas, borrow earth is not easily available which has to be hauled from a long distance. Quite often, large areas are covered with highly plastic and expansive soil, which is not suitable for such purpose. In India about 51.8 million hectares of the land area are covered with Expansive soils. The Black cotton soils are very hard when dry, but lose its strength completely.When in wet condition. The problematic soils are either removed and replaced by good and better Quality material or treated using additive. The stabilization of the problematic soils is very important for many of the geotechnical engineering application such as pavement structures, roadways, building foundations, channel and reservoir linings, irrigation systems, water lines, and sewer lines to avoid damage due to settlement of soft soil or to the swelling action of expansive soil. In the present investigation behaviour of black cotton soil with and without stabilization has been studied.

II MATERIAL PROPERTIES

Geotechnical properties of expansive soil

Soil used in the experiments has been collected from a village near Lalkudi located in Trichy (Tamil Nadu). The soil is defined as highly compressible clay, CH, as per IS 1948 (1970). The geotechnical properties of parent soil is determined from lab test is tabulated in table below.

Terrasil is a nanotechnology based material. It is made of 100% organo-silane molecules. Terrasil forms Si-O-Si bonded nano-siliconize surfaces and converting water loving Silanol groups to water repellent Alkyl Siloxane groups in soil

Table1 Physical properties of parent soil Properties of terrasil

S.NO	Physical properties		Value
1	Grain size distribution	Gravel	0 %
		Sand	21 %
		Clay and Silt	79 %
2	Specific gravity		2.73
3	Liquid limit		56.98 %
4	Plastic limit		25 %
5	Plastic index		31.98 %
6	I.S. Classification		CH
7	Swelling test		35 %
8	Maximum dry density (M.D.D)		1.76 g/cc
9	Optimum moisture content (O.M.C)		16.2 %
10	CBR value (un soaked)		9.67 %

11	CBR value (soaked)	1.78 %

Chemical compound	Value in range %
Hydroxyalkyl-alkoxy alkysilyl	65-70 %
Benzyl alcohol	25-70 %
Ethylene glycol	3-5 %

Table 2. Chemical Composition of Terrasil

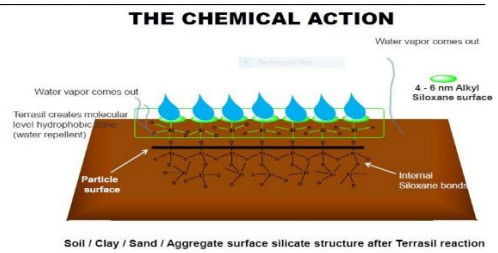


Fig 2. Soil treated with Terrasil

III REACTION MECHANISM

A simplified diagram of the reaction mechanism of Terrasil with soil is shown in figure below. Soil when treated with Terrasil with forms Si-O-Si bonded nano-siliconize surfaces and converting water loving Silanol groups to water repellent Alkyl Siloxane groups in soil.

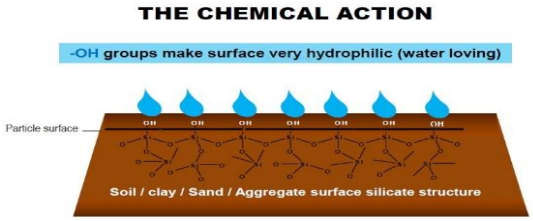


Fig 1 Untreated soil reaction mechanism

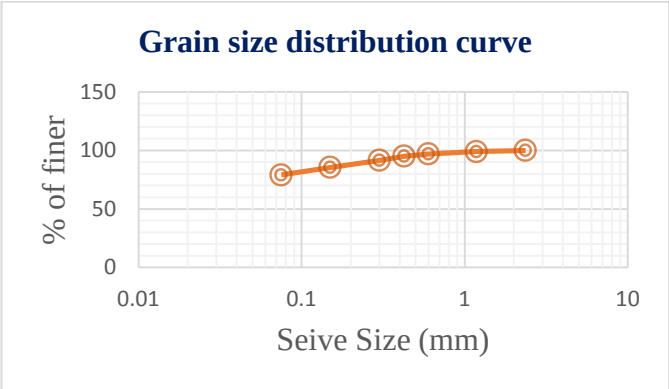
Properties of cement

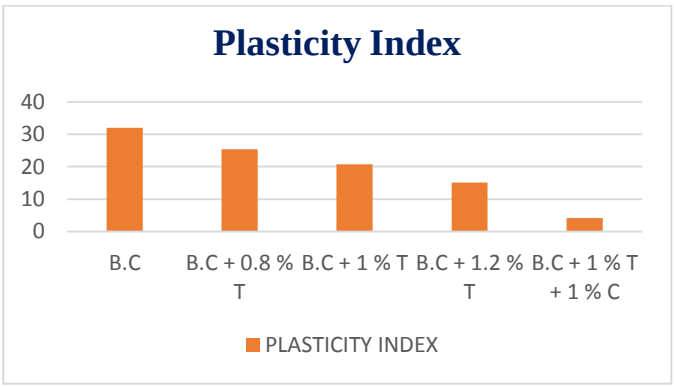
Cement properties are CaO (63%), SiO_2 (20%), Al_2O_3 (6.3%), Fe_2O_3 (3.3%), SO_3 (1.5%), MgO (2.4%), and Alkali (1%)

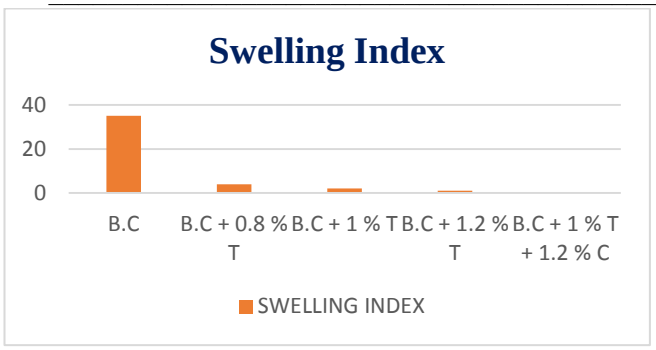
Table 3 Test Results of Various Combination of B.C Soil, Terrasil, With Cement

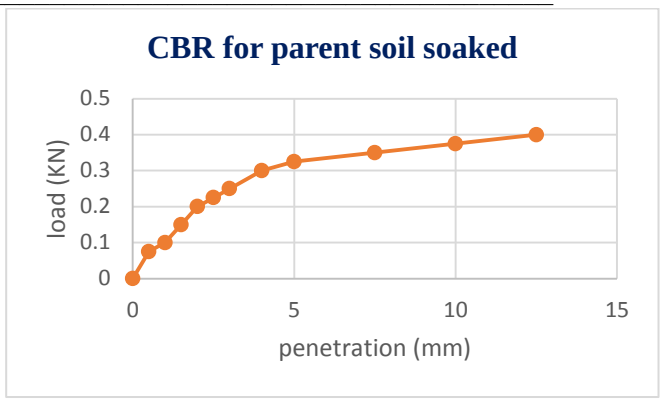
Combination	B.C	B.C + T 0.8 %	B.C + T 1 %	B.C + T 1.2 %	B.C + T % + C 1%
Liquid limit %	56.98	52.38	47.05	48.38	16.6
Plastic limit %	25	27	26.3	33.3	12.5
Plasticity index %	31.98	25.38	20.75	15.05	4.1
Swelling index	35	4	2	1	0
O.M.C %	16.2	13.2	13.2	13.2	18.7
M.D.D g/cc	1.76	1.85	1.86	1.78	1.58
CBR (un soaked) %	9.67	32.73	39.81	31.25	40.00
CBR (soaked) %	1.78	28.64	36.83	24.18	36.83

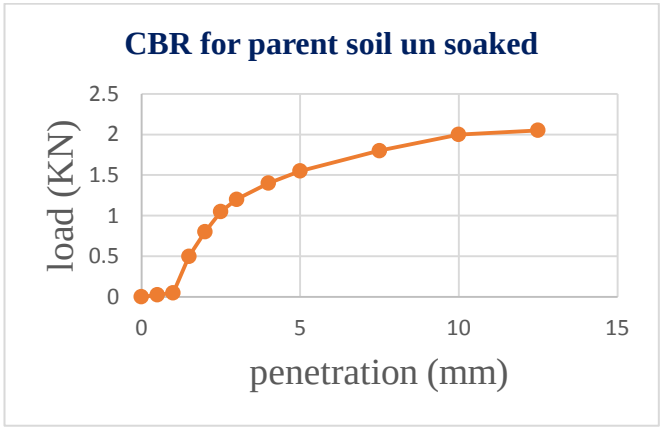
IVRESULTS AND DISCUSSION

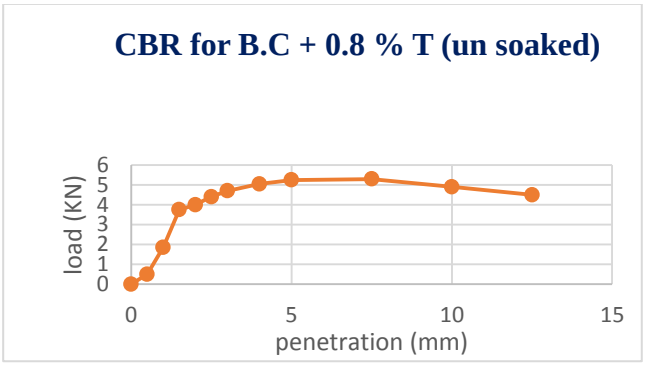


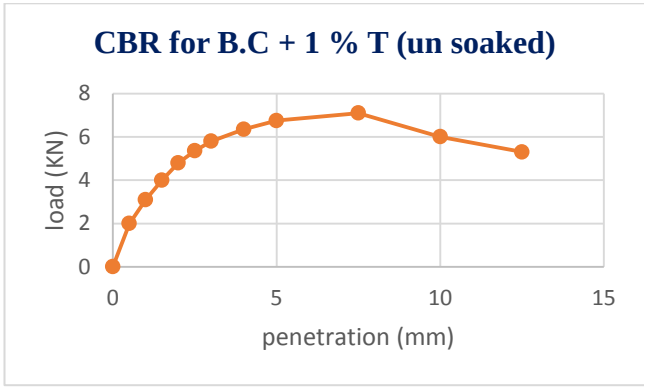


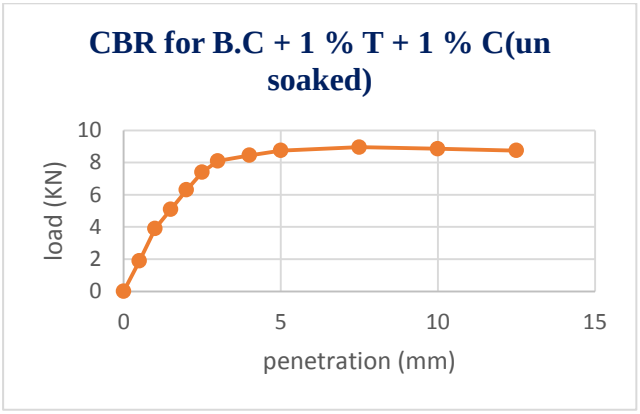

Swelling Index
40
20
0
B.C
B.C + 0.8 % T
B.C + 1 % T
B.C + 1.2 % T
B.C + 1 % T + 1.2 % C
SWELLING INDEX

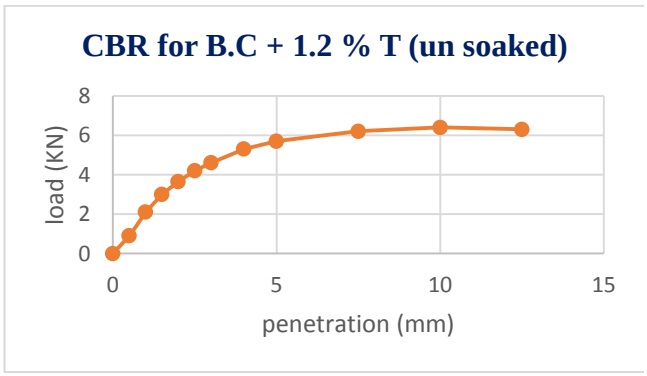

CBR for parent soil soaked
load (KN)
0.5
0.4
0.3
0.2
0.1
0
0
5
10
15
penetration (mm)

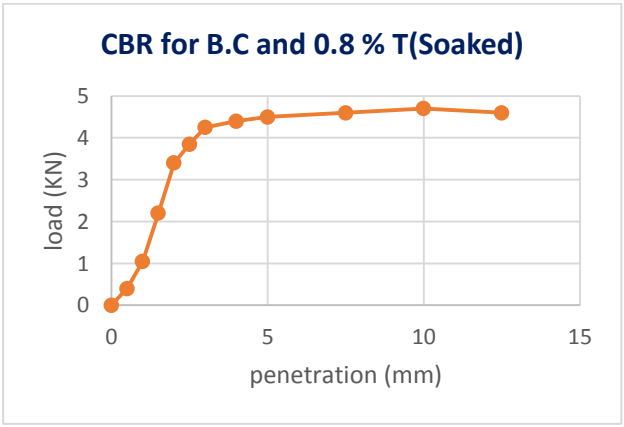

CBR for parent soil un soaked
load (KN)
2.5
2
1.5
1
0.5
0
0
5
10
15
penetration (mm)

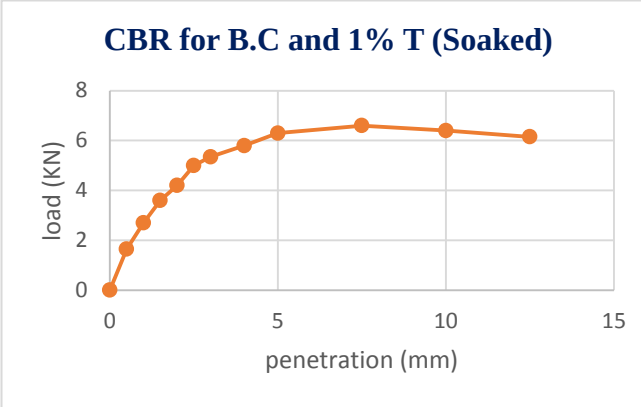

CBR for B.C + 0.8 % T (un soaked)
load (KN)
6
5
4
3
2
1
0
0
5
10
15
penetration (mm)

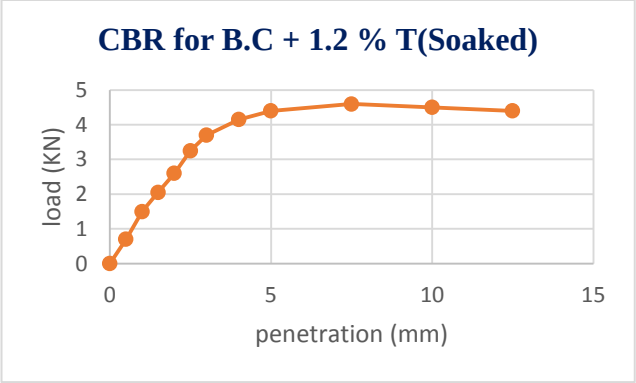

CBR for B.C + 1 % T (un soaked)
load (KN)
8
6
4
2
0
0
5
10
15
penetration (mm)

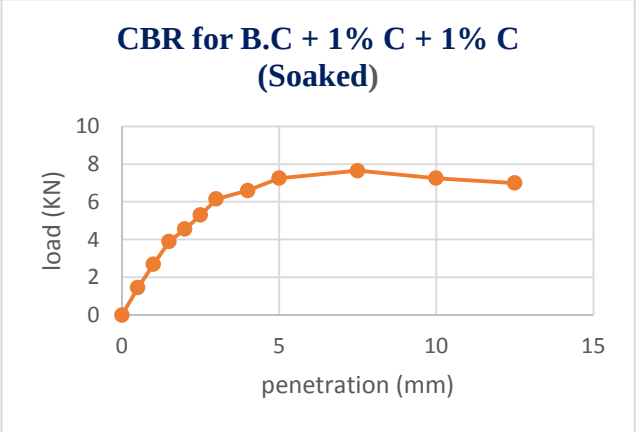

CBR for B.C + 1 % T + 1 % C(un soaked)
load (KN)
10
8
6
4
2
0
0
5
10
15
penetration (mm)


CBR for B.C + 1.2 % T (un soaked)
load (KN)
8
6
4
2
0
0
5
10
15
penetration (mm)


CBR for B.C and 0.8 % T(Soaked)
load (KN)
5
4
3
2
1
0
0
5
10
15
penetration (mm)







- Liquid limit decreases with increases in Terrasil
- Plastic limit increases with increases in Terrasil.
- Plasticity index Decreases with increases in percent of terrasil with cement
- Free swell decreases with increases in Terrasil.
- M.D.D increases and OMC decreases with increases in percent of Terrasil.

V CONCLUSION

1. CBR values ware increased by the addition of stabilizers to soil. CBR values T 0.8 % and 1 % were increases, where 1.2% T it decreased.
2. 1. It has been observed that maximum dry density of Black Cotton soil increase with increase in Terrasil content. The maximum dry density of parent Black Cotton soil was observed to be 1.76 g/cc. With the addition of Terrasil, MDD value starts increasing.
3. It has been observed that optimum moisture content of parent soil was 16.2 %. With the addition of Terrasil, OMC value starts Decreasing.
4. It has been observed that compressive bearing strength of Black Cotton soil increases with increase in percentages of Terrasil in parent soil. Dosage 2 (1%) gives the maximum value of bearing strength.

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