Effect of Terrazyme on CBR and shear strength of expensive 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 lot 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

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

Bergmann 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. 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 Gangadharma 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 Shankar 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. 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. 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. 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 Avijeet 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

| Property          | Value       |
|-------------------|-------------|
| 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    |
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**

a. Shear Strength of the soil increased from 5.39 kPa at 0% Terrazyme to 27.5 kPa at 4% Terrazyme, percentage increase is 410%.

b. With increase in percentage of Terrazyme the un–soaked CBR values are also increased from 3.93 to 8.03, percentage increase is 104%.

c. 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.

**References**

1. Bergmann R. Soil stabilizers on universally accessible trails. USDA Forest Service, San Dimas Technology and Development Center. USA; 2000.

2. Ravi Shankar AU, Harsha Kumar Rai, Ramesh Mithanthiya I. Bio Enzyme Stabilized with Lateritic Soil as Highway Material. *Journal of IRC*. 2009.

3. Agarwal P, Sunet K. Effect of Bio–Enzyme Stabilization on Unconfined Compressive Strength of Expansive Soil. *International Journal of Research in Engineering and Technology, IJRET*. 2014;5:30–33.

4. Baby M, Gowshik A, Karthick Rajeshwar A V , et al. Experimental Study of Expansive Soil Stabilized with Terrazyme. *International Journal of Innovative Research in Science and Technology, IJIRSET*. 2016;5.

5. Hiraman AS, Joshi SR, Vijaykumar S. Effect of Bio–Enzyme (Terrazyme) on the Properties of Sub grade Soil of Road. *International Journal of Innovative Research in Science and Engineering*. 2017;3:231–236.

6. Joydeep S, Itendra Prasad S. Stabilization of Black Cotton Soil using Bio–Enzyme for Highway Material. *International Journal of Innovative Research in Science, Engineering and Technology, IJIRSET*. 2015;4(12):12453–12459.

7. Ramesh HN, Sagar SR. Effect of Drying on the Strength Properties of Terrazyme Treated Expansive and Non Expansive Soils. *Indian Geotechnical Conference*. India; 2015.

8. Khushbu S, Mit Shah. Soil Stabilization using Terrazyme. *International Journal of Advanced Engineering and Research Development*. 2016;3:359–365.

**Table 2 Properties of Terrazyme**

|                |               |
|----------------|---------------|
| Specific Gravity | 1.414          |
| PH              | 3.5           |
| Extracted from  | Molasses      |

**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                 |

**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):