

# To Improve the Strength Characteristics of Soil using Terrazyme

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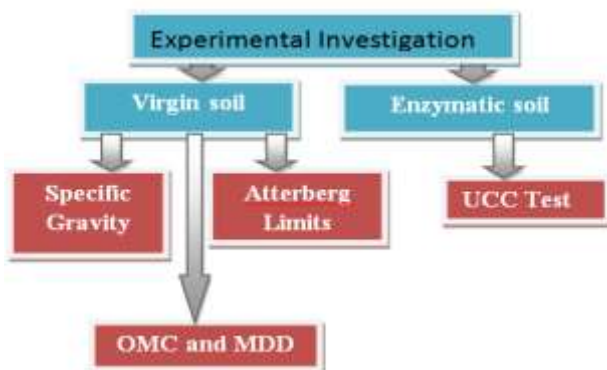
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**Abstract** - Soil stabilization is a process of improving the strength characteristics of soil. The main aim of any project is cost reduction, performance, durability and time. Terrazyme, a Bio-enzyme is a natural, nontoxic, nonflammable, non-corrosive liquid enzyme formulation fermented from vegetable extracts that improves the engineering qualities of soil, facilitates higher soil compaction densities and increases stability. Bio enzyme reduces the voids between the particles of soil and it reduces the quantity of adsorbed water in soil so that compaction caused by enzymes can be maximized. There is a urgent need for development of technologies for improvement of geotechnical properties of soil. In Karnataka there is a wide range of Black Cotton Soil availability. In this study Black cotton soil is mixed with varying percentages (0.1, 0.2, 0.3, 0.4, 0.5) of Terrazyme for different curing periods (0,3,7,14,21 days) and Unconfined compressive strength (UCS) of soil.

**Key Words:** Black Cotton Soil, Terrazyme and Unconfined compressive Strength (UCS)

## 1. INTRODUCTION:

Black Cotton Soils in India, involve around one-fifth of land region of the nation. They contain clay mineral of montmorillonite material. These soils are hard in dry state yet lose their heap conveying limit when once they are permitted to soak up water. They have high shrinkage and swelling attributes. By and large, these swelling soils are likely to change with climatic condition. This leads to development of soil stabilization. Soil properties can be improve by mechanical or chemical stabilization is most widely used. Recently the availability of natural resources for soil improvement is difficult and less durable hence bio enzyme which is nontoxic, non corrosive and inflammable liquid which can be mixed with water at optimum moisture content.



## 2. Materials required

### 2.1 Terrazyme

TerraZyme is a natural, nontoxic, non-corrosive and noninflammable liquid, produced by formulating vegetable extracts. Organic enzymes come in liquid form. They are perfectly soluble in water, brown in color with smell of molasses. Their aroma has no effect. Neither gloves nor masks are required during handling. TerraZyme is specially formulated to modify the engineering properties of soil. They require dilution in water before application. TerraZyme when added to water and mixed with soil alters the engineering properties depending upon the type of the soil and dosage of enzyme. These enzymes are liquid additives, which act on the soil to reduce the voids between soil particles and minimize absorbed water in the soil for maximum compaction. The basic properties of Terrazyme are listed below in table no.1

**Table 1:** Properties of Terrazyme

Boiling Point	212° F
Specific Gravity	1.05
Evaporation Rate	Same as water
Solubility in water	Complete
Appearance/ Odor	Brown liquid, Non-Obnoxious
Melting point	1
pH Value	4.30 to 4.60

### 2. 1 Black Cotton Soil

The soil used in this study is black cotton soil obtained from Jewargi in Kalburgi district, Karnataka. The BC soil for the present study was obtained from a depth of 1m below ground level (GL).

## 3 RESULTS AND DISCUSSIONS

### 3.1 Physical properties

The preliminary test was conducted on the sample to determine its engineering properties. The various properties such as determination of its liquid limit, plastic limit, specific gravity and dry density, particle size distribution were

determined. The liquid limit was determined using Casagrande's apparatus. Plastic limit was found by following the procedure enlisted IS: 2720 (Part 5)-1985. Sieve Analysis was conducted to know the gradation of the particle by following the procedure enlisted in IS: 2720 (Part 4). Dry sieve analysis was conducted to know the friction of gravel and sand. Wet sieve analysis was done to know the clay and silt content. The standard proctor test was conducted to determine the optimum moisture content (OMC) and maximum dry density (MDD). Specific gravity of sample was found using pycnometer test and its value marked presence of organic matter. The unconfined compressive strength of soil was found using UCC test. The test results are tabulated and shown in table 2.

**Table 2:** Physical properties of black cotton soil

Properties	Values
Specific gravity, G	2.78
Liquid limit (%)	70
Plastic Limit (%)	32
Shrinkage Limit (%)	11
MDD (g/cc)	1.51
OMC (%)	22
Sand (%)	7.78
Silt and clay content (%)	92.22
UCS (KN/mm <sup>2</sup> )	45.42
Classification of soil	CH

**3.2 Unconfined compressive strength test on Enzymatic soil**

UCC test was conducted for different dosage level on same quantity of soil. Treated soil was then tested at optimum dosage for curing period of 0, 3,7,14 and 21 days. The test results are tabulated and shown in table 3 and presented graphically in figure 1, 2, 3, 4 and 5.

**Enzyme dosage**

The enzyme dosage varies from 200 ml/3.5 m<sup>3</sup> to 200mL/1.5m<sup>3</sup> of the soil, and it depends upon soil properties. In this experimental investigation the enzyme dosages assumed for Expansive Clayey soil was 200mL for bulk volume 2.5 m<sup>3</sup>.

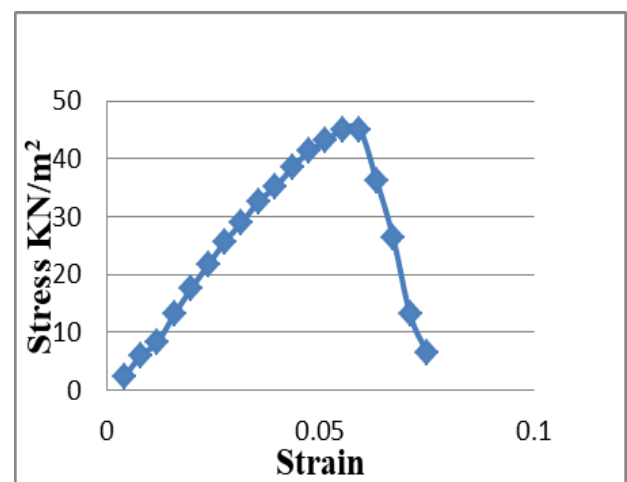
Bulk Density of BC Soil = 1.51g/cc  
 Weight = Bulk Density × Volume  
 200 mL for 2.5 m<sup>3</sup> of soil = 1.51×2.0×1000  
 = 3900 kg of soil  
 For 1 kg of soil = 0.051 mL of Enzyme  
 For 2.1kg of soil = 0.10 ml of Enzyme

**Table 3:** Enzyme Dosages

Dosage NO	Enzyme Dosages
1	0.1 mL
2	0.2 mL
3	0.3 mL
4	0.4 mL
5	0.5 mL

**Table 4 :** Unconfined Compressive Strength of black cotton soil with Terrazyme

Black Cotton Soil + Terrazyme	Unconfined compressive strength (KN/m <sup>2</sup> )				
	Curing period in days				
	0 days	3 days	7 days	14 days	21 days
0.1 ml	81.95	104.09	104.62	106.82	110.10
0.2 mL	62.45	82.53	113.89	123.65	144.45
0.3 mL	70.84	82.66	82.31	121.07	122.69
0.4 mL	96.03	105.30	125.85	157.51	170.73
0.5 mL	75.62	76.31	102.37	94.30	144.44



**Fig 1 :** Stress V/S Strain of BC Soil Without Terrazyme

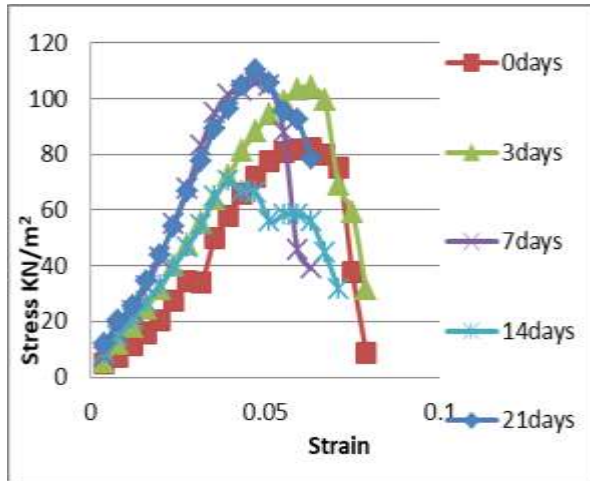


Fig 2: Stress V/S Strain of BC Soil Admixed With 0.1ml Terrazyme

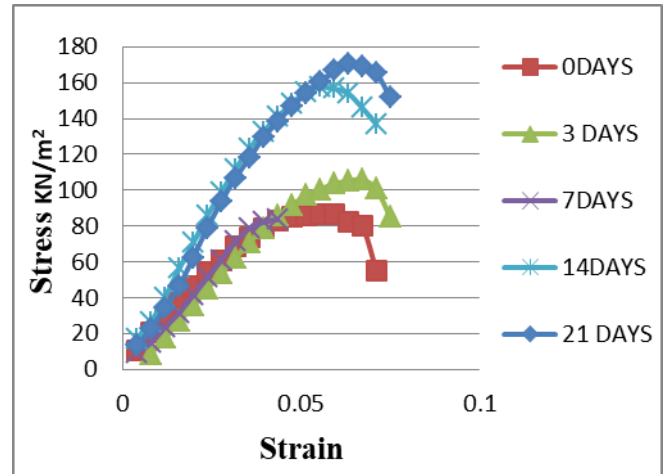


Fig 5: Stress V/S Strain of BC Soil Admixed With 0.4ml Terrazyme

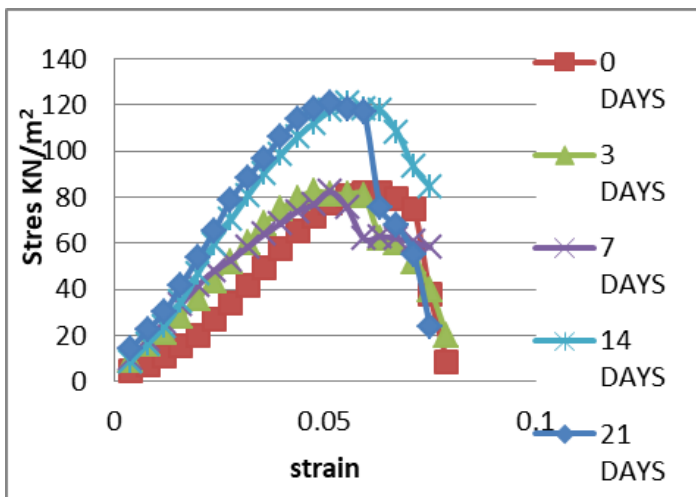


Fig 3: Stress V/S Strain of BC Soil Admixed With 0.2ml Terrazyme

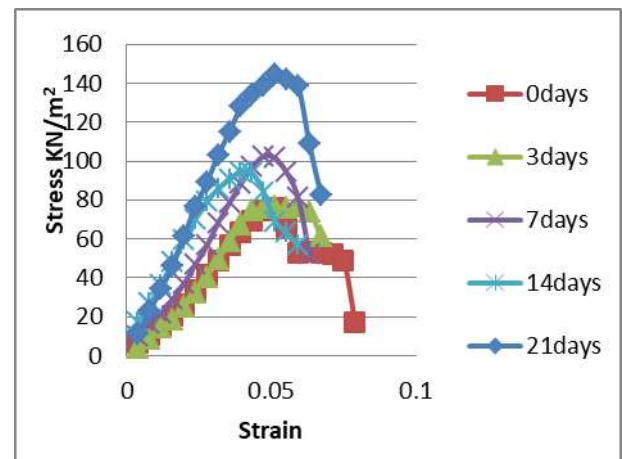


Fig 6: Stress V/S Strain of BC Soil Admixed With 0.5ml Terrazyme

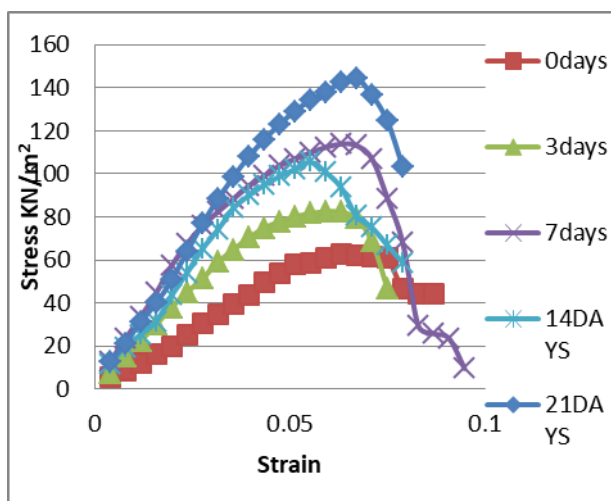


Fig 4: Stress V/S Strain of BC Soil Admixed With 0.3ml Terrazyme

#### 4. CONCLUSION

Performance of Bio-Enzyme stabilized soil has been investigated in this work. Based on the tests conducted in the laboratory, the following conclusions were drawn:

- It can be seen that the increase in age of curing UCS increases indicating long term strength gain. As percentage of terrazyme increases the value UCS also increases.
- The UCS value increases from 45.42KN/m<sup>2</sup> to 170.73KN/m<sup>2</sup> when compared to the original soil after 4weeks of curing period. This is due to the reaction of enzyme with clay which results in cementation effect
- The 0.4mL dosage of enzyme is the optimum one because UCS is increased after curing period of 21 days.

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