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Effect of Bio Enzyme on Index & Engineering Properties of Expansive Soil

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Abstract - *A good pavement is needed for the safe, economic and comfortable movement to traffic. But, types of soil exhibits high plasticity characteristics high plasticity characteristics, low strength properties, high swell shrink characteristics which cause serious problems on civil engineering structures. Therefore an attempt has been made to evaluate the effect of Terrazyme on the engineering properties of black cotton soil. The evaluation involved the determination of the geotechnical properties of the soil in its natural state when mixed with different proportions viz., 150and 200ml/m³ of Terrazyme. The results show an increase in California Bearing Ratio by 300% at 150ml/m³ and 200% at 200ml/m³ dosage of Terrazyme. The unconfined compressive strength increased by 200% at 150ml/m³ and 150% at 200ml/m³ dosage of Terrazyme.*

Keyword-Terrazyme, Black cotton soil, California bearing ratio, unconfined compressive strength.

1. INTRODUCTION

Lack of adequate road network to cater the increased demand and increased distress in roads leading to frequent maintenance has always been a big problem in our state. Expansive soils typically exhibit A large amount of volumetric swelling and shrinkage, in response to changes in moisture content. Soil stabilization is a procedure where natural or manufactured additives or binders are used to improve the properties of soil. As the quality of a soil layer is increased, the ability of that layer to distribute the load over a great area is generally increased so that a reduction in the required thickness of the soil and surface layers may be permitted.

The dust formation of various stabilizers is more when compared to Terrazyme. Also the energy consumption is less when compared to other stabilizers as Terrazyme is obtained from fermentation process. Aggregate consumption will be less in pavement layers and thickness of each layer can be reduced when Terrazyme is used which adds to the sustainability feature of the product. On the economy aspects, use of Terrazyme has a huge impact on minimizing the cost of maintenance there by contributing in overall reduction of the project cost.

I. OBJECTIVES OF THE RESEARCH

i) To study the change in properties of untreated and enzyme treated soil. ii) To study the compaction characteristics of untreated and enzyme treated soil. iii) Study of quantitative changes in California bearing ratio values of untreated soil and soil treated with different dosage of enzyme. iv) To evaluate the strength behavior of untreated and treated soil based on unconfined compressive strength test for different curing periods.

II.MATERILAS AND PRPOERTIES OF MATERIALS USED

A. Soil

Properties of soil confirming to IS 2720, Part 4 & Part 5. The properties of black cotton soil used are as shown in table 1.

Table 1: Properties of Black Cotton Soil

PROPERTIES	VALUE
Specific Gravity	2.45
Grain Size Distribution Gravel Sand Silt + Clay	 1.41 31.81 66.78
Liquid limit (%)	55
Plastic limit (%)	31
Plasticity Index (%)	24
IS classification of soil	CH
Maximum Dry Density (g/cc)	1.73
Optimum Moisture Content (%)	17
California Bearing Ratio (Soaked) (%)	1.34
Unconfined Compressive strength (kN/m^2)	208

B. Terrazyme

In clay water mixture positively charged ions are present around the clay particle that remains attached or absorbed layer or double diffused layer on the clay surface. By utilization fermentation process specific micro organisms can produce stabilizing enzyme in large quantity. These soil stabilizing enzymes catalyze the reactions between the clay and organic cat-ions and accelerate the cat-ion exchange without becoming part of the end product.

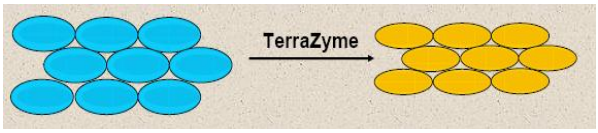

Fig 1: Replacement of Absorbed Water by Cations.

Terrazyme replaces absorbed water with organic cations, the neutralizing the negative charge on a clay particle.

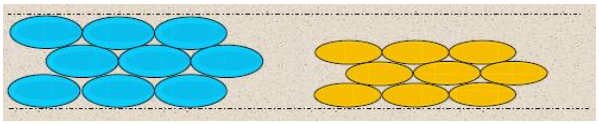

Fig 2: Reduction in Layer Thickness of Soil.

The organic cations also reduce the thickness of the electrical double layer. This allows Terrazyme treated soils to be compacted more together.

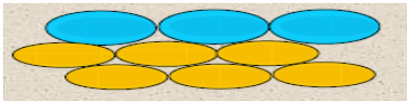

Fig 3: Reduction of Swell in Clay.

Terrazyme resists being replaced by water, thus reducing the tendency of some clay to swell.

Terrazyme promotes the development of cementitious compounds using the following, general reaction:

H_2O+ clay Terrazyme Calcium Silicate Hydrates

III.TESTS ON SOIL

Grian Size analysis – The test was conducted as per IS 2720 (Part 4) 1985. 1000 grams of soil sample was taken for test, sample was oven dried.

Atrerberg Limits test – The atterberg limits test were conducted as per IS 2720 (Part 5) 1985. The soil was oven dried and it was sieved through 425 micron sieve.

Compaction test – Modified procter test was conducted as per IS 2720 (Part 8) 1983.This test was conducted to determine the MDD and OMC of the soil. This test was conducted for native soil and as well as for enzyme treated soil cured for different weeks.

California Bearing ratio – The test was conducted according to IS 2720 (Part 6) 1979.This test was useful in finding out CBR value of native soil and enzyme treaded soil.

Unconfined compressive strength – The test was conducted as per IS 2720 (Part 10) 1991. This test was conducted to determine unconfined compressive strength of native soil and enzyme treated soil.

Atterberg limits, compaction test, California Bearing ratio and unconfined compressive strength test were conducted for both native soil and enzyme treated soil (150ml/m^3 and 200ml/m^3) for curing period of 0day, 7days, 14days, 21days, 28days, 35days, 42days, 49days and 56days.

IV. RESULTS AND DISCUSSIONS

Plasticity Index:

Table 2: Atterberg Limits Results When Treated With Terrazyme

Atterberg Limits	150ml/m^3	200ml/m^3
	Plasticity index (%)	Plasticity index (%)
0 Day	23.84	23.93
7 Days	23.32	23.83
14 Days	22.78	23.67
21 Days	21.60	23.28
28 Days	20.62	22.08
35 Days	19.63	21.62
42 Days	19.24	21.28
49 Days	18.66	21.04
56 Days	18.24	20.81

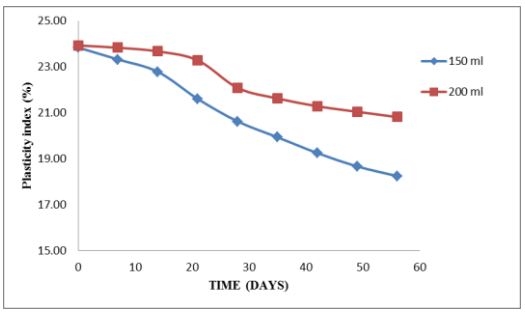

Fig 4: Pi Variation with Addition of Terrazyme

The reduction in Plasticity Index is an induction of soil improvement.

California Bearing Ratio:

TABLE 3: CALIFORNIA BEARING RATIO RESULTS

CBR	(%)	
	150ml/m^3	200ml/m^3
0 Day	2.30	2.30
7 Days	2.50	2.50
14 Days	2.89	2.89
21 Days	3.46	3.07
28 Days	4.41	3.46
35 Days	4.61	3.84
42 Days	5.00	4.02
49 Days	5.57	4.23
56 Days	5.76	4.41

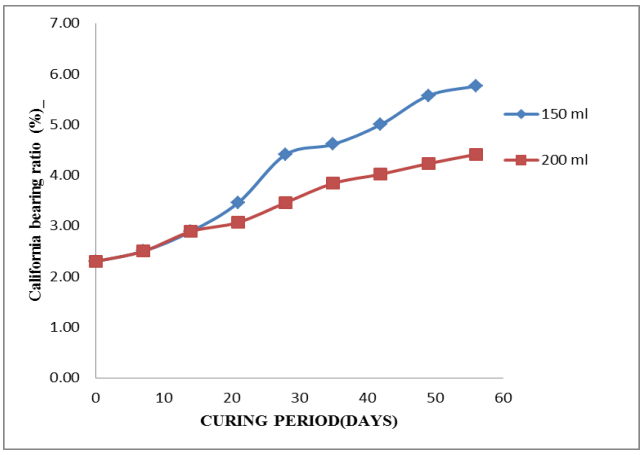

Fig 5: California Bearing Ratio Variations with Addition of Terrazyme

AS number of curing days increased the CBR value is also increasing.

Unconfined compressive Strength:

TABLE 4: UNCONFINED COMPRESSIVE STRENGTH TEST RESULT

Days	Stress (kN/m^2)	
	150ml/m^3	200ml/m^3
0 Day	221	217
7 Days	258	235
14 Days	289	262
21 Days	356	299
28 Days	439	360
35 Days	493	393
42 Days	525	436
49 Days	573	481
56 Days	619	524

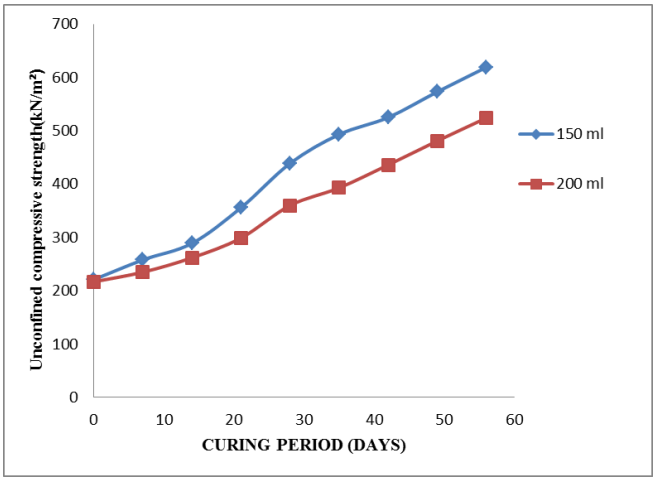

Fig 6: Unconfined Compressive Strength Variation

As number of curing dyas increased the UCS value is increased.

V. CONCLUSIONS

Based the results following conclusions have been drawn.

1. For 150ml/m3 dosage the plasticity index is reduced by 30% and 15% reduction was observed for 200ml/m3 dosage.

2. The increase in California Bearing Ratio value for 150ml/m3 dosage has better effect compared to the other dosage.

3. Unconfined Compressive Strength increased by 200% for 150ml/m3 dosage and 150% at 200ml/m3 dosage. Concluding the better performance of 150ml/m3 dosage.

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