

Experimental Study of Expansive Soil Stabilized with Terrazyme

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Abstract - In this experimental study, a step is taken to stabilize the black cotton soil for the construction of roads and buildings. A bio-enzyme called Terrazyme is used to stabilize the expansive soil. In this study, black cotton soil stabilized with Terrazyme of different dosages of 200ml/3m³, 200ml/2.5m³ and 200ml/2m³ are tested after the curing period of 0 days, 14 days and 28 days.

Keywords— Terrazyme; Bio-Enzyme; Black Cotton Soil;

I. INTRODUCTION

Black cotton soil mostly present in the districts of Tamil nadu like Salem, Ramanathapuram, Coimbatore etc. Black cotton soil is good for agriculture because it is highly fertile. But it is not suitable for the construction of roads and foundation due to its instability. Black cotton soil is highly potential for shrinkage and swelling. Hence it is called as expansive soil. Even 5 cm rain can damage the roads and make unpassable. So it is necessary to stabilize the black cotton soil. When the expansive soil is up to a limit or small depth, the soil can be stabilized by replacing the soil with non-expansive soil. But when the black cotton soil is up to a greater depth, then the replacement is impossible. The other method to stabilize the black cotton soil is mixing the soil with chemical stabilizer. In this study, Terrazyme, a bio-enzyme is used to stabilize the black cotton soil. Terrazyme is a commercially available enzyme which improves the stability of the soil.

II. MATERIALS

A. Black cotton soil

The black cotton soil which was used for this experiment was collected from sankari which is located in the district of Salem.

Table 1 Properties Of Black Cotton Soil

S.No	Properties	Value
1	Specific Gravity	2.67
2	Atterberg's limits	
	Liquid limit %	60.2
	Plastic limit %	32
	Plasticity index	28.2
	Shrinkage limit %	10.2
3	Grain size distribution	
	Gravel %	0
	Coarse sand %	8.57
	Fine sand %	18.20
	Silt and clay %	73.23
4	IS classification	CH
5	Free swell index %	72.00
6	Max dry density	15

7	Optimum moisture content %	22.80
8	CBR Value %	
	Soaked	1.20
	Un soaked	2.88
9	Swelling Pressure	124
10	Uniform confined strength	3.57
11	Coefficient of permeability	1.6 * 10 ⁻⁸ cm/sec

B. Bio-enzyme

The enzyme used for this experiment to stabilize the black cotton soil was Terrazyme.

Table 2 Properties of Terrazyme

Properties	Value
Boiling Point	212°F
Specific Gravity	1.05
Solubility	100%
Appearance	Brown liquid
Odour	Non-obnoxious

1. Amount of Terrazyme

The amount of Terrazyme varies from 200ml/3.5m³ to 200ml/2m³

For specimen 1

$$200\text{ml for } 3.0 \text{ m}^3 \text{ of soil} = 1.56 * 3.0 * 1000 \\ = 4680 \text{ kg of soil}$$

$$\text{For } 1 \text{ kg} = 0.051 \text{ ml of enzyme}$$

For specimen 2

$$200\text{ml for } 2.5 \text{ m}^3 \text{ of soil} = 1.56 * 2.5 * 1000 \\ = 3900 \text{ kg of soil}$$

$$\text{For } 1 \text{ kg} = 0.051 \text{ ml of enzyme}$$

For specimen 3

$$200\text{ml for } 2.0 \text{ m}^3 \text{ of soil} = 1.56 * 2.0 * 1000 \\ = 3120 \text{ kg}$$

$$\text{For } 1 \text{ kg} = 0.064 \text{ ml of enzyme}$$

Table 3 Amount of enzyme

200ml/m ³ of soil	ml/kg of soil
3.0	0.042
2.5	0.051
2.0	0.064

III. EXPERIMENTAL RESULTS

A. Results on stabilized black cotton soil

1. Atterberg limits

The experiment gives the results of consistency limit for various proportions of black cotton soil with Terrazyme.

Table 4 consistency limits

Dosage	Liquid limit	Plastic limit	Plasticity index
Untreated	60.2	32	28.20
200ml/3.0m ³	59	31.50	27.50
200ml/2.5m ³	57.78	30.79	26.99
200ml/2.0m ³	56.53	30.09	26.44

2. Standard proctor test

For black cotton soil with different proportions of Terrazyme, standard proctor test was conducted and resulted below

Table 5 standard proctor test

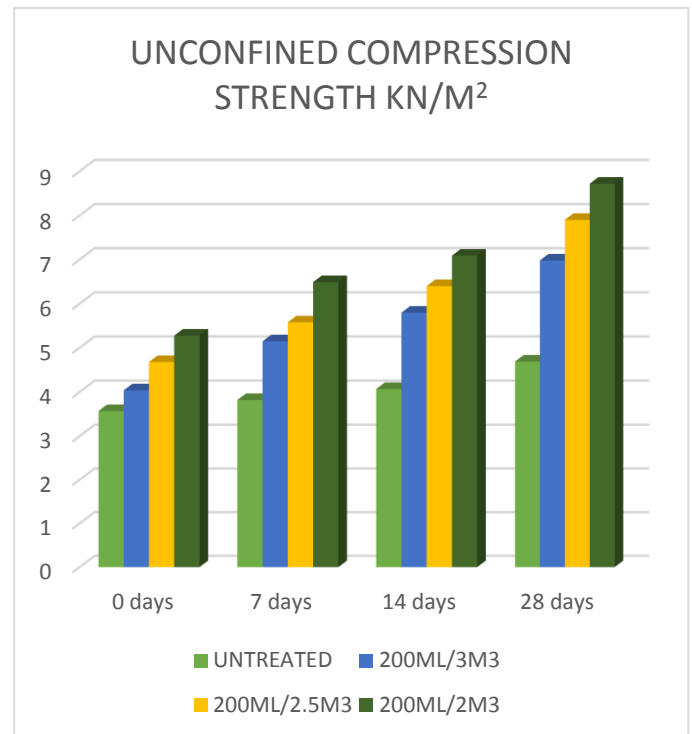
Dosage	Optimum moisture content %	Maximum dry density (g/cm ³)
Untreated	22.80	1.5
200ml/3.0m ³	22.20	1.542
200ml/2.5m ³	21.90	1.586
200ml/2.0m ³	21.80	1.612

3. Unconfined compression test

Unconfined compression strength of black cotton soil with Terrazyme was evaluated as follows

Table 6 unconfined compression strength

Dosage	0 days	7 days	14 days	28 days
Untreated	3.57	3.82	4.07	4.69
200ml/3.0m ³	4.04	5.15	5.80	6.98
200ml/2.5m ³	4.68	5.58	6.40	7.90
200ml/2.0m ³	5.28	6.49	7.09	8.72

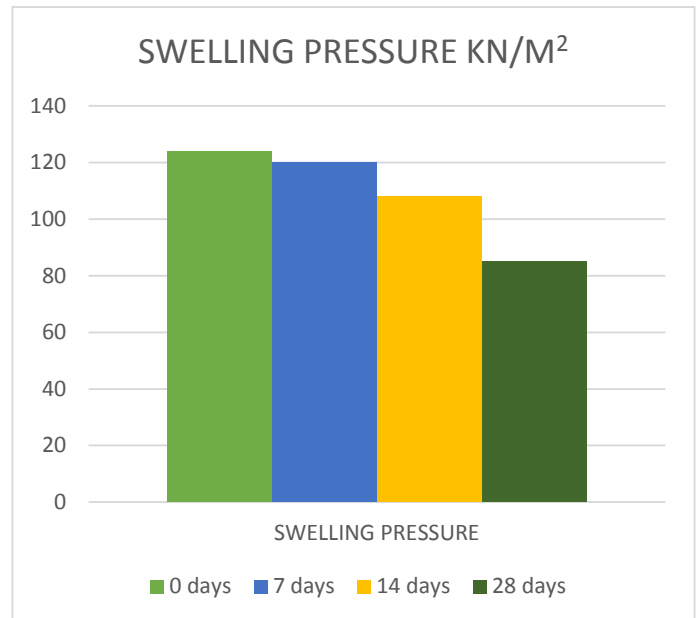
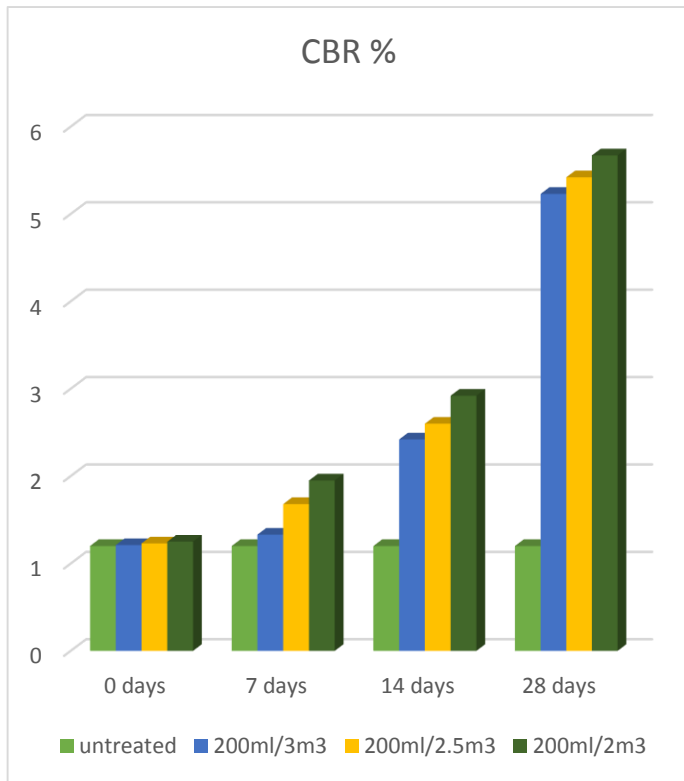


4. CBR test

California Bearing Ratio test was conducted for different proportions of black cotton soil with Terrazyme. The mould is kept in water for 4 days and tested.

Table 7 California bearing ratio

Dosage	0 day	7 days	14 days	28 days
Untreated	1.20			
200ml/3.0m ³	1.21	1.33	2.42	5.23
200ml/2.5m ³	1.23	1.68	2.60	5.42
200ml/2.0m ³	1.25	1.95	2.92	5.67



IV. CONCLUSION

- It is found that the value of liquid limit decreases from 60.2% to 56.53% and the plastic limit also decreases from 32% to 30.09%
- The UCS value increases from 3.57% to 8.72% when compared to actual soil with 4 weeks of curing.
- It is founded that the CBR value increases from 1.20 % to 5.67 %.
- This experiment shows that the Swelling pressure reduces from 124 KN/m² to 85.2 %
- Maximum dry density increases from 1.5 g/cm³ to 1.612 g/cm³.
- Optimum moisture content decreases from 22.80% to 21.80%
- Hence the clayey property of expansive soil is changed.

REFERENCES

- [1] Faizal ali, "Stabilization Of Residual Soil Using Liquid Chemical" (2012), Civil Engineering Department, Faculty Of Engineering, national Defence Ministry Of Malaysia, Kuala Lumpur Malaysia.
- [2] Brazetti.R and Murphy.S.R (2000), "General Usage Of Bio-Enzyme Stabilizers In Road Construction In Brazil", 32nd annual meeting on paving Brazil, October 2000.
- [3] Marasteanu.M.O., Hozalski.r, clync.t.r & velasquez.r,(2005),"Preliminary Laboratory Investigation of Enzyme Solution as a soil stabilizer",minnesta department of transportation, research services.
- [4] Das.B.M,"Principles of Geo technical Engineering",5th Edition,California State University, Sacramento
- [5] Das.B.M,"Advanced Soil Mechanics", New York: taylor and francis, pp.123-178.
- [6] Brooks (2009),"Effect Of Swelling On Black Cotton Soil By Stabilizing Rice Husk Fly Ash"
- [7] Joydeep Sen & Jitendra Prasad Singh, "Stabilization Of Black Cotton Soil Using Bio-Enzyme For A Highway Material.
- [8] Bajpai.P,(2014),"Non-Conventional Soil Stabilization Techniques The Way Forward To An Aggregate Free Pavement And A Cost Effective Method Of Road Construction",International Journal Of Scientific And Engineering Research.

5. Swelling pressure

Swelling pressure test was conducted using consistometer and resulted and tabulated below.

Table 8 Swelling pressure

Dosage	Swelling pressure
Untreated	124
200ml/3.0m ³	120
200ml/2.5m ³	108
200ml/2.0m ³	85.2