

# Review on enhancing the Geotechnical Properties of Black Cotton Soil using Terrazyme

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**Abstract** - The cost, performance, durability, and time of every project are its most crucial components. Black cotton soil, due to its strong swelling and shrinkage qualities, also known as expansive clay soil and regur soil, presents considerable difficulties in building and agriculture. Building on black cotton soil has its challenges, including foundation and road settlement, among others. Due to the shortcomings of conventional soil stabilizing technologies, new ways for enhancing the engineering properties of soil are being investigated. There is a demand for the creation of novel techniques to enhance the geotechnical properties of soil due to the inefficiency and high costs associated with conventional methods. Study examines the use of terrazyme, a state-of-the-art enzymatic soil stabilizer, to improve the geotechnical properties of black cotton soil, optimum moisture content, maximum dry density, liquid limit, plastic limit, plasticity index, and CBR test, which are used for pavement base courses, sub-base courses, and sub-grades. In this review paper, we mix the terrazyme at the rate of 200ml/2m<sup>3</sup>, 200ml/1.5m<sup>3</sup>, and 200ml/1m<sup>3</sup> in black cotton soil to enhance the geotechnical properties of Black cotton soil.

**Key Words:** Black Cotton Soil, Terrazyme, CBR, liquid limit, plastic limit, plasticity index, optimum moisture content, maximum dry density.

## 1. INTRODUCTION

Black cotton soil, renowned for its unique composition and challenging geotechnical characteristics, has long posed a significant hurdle in construction and infrastructure development. The inherent expansiveness and high plasticity of this soil type often lead to substantial foundation problems, risking the stability and longevity of structures built upon it. In recent years, however, a groundbreaking solution has emerged in the form of terrazyme – A natural biotechnological catalyst that holds the promise to transform the geotechnical characteristics of black cotton soil.

This review paper delves into the transformative journey of harnessing terrazyme for the enhancement of geotechnical properties in black cotton soil. Terrazyme, derived from microbial sources, brings a novel and eco-

friendly approach to soil stabilization, presenting a sustainable alternative to traditional chemical stabilizers. As we navigate through the literature, we will investigate the fundamental mechanism of terrazyme action, its influence on soil structure and the consequent enhancement in critical geotechnical parameters.

## 1.1 Objective of the Study

- Assess the current state of research and development in the field of geotechnical engineering, specifically focusing on the utilization of Terrazyme for improving the properties of black cotton soil.
- Investigate the optimal dosages and treatment durations of the Terrazyme application, aiming to identify the most effective conditions for achieving desired improvements in geotechnical properties.
- Terrazyme dosages to suit the specific characteristics of various subtypes within the black cotton soil category, recognizing that distinct variations may demand customized treatments to achieve optimal geotechnical improvements.

## 2. LITERATURE REVIEW

**Priyanka Vaishnava et al. (2015)** conducted a study about the different dosages of terrazyme that were mixed with virgin soil (Dehradun) for various lengths of time. In this study, the result shows a noticeable improvement in the soil's index properties, including specific gravity, maximum dry density, optimal moisture content, and California bearing ratio (both soaked and unsoaked).[1]

**Mahesh C Swami et al. (2019)** conducted a laboratory test and mainly focused on the plastic limit of Black cotton soil with various dosages of terrazyme like 0.25 ml, 0.50 ml, 0.75 ml. and 1ml per 100 ml of water. These dosages give favorable results regarding the geotechnical properties of soils which is useful in pavement construction including base courses, sub- base courses, and sub-grades.[2]

**Abhishek Tiwari et al. (2019)** research involves a series of tests conducted on both virgin soil and terrazyme mixed soil with various kinds of dosages like 0.5/0.75/1.5 cubic meters of soil per 200 ml terrazyme. Remarkable enhancements in soil engineering characteristics, encompassing specific gravity, consistency limits, optimum moisture content, maximum dry density, unconfined compressive strength, swelling index, and California Bearing Ratio (CBR) in soaked conditions, manifest upon the incorporation of terrazyme into the soil sample. Also, it underlines that in order for terrazyme to have the intended benefits, the soil utilized must have at least 10% clay content.[3]

**Pala Gireesh Kumar et al. (2020)** tackle these difficulties and improve the durability of construction, the investigation examines a ground enhancement method utilizing the bio enzyme. This research added the terrazyme concentration in soil samples. In terrazyme dosage of 0.2-0.4 ml gives an effective and economically viable solution and also it stands out for its eco-friendly nature.[4]

**Sukhdeep Singh et al. (2020)** The study involves blending commercially obtained black cotton soil with Terrazyme at different proportions (ranging from 250ml/2m<sup>3</sup> to 250ml/0.5m<sup>3</sup>) and subjecting the samples to tests during curing periods of 0, 7, 14, 21, and 28 days to assess the improvement in strength. The experimental outcomes reveal a substantial enhancement in the strength of black cotton soil through Terrazyme stabilization. Specifically, the unrestrained compression strength values witnessed an increase from 40.25 to 73.33 across various Terrazyme ratios after a 28-day curing period. Additionally, the unsoaked CBR values exhibited a rise from 5.45 to 8.35, indicating a 53.21% improvement at the end of the 28-day period.[5]

**V. Vasiya et al. (2021)** In this study, the use of biodegradable Terrazyme in reinforcing black cotton soil, renowned for its high plasticity, was investigated through experimental research. Derived from vegetation through fermentation and extraction, Terrazyme demonstrated environmentally friendly traits, with its soluble nature in water. Varying proportions of terrazyme were incorporated into the soil in the study, revealing improvements in index properties and strength parameters. The optimal dosage was determined as 2% by weight of dry soil, resulting in reduced Atterberg's limits, free swell index, and enhanced cohesion and shearing resistance in triaxial tests.[6]

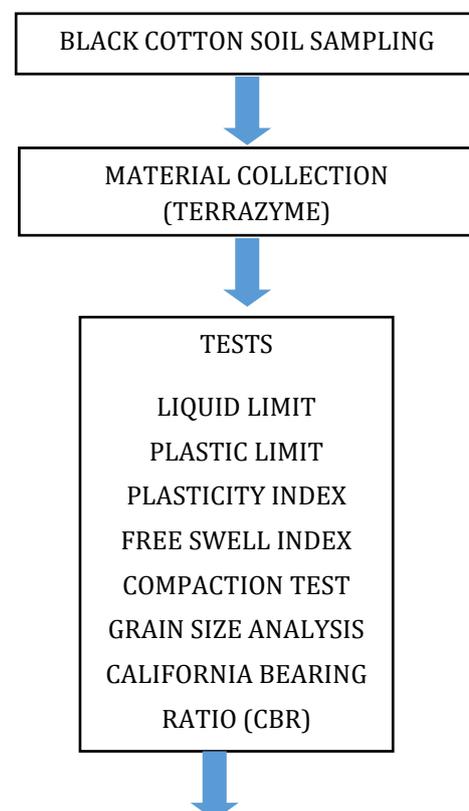
**Sanna Majoor et al. (2022)** studied that the incorporation of biodegradable materials in geotechnical engineering has proven effective in strengthening unstable soil. These materials, derived from plant fermentation and extraction, contribute to a reduction in void ratio,

decreased water absorption, and enhanced compaction. Terrazyme, characterized by its natural proteins, stands out for its environmentally friendly attributes and water solubility, devoid of toxicity. Black cotton soil, susceptible to high plasticity and swelling, is prone to issues such as foundation settlement due to moisture fluctuations. This research investigates the reinforcement of black cotton soil with Terrazyme, assessing various proportions. Experimental findings demonstrate enhancements in both index properties and strength parameters, identifying an optimal Terrazyme dosage at 2% of the dry soil weight.[7]

**K. Ashok et al. (2022)** studied that the optimal terrazyme dosage, determined experimentally, ensures biodegradability without harm to the environment. Bio-enzymes, by reducing void spaces, minimizing water absorption and enhancing compaction play a vital role. Terrazyme, a non-toxic, non-flammable liquid enzyme from vegetable extracts, expedites cationic exchange. Stabilized black cotton soil, evaluated at different curing periods and enzyme quantities, demonstrated increased strength, indicating enhanced bearing capacity and deformation resistance. [8]

### 3. METHODOLOGY

Methodology mainly consists of material collection. There are various procedures that are to be involved in this project work to make this project a successful outcome:



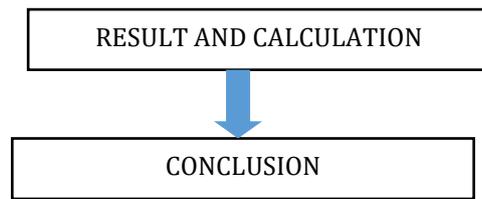


Figure 1 Flow Chart

### 3.1 Sample of Black Cotton Soil

The black cotton soil sample collected from Chilla Ghat near Banda exhibits distinctive properties characteristic of this soil type known for its high clay content, the sample showcases a rich, dark color indicative of organic matter accumulation. The soil's unique ability to swell when wet and shrink when dry, commonly referred to as shrink-swell behavior, is likely to be observed in this specimen.

Table 1 Geotechnical properties of Black Cotton Soil

TESTS	RESULT
<b>Atterberg's Limit</b>	
Liquid Limit	55%
Plastic Limit	25.74%
Plasticity Index	29.26%
<b>Standard Proctor Test</b>	
Maximum Dry Density	1.43g/cc
Optimum Moisture Content	20%
Bulk Density	1.62g/cc
<b>California Bearing Ratio</b>	
Soaked	21.80 kg/cm <sup>3</sup>

### 3.2 Terrazyme

Terrazyme is a bio enzymatic soil stabilizer. Terrazyme is a liquid extract from sugar molasses that improves the engineering. Terrazyme is an alternate tool for building roads.

Terrazyme, manufactured by Nature Plus Inc. U.S. (Under ISO – 9002 procedures). For this project, we have ordered the Terrazyme from Avijeet Agencies (P) Ltd, Head Office, Chennai. These are properties which are available in their site.

Table 2 Properties of Terrazyme

Boiling Point	212
Specific Gravity	1.000 to 1.090
Melting Point	Liquid
Vapor Density	1
pH Level	4.30 to 4.60
Appearance	Browns clear liquid

### 4. Expected Outcomes

Terrazyme is economical to use as a soil stabilizer. Since we know that black cotton soil is an expansive soil using terrazyme in it gives the favorable result in all geotechnical properties. It may give good results in MDD & OMC and also increase the CBR value of black cotton soil.

### 5. Future Scope

- Terrazyme soil stabilizer has a promising future in the field of soil stabilization and erosion control.
- With its enzymatic composition, Terrazyme offers a natural and environmentally friendly solution for stabilizing soil and preventing erosion.
- It has the potential to be widely used in various industries, including construction, landscaping, and agriculture.
- As sustainability and eco-consciousness continue to gain importance, Terrazyme's ability to improve soil stability while minimizing environmental impact positions.
- Terrazyme is economical and its effects on the soil with varying dosages and varying stabilizing duration.

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