

Effect of Terrazyme on CBR and shear strength of expansive soil

Abstract

Expansive soils are properly treated before the start of any construction on them. The process of treatment is called ground improvement technique. There are lots of methods are available to increase the strength of expansive soils. Among all the methods soil stabilization is the oldest and simplest method to perform in the field. Numbers of materials were tested from the past two decades. The present paper focus on recently excogitated materials called bio-enzymes. Different types of bio-enzymes available, among which Terrazyme was mixed to the soil in the present paper, quantitative changes were observed in CBR and Tri-axial shear strength of soil before and after the addition of enzyme to the soil.

Keywords: expansive soil, soil stabilization, bio-enzyme, CBR, shear strength

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Introduction

Soil stabilization means to develop an improved soil material which has all the intended engineering properties utilized during design. The following steps are involved in the soil stabilization:

1. Evaluate the properties of soil to be stabilized
2. Adding stabilizing material to the soil
3. Testing the soil after mixing the stabilizer in the laboratory.

Bio-enzyme

Bio-Enzymes are harmful liquids extracted from vegetables, weakened in water before its application to the soil. They strengthen the soil and improve the load carrying capacity and also affect swelling and shrinkage properties.

Literature review

Bergmann¹ through his experimental studies concluded that Bio-Enzymes need some percentage of clay to strengthen the soils. His results revealed that minimum clay content should be 2%, 10 to 15% of clay will show better results. Sharma has conducted experimental studies on 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. Also it was found that there was 100% improvement in shear strength found by using unconfined compression test. Mithanthaya et al.,² investigated the geo-technical properties of the lateritic soil stabilized 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 3.5m³ of soil. CBR value was increased by 400%, UCC value was increased by 450% and Permeability was decreased to 42%. Sureka Naagesh and Gangadhara S investigation on swelling properties of Terrazyme treated expansive soil, revealed that soil treated with Terrazyme showed less swelling pressure compared to original soil sample. Lekha BM, Ravi Shanka AU and Goutham S in their work, laboratory tests were conducted on Black Cotton soil stabilized with Nano-chemicals. A chemical named Terrasil was used as stabilizer

in varying percentages and the soil was cured for 7–28 days.^{3–6} It is noted that CBR value increases with the increase in percentage of SL stabilizer. Permeability is found to be nil for treated soil. Ramesh HN et al.,⁷ experimental studies on strength properties of Terrazyme treated expansive and non-expansive soils revealed free swell index of soil decreased from 118% to 45% for desiccators and 27% to air dry conditions for third dosage of Terrazyme for at 30 days. Nandini DN, Vinoda A and Prathap Kumar MT, experimental studies on red soil stabilized with Terrazyme in three different levels revealed that dosage showed better compaction in terms of maximum dry density.⁸ Srinivasa G and Amith Kadaba Sheshadri, investigations on black cotton soil stabilization using Terrazyme revealed there is decrease in liquid limit and plastic limit from 61.40% to 56.49% and 34.00% to 31.70% respectively. CBR value increase of 387% compared to the untreated soil.

Materials

Materials used in the present paper are Black Cotton soil and Terrazyme. Soil was brought from Ramaraju Palli village, Kadapa District in Andhra Pradesh. Terrazyme was obtained from Avijeeet Agencies Private Limited, Chennai.

Testing procedure

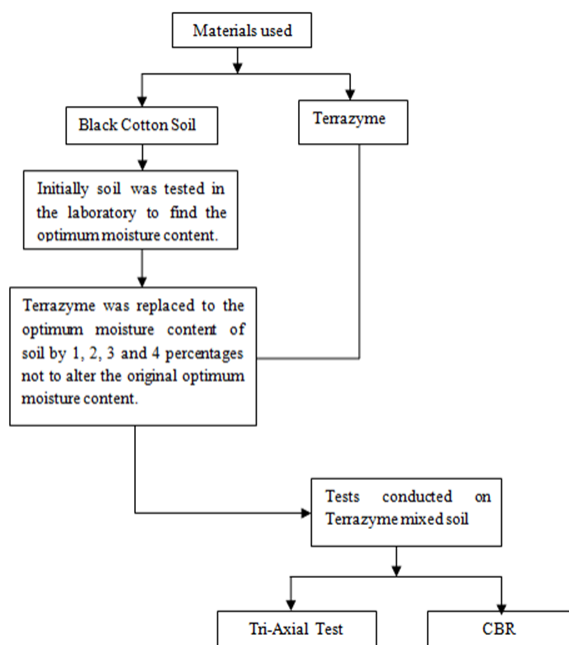
Soil was tested in the laboratory in the following manner (Figure 1) (Table 1) (Table 2):

Table 1 Properties of soil

Specific Gravity	2.34
Liquid Limit	66%
Plastic Limit	28%
Soil Classification	CH
MDD	1.36 gm/cc
OMC	26%
CBR (%)	Un-soaked-4 Soaked-2
Shear Strength	5.39 kPa

Table 2 Properties of Terrazyme

Specific Gravity	1.414
PH	3.5
Extracted from	Molasses

**Figure 1** Flow Chart representing testing procedure.

Results

CBR, Unconsolidated Undrained Tri-Axial Test was conducted to find the shear strength on the Terrazyme treated stabilized soil. The results are tabulated below (Table 3) (Table 4):

Table 3 CBR results of treated and untreated soil samples

Terrazyme Dosage replaced to OMC of soil	CBR (%)	
	Un-soaked	Soaked
0% of Terrazyme	3.93	2.48
1% of Terrazyme	5.25	4.43
2% of Terrazyme	6.23	4.59
3% of Terrazyme	7.38	4.92
4% of Terrazyme	8.03	6.39

Table 4 Shear strength values of treated and untreated soil samples

Terrazyme Dosage replaced to OMC of soil	Shear Strength (kPa)
0% of Terrazyme	5.39
1% of Terrazyme	11.77
2% of Terrazyme	21.58
3% of Terrazyme	25.5
4% of Terrazyme	27.5

Properties of the soil were increased because when Terrazyme reacts with clay it forms a compound called Calcium Silicate Hydrate which results to impart the strength of soil and it also reacts with the adsorbed water layer present between the clay particles and reduces its thickness. When the external load is applied on the soil the particles come closer and will get a closer arrangement which helps to increase the density of the soil.

Conclusion

- Shear Strength of the soil increased from 5.39 kPa at 0% Terrazyme to 27.5 kPa at 4% Terrazyme, percentage increase is 410%.
- With increase in percentage of Terrazyme the un-soaked CBR values are also increased from 3.93 to 8.03, percentage increase is 104%.
- When compared the results of soaked CBR of both treated and un-treated soil samples an improvement was found from 2.48% to 5.89%, percentage increase is 138%.

Acknowledgements

None.

Conflict of interest

The author declares there is no conflict of interest.

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