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Compaction and Strength Characteristics of Terra-Zyme and Hypo sludge stabilized Locally available Soil

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Abstract - Now-a-days due to the urbanization it is obligatory to carry out the developmental project in most economical and environmental friendly way. Stabilization is a technique to improve the strength characteristics. Due to the costly additives stabilization technique is getting more demand. To balance this many waste materials are being used to avoid disposal problems and hazards environmental materials. Red soil was originated from the weathering of earliest metamorphic rock of the Deccan plateau. Thin organic layers overlying a yellowish brown leached deposit resting on an alluvial. The coloration is mainly due to ferric oxides occurring as thin coatings on the soil particles while the iron oxide occurs as heamatite or as hydrous ferric oxide. Red soils denote the third largest soil group of India covering an area of about Lakhs sq. Km. The project aims in utilization of non-traditional bio-enzyme of vegetable extract known as Terra-zyme is used and along with pulp waste after being processed from paper mills (which is hazardous landfill material) in the stabilization of red soil in terms of strength. In our present study investigations are carried out to know the success of addition of bio enzyme on Red soil along with varying percentages of Hyposludge to improve the geotechnical properties of soil. The results of consistency limits, Compaction test, Unconfined Compressive strength test, California Bearing Ratio test by varying its quantity of both the additives are presented in this paper. The results show the appreciable increase in strength at some curing periods.

Key Words : Terra-zyme,Compressive strength test, California Bearing Ratio, Consistency limits, stabilization

1.INTRODUCTION

The biggest meet head-on in growing countries resembling India is to provide a wide-ranging network of road system, overall in providing connectivity to remote villages. The expenditure of construction materials and methods has been rapidly growing year after year. Therefore, by effectively utilizing locally offered soil stabilization practice existed a means to decide by adopting the suitable low-cost road construction methods. Chief goal of these type of construction are: to effect cost-cutting measure in the opening assembly cost of lower layers of pavement structure that is subgrade and subcase and the flexibility to upgrade the pavement structure to higher specification at the later stage by resorting to the stage-construction of the pathway to satisfy the road traffic demand. The phrase soil stabilization includes the effective compaction, batching or the adding of appropriate admixture or stabilizers for the gain of strength of unprocessed soil. Soil stabilization refers to the Physical,Chemical and Physico-chemical methods to make sure that the stabilized soil serves its intended principle as pavement component material.

1.1 Methods of Soil stabilization

- Mechanical Stabilisation
- Physical Stabilisation
- Chemical Stabilisation
- Physio Chemical Stabilisation

Stabilization can be performed with different materials such as cement, bitumen, lime, geotextile, grouting, sodium chloride, calcium chloride, flyash, blast furnace slag, glass powder and others. Due to the declination in the magnitude of locally available resources it provided the way to discover the alternative way to experience with innovative materials in order to achieve better strength parameter.

1.2 Objectives of the study

- To evaluate engineering properties of bio enzyme and hyposludge stabilized soil.
- To study the outcome of hyposludge in soil stabilization, in the way to decrease the waste disposal problem, environmental pollution.
- To arrive at an optimum bio enzyme and hyposludge content.

1.3 Scope of the study

- The result of Terrazyme and Hyposludge dosage on the compaction characteristics of locally available soil.
- The effect of Terrazyme and Hyposludge dosage on maximum dry density and the optimum water content.
- The effect due to the Terrazyme and Hyposludge dosage levels, curing duration on UCS of locally available soil.

1.4 TERRAZYME

Terrazyme is a non-artificial, liquid enzyme formulated non-toxic that changes the substantial and compound features of soil. The geotechniqual qualities in soil progress in elevated compaction densities and by packed bonding of particles increases in soil firmness because of enzymatic activity. The breakdown of organic supplies and the wetting and bonding capability of soil element upon adding this enzyme increases

because of catalization. By adding the additive, soil material will become more wet and dense and also enhances the chemical bonding which helps to combine the particles all together which is further resistant to weathering and require less compaction effort. Advantages are: Cost effective, Eco Friendly, Ease of handling, Durability.

1.5 HYPOSLUDGE

Hypo sludge is also generally referred as paper waste. It contains low percentage of calcium and least extent of silica content and because of magnesium content, it reacts like cement. Paper production generally leads in deposition of unyielding waste. For the building up of high quality of paper, paper filaments can be remanufactured till it attains weak and short sections. Low featured/quality fibres as referred as waste sludge and which contributes the landfill. The combination of lime(used in recycling of paper) and paper waste is named as Hyposludge. Disposal of immense amount of waste caused problems like polluting of soil, lakes, rivers etc, air pollution due to burning. Advantages: Eco – friendly, Cost of construction, Strength, Easy replacement.

2.MATERIALS AND METHODOLOGY

Redsoil is a type of *soil* that distributes in a warm, having slender organic, temperate, humid climate under diverse forest, and organic-mineral layers overlying a yellowish-brown leached deposit upon alluvial *red* layer. In our present work, we have collected locally available soil(4.75mm passing)sample from near **REVA UNIVERSITY, Bengaluru** and acquired from 2m depth having appearance of Red colour sieved throughout 4.75mm and 425µ IS sieve which is oven dried.

Table -1: Physical properties of soil

Physical Properties		
Sl.no	**Property**	**Result**
1	Specific gravity	2.44
2	Atterberg limits	
	Liquid limit %	23.5
	Plastic limit %	17
3	% fraction	
	Gravel	30.2
	Sand	68.1
	Silt/clay	1.7
Geotechnical Properties		
4	Light compaction	
	Max.dry density(g/cc)	1.9
	Optimum moisture content in %	11.8
5	UCS(kg/cm^2)	1.33
6	CBR	
	Unsoaked	4.81
	Soaked	3.95

Table -2: Physical characteristics of Terrazyme

Boiling Point:	212^0 F
Specific Gravity:	1.05
Melting Point:	Liquid
Evaporation Rate	Same as water
Solubility in Water:	Complete
Appearance/Odour:	Brown Liquid, Non-obnoxious

Table-3: Chemical properties of Hyposludge

Constituent	% by wt.	Test method
$SI0_2$	5.88	IS 1760-1991
Al_2O_3	0.53	
Fe_2O_3	0.67	
CaO	47.51	
MgO	2.99	
$^{**}SO_4$	<0.05	
Loss of ignition	42.05	

Calculations for Enzyme Dosages

In the present work, computation for application of terrazyme has been done for the stage of OMC.

At OMC

Bulk density of Red soil = 2.13 g/cc

Bulk density = Weight/Volume

Weight = Bulk density*Volume

- **For Dosage 1 (D1)**

200 ml for 2.0 m^3 of soil = 2.13*2*1000 = 4260 gm of soil, therefore, for 3kg of soil = 0.14 ml of Enzyme

- **For Dosage 2 (D2)**

200 ml for 2.5 m^3 of soil = 2.13*2.5*1000 = 5325 gm of soil, therefore, for 3kg of soil = 0.1126 ml of Enzyme

- **For Dosage 3 (D3)**

200 ml for 3.0 m^3 of soil = 2.13*3*1000 = 6390 gm of soil, therefore, for 3kg of soil = 0.093 ml of Enzyme

3. LABORATORY RESULTS

Standard Compaction Test results

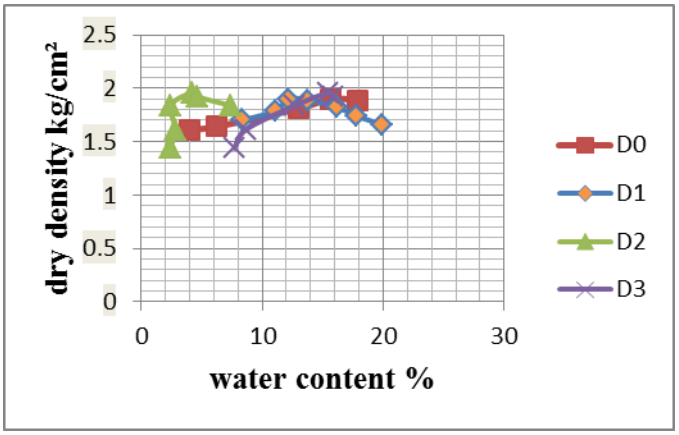


Table 4:Standard Compaction test results for Terra-zyme addition as an additive

	Dosages (ml)	Dry density (kN/m³)	Water content(%)
D1	0.14	19.24	12.71
D2	0.1126	22.13	4.167
D3	0.093	18.64	12.14

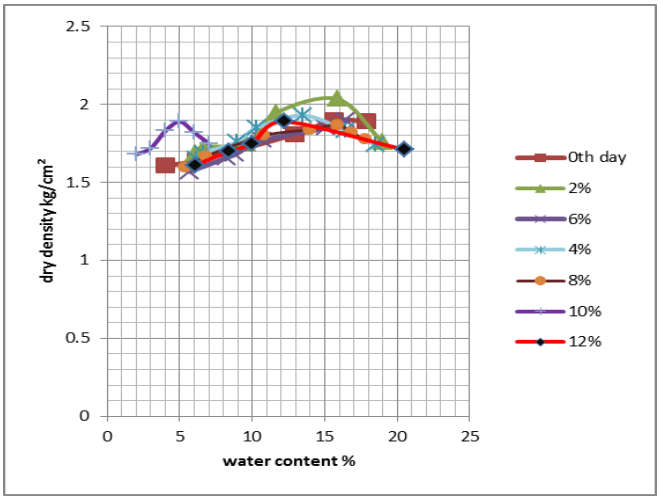
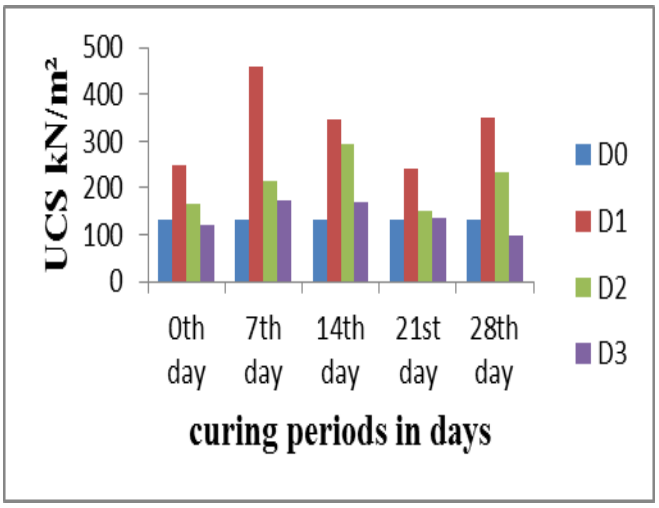


Table 5:Standard Compaction test results for Hyposludge addition as an additive

Additive percent	Dry density	Water content
2%	2.035	15.87%
4%	1.93	13.5%
6%	1.9	16.45%
8%	1.87	15.9%
10%	1.89	14.8%
12%	1.89	14.9%

Unconfined Compressive Strength test results



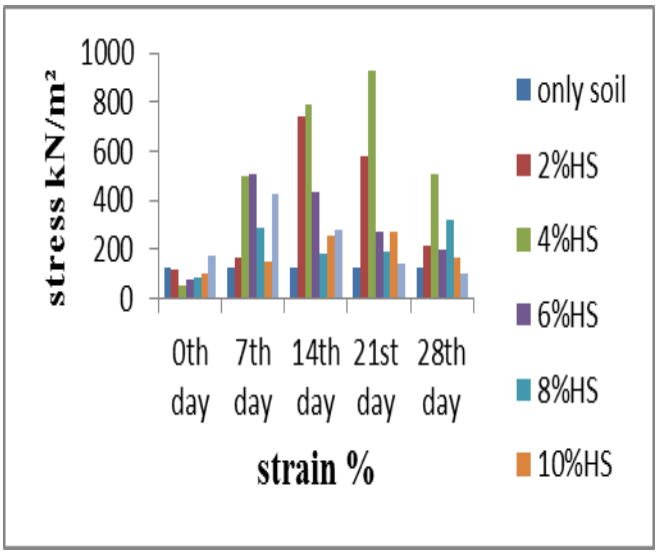
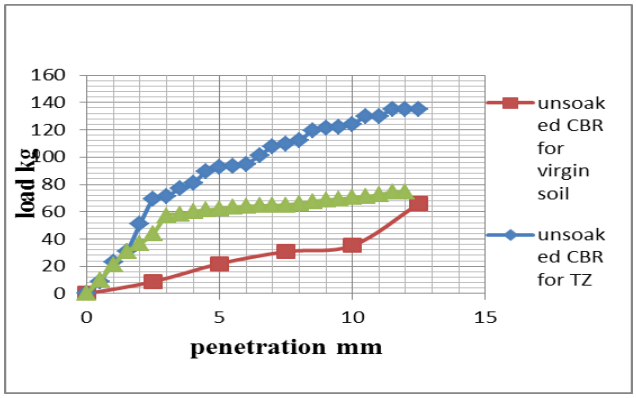


Table 6- UCS test results for both Terrazyme and Hyposludge stabilized soil

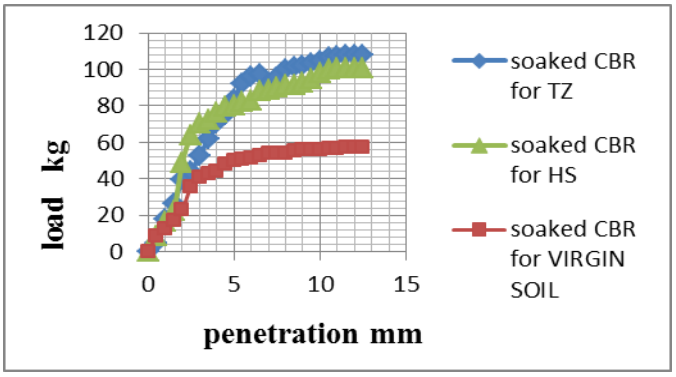
% additive /curing periods	0th day	7th day	14th day	21st day	28th day
D0	130.42	130.42	130.42	130.42	130.42
D1	250.06	457.96	347.15	242.22	351.07
D2	164.75	215.74	293.19	152.00	235.36
D3	121.60	175.59	168.67	135.33	99.046

%additive/curing period	0th day	7th day	14th day	21st day	28th day
0	130.4	130.4	130.42	130.42	130.42
2	129	163.7	738.43	576.6	217.0
4	119.	497.2	787.5	924.76	509.94
6	124.	509.0	436.4	272.62	201.03
8	234.	291.3	183.38	199.3	319.69
10	106	154.0	256	273.6	166.71
12	171	423.6	276.54	140.23	101.00

California bearing ratio test results



Load Penetration curve for soaked condition of untreated soil and additives



Load Penetration curve for unsoaked condition of untreated soil and additives

Sl.no	Samples added	UnsoakedCBR(%)	Soaked CBR (%)
1	Untreatedsoil	4.81	3.95
2	Hyposludge	4.83	3.98
3	Terrazyme	4.84	4.76

4. CONCLUSIONS

- The stabilisation of red soil in combination of Terra-zyme gave the noteworthy outcome in gaining strength. Depend upon the cause of dry density and the optimum water content the dosage quantities are fixed. Another additive Hyposludge is added from 2% to 12% .
- Compaction characteristics of the three levels of the Terrazyme dosage are computed in terms of the MDD and OMC.
- The additive Terrazyme added to untreated soil gave the highest dry density at dosage 1.
- The additive Hyposludge which was added to the soil gave the maximum dry density for 2% addition.
- The results achieved from UCS test by the Terrazyme addition shows good gain in strength terms at the 7days of curing at all the dosage levels.
- The Hyposludge stabilized UCS values got increased at 4% addition at the curing duration of 21days(3weeks).As the curing period increases further,there was significant decrease in UCS test values.
- The CBR test has been carried for the optimum quantity of the Terrazyme and for Hyposludge,it can be concluded as the addition of additives Terrazyme and Hyposludge the CBR value has got increased comparatively to controlled untreated sample.The Terrazyme stabilized soil shows good result compared to controlled untreated sample and Hyposludge.

FUTURE WORK

- Studies can be conducted on the other type of problematical soil with different trail percentages.
- Other lab tests like durability to identify the geotechnical characteristics of soil, bearing capacity test, Permeability tests can be performed.
- Combination of diverse materials of additives can be investigated and checked for its strength.

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