JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

STABILIZATION OF CLAY SOIL USING TERRAZYME

PHANI KUMAR.V [1] Sr. Gr. Assistant Professor,

P. Lakshmi Tulasi [2] , K. Mani Deepika [3]

P. Nani [4] P. Konda Babu [5]

Department of Civil Engineering in Seshadri Rao Gudlavalleru Engineering College, Gudlavalleru, India.

Abstract : The critical factors in any project include cost, performance, durability, and time. Traditional methods have often been inefficient and time-consuming, underscoring the pressing necessity for the advancement of techniques that enhance soil's geotechnical properties. Because of the soil's insufficient strength, it struggles to support the loads placed upon it during or after construction. TerraZyme emerges as the ideal remedy for this problem. It is a natural, non-toxic, biodegradable liquid that significantly improves soil strength by reducing voids. It improves soil compaction with minimal effort and boasts a lasting effect. A standard sample of terrestrial soil was treated with TerraZyme as an additive. Subsequent tests were conducted at varying dosages, including Consistency Limits, Compaction, Unconfined Compression, Tri-axial Test. Based on the experimental findings, the optimal dosage of TerraZyme was determined. Since the enzyme is an organic liquid, it undergoes biodegradation and does not cause any adverse effects on the environment.

IndexTerms - Terrazyme, Consistency Limits, Compaction, Unconfined Compression, Tri-axial test.

I. INTRODUCTION

Soil stabilization involves enhancing the strength and durability of soil through modifications to its physical properties. It's crucial for this process to be cost-effective, environmentally friendly, and yield optimal outcomes. Enhancing the soil's strength is strongly advised for any construction endeavour to prolong the structure's lifespan. Soil stabilization can be accomplished through diverse techniques including the use of surfactants, biopolymers, synthetic polymers, copolymer-based products, cross-linking styrene acrylic polymers, tree resins, ionic stabilizers, fiber reinforcement, calcium chloride, calcite, sodium chloride, magnesium chloride, and other methods. In this particular project, enzymatic stabilization is conducted utilizing a specific enzyme known as TerraZyme.

Every enzyme is meticulously designed to catalyze a chemical reaction within or between molecules without undergoing any change itself. Acting as hosts for other molecules, enzymes significantly speed up the rate of typical chemical and physical reactions. The enzyme facilitates the soil materials to achieve better wetting and denser compaction. Additionally, it enhances the chemical bonding among soil particles, resulting in a more enduring structure that exhibits increased resistance to weathering, water penetration, and general wear and tear.

In the current era, bio-enzymes have emerged as highly efficient soil stabilizers, primarily due to their affordability, easy production, effective outcomes, and straightforward application methods. Although enzymes may entail initial costs, their minimal requirement for achieving desired results renders the overall project economically viable. Various enzyme types, such as renolith, Perma-Zyme, Terrazyme, Fujibeton, among others, offer distinct properties and are suitable for specific applications. This paper offers an in-depth examination of a specific enzyme called TerraZyme.

1.1.TerraZyme:

Terrazyme, crafted from natural vegetable extracts, stands as a safe and eco-friendly substance. Its attributes of being non-toxic, non-corrosive, and non-flammable make it a dependable choice across various applications. Sporting a brown hue and a scent reminiscent of molasses, Terrazyme offers a user-friendly experience, eliminating the need for protective gear like masks or gloves.

Its compatibility with water simplifies application, although for optimal performance, it's recommended to dilute Terrazyme with the appropriate moisture content specific to the soil. When applied, Terrazyme effectively interacts with the soil by reducing the gaps between soil particles. This action leads to reduced water absorption and heightened compaction, thereby bolstering soil stability.

Precision in dosing Terrazyme is paramount for its efficacy. Under-dosing may yield subpar results, compromising soil stability. Conversely, over-dosing can escalate costs and render the stabilization process ineffective. Therefore, careful attention to dosage ensures desired outcomes while maximizing resource efficiency.

1.1.1 Mechanism of Stabilization:

Terrazyme interacts with the water layer that surrounds clay particles, leading a decrease in the thickness of this layer. As a result, the empty spaces between soil particles decrease, which encourages the soil particles to align more closely and reduces compaction. This process eventually results in a loss in the capacity of soil to swell and a reduction in its ability to allow liquids to pass through.

1.1.2 Benefits of TerraZyme:

By adding TerraZyme to soil, it improves both the strength and stiffness of the soil, leading to a significant decrease in maintenance expenses, often ranging from 30 to 50%. This treatment also reduces the plastic properties of the soil. Furthermore, the thickness of the pavement may be reduced by 30 to 50%, resulting in a 50% reduction in construction time. TerraZyme greatly enhances the soil's ability to bear weight, providing several advantages in building projects.

II. GEOTECHNICAL PROPERTIES OF SOIL:

The soil samples used in this study were obtained from Gudlavalleru Engineering College in Gudlavalleru. These samples were identified as High Compressibility Clay (CH) soil. The soil samples were collected from the field, dried naturally, and then filtered through a 425 μ screen for examination.The parameters of soil are shown in Table-1.

Table-1: Properties of Soil

S. No	Properties	Value
1	Gravel %	1.76
2	Sand %	3.97
3	Silt + Clay %	94.27
4	Differential free swell %	70
5	Liquid Limit %	80.66
6	Plastic Limit %	34.5
7	Plasticity Index %	46.16
8	IS classification	CH
9	Optimum Moisture Content %	29.99
10	Maximum Dry Density g/cc	1.252
11	Unconfined Compressive Strength (C_u) KN/m^2	65.62
12	Cohesion (c) KN/m^2	30
13	Angle of internal friction	0^0
14	Coefficient of consolidation (C_V) mm^2/sec	0.009
15	Compression index (C_c)	0.4

III. METHODOLOGY

3.1 Tests on Clayey Soil

The experiments performed on clayey soil used varying dosages of terrazyme, as shown in table-2.

Table-2: Tests conducted on Clayey Soil

S. No.	Soil	Dosage of Terrazyme inml/Kg of soil	Tests conducted
1	Expansive Soil	Untreated	Liquid Limit, PlasticLimit, Compaction, Unconfined Compressive test, Triaxial Shear test.
		0.1	
		0.2	
		0.3	
		0.4	

IV. EFFECT OF TERRAZYME:

The impact of Terrazyme varies depending on the type of soil and the dosage used. Here are some general alterations observed in various soil properties following the application of diluted Terrazyme:

4.1. Compaction:

A compaction test is a standard laboratory procedure used to determine the optimum moisture content and maximum dry density of a soil sample. This test helps assess the soil's suitability for construction purposes, such as roadbeds, embankments, and foundations. During the test, the soil sample is compacted in layers using a standard compaction method and varying levels of moisture content. The resulting relationship between moisture content and dry density is plotted on a compaction curve, from which engineers can determine the optimal moisture content and corresponding maximum dry density for the soil. This information is crucial for ensuring proper soil compaction and stability in construction projects. Figure-1 illustrates the performance of clayey soil at different dosages of terrazyme , as measured by the optimum moisture content (OMC) and maximum dry density (MDD).

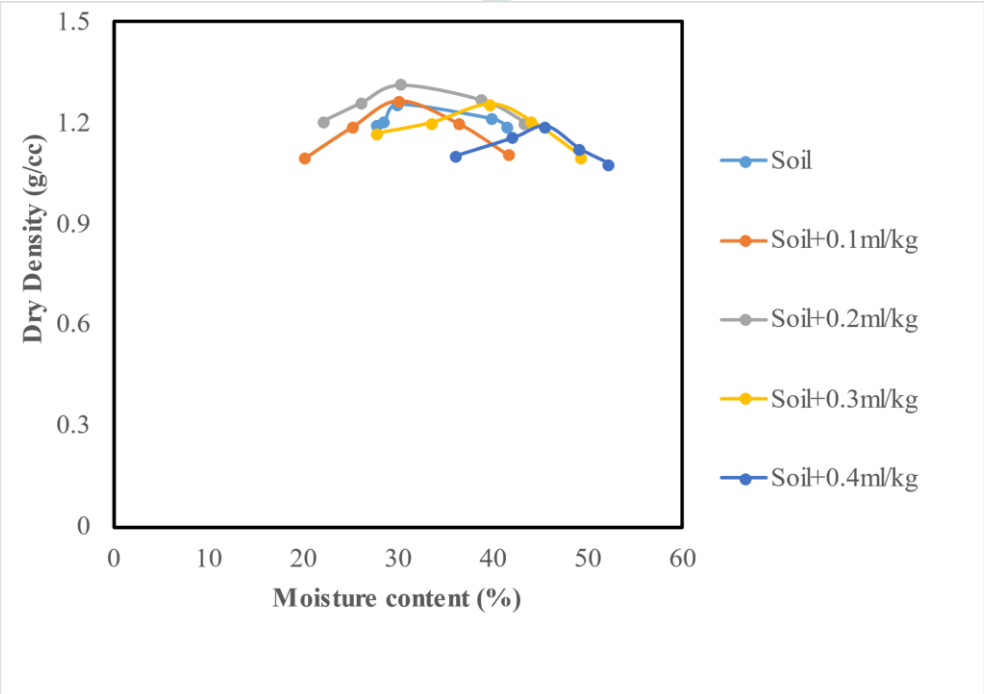

Fig-1: Graph for OMC vs MDD

4.2. Unconfined Compression Test:

UCS stands for Unconfined Compressive Strength. It is a measure of the maximum compressive stress a soil sample can withstand under an unconfined condition, meaning without any lateral support. The UCS test is commonly performed in geotechnical engineering to assess the strength characteristics of soil, particularly cohesive soils like clays and silts. During the UCS test, a cylindrical or cubical soil specimen is prepared and subjected to axial compression until failure occurs. The applied load and resulting deformation are measured, allowing engineers to calculate the UCS of the soil sample. This strength parameter is crucial in designing structures such as foundations, retaining walls, and slopes, as it helps determine the soil's ability to support applied loads without undergoing excessive deformation or failure. Figure-2 illustrates the performance of clayey soil under various dosages of terrazyme, characterized by undrained cohesion.

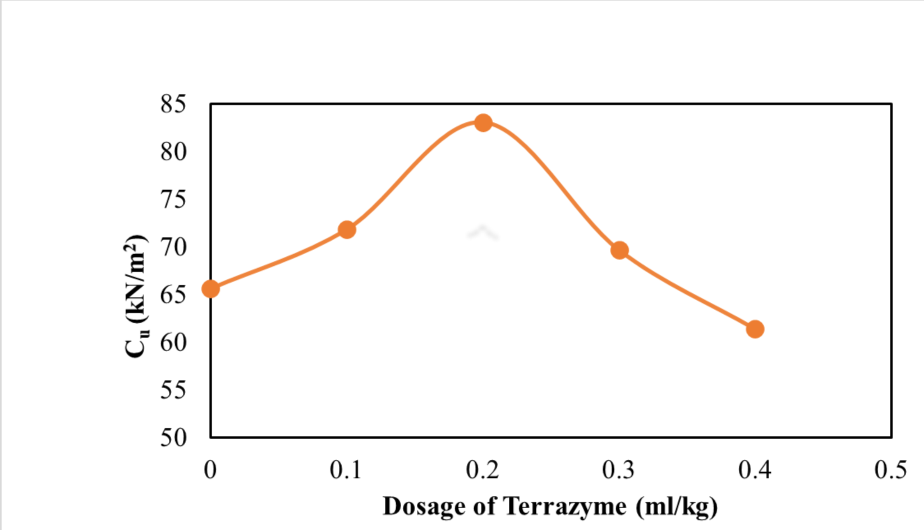

Fig-2: Graph for Cu (kN/m^2)

4.3. Tri-Axial Test:

A triaxial test is a laboratory experiment used to determine the mechanical properties of soil, particularly its shear strength and stress-strain characteristics. It involves subjecting a cylindrical soil sample to different levels of confining pressure while applying axial load. The test helps engineers and geotechnical professionals understand how soils respond to various stress conditions, aiding in the design of structures like foundations, retaining walls, and embankments. Triaxial tests provide valuable data for analyzing soil behavior under different loading conditions, contributing to the safety and efficiency of civil engineering projects. Figure-3 and figure-4 illustrates the performance of clayey soil under various dosages of terrazyme, evaluated by cohesion and angle of internal friction.

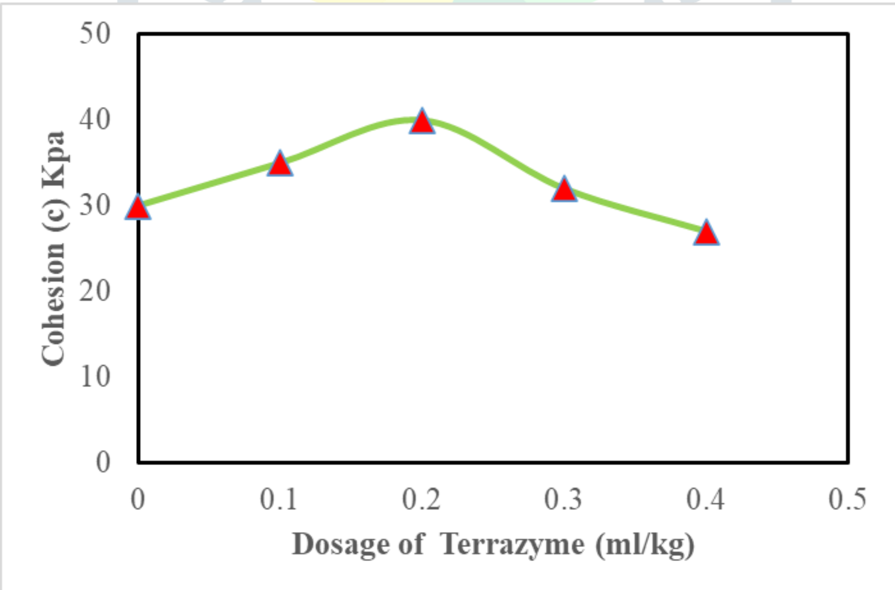

Fig-3: Graph for c (kPa)

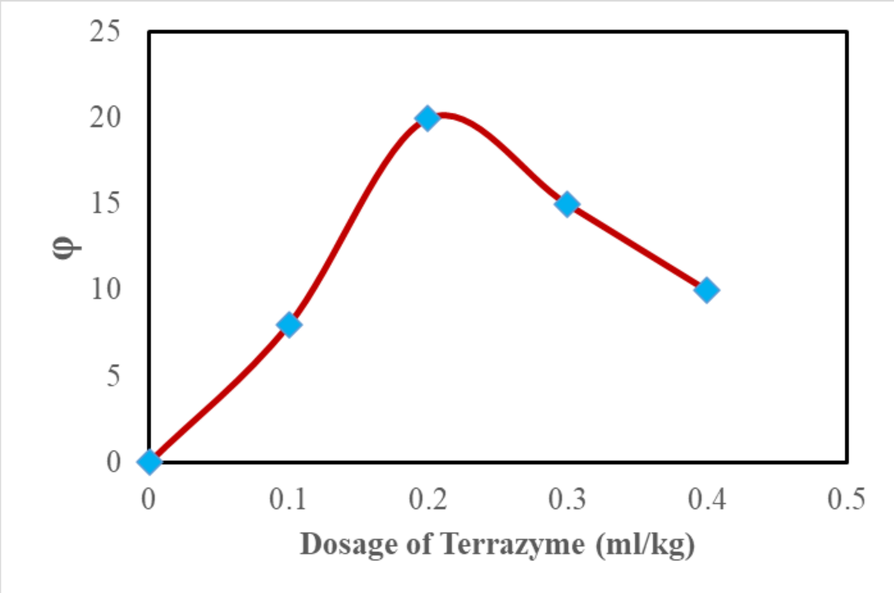

Fig-4: Graph for ϕ (degree)

V. CONCLUSIONS:

Through our research, we have successfully stabilized the clayey soil using various dosages of terrazyme. Upon conducting experiments on clayey soil with varying dosages of terrazyme, we have determined that the soil has been successfully stabilized. The addition of terrazyme is positively correlated with the increase in OMC. The MDD (maximum dry density) shows a positive correlation with the increasing addition of terrazyme up to a dosage of 0.2ml/kg of soil. The inclusion of terrazyme leads to a decrease in the Differential Free Swell Index.The cohesion of the soil increases as the amount of terrazyme added increases, up to a maximum of 0.2ml/kg of soil.The compression index decreases as the amount of terrazyme added increases. The coefficient of consolidation demonstrates a positive correlation with the incremental inclusion of terrazyme, up to a dosage of 0.2ml/kg of soil.

After careful analysis, we have shown that the addition of terrazyme to clayey soil results in a 33% increase in cohesiveness, a 35% decrease in compression index, and a 211% increase in the Coefficient of consolidation. The strength parameters are enhanced and the soil swelling is reduced by incorporating 0.2ml of terrazyme per kg of soil.

VI. REFERENCES:

[1] Andrew, R.T., Fadi, M.S., Nicholas, E.H. and Elahe, M. (2003): “An Evaluation of Strength change on Subgrade soils stabilized with an Enzyme Catalyst solution using CBR and SSG comparisons”, Geometrics, Inc. Columbia, Sc 29210, USA, July 2003.

[2] Andromalos, K.B., Hegazy, Y. A., Jasperse, B. H. (2000): “Stabilization of Soils by Soil Mixing” Proceedings, International Conference on Soft Ground Technology, ASCE, Noorwijkerhout, Netherlands, pp. 194-205.

[3] 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.

[4] “Effect of Terrazyme usage on increase of CBR”, Technical report by Soil Mechanics Laboratory, National Road Department, Thailand, 1996.

[5] Fine, L., Remington J. (1972): The Corps of Engineers: Construction in the United States. Airfields for Very Heavy Bombers.

[6] Hitam, A. and Yusof, A. (1998): “Soil stabilizers for plantation road”, National seminar on Mechanization in Oil Palm Plantation, 30 June 1998, Selangor, Malaysia.

[7] IRC: 37-2001 “Guidelines for the design of flexible pavements”, The Indian Roads Congress, New Delhi [8]. IRC: SP: 20 -2002 “Rural roads Manual”, The Indian Roads Congress, New Delhi.

[8] Mr. K. Ashok, G.C.K. Kishore, M. Akhila, P. Emmanual, T. Lokesh, “Stabilization of Black Cotton Soil Using Terrazyme” .International Journal For Technological Research In Engineering Volume 9, Issue 10, June-2022.

[9] IRC: 37-2001 “Guidelines for the design of flexible pavements”, The Indian Roads Congress, New Delhi

[10] IRC: SP: 20 -2002 “Rural roads Manual”, The Indian Roads Congress, New Delhi

[11] IS 2720 (Part III) (1980) “Determination of Specific gravity” Bureau of Indian Standards, Manak Bhavan, New Delhi.

[12] IS 2720 (Part IV) (1975) "Determination of Grain Size" Bureau of Indian Standards, Manak Bhavan, New Delhi.
[13] IS 2720 (Part V) (1985) "Determination of Liquid and Plastic limit" Bureau of Indian Standards, Manak Bhavan, New Delhi.
[14] IS 2720 (Part VII) (1980) "Determination of Moisture content and Dry density" Bureau of Indian Standards, Manak Bhavan, New Delhi.
[15] IS 2720 (Part X) (1973) "Determination of Unconfined Compressive Strength" Bureau of Indian Standards, Manak Bhavan, New Delhi.