

STABILIZATION OF SOIL USING BIO-ENZYME (TERRAZYME)

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ABSTRACT

In developing countries like India, the foremost vital demand of any project when performance criteria is its economical practicableness and usefulness criteria. The standard strategies are time intense and don't seem to be economical possible. Thence there's a necessity to get the opposite potential ways that to satisfy the performance additionally as economical criteria. During this study, common out there bio-enzymes and their result on engineering properties of soil are mentioned.

The stabilization of soil with bio-enzymes may be a revolutionary technique that turning into common worldwide. Recently there are many bio-enzymes out there for soil-stabilization like Renolith, Permazyme, Terrazyme, Fujibeton etc. These enzymes are tested to be terribly effective and economical. Another advantage of this bio-enzyme is that these are environmental friendly. Once the bio-enzymes mixed with soil it alerts its engineering properties. Their potency depends on their dose, sort of soil out there and field conditions. The employment of bio-enzymes in soil stabilization isn't very hip thanks to lack of awareness among engineers and non availableness of standardized knowledge.

Keywords: Bio catalyst, untraditional Soil Stabilizer, Terrazyme, Soaked CBR, Unconfined Compressive strength, hardening time, stabilization.

1. INTRODUCTION

The process of up the strength and sturdiness of soil is understood as soil stabilization, the most aim of stabilization is price reduction and to expeditiously use the domestically on the market material. Commonest application of stabilization of soil is seen in construction of roads and airfields pavement. Chemical stabilization is completed by adding chemical additives to the soil that physically combines with soil particles and alter the geotechnical properties of soil. Enzymes enhance the soil properties and supply higher soil compaction and strength. TerraZyme is non harmful, non corrosive and flammable liquid which might be simply mixed with water at the optimum wet content. TerraZyme improves the properties of soil and strength of soil considerably. Lifetime of a structure will increase as CMB price is accrued and consistency limits are slashed. The chemical bonding of the soil particles is accrued by the employment of TerraZyme and a permanent structure is created that is proof against wear and tear, weathering and infiltration of water in soil. Aside from up strength of soil this bio protein replaces the necessity of granular base and sub base. TerraZyme indefinite quantity entirely depends on the kind of soil, clay content and malleability index of soil. totally different parameters were thought of within the gift work to test the consequences of TerraZyme on native soil.

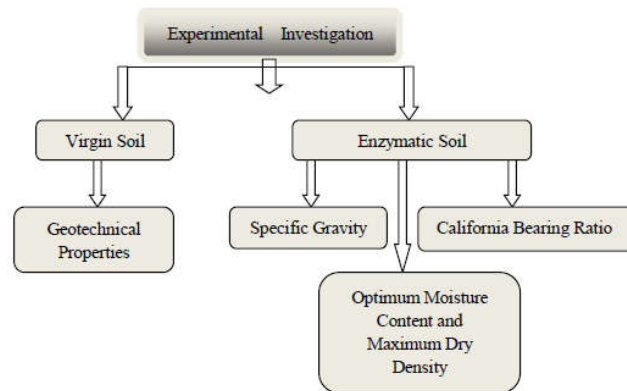


Figure 1. Experiments performed on soil

1.1.TERRAZYME

TerraZyme may be a liquid accelerator that is organic in nature and is developed from the vegetable and fruit extract. It improves the standard of soil like CBR, sturdiness and reduces the OMC, malleability index of soil. The impact of TerraZyme on soil is permanent and also the soil becomes bio degradable in nature. The rationale behind the development of soil properties is that the cat ion-natural action capability of the clay. Friction among the soil particles will increase because the water is expelled out from the soil. Terrazyme forms a protecting coating round the clay particles and thereby creating clay particles water repellent. These organic enzymes are available in liquid type and are dead soluble in water, brown in color and smells like sirup. Irritation in eyes could also be caused by TerraZyme typically however the handling of this accelerator is simple i.e., masks and gloves don't seem to be needed. Dose of TerraZyme is of utmost importance, if less quantity of TerraZyme is mixed with soil the results won't be satisfying which suggests soil can come through less stability and if TerraZyme is overdosed it'll end in the upper price and stabilization will become ineffective. So as to seek out out the optimum dose of TerraZyme specifically soil series of CBR check is performed on every sample with completely different quantity of TerraZyme.

1.1.1. Mechanism of Stabilization

Terrazyme reacts with absorbed water layer of clay particle and causes reduction within the thickness around particle of soil, this end in the reduction of voids between the particles of soil, thereby giving soil particle a more in-depth orientation with low compaction. This ultimately ends up in the decrease in swelling capability of soil and it conjointly reduces porosity of soil.

1.1.2. Advantages of TerraZyme

As the strength and stiffness of the soil is raised by adding TerraZyme to soil maintenance price gets reduced by thirty to fifty the concerns. It decreases the plastic characteristic of soil. Pavement thickness is reduced by thirty to fiftieth. Construction time is reduced by fifty the concerns. TerraZyme improves load bearing capability of soil.

1.1.3. Properties of TerraZyme

It is an organic liquid developed from vegetable extracts. Temperature shall be maintained at fifty five degree Celsius otherwise TerraZyme loses its properties. This organic

liquid is stable in nature and also the risk of decay is negligible. It's needed to dilute TerraZyme with water before application. The aroma of TerraZyme has no harmful impact.

1.1.4. Benefits of Terrazyme

1. TerraZyme will increase the sturdiness of pavement and reduces swelling properties of soil.
2. Reduces construction price by concerning 20-40% because of reduction within the transportation of materials and employ of onsite materials.
3. The utilization of TerraZyme enhances weather resistance and improves load bearing capability of soils.

2. MATERIAL AND STRATEGIES

The check procedures for determination of properties of soils like sieve analysis, relative density, liquid limit, plastic limit, cohesion, cut resistance, porosity, optimum wetness content, most dry density, unconfined compressive strength and CBR worth.

1. Sieve Analysis
2. Specific Gravity
3. Liquid Limit
4. Plastic Limit
5. Direct Shear Test
6. Permeability Test
 - a. Constant Head Method
 - b. Falling Head Method
7. Standard Proctor Compaction Test
8. Unconfined Compaction Test
9. California Bearing Ratio Test

3. RESULTS AND ANALYSIS

Results of varied tests conducted on soil samples Natural soil, like specific gravity; grain size distribution; consistency limits; direct shear check; permeability; normal proctor check; CBR test and UCC test

3.1. Specific Gravity

S. No.	Soil Sample	Specific Gravity (G)
1	Natural Soil	2.44
2	0.01% Terrazyme added soils	2.43

Table 1. Specific Gravity Values

3.2. Grain Size Distribution of Natural Soil

IS. Sieve	Wt. of retained in each sieve (gms)	Percentage retained	Cumulative percentage retained on each sieve	Percentage finer
4.75mm	161	32.8	32.8	67.21
2.00mm	129	26.3	59	40.9
1.00mm	77	15.7	74.7	25.3
600 μ	34	6.9	81.7	18.3
425 μ	23	4.7	86.3	13.7
300 μ	17	3.5	89.8	10.2
150 μ	31	6.3	96.1	3.9
75 μ	12	2.4	98.5	1.5
Pan	7	1.5	100	0

Table 2. Grain Size Distribution

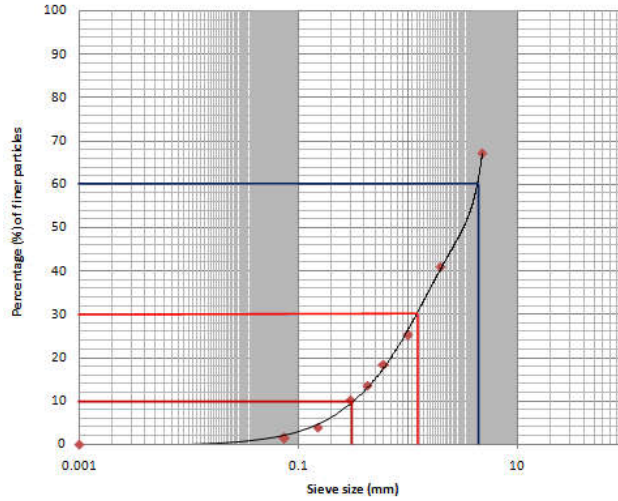


Figure 2. Grain Size Distribution Curve

3.3. Liquid Limit

S. No.	Soil Sample	Liquid Limit (%)
1	Natural Soil	36.5
2	0.01% Terrazyme added Soil	49

Table 3. Liquid Limit Values

3.4. Plastic Limit

S. No.	Soil Sample	Plastic Limit
1	Natural Soil	33.3
2	0.01% Terrazyme added Soil	20.5

Table 4. Plastic Limit Values

3.5. Consistency Indices

S. No.	Soil Sample	Plasticity Index (%)	Liquidity Index (%)	Consistency Index (%)	Flow Index (%)	Toughness Index (%)
1	Natural Soil	3.2	20	80	5.7	5.6
2	0.01% Terrazyme added Soil	28.5	93.9	70.5	7.8	3.6

Table 5. Consistency Indices Values

3.6. Direct Shear Test

S. No	Soil sample	Cohesion (kg/cm ²)	Angle of Internal Friction (Φ)
1	Natural Soil	0.31	60 ⁰
2	0.01% Terrazyme added soil	0.24	58 ⁰

Table 6. Direct shear test values

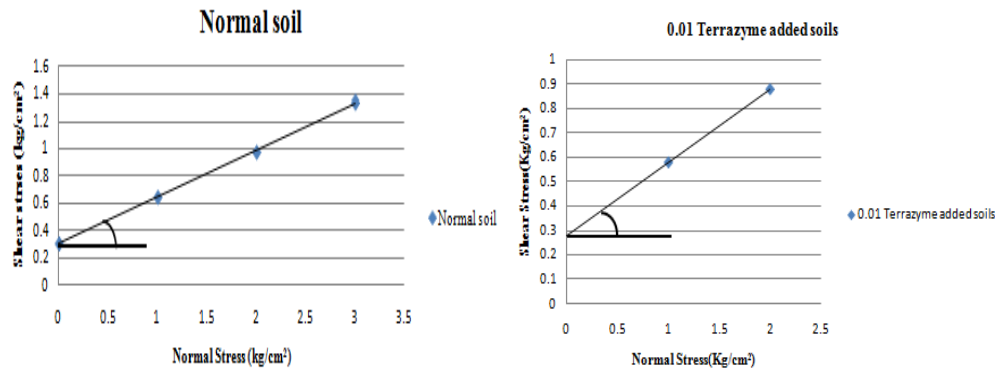


Figure 3. Variation of Angle of Internal Friction and Cohesion(c)

3.7. Permeability

S.No	Soil Sample	Coefficient of permeability (K) cm/s	
		Constant head method	Falling head method
1	Natural Soil	1.2×10^{-4}	1.9×10^{-4}
2	0.01% Terrazyme added soil	5.1×10^{-5}	4.8×10^{-4}

Table 7. Permeability values

3.8. Standard Proctor Test

S.No	Soil samples	Optimum moisture content(%)	Bulk density (gm/c.c)	Dry density (gm/c.c)
1	Natural Soils	16	1.88	1.61
2	0.01% Terrazyme added soil	16	1.89	1.65

Table 8. Standard Proctor test values

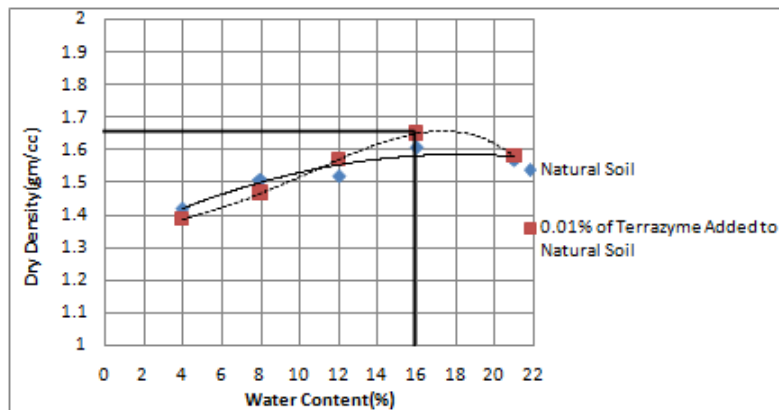


Figure 4. Variation of Standard Proctor Test Values

3.9. CBR (California Bearing Ratio) Test

Penetration (mm)	Natural Soil (KN)	0.01%Terrazyme soils (KN)
0	0	0
50	2.2	5.4
100	3.2	7.4
150	3.8	8.8
200	4.3	9.8
250	4.6	10.7
300	5	11
350	5.2	11.3
400	5.3	11.7
450	5.5	12
500	5.6	12.2
550	5.8	12.4
600	5.8	12.7
650	5.9	12.8
700	6	13
750	6	13.1
800	6.1	13.2
850	6.2	13.4
900	6.2	13.5
950	6.2	13.6
1000	6.2	13.7
1050	6.2	13.8
1100	6.3	13.8
1150	6.3	13.9
1200	6.3	14
1250	6.3	14

Table 9. CBR values

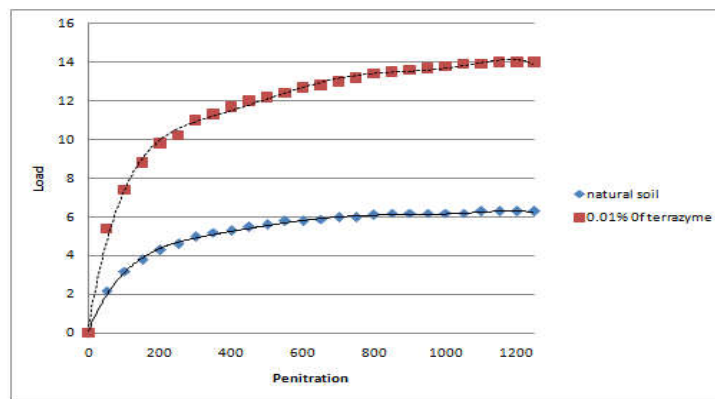


Figure 5. Variation of CBR Load Values

S.No	Description	CBR values (%)
1	Natural Soil	34.2
2	0.01% Terrazyme added soil	75.9

Table 10. CBR results

3.10. Unconfined Compression Test

Penetration (mm)	Natural Soil (N/mm ²)	0.01% Terrazyme added soil (N/mm ²)
0.006	0.7	2.4
0.013	1.04	2.5
0.02	1.47	2.67
0.026	1.63	2.9
0.033	1.71	2.9
0.04	1.78	2.9

Table 11. Unconfined compression test values

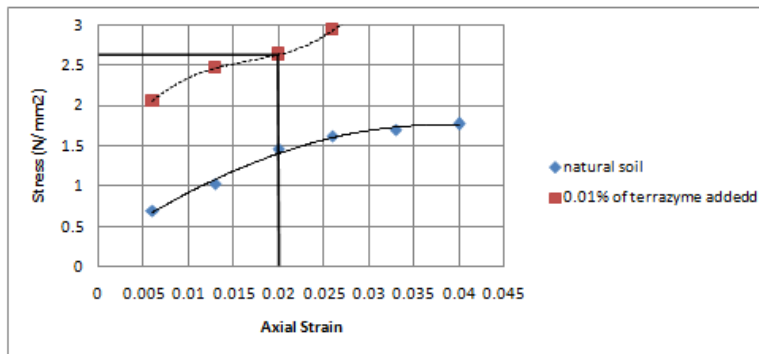


Figure 6. Variation of Unconfined Compression Values

S.No	Description	UCC values(N/mm ²)
1	Natural Soil	1.47
2	0.01%Terrazyme added soil	2.67

Table 12. UCC test results

3.11. Final Results

S.No	Name Of Test	Natural Soil Sample Values	Stabilized Natural Soil Sample Values
1	Specific Gravity	2.44	2.42
2	Liquid Limit	36.5%	49%
	Plastic Limit	33.3%	20.5%
3	a)Plasticity Index	3.2%	28.5%
	b)Liquidity Index	20%	93.9%
	c)Consistency Index	80%	70.5%
	d)Flow Index	5.67%	7.82%
	e)Toughness Index	5.64%	3.64%

4	Direct Shear Test a) Angle of Internal Friction(ϕ) b) Cohesion (c)	60 ⁰ 0.31 Kg/cm ²	58 ⁰ 0.24 Kg/cm ²
5	Permeability a) Constant Head Method b) Falling Head Method	1.15 x 10 ⁻⁶ m/s 1.89 x 10 ⁻⁶ m/s	5.121 x 10 ⁻⁷ m/s 4.801 x 10 ⁻⁶ m/s
6	Standard Proctor Test a) Maximum Dry Density b) Optimum Moisture Content	1.6 g/cc 16%	1.65 g/cc 16%
7	Unconfined Compression Test	1.47 N/mm ²	2.67 N/mm ²
8	California Bearing Ratio	34.23%	75.89%

Table 13. Final results of stabilization of soil using bio-enzyme (terrazyme).

4. CONCLUSION

Based on the tests conducted on natural soil, terrazyme supplemental soil; the subsequent conclusions are drawn; that are applicable solely to materials used and tests conditions custom-made in study.

1. Compared to the take a look at values in natural soil, 0.01% Terrazyme supplemental soil the precise gravity remains constant.
2. Compared to the natural soil, the liquid limit of soil is magnified for zero.01% Terrazyme supplemental soils. The liquid limit is magnified by thirty four.25% for 0.01% Terrazyme supplemental soil.
3. Compared to the natural soil, the plastic limit of soil is reduced for zero.01% Terrazyme supplemental soils. The plastic limit is reduced by thirty eight.43% for 0.01% Terrazyme supplemental soils.
4. Compared to the natural soil, the cohesion of soil is reduced for zero.01% of Terrazyme supplemental soils. The cohesion worth is reduced by twenty two.6% for 0.01% Terrazyme supplemental soils
5. Compared to the natural soil, the porousness of soil is reduced for zero.01% Terrazyme supplemental soils. The porousness is reduced by fifty seven.5% for 0.01% of Terrazyme supplemental soil.
6. 6.Compared to the natural soil, the standard proctor take a glance at price of soil is enlarged for zero.01% Terrazyme supplemental soil. the standard proctor take a glance at price is enlarged by a try of.5% for 0.01% Terrazyme supplemental soil.
7. Compared to the natural soil, the CMB price of soil is enlarged for zero.01% Terrazyme supplemental soils. The CMB price is enlarged by fifty four.9% for 0.01% Terrazyme supplemental soil
8. Compared to the natural soil, the UCC worth of soil is magnified for zero.01% Terrazyme supplemental soils. The unconfined compression values magnified is by forty four.9% for 0.01% Terrazyme supplemental soil

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