International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056
Volume: 04 Issue: 01 | Jan -2017 www.irjet.net p-ISSN: 2395-0072

STUDY ON BC SOIL USED AS SUBGRADE AND TREATED WITH TERRAZYME- A BIO-ENZYME

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Abstract - *In India vast area was occupied by Black Cotton Soil which contains clay as chief constituent. These soils show minimal bearing capacity and low strength. They swell when come in contact with water and shrink as they dry out. Engineers face problems with such type of soils, which do not possess sufficient strength to carry the imposed loads during construction and the life of the structure. Properties of the soil must be increased to achieve economy and to improve the performance of structures.*

Soil stabilization is the process of reducing undesirable behaviour of expansive soils. Conventional stabilization methods are time consuming and are proved to be not economical; it became necessary to look for alternative eco-friendly stabilizers like bio-enzymes. Recently there are many bio-enzymes available for soil stabilization such as Renolith, Permazyme, Terrazyme and Fujibeton, proved to be effective and economical.

The present study deals the effect of Terrazyme a bio-enzyme on shear strength and CBR value of expansive soil. Laboratory tests were conducted on various dosages, stabilizer was added by replacing 1%,2%,3%,4% of the optimum water content of the black cotton soil.

Key Words: **Expansive soil, Terrazyme, Shear strength, CBR.**

1.INTRODUCTION: Infrastructure projects such as highways, railways, etc. requires soil material in very large quantity. Usually, large areas are covered with highly plastic and expansive soil, which is not suitable for such purpose. Extensive laboratory tests have been carried out by various researchers using saw dust ash and have shown promising results for application of such expansive soil after stabilization.

1.1. Objectives of Present Study

1. To study the properties of the black cotton soil.
2. To study the effect of Terrazyme on shear strength and CBR value of black cotton soil.

2. LITERATURE REVIEW

BERGMANN (2000) through his experimental studies, he conclude that Bio-Enzymes need some clay percentage to strengthen the soils. He found that minimum of 2% clay must be present for successful stabilization, 10 to 15% of clay will show better results.

SHARMA (2006) has conducted experimental studies Bio-Enzymatic stabilization of three variety type of soils namely high plastic clay (CH), low plastic clay (CL), and low plastic silt (ML). His results showed that CH soil showed improvement in CBR value with saturation moisture reduction from 40 to 21% after 4 weeks of stabilization. Also it was found that there was 100% improvement in UCS.

MITHANTHAYA.I.R, HARSHA KUMAR RAI and **RAVISHANKAR A.U** (2009) investigated the modified geo-technical properties of the lateritic soils by stabilizing with enzyme. Quantity changes in CBR values, UCC and Permeability were observed with four different dosages of Terrazyme. 200ml of Terrazyme was added to 2, 2.5,3 and 3.5m^3 of soil. CBR value was increased by 400%, UCC value was increased by 450% and Permeability was reduced by 42%.

3.MATERIALS AND METHODOLOGY:

In this process the soil sample is collected from RAMARAJUPALLI village near Kadapa. The experimental investigations on soil sample are done to understand the index and engineering properties of the collected soil sample. This experimental study helps to classify the soil. The obtained values of index and engineering properties of the soil.

Figure 3.1. Black Cotton Soil Sample

Terrazyme is obtained from Avijeet Agencies Chennai.

Figure 3.2. Black Cotton Soil Sample

4 BLACK COTTON SOIL PROPERTIES

Table 1: Properties of Black Cotton Soil Sample

S.No	Experiments	Results
1.	Specific Gravity of Soil Particles	2.34
2.	Liquid Limit	66%
3.	Plastic Limit	28%
4.	Plasticity Index	38%
5.	Grain Size Analysis Clay % Silt % Sand %	 68% 18% 14%
6.	IS Classification of Soil	CH
7.	Free Swell Index	85%
8.	Standard Proctor Compaction Test	MDD-1.36 gm/cc
9.	California Bearing Ratio	Un-soaked- 3.93 Soaked-2.48
10.	Unconfined Compression Test	Un-soaked: Shear Strength (kPa) 5.39; Soaked for 4 days: 10.8; Soaked for 7 days: 17.65

5. PROPERTIES OF TERRAZYME

Table 2: Properties of Terrazyme

Colour	Dark Brown
PH	3.50
Specific Gravity	1.414
Evaporation Rate	Same as Water
Odour	Smell like Molasses
Extracted from	Molasses

Source: Stabilization of Black-Cotton Soil using Bio-Enzyme for a Highway Material by Joydeep Sen and Jitendra Prasad Singh.

6. RESULTS AND DISCUSSIONS

Unconfined Compression Test Result:

Unconfined Compression is performed to determine the shear strength of the soil. Unconfined Compression samples are placed kept for a curing period of 4 and 7 days.

Table 3: Shear Strength obtained from Unconfined Compression test of soil treated with Terrazyme at various percentages for both cured and un-cured specimens.

DOSAGE OF TERRAZYME	SHEAR STRENGTH(kPa)		
	Samples of 0 days of curing	Samples of 4 days of curing	Samples of 7 days of curing

0% Terrazyme	5.39	10.8	17.65
1% Terrazyme	11.77	29.43	40.71
2% Terrazyme	21.58	35.80	58.36
3% Terrazyme	25.50	41.20	72.55
4% Terrazyme	27.50	49.05	78.48

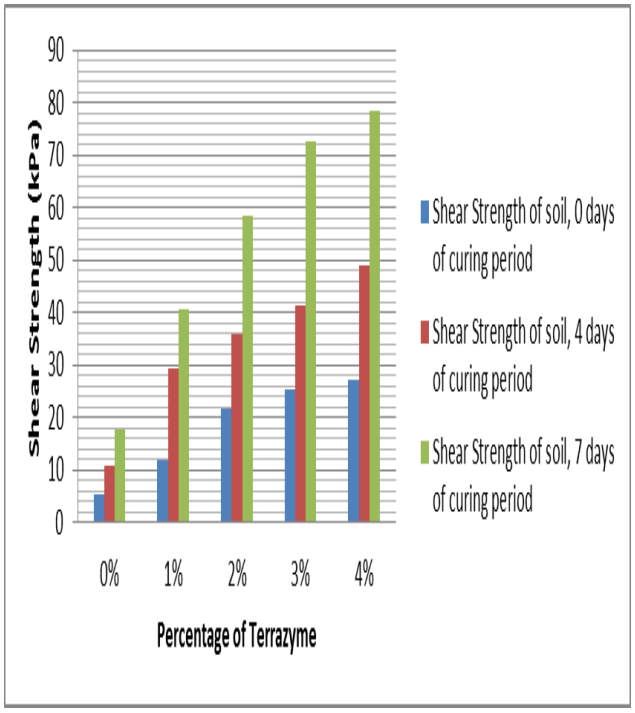

Figure 6.1. Shear Strength variation with percentage of Terrazyme and days of curing.

CBR Test Result:

CBR test is performed to determine the CBR value. To ascertain the behaviour of soil under soaked conditions the samples are soaked for 4 days.

Table 4: CBR values with varying percentages of Terrazyme for both soaked and un-soaked soil samples.

DOSAGE OF TERRAZYME	CBR Value	
	Un-Soaked	Soaked for 4 days
0% Terrazyme	3.93	2.48
1% Terrazyme	5.25	4.43
2% Terrazyme	6.23	4.59
3% Terrazyme	7.38	4.92
4% Terrazyme	8.03	6.39

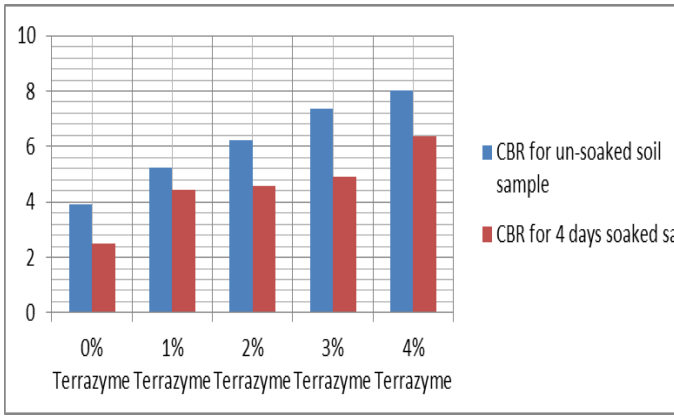

Figure 6.2. Variation of CBR values with percentage of Terrazyme and days of soaking.

Tri-Axial Test Result:

Tri-Axial test is performed to determine the shear parameters of the soil.

Table 5: Variation of Shear Parameters and Shear Strength with variation in percentage of Terrazyme.

SHEAR PARAMETERS	DOSAGE OF TERRAZYME				
	BC Soil + 0% Terrazyme	BC Soil + 1% Terrazyme	BC Soil + 2% Terrazyme	BC Soil + 3% Terrazyme	BC Soil + 4% Terrazyme
Cohesion (kPa)	6.40	9.80	17.70	24.50	35.32
Angle of Internal Friction	2°50°	2°10°	1°50°	1°10°	0°40°
Shear Strength (kPa)	6.85	18.20	25.20	29.70	38.60

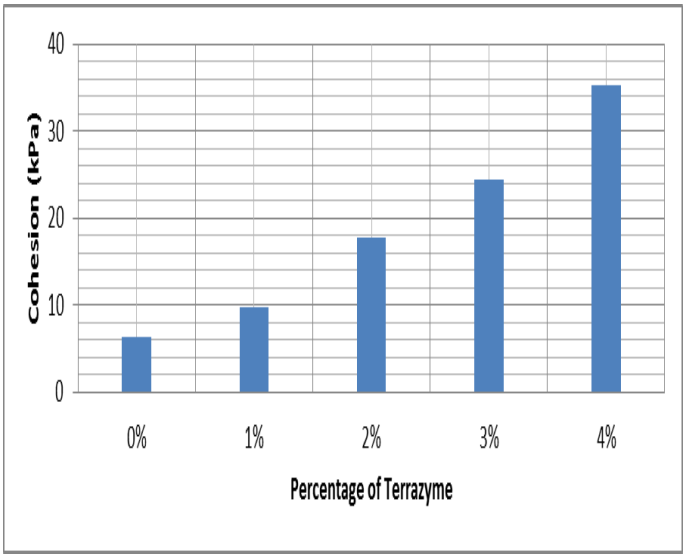

Figure 6.3. Variation of cohesion with percentage variation of Terrazyme

7. COCLUSIONS:

1. Shear Strength of the soil increased form 5.39 kPa at 0% Terrazyme to 27.5 kPa at 4% Terrazyme, percentage increase is 410%.
2. With increase in percentage of Terrazyme and days of curing shear strength of the soil increased from 10.8 kPa to 49.05 kPa, results are tabulated for 4 days of curing period. Percentage increase is 354.1%.
3. With increase in percentage of Terrazyme and days of curing shear strength of the soil increased from 17.65 kPa to 78.48 kPa, results are tabulated for 7 days of curing period. Percentage increase is 344.6%.
4. With increase in percentage of Terrazyme the un-soaked CBR value was increased from 3.93 to 8.03. Percentage increase is 104.32.
5. With increase in soaking period CBR values are increased when compared with untreated soaked soil samples.
6. Tri-Axial results showed, with increase in percentage of Terrazyme shear strength of the soil increased from 6.40 kPa to 35.32 kPa, percentage increase is 451.87.
7. Tri-Axial results showed with increase in percentage of Terrazyme, cohesion of the soil increased from 6.85 kPa at 0% Terrazyme to 38.60 kPa at 4% Terrazyme, percentage increase is 463.50.

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