

STABILIZATION OF SOIL USING TERRAZYME FOR HIGHWAY CONSTRUCTION

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Abstract: *A method for constructing Highway, road, yards or parking it is the replacement of melting and soling. In civil Engineering it is introduced as a bio enzyme named Terrazyme, can be used as soil stabilizer. Day by day the populations are growing with high traffic volume and density that's why highway is required. Sub-base is the actual layer of flexible pavement through which wheel load can be transferred and spread in such a way that it prevents Shear and Unconsolidated deformation. There is a new technology which can improve the different properties of sub soil. It is an experiment to stabilise the soil by using Terrazyme which is a naturally processed bio enzyme and it is ready to use. It is a non-corrosive non-flammable liquid formation produced by fermentation of vegetable extract that improve geotechnical or engineering properties of soil providing higher soil compaction densities and increasing stability. The main feature of TerraZyme is the remarkable cost saving aspect. TerraZyme saves cost from 15% to 40% in comparison to the conventional system of road construction. Maintenance cost is dramatically reduced up to about 75%.*

In this study laterite soil with different index properties have been tested for stabilization and strength of stabilized soil is evaluated after the curing period of 0 day, 7 day, 14 days, 21 days and 28 days for different enzyme dosage 200ml/3m³, 200ml/2.5m³, 200ml/2m³, 200ml/1.5m³. The obtained results were analyzed and investigated in terms of compaction, Unconfined Compressive Strength (UCS) and California Bearing Ratio (CBR). The changes in engineering properties of the stabilized and unstabilized soils were monitored after curing periods of 0, 7, 15, 21 and 30 days. Changes in compaction properties, UCS and CBR were observed. Based on laboratory data, it has found that laterite treated with terrazyme can give better CBR value. It was also studied that kalone cannot be treated with Terrazyme. Cohesive soil is mostly preferable for Terrazyme.

Keywords—CBR, Laterite soil, Soil stabilization, Terrazyme, UCC

1. INTRODUCTION

In recent days it is required smooth and economical vehicular operation due to heavy population which requires good highways with proper geometric design well shear characteristics. Highway is closely related to our social, economic, cultural development of the country. Laterite soil or black cotton soil can be found in Kerala. The methodology which can improve the strength and durability of soil is known as Soil Stabilization. There are so many stabilizing agents available but, in this study, we have used Terrazyme. Main advantage of this bioenzyme is that it can be easily manufactured and cost is very low. In this study untreated soil is used first then treated soil with terrazyme is used for the unconfined compressive strength (UCC), a California Bearing Ratio (CBR) test and Standard Proctor Test was done.

1.1 Mechanism by using Terrazyme

Cat-ions are present around the clay particles, forming a thin film of water around the clay particles. That remains attached on clay surface. The absorbed water gives plasticity to the clay particles. Sometimes the clay may get swelled and the size increases. If the clay is dried the size of the clay cannot be reduced. It shows the true improvement of soil properties.

Cat-ion exchange process only allow the size degradation. Using fermentation process specific microorganisms can produce soil stabilizing enzyme in large quantity.

1.2 Different Work

In laboratory different tests conducted to study about subbase materials.in this study samples were collected to assess the suitability of bio enzyme in black cotton soil.

2. MATERIALS

The black cotton soil which is used for this study is collected from Dhanbad district. All information is available in table no 1.

2.1 Physical Properties

Table 1 Enzyme Properties

Physical/ Chemical Characteristics	
Boiling Point	212°F
Evaporation rate	Same as water
Odour	Brown
Solubility in water	Totally soluble
Sp.gravity	1.05

2.2 Enzyme Dosage

The enzyme dosage varies from 200ml/3.0m³ to 200ml/1.5m³ of the soil, During Examination investigation the Enzyme dosages assumed for clayey soil was 200ml for bulk volume 3.0m³ to 1.5m³ of soil.

Bulk Density of BC soil=1.56 g/cc

Weight=Bulk Density × Volume

For Dosage 1

200 ml for 3.0 m³ of soil = 1.56 × 3.0 × 1000 = 4680 kg of soil

For 1 kg = 0.042 ml of Enzyme

For Dosage 2

200 ml for 2.5 m³ of soil = 1.56 × 2.5 × 1000 =3900 kg of soil

For 1 kg = 0.051 ml of Enzyme

For Dosage 3

200 ml for 2.0 m³ of soil = 1.56 × 2.0 × 1000 = 3120 kg of soil

For 1 kg = 0.064 ml of Enzyme

For Dosage 4

200 ml for 1.5 m³ of soil = $1.56 \times 1.5 \times 1000 = 2340$ kg of soil

For 1 kg = 0.085 ml of Enzyme

Table 2 Enzyme Dosages

Dosage	200ml/m ³ of soil	ml/kg of soil
1	3.0	0.042
2	2.5	0.051
3	2.0	0.064
4	1.5	0.085

Table 3 Properties of black cotton soil

Property	Value	I S Codes
Specific Gravity	2.48	IS2720 (Part III)
Liquid limit (%)	61.40	IS2720 (Part V)
Plastic limit (%)	34.00	
Plasticity index	27.40	
Shrinkage limit (%)	16.60	
Grain size distribution		
a) Gravel (%)	0.00	IS 2720 (part IV)
b) Coarse Sand (%)	10.17	
c) Fine sand (%)	20.87	
d) Silt & Clay (%)	68.70	
CBR Value (%)		
IS Standard Compaction		
a) Un-soaked condition	2.86	
b) Soaked condition	1.19	

3. INVESTIGATION AND OBSERVATION

3.1 Unconfined compressive strength test on Enzymatic Soil

UCS test was done for different dosage level on same quantity of soil. The soil specimen was evaluated at most favourable dosage for curing periods of 0, 7, 14, 28 days. This test was also conducted for the untreated soil also for the same curing period. The observation data are tabulated and shown in Table 4.

Table 4 Unconfined compressive Strength Test on Black cotton Soil by Optimum dosage of Terrazyme

Curing Period in days	0	7	14	21
UCS value in(Kg/m ²) for untreated soil sample	20	22	28	28.65
UCS value in(Kg/m ²) for tested soil sample	30.26	36.17	69.25	76.3

3.2 Standard Proctor Test

Black cotton or Laterite soil was tested with optimum dosage of bio enzyme (Terrazyme). The compaction test was conducted to determine MDD and OMC. This test was done for curing period 0,7,14,21 days respectively. The test was also done for untreated soil sample. The values of this Proctor test are given in the following table 5.

Table 5 Compressive Strength Test

BC soil sample	Curing Period	OMC %	MDD%
Untreated	0	16	1.17
Treated with bio enzyme	0	14.4	1.8
Treated with bio enzyme	7	14.1	1.84
Treated with bio enzyme	14	13.8	1.88
Treated with bio enzyme	28	13.6	1.90

1.3 California Bearing Ratio (CBR) Test

This test is simply a penetration test. The mechanical strength of different layers is need to be evaluated and CBR test only can give the results. This test can be conducted by treating the laterite soil with optimum dosages of Terazyme for curing period of 0days,7days,14days, 28days. The observation data are given in table 6.

Table 6 CBR Test

Curing Period	0 Days	7 Days	14 Days	28Days
Undisturbed Soil sample	2.1			
BC soil treated with Bioenzyme	2.3	3.9	4.6	5

4. CONCLUSION

The UCS test, Standard Proctor Test and CBR test were conducted on Black Cotton soil and the following conclusions were drawn.

1. Minimum changes were found in MDD of Terazyme treated soil which is from 1.48gm/cm³ to 1.63 gm/cm³ but it decreases for OMC from 23% to 20%. This Phenomena happens due to cation exchange which takes more time without Bioenzyme.
2. UCS value is increased by 51% when 0th day is compared for treated and untreated soil sample.
3. It is observed that the CBR values of treated laterite soil are increased with the increased of curing periods which indicates that soil treated with enzyme renders improved density values by reducing the void ratios.
4. Terazyme is a natural, non-toxic, biodegradable liquid. It is non-poisonous to the user.
5. The strength of soil can be increased by treating with Terazyme.
6. The liquid limit, plastic limit and Optimum Moisture content values getting decreased if treated with Bioenzyme.

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