



STUDY ON EXPANSIVE SOIL TREATED WITH TERRAZYME – A BIO ENZYME AS SUBGRADE

S.JYOTHIRMAYEE¹, B.DILEEP KUMAR REDDY², N.MURALI MOHAN³ & B L NIRANJAN REDDY⁴
^{1,2,3&4} Assistant Professor, Department of Civil Engineering, JNTUA College of Engineering Pulivendula, Kadapa, India. E-Mail: jyothi.sirigireddy16@gmail.com

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 bioenzymes. 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.

Keywords: Expansive soil, Terrazyme, Shear strength, CBR.

I. 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.

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

II. Literature

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. 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

III. 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. Terrazyme is obtained from Avijee Agencies Chennai.



IV. 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 %	68%		
	Silt %	18%		
	Sand %	14%		
6.	IS Classification of Soil	CH		
7.	Free Swell Index	85%		
8.	Standard Proctor Compaction Test	OMC-26% MDD-1.36 gm/cc		
9.	California Bearing Ratio	Un-soaked- 3.93 Soaked-2.48		
10.	Unconfined Compression Test	Un- soaked	Soaked for 4 days	Soaked for 7 days
	Shear Strength (kPa)	5.39	10.8	17.65

V. 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.

VI. 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

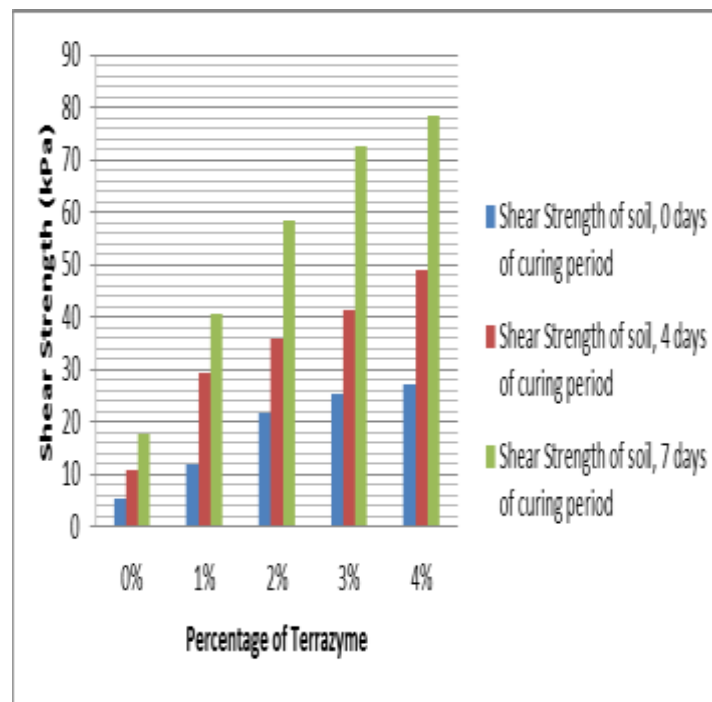


Figure 6.1. Shear Strength variation with percentage of Terrazyme and days of curing

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 4days
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

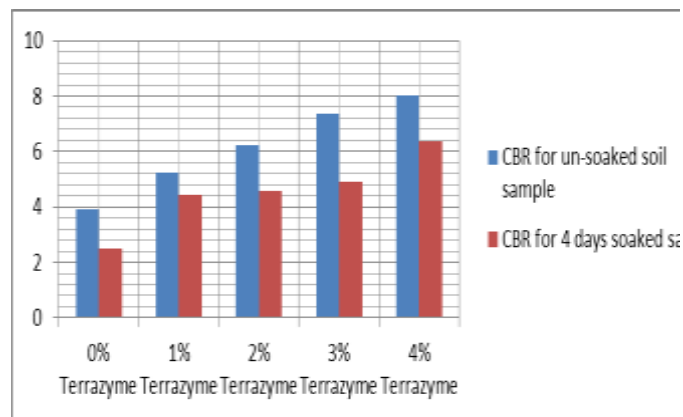


Figure 6.2. Variation of CBR values with percentage of Terrazyme and days of soaking

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

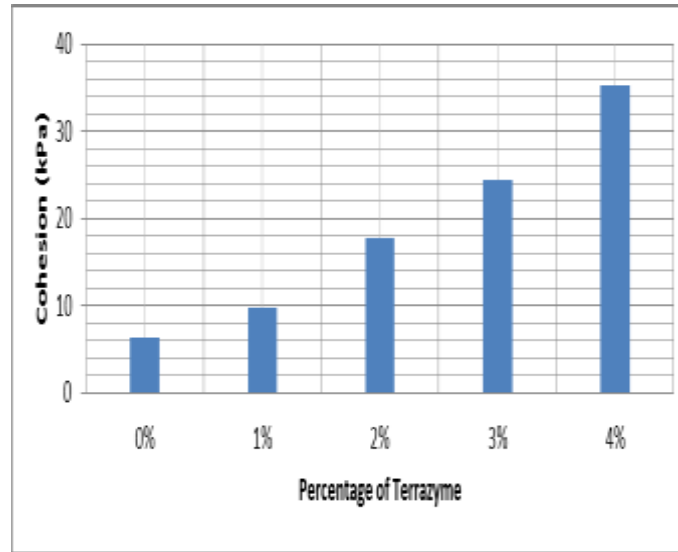


Figure 6.3. Variation of cohesion with percentage variation of Terrazyme

VII. Conclusions

- 7.1.1 Shear Strength of the soil increased from 5.39 kPa at 0% Terrazyme to 27.5 kPa at 4% Terrazyme, percentage increase is 410%.
- 7.1.2 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%.
- 7.1.3 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%.
- 7.1.4 With increase in percentage of Terrazyme the un-soaked CBR value was increased from 3.93 to 8.03. Percentage increase is 104.32.
- 7.1.5 With increase in soaking period CBR values are increased when compared with untreated soaked soil samples.
- 7.1.6 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.
- 7.1.7 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.

References

1. Lekha.B.M, Goutham.S, Chaitali.N, and Ravi Shankar.A.U, " LABORATORY INVESTIGATION ON BLACK COTTON SOIL STABILIZED WITH NON TRADITIONAL STABILIZER" e-ISSN: 2278-1684, p- ISSN: 2320-334X, PP 07-13.
2. Manjunath.C, Pavaitra.D and Amarnath.M.S," A STUDY ON EFFECT OF DOSAGE OF BIO-ENZYME ON STRENGTH AND PLASTICITY CHARACTERISTICS OF SOILS."
3. Chaudhary.S.K., "INNOVATIVE CONSTRUCTION TECHNOLOGY FOR QUALITY CONSTRUCTION OF RURAL ROAD", Road Engineering Rural Infrastructure, August-2012.



4. Joydeep Sen and Jitendra Prasad Singh, "STABILIZATION OF BLACK COTTON SOIL USING BIO-ENZYME FOR A HIGHWAY MATERIAL",IJRSET, Volume-4, Issue-12, December-2015.
5. Tanveer Ahmed Khan and Mohd Raihan Taha, "EFFECT OF THREE BIOENZYMES ON COMPACTION, CONSISTENCY LIMITS, AND STRENGTH CHARACTERISTICS OF A SEDIMENTARY RESIDUAL SOIL", Advances in Material Sciences and Engineering, Volume-2015.
6. Nandini.D.N, Vinoda.A and Prathap Kumar.M.T, "COMPACTION AND STRENGTH CHARACTERISTICS OF TERRA-ZYME STABILIZED RED SOIL" ,IJRPETM, Volume-1, Issue-1, July-2015.
7. Srinivasa.G and Amith Kadaba Sheshadri, "BLACK COTTON SOIL STABILIZATION BY BIO ENZYMES ", AIJREAS, Volume -1, Issue 10 (2016, oct).
8. Sureka Naagesh and Gangadhara.S, " SWELLING PROPERTIES OF BIO-ENZYME TREATED EXPANSIVE SOIL" International Journal of Engineering Studies"ISSN 0975- 6469 Volume 2, Number 2 (2010), pp. 155–159.
9. Ravi Shankar.A.U, Harsha Kumar Rai and Ramesha Mithanthaya.I, " BIO-ENZYME STABILIZED LATERITIC SOIL AS A HIGHWAY MATERIAL" , Journal of the Indian Roads Congress, July- September 2009.
10. Ramesh.H.N and Sagar.S.R, "EFFECT OF DRYING ON THE STRENGTH PROPERTIES OF TERRAZYME TREATED EXPANSIVE AND NON-EXPANSIVE SOILS ",50th INDIAN GEOTECHNICAL CONFERENCE, 17th– 19th DECEMBER 2015, Pune, Maharashtra, India.
11. Ishwarya S Dhanesh and Twinkle Vinu Mohandas, "Effect of bio-enzyme on geotechnical properties of Thonnakkal clay",International Journal of Engineering Trends and Technology (IJETT) – Volume 36 Number 9 - June 2016.
12. Vijay Rajoria and Suneet Kaur "A REVIEW ON STABILIZATION OF SOIL USING BIO-ENZYME", International Journal of Research in Engineering and Technology, eISSN: 2319-1163 | pISSN: 2321- 7308.
13. Puneet Agarwal and Suneet Kaur "EFFECT OF BIO- ENZYME STABILIZATION ON UNCONFINED COMPRESSIVE STRENGTH OF EXPANSIVE SOIL",International Journal of Research in Engineering and Technology, eISSN: 2319-1163 |pISSN: 2321-7308