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### REVIEW PAPER ON STABILIZATION OF LATERITIC SOIL BY USING TERRAZYME

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#### ABSTRACT

The most important aspect of any project is its cost, durability, performance and time. Development of new techniques is needed to achieve this aspect. One of the major reasons for the damage of the roads in India is lack of strength possessed by subgrade soil and also it fails to bear the loads imposed on it during or after the construction. Bio-enzyme is a natural, non-flammable, non-corrosive, non-toxic liquid formulation fermented from the vegetable extract that enhances geotechnical properties of soil facilitate higher soil compaction densities and increases stability. One of such bio-enzyme, Terrazyme, has been used in present work to study. It mixed with virgin soil with various dosages of Terrazyme with different duration. As terrazyme is an organic liquid, it is biodegradable in nature and it does not have any harmful effect on the environment. The tests required for this study are specific gravity, plastic limit, liquid limit, CBR and Standard Proctor test. Terrazyme reduces the voids between particles of soil and minimizes the amount of absorbed water in the soil, because of this compaction strength of soil increases.

*Keywords: Bio-Enzyme; Terrazyme; Lateritic soil; Soil Stabilization; CBR.*

#### I. INTRODUCTION

Soil stabilization is the process of increasing the strength and durability of soil by altering the physical properties of the soil. Soil stabilization is a treatment of soil with the objective of improving its engineering properties of soil so as to improve its engineering performance. the aim of stabilization is to reduce the cost of construction.

The lateritic soil covers the large area of Konkan belt. This soil is formed by sedimentation action of the parent rock. This type of soil is good for drainage purpose, but water retention capacity of this soil is very poor. So, it is necessary to adopt the stabilization techniques for road construction on soil with poor engineering properties.

This research work investigates the effect of treating a soil having poor geotechnical properties with one of bio-enzyme, terrazyme. Bio-enzyme found to enhance geotechnical and engineering properties of road sub-grade and thus the performance of road. Terrazyme increases the chemical bonding of the soil particles and it also replaces need of sub base.

#### II. STABILIZATION OF SOIL USING BIO-ENZYME

Bio-enzyme is a natural, non-corrosive, non-toxic, and non-flammable liquid fermented from vegetable extracts. Enzyme is easy safe and convenient to use thus there is no need of safety equipment while using enzyme. Enzyme effectively increases the compaction of soil and strength of soil. Now a days, due to its low cost, easy manufacturing, simple application technique and effective result, Bio-enzyme are becoming the most efficacious soil stabilizer. Because of very small amount of enzyme needed for required result the over all project become economical. There are many types of enzyme present in market like Perma-zyme, Renolith, Terrazyme etc. In this paper we have discussed in detail about a particular enzyme i.e. terrazyme.

### III. MATERIAL

#### Material

- **Lateritic Soil:** - Lateritic soil is a rusty colour, aluminium and iron rich rock like appearing soil that gets formed due to prolonged weathering of the parent rocks mainly in humid and hot tropical areas.
- **Terrazyme:** Terrazyme is an inflammable liquid which is brown in colour and is formulated from the vegetable and fruit extract. It is easily mixed with water and for optimal results should be diluted with an optimum moisture content of that soil. It reacts with the organic matter in the soil to form cementitious material. This decreases the swelling capacity of the soil particles and reduces permeability by increasing the chemical bonding between the soil particles making a permanent structure. The treated soil becomes water resistant and also increase safe bearing capacity.

*Table 1: property of terrazyme.*

Boiling Point	212
Specific Gravity	1.000 to 1.090
pH Value	4.30 to 4.60
Vapor Density	1
Melting Point	Liquid
Appearance	Brown clear liquid
Total dissolved solids	19.7ppm
Hazardous content	None
Evaporation rate	Same as a water
Reactivity data	Stable
Cation exchange capacity	3.87%
Solubility in water	Complete

### IV. MECHANISM OF TERRAZYME

Terrazyme is a surfactant which changes the hydrophilic nature of clay and lime materials to hydrophobic. The clay particles are surrounded by an absorbed water layer containing sufficient positive metals like NA, K, Al, Mg etc. which is the reason of the bond between the negative clay particles and water molecules. The terrazyme assists the expulsion of these absorbed layers of water and also aids the lubrication of soil particles and increases the compatibility of many soils. The reaction of terrazyme on these materials is particularly effective because of the ion-exchange capacity of clay minerals. The property that clay minerals have of absorbing certain ions such as terrazyme molecule, thereby changing its physical properties. Of special importance is that terrazyme changes the plastic characteristics of these materials due to reduction in its water absorbing capacity. Unlike most other stabilizers, the effect of terrazyme is permanent.

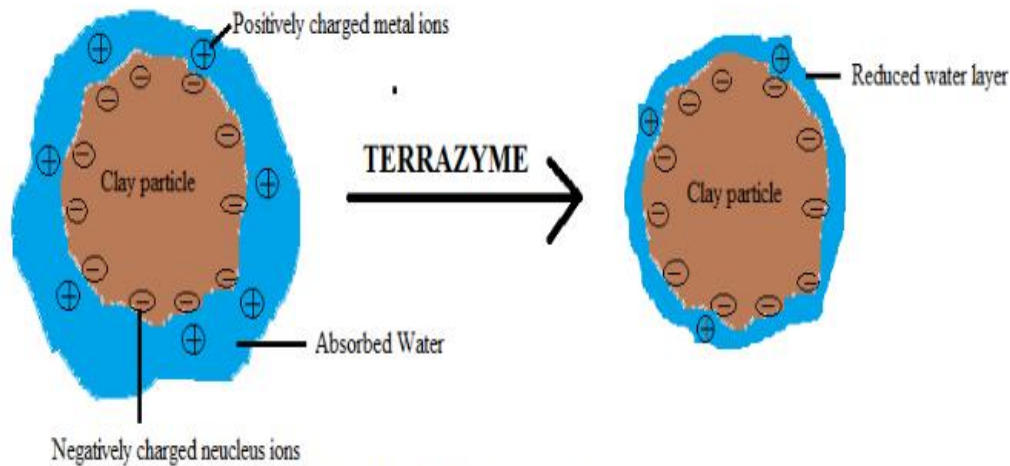


Figure No. 1. Mechanism of terrazyme

## V. EFFECT OF TERRAZYME

Effect of terrazyme varies according to type of soil and dosages. Some of general changes in soil properties after addition of terrazyme are discussed below.

### → Density

Soildensity is equal to the dry mass of the soil divided by the volume of the soil. Terrazyme reduces the voids. By enzyme action density of soil will increase, because of that soil compaction and strength of soil increases.

### → California Bearing Ratio

The Californiabearingratio (CBR), defined as the ratio of force per unit area required to penetrate a soil mass. It is a penetration test for evaluation of the mechanical strength of natural ground, subgrades and base courses beneath new carriageway construction. It was developed by the California Department of Transportation before World War II.

After addition of terrazyme the values of CBR increases. This is because increase in compaction and reduction in voids between soil particle, helping to resist penetration.

### → Compaction

In geotechnical engineering, soilcompaction is the process in which a stress applied to a soil causes densification as air is displaced from the pores between the soil grains. For compaction standard proctor test performed in laboratories. This experiment performed to determine optimal moisture content at MDDfor the sample soil.

After addition of terrazyme it is seen that OMC reduces and MDD increases for sample soil.

### → Consistency limits

Consistency limits define as, “The moisture contents of a soil at the points where it passes from one stage to the next are called consistency limits or Atterberg limits.”

With the addition of terrazyme liquid limit and plastic limit both decreases descriptive the denseness of soil. By enzyme action soil changes its state at lower water content.

→ **Permeability**

Permeability is defined as, “the property of a porous soil which permits the passage or seepage of water (or other fluids) through its interconnecting voids.”

With the terrazyme the permeability of soil decreases, this is because of enzyme action which reduces the voids and not letting the water to flow easily through soil.

**VI. ADVANTAGES**

- The soils treated with Terrazyme renders improved density values by reducing the void ratios to a large extent which results in an overall improvement in the California Bearing Ratio
- It facilitates higher soil compaction densities, and increases soil strength and stability for lasting roads.
- Terrazyme replaces Soling and WBM of conventional road structure.
- Terrazyme also reduces the crust thickness of asphalt layers.
- Terrazyme also proves to increase the road quality and decreases the maintenance Cost
- Terrazyme treated roads can be used all weather roads
- Terrazyme is natural and organic material.
- Terrazyme is Eco-friendly material.

**VII. DISADVANTAGES**

- **Type of soil:** - Terrazyme reacts only with the clay particles it is necessary for the soil to have higher clay content to get required results.
- **Correct application:** -As a very small amount of the enzyme is needed for an application, it is important to pour the diluted terrazyme evenly throughout the soil to get the best results.
- **Availability of terrazyme:** - Terrazyme is not easily available in India and has to be ordered from the specified agency. As the transportation of terrazyme takes time, it can delay the project if not ordered in advance.

**VIII. FORTHCOMING PROSPECTIVE IN INDIA**

TERRAZYME is being widely used in India because of its successful implementations, it's a revolutionary technique and can be successfully used for soil stabilization. The cost effectiveness and accomplishment of higher strength is an add on. Many of the highway projects in states of India like Maharashtra, Karnataka and Kerala have accepted these techniques. The only drawback is that the requirement of terrazyme for different soils vary. Researches are being done to make obsolete these drawbacks.

- **The List of awarded works using Terrazyme in PMGSY and other state schemes: -**
  - a) Karnataka 180 km.
  - b) Andhra Pradesh -150 km.
  - c) Chhattisgarh 190 km.
  - d) Orissa 350 km.
  - e) Tamil Nadu 80 km.
  - f) Assam- 220 km.

**IX. CONCLUSION**

- Terrazyme is a natural, non-corrosive, non-toxic, and non-flammable and biodegradable liquid.
- Terrazyme reduces permeability of soil, because of that soil resist water flow through soil.
- Terrazyme increases Californiabearingratio, which is obvious increases strength and compaction of soil.
- It is eco-friendly and does not cause any harm to the user.

- Terrazyme decreases voids between soil, because of it has been observed that the compaction and density of soil increases.
- OMC and Consistency limits of the soil decreases due to enzyme action as it decreases voids between soil.
- It is necessary to know the type of soil and clay content of soil, because terrazyme reacts only with the clay particles.
- Terrazyme increases the strength of soil with increase in time.

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