



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJIRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 11, Issue 9, September 2022

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.118



9940 572 462



6381 907 438



ijirset@gmail.com



www.ijirset.com

Subgrade Stabilisation Using Ecofriendly Material at Munroe Island

Aiswarya S¹, Ayana L¹, Cyriac Thomas¹, Sibey John Varghese¹, Ms. Swathy S Pillai²

U G Students, Department of Civil Engineering, St Thomas College of Engineering and Technology, Kozhuvalloor,
Chengannur, Kerala, India

Assistant Professor; Department of Civil Engineering, St. Thomas College of Engineering and Technology,
Kozhuvalloor, Chengannur, Kerala, India

ABSTRACT: Economy of the nation is dependent on road infrastructure for which the roads should be intended to meet the steadily changing burdens and environment. Attributable to bang in vehicle development, vehicle load on our road is broadening quickly which requests for good nature of subgrade from economical design perspective. It turns out to be expensive to utilize soil having subgrade requires the interest for enhancing the quality of subgrade utilizing stabilizers to increase the CBR values, so that less thickness of asphalt can be designed with no bargain with property of asphalt development. In this project, an exertion has been made to enhance the CBR of asphalt by using inventive materials like terrazyme for subgrade soil adjustment and also OMC by heavy compaction has been carried out. Classification of soil can be derived by finding out the Atterberg's limits under Indian Standard Code.

KEYWORDS: Terrazyme, CBR values, UCC, Virgin soil, Consistency limit, Compaction

I. INTRODUCTION

In developing countries like India the biggest drawback to provide a complete network of road system is the limited finances available to construct road by the conventional methods. There is a need for suitable methods for low cost road construction, followed by stage development of roads for thriving traffic needs. The construction cost can be considerably diminished by using local materials including local soils for the lower layers of pavement like sub-base course. As the main problem in developing countries like India, is to have maximal road length at minimal cost. This issues can be solved by adopting construction of low cost roads and by stage construction of roads. Therefore best application of locally available and the cheapest materials have to be made in road construction.

All pavements acquire their ultimate support from the underlying sub-grade; therefore, the knowledge of basic soil mechanics is essential. Therefore, highway engineers are facing the problems of providing very convenient materials for the highway construction. The term soil stabilization means the enhancement of the stability or bearing power of the soil by the use of controlled compaction, proportioning and/or the addition of suitable admixtures or stabilizers.

Soil stabilization may result in any one/more of the following changes;

- a) Increase in stability, change in the properties like density or swelling, change in physical characteristics
- b) Change in chemical properties.
- c) Retaining and desired minimum strength by water proofing.

The stability of the underlying soils is the key factor governing the long term achievement of pavement structure. So the pavement layers should be able to abide excessive permanent deformation, resist shear and avoid excessive deflection resulting in weakness of cracking in overlying layers of the pavement.

II. MATERIALS USED

Terrazyme-Soil stabilizer

Terrazyme is a natural organic liquid with a brown colour and is formulated using fruit and vegetable extract. The effect of terrazyme is due to the enzymatic reaction takes place between clay and organic cat-ion and forming a protective coating around clay particles and making clay particle water repellent. Due to the cationic interexchange, it reduces the thickening of



absorbed layer and it reduces the voids in the soil and thereby achieving maximum compaction. It improves the load bearing capacity of soil as well as reduces the pavement thickness and maintenance cost. The terrazyme is obtained from Vijay Bio Tech Kochi.

Properties of Terrazyme –supplied by manufacturer

PROPERTY	VALUE
Specific Gravity	1.05
pH value	3.50
Appearance	Dark Brown
Total dissolved salts	19.7ppm
Hazardous content	None
Boiling Point	212°F
Evaporation Rate	Same as water
Solubility of water	Complete
Reactivity data	Stable

CLAY SOIL (MUNROE CLAY)

Munroe clay, found in Kollam district of Kerala, India, is a soft soil with associated problems of low shear strength and compressibility. Several studies shows that the soil has a unique combination of minerals such as kaolinite, iron oxides, and aluminium oxides. In the present study, Munroe clay was collected from South region of Munroe Island, Kollam from a depth of 1m in polythene bags to preserve the natural moisture content.

III. RESULTS AND DISCUSSIONS

PHYSICAL PROPERTIES OF CLAY SOIL

To determine the physical properties of soil preliminary test was conducted. Natural water content of soil was found out using oven drying method for 24 hours. Specific gravity was found out using Pycnometer and Atterberg's limit was found out using Cassagrande apparatus. Using Standard proctor test OMC and maximum dry density was found from it. Direct shear test was conducted to find the shear strength parameters of the soil. California bearing ratio test was done to find the CBR value of subgrade soil. The result of preliminary test was tabulated in table and shown below.

ENZYME DOSAGE FIXATION

TEST CONDUCTED	RESULTS
1. SPECIFIC GRAVITY	2.12
2. CONSISTENCY LIMIT (%)	58
i. LIQUID LIMIT	42.1
ii. PLASTIC LIMIT	
3. COMPACTION USING PROCTOR	22 %
i. O.M.C	1.32 g/cc
ii. MAX DRY DENSITY $\gamma_{d \max}$	

4. CBR VALUE (%) For 2.5 mm For 5mm	5.84 6.6
5. UCC UNCONFINED COMPRESSIVE STRENGTH	3.8 kg/cm ²

The experiment is done to find out the optimum dosage. 200g UCC sample is prepared for various dosages of enzyme and UCC test is conducted. The results were shown in table below and from the graph drawn optimum dosage is fixed.

Table 4.2 Enzyme dosage

Sl.No	Dosage per 200g of soil (ml)	UCC (kN/m ²)
1	0.05	28.1
2	0.1	30.26
3	0.15	29.5
4	0.2	19.4
5	0.25	16.8
6	0.3	12.1

Optimum dosage = 0.1 ml

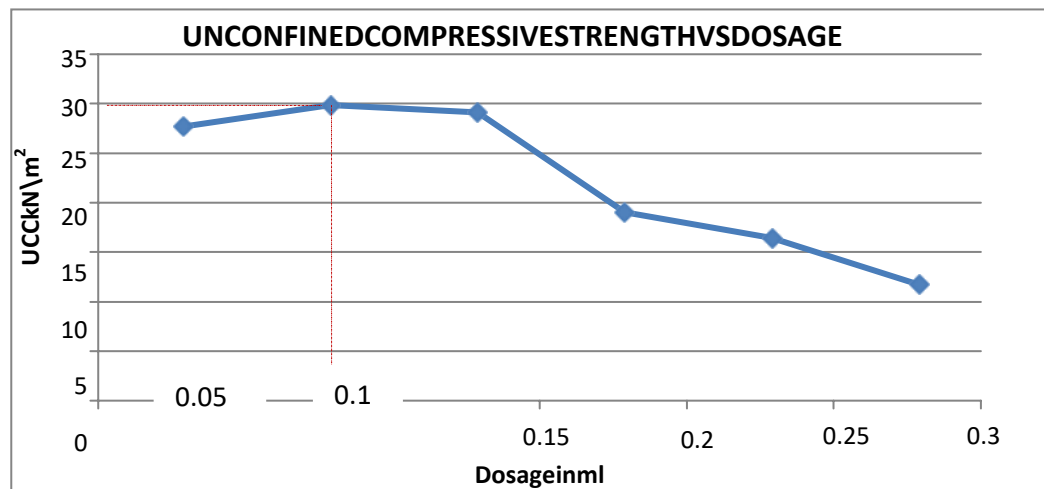


Fig 4.2 Enzyme dosage graph

SOIL STABILISATION USING TERRAZYME

The soil was stabilized using optimum percentage of Terrazyme. The tests were conducted after 0, 7, 14 and 28 days of curing. The main tests conducted on the sample to determine the improvement of properties were:

- Unconfined compressive strength (IS:2720, Part-X)
- Modified proctor test (IS:2720, Part-VIII)
- California Bearing Ratio (CBR) test (IS:2720 Part-XVI)

Unconfined Compressive Test

The soil sample is sieved through 425 μ was taken. It was mixed with optimum percentage of Terrazyme and the unconfined compression test was conducted. The results obtained on the 0th, 7th, 14th, 28th day were taken and the stress-strain graph was then plotted from the unconfined compressive strength and the cohesion was determined for 0th, 7th, 14th, 28th day. Unconfined compressive strength was also conducted for the virgin soil for the same curing period and the increase in results were compared.

UCCTest on Virgin Soil

The unconfined compression test was conducted for the virgin soil and results obtained are as tabulated below for different curing periods. The UCC graph for various curing periods is shown below.

Table unconfined compressive strength values for virgin soil

Sl.No	Curing period in days	Compressive Strength (q) in kN/m ²
1.	0	19.3
2.	7	22.0
3.	14	28.01
4.	28	29.05

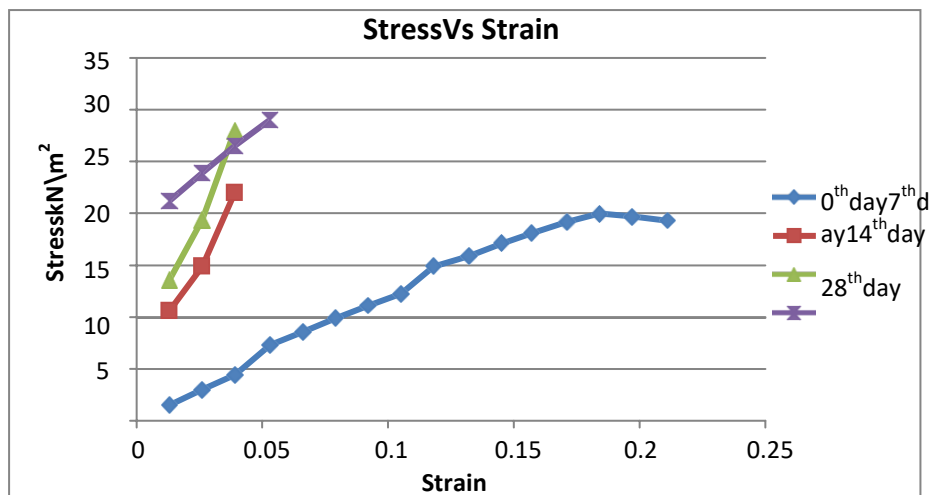
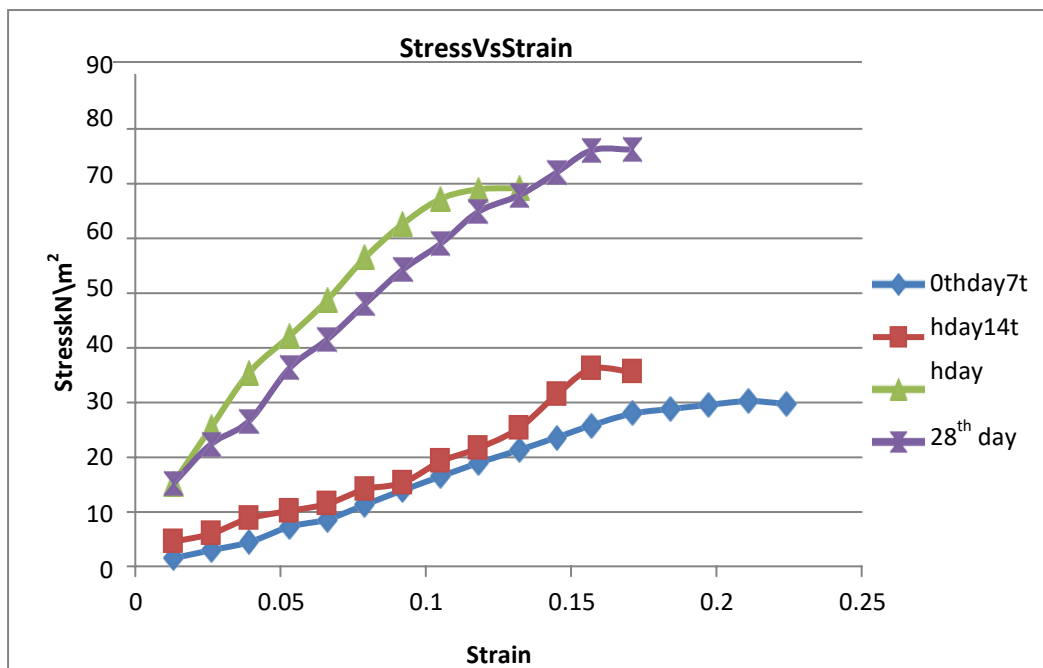


Fig UCC graph for virgin soil for different curing periods

UCCTest on Enzymatic Soil

The unconfined compression test was conducted for soil sample with terrazyme and the results obtained are as tabulated below for different curing periods. The UCC graph for various curing periods is shown below.

Sl.No	Curingperiodindays	CompressiveStrength (q)in kN/m ²
1.	0	30.1
2.	7	34.21
3.	14	68.9
4.	28	78.2



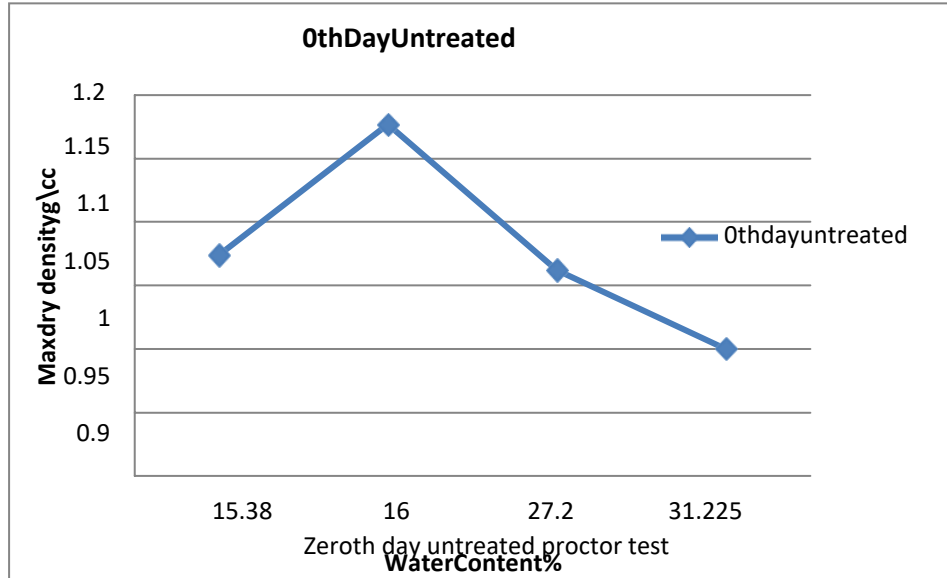
UCC graph for different curing period

Standard Proctor Test

Compaction of soils is a mechanical process by which the soil particles are packed closely together by reducing the air voids and increase in dry density. The moisture content at which the soil attains the maximum dry density is known as optimum moisture content.

Virgin Soil Test

The standard proctor test was conducted in order to determine the initial properties of the clay soil sample. The results are obtained and graph was plotted as shown below



A graph was plotted between dry density and water content and the optimum moisture content is obtained as the value corresponding to maximum dry density from the graph.

Enzyme Treated Soil

The soil sample was treated with the enzyme at optimum enzyme dosage at OMC and were tested for different curing days such as 0th day, 7th day, 14th day and also on 28th day in order to compare the results with the untreated soil sample to know the effect on enzyme on stabilization.

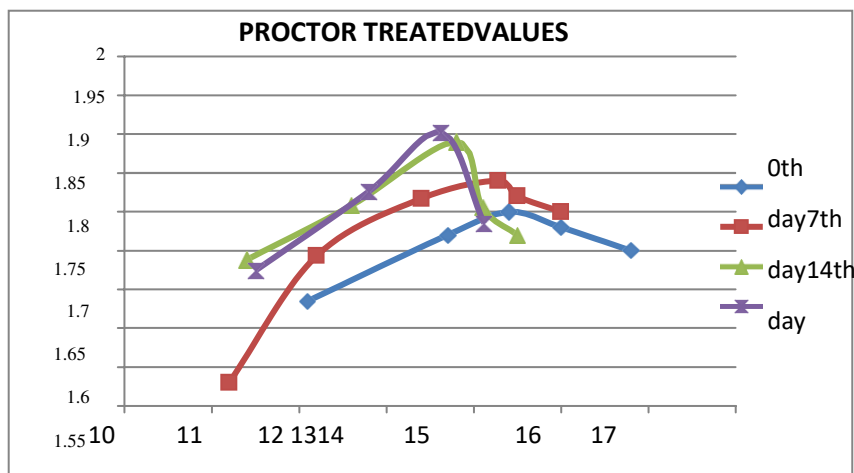


Table Standard proctor test values for enzymatic soil

Sample	Curing period(days)	OMC (%)	MDD(g/cc)
Untreated	0	15.67	1.2
Treated	0	13.74	1.76
	7	13.19	1.79
	14	13.48	1.85
	28	13.58	2.01

California Bearing Ratio Test

CBR value is defined by IS :2720 (part XVI) – 1979 is the ratio of the force per unit area required to penetrate a soil mass with a circular plunger of 50mm diameter at the rate of 1.25mm/min, to that required for corresponding penetration of a standard material.

The soil sample sieved through 20 mm sieve was taken. The soil was mixed with optimum amount of Terrazyme, 0.1 ml and the CBR test was conducted and the California bearing ratio was determined. After conducting 0th day CBR for treated soil sample at OMC obtained from proctor test results, graph was plotted. X-axis for penetration and y-axis for corrected load. Similarly for 7, 14, 28 days curing graph was plotted and results were interpreted. It was found that as days of curing increased the CBR value was also increased.

Virgin Soil Test

CBR test was conducted as per the procedure described earlier for unsoaked condition in order to determine the geotechnical properties of the clay soil sample. Tabulated readings are shown in Table.

Zero day CBR test value for virgin soil

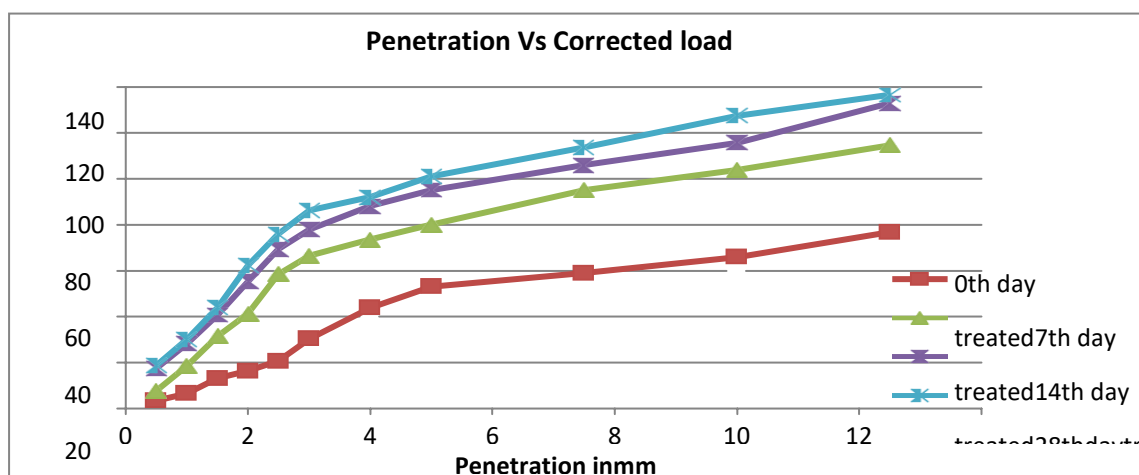
CBR at 2.5 mm penetration	1.6%
CBR at 5 mm penetration	2.141%

Enzyme Treated Soil

The soil sample treated with the enzyme at the optimum enzyme dosage at OMC condition was tested for different curing periods i.e., 0th day, 7th day, 14th day and 28th day. Penetration versus corrected load graph is shown in Fig.

CBR test values for enzymatic soil

Curing period (days)	0	7	14	28
CBR at 2.5mm penetration	1.41	3.91	4.76	5.22
CBR at 5mm penetration	2.38	3.622	4.24	4.55



IV. CONCLUSION

Clay soil is the typical soil of tropics which are the end product of decomposition when heavy rainfall washes away calcium and silica leaving behind iron with silica. In the majority of cases, this soil doesn't satisfy conventional particulars for road construction materials especially road bases. It undergoes property changes during construction, calibration being considered to be the most sensitive. The poor performance of the soil has forced engineers to attempt to enhance the engineering properties of the soil. Terrazyme, a bio-enzyme has led to construction of an economical and stronger roads meeting the needs of the growing population.

By adding Terrazyme, the maximum dry density has increased to 1.2 g/cc to 2.01 g/cc and reduction in the optimum moisture content from 15.67 % to 13.58 % after the curing periods of 28 days. The decrease is due to active cation exchange process which generally takes longer period in the absence of such stabilizers. Also an increase in the CBR value which was observed from 2.141 % to 4.55 % for unsoaked CBR after curing for 28 days. This increase is due to the soil which treated with enzyme, provides improved density values by reducing the void ratios. Increase in the unconfined compressive strength was also observed which 19.3 k/m² was initially on 0th day to 76.31 K/m² after curing with enzyme for 28 days which is due to the reaction of enzyme with clay which results in cementation effect. Bio-Enzyme stabilization results in the improvement of physical strength and characteristics of clay soil. The CBR value has shown increase in the strength when treated with the bio-enzyme. There are significant improvement in the strength and characteristics of soil when clay treated with enzyme.

REFERENCES

- [1] Vijay Rajoria, Sunnet Kaur (2017), A review on stabilization of soil using bio- enzyme, *International journal of research in engineering and technology*, Vol3.
- [2] Joydeepsen, Jitendra Prasad Singh (2016), Stabilization of black cotton soil using bio-enzyme for a highway material, *IJIRSET: International journal of innovative research in science*, Vol4, issue 12.



- [3] **Ansu Thomas, R.K. Tripathi** (2016), Effect of enzymes on the unconfined compressive strength of soil, *International journal of applied research*, Vol 10.
- [4] **Venikasaini, Priyanka Vaishnava** (2018), Soil stabilization using terrazyme, *International journal of advances in engineering and technology*, ISSN 22311963.
- [5] **Purnima bajpal** (2018), Non-conventional Soil stabilization techniques The way forward to an aggregate free pavement and a cost effective method of road construction, *International journal of scientific and engineering research*, Vol 5.
- [6] **Saurabh.B. Gautham, C.B. Mishra** (2016), Sub-grade soil stabilization using terrazyme, *IJARIE*, Vol 2, Issue 3.
- [7] **Lekha.B.M, Goutham.S, Chaitali.N, and Ravi Shankar.A.U** (2019), Laboratory investigation on black cotton soil stabilized with nontraditional stabilizer, *e-ISSN: IJIRSET*, 2278- 1684, *p-ISSN: 2320-334X*, PP 07-13.
- [8] **Nandini.D.N, Vinoda.A and PrathapKumar.M.T** (2016), Compaction and strength characteristics of terra-zyme stabilized red soil, *IJRPETM*, Volume 1, Issue-1.
- [9] **Sureka Naagesh and Gangadhara.S** (2019), Swelling properties of bio-enzyme treated expansive soil, *International Journal of Engineering Studies*, ISSN 0975- 6469 Volume 2, and Number 2, pp. 155–159.
- [10] **Ramesh.H.N and Sagar.S.** (2020), Effect of drying on the strength properties of terrazyme treated expansive and non expansive soils, *50th Indian geotechnical conference, Pune, Maharashtra, India*.
- [11] **Tajamul Farooq and Sukhdeep Singh** (2020), Stabilization of black cotton soil by using bio-enzymes for pavement construction, ISSN 2455-2631 Volume 5, and Number 2, pp. 681–693.



INNO SPACE
SJIF Scientific Journal Impact Factor
Impact Factor: 8.118



ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 **9940 572 462**  **6381 907 438**  **ijirset@gmail.com**



www.ijirset.com

Scan to save the contact details