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Experimental Investigation of Soil Stabilization with Bio-Enzymes

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Abstract: ***Nowadays various materials and techniques are being used for soil stabilization. The choice of particular material and method depends on properties of soil and type of construction also on cost and environmental considerations. There is needed to look toward different industrial waste materials which are being produced in huge quantities. Soil stabilization using waste ceramic dust is one of such method, which can be used to improve the geotechnical properties of soil.***
Keywords: ***Soil stabilization, waste materials, durability, CBR value, Atterberg limit***

I. INTRODUCTION

The process of improving the strength and durability of soil is known as soil stabilization. The main aim of stabilization is cost reduction and to efficiently use the locally available material. Most common application of stabilization of soil is seen in construction of roads and airfields pavement. Life of a structure increases as CBR value is increased and consistency limits are decreased. Chemical stabilization is done 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 provide higher soil compaction and strength.

TerraZyme is nontoxic, non corrosive and inflammable liquid which can be easily mixed with water at the optimum moisture content. TerraZyme improves the properties of soil and strength of soil significantly. The chemical bonding of the soil particles is increased by the use of TerraZyme and a permanent structure is formed which is resistant to wear and tear, weathering and infiltration of water in soil.

Apart from improving strength of soil this bio enzyme replaces the need of granular base and sub base. TerraZyme dosage entirely depends on the type of soil, clay content and plasticity index of soil.

Black cotton (BC) soils are extremely clayey soils, grayish to blackish in color, meet a good space of 30,000 sq. metric linear units across many states of India i.e. in MP, Maharashtra, Karnataka, Andhra Pradesh, and Tamil Nadu and UP.

The BC soils contain clay mineral montmorillonite clay mineral that has high expansive characteristics.

II. LITERATURE REVIEW

Lacuoture and Gonzalez (1995) conducted study on the effects of TerraZyme on sub-base and sub-grade. The reaction of the soil treated with Bio Enzyme was observed and compared with soil without Bio Enzyme. It was concluded that soil showed improvement in short duration of time but the cohesive soils showed improvement successively.

Bergmann (2000) concluded from his study on bio enzyme that for imparting strength to the soil, bio enzyme requires some clay content. He stated that for successful stabilization of soil minimum 2% clay content is required and 10 to 15 % of clay content gives good results. Compared to 28 % of untreated soil CBR after 1, 2, 3, 14 week was found as 37, 62, 66 and 100 respectively.

Manoj Shukla et al. (2003) carried out test on five different type of soil. The clay content in soil varies from low to high. Tests were conducted on soil samples with and without Bio Enzymes to determine different engineering properties, Atterberg's limit, CBR and UCS at different curing period in laboratory. It was observed that pavement thickness is reduced by 24 to 48 %. In places where the availability of granular material is less, Bio Enzyme treated soil with thin bituminous coating can satisfactorily fulfill the pavement requirement.

Venkatasubramanian & Dhinakaran (2011) performed test on 3 different soils with different properties. These soils were tested with different dosage of enzyme. The liquid limit and plasticity index of soil were reported as 28, 30, 46 % and 6, 5 and 6 % respectively. An increase of 157 to 673 % is seen in CBR after 4 weeks of curing and 152 to 200 % in UCS.

Suneet Kaur (2014) carried out a theoretical evaluation of enzyme. Reduction of about 18 to 26 % is seen in cost of construction of roads by using TerraZyme as a soil stabilizer, constructed by public work department in Maharashtra. Structures made of bio enzyme are economical and have greater strength.

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III.RESULTS

A. *Atterberg Limit*

TABLE I Atterberg limit

Dosage no.	Soil enzyme dosage	Liquid Limit	Plastic Limit	plasticity index
0 ml	untreated	41.6	19.06	22.54
1 ml	1 ml/kg	41.5	20.22	21.28
2 ml	2 ml/kg	41.2	21.31	19.89
3 ml	3 ml/kg	41.3	22.19	19.11
4 ml	4 ml/kg	41.4	23.54	17.86

B. *Optimum Moisture Content and Maximum Dry Density*

TABLE II OMC and MDD

Dosage no.	Soil enzyme dosage	OMC	MDD
0 ml	untreated	18.4	1.77
1 ml	1 ml/kg	18.1	1.69
2 ml	2 ml/kg	18.7	1.71
3 ml	3 ml/kg	20.7	1.68
4 ml	4 ml/kg	23.6	1.65

C. *California Bearing Ratio Results*

TABLE III CBR TEST RESULTS

Days of curing	Soil enzyme dosage	CBR value
0 days	untreated	2.28
7 days	1 ml/kg	4.49
14 days	1 ml/kg	5.78
21 days	1 ml/kg	6.48
28 days	1 ml/kg	7.53

TABLE IV

Days of curing	Soil enzyme dosage	CBR value
0 days	untreated	2.28
7 days	2 ml/kg	5.36
14 days	2 ml/kg	6.83
21 days	2 ml/kg	7.18
28 days	2 ml/kg	7.97

TABLE V

Days of curing	Soil enzyme dosage	CBR value
0 days	untreated	2.28
7 days	3 ml/kg	6.24
14 days	3 ml/kg	7.71
21 days	3 ml/kg	8.06
28 days	3 ml/kg	8.93

TABLE VI

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Days of curing	Soil enzyme dosage	CBR value
0 days	untreated	2.28
7 days	4 ml/kg	7.23
14 days	4 ml/kg	8.58
21 days	4 ml/kg	9.07
28 days	4 ml/kg	9.81

IV. CONCLUSION

A. Based on the Results of This Study the Subsequent Conclusions Could Also be Drawn

1) The strength has been compared on the basis of CBR for virgin and Terrazyme strengthened soil below 4 days soaked and different days curing conditions.

2) It was found that OMC is increased & MDD is decreased, with the increase of Terrazyme proportion up to 4% and further more addition of Terrazyme shows there is decrease in OMC & increase in MDD.

3) Terrazyme have a good potential to reduce the cost of pavement layers if weak sub-grade are encountered on the alignment.

4) On low volume paved roads, designers should consider the installation of Terrazyme to improve the California Bearing Ratio,

5) Reduce layer thickness and increase structural number of pavement.

V. FUTURE SCOPE

A. There is a lot of scope for research work in the future with Terrazyme. It is economical, eco-friendly, durable and significantly improves the Geotechnical properties of soil. it can be used with approximately all type of soils.

B. The characteristics of impermeability and non-leaching of this technology should be taken benefit of by using in roads in high rainfall areas and also riverbanks which have to be protected from sewage and other pollutants leaching on to the rivers.

C. The suitability of using waste material like demolition waste, all types of slag, marble, granite, stone dust, fly ash, etc. to be stabilized with this Terrazyme technology along with soil and used in road construction.

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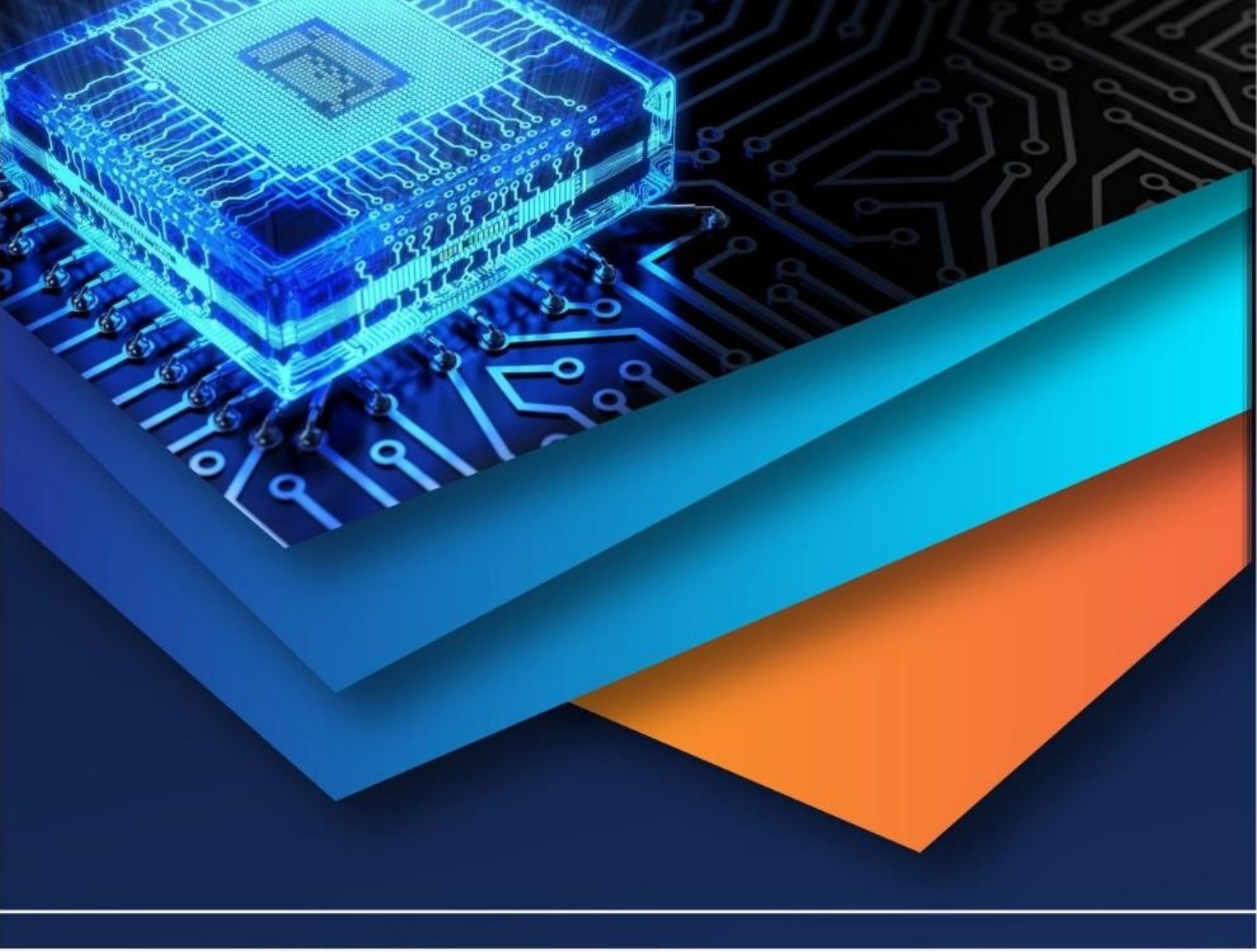
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