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ANALYSIS OF INDEX PROPERTIES AND CBR VALUES OF TYPICAL SOIL USED IN SUBGRADE CONSTRUCTION UNDER INFLUENCE OF TERRAZYME AND WASTE PLASTIC CEMENT BAG STRIPS

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Abstract - *Improvisation of the soil is done by the different technique to modify its engineering properties. It helps in improving the shear strength, stiffness modulus, water resistance and increases the load bearing capacity of the sub-grade soil which having the poor engineering properties. So, there is a need of new technique which is low in cost, eco-friendly and effective in improving the sub-base soil strength. Enzymes are the biological product which enhances the soil sub-grade strength by the catalytic reaction with the soil particles. Terrazyme is a bio-enzyme which is non-toxic, inflammable and non-corrosive liquid water from vegetable extract and the sugar molasses by the process of fermentation. It helps in improving the geotechnical properties of the soil and also reduces the permeability of sub-grade. It gives the best result when the soil is treated with optimum dose of terrazyme and cured for several days after application.*

Plastic waste is one of the major problems for our environment. Plastic cement bag generated from the construction industry can be utilized as a material in the soil stabilization of sub-grade soil. Cement bags can be converted into form of strips of various lengths which will act as a reinforcement in the soil sub-grade. By this way the waste generated by the cement plastic bag can be minimized and utilized as stabilizer.

This dissertation work deals with the effect of terrazyme with soil mixed with plastic bag strips of different length. Experiments are performed on the soil sample treated with terrazyme solution with various percentages such as 0.2%, 0.3% and 0.4% by weight of dry soil and mixed with cement plastic bags strips of different length such as 1cm, 2cm and 3cm with different percentage. The experimental investigation is carried out to find the suitable combination of terrazyme and the plastic bag strips for getting desired level of the CBR value in the sub -grade. The result obtained from the treated soil is compared with the untreated soil sample and presented in this thesis.

KEYWORDS:- Stabilization, Soil, Bio-Enzyme, Terrazyme, Cement Plastic bag Strips, Strength Characteristics, CBR Test, Cost Effective

1. INTRODUCTION

Life and performance of a pavement is mainly depends on the characteristics of the subgrade soil. Geotechnical engineers who are dealing with poor bearing capacity soil have always problem in the construction of road.

In many part of India sub-grade soil have poor CBR value. To construct pavement on this surface either we have to replace the soil or to do some special treatment like soil stabilization.

From analysis of some research papers it has been found that improving in-situ soil's engineering properties is referred to as either soil modification or soil stabilization. Soil stabilization is done to improve the density of soil, mixing the soil with admixture and foreign materials to change the physical and chemical Soil stabilization can be carried out by mechanical and chemical means. Conventionally or traditionally soil is improvised by various engineering methods and techniques such as lime stabilization, cement stabilization, bitumen stabilization, mechanical stabilization and chemical stabilization. These techniques have their own limitations. The choice of a particular method depends on the type of soil and degree of improvement. Many geotechnical researches are carried out in recent times on chemical based improvisation of soil, which has poor engineering properties. There are so many additives for improvisation of soil, such as calcium chloride, sodium chloride and sodium silicate. The terrazyme is also one of them, which has been tested by many researchers for soil improvisation. This experiment has been done the area of Darbhanga district of Bihar, for improving the engineering properties of soil which is used for construction of pavement of approximately 5-6 km. the result of terrazyme based stabilization are proven good. But little expansive if used on large scale project.

Researches using waste material such as crumbled rubber, plastic, including the plastic bag used in cement transportation, the results are increasing. Looking to these materials separately used for stabilization, it is considered that a research can

be taken up by using both terrazyme and waste plastic cement bags to analyse the effect on engineering properties of soil and CBR value. This research is intent to see the influence on both materials of soil properties with a hope to have new knowledge in geotechnical engineering.

1.1 OBJECTIVE AND SCOPE OF THE STUDY

In the context of discussion presented in the previous paragraph the main objective of the present work is to carry out the experimental investigation on the use of terrazyme and plastic bags strips as stabilizer in the sub-grade to improve the strength of soil.

To achieve the objective of the present project work following scope of work has been selected.

To analyse the soil properties under influence of terrazyme and waste plastic Cement bag strips.

To compare the results obtained from experimental analysis for optimum proportion of terrazyme and waste plastic Cement bag strips.

2. REVIEW OF PAST WORK

From the literature review, it is concluded that the several research works are carried out by researchers on the various types of sub-grade soil using bio-enzyme terrazyme. They uses the terrazyme as a soil stabilization for the increasing the CBR value in the sub-grade, sub base and also for surface course of the pavement. I also surveyed for the research carried out for the utilization of the cement plastic bag waste in road construction. However, it is seen that there is no work is carried out for stabilization of soil sub-grade with the combination of material such as terrazyme and cement plastic bag strips on various percentage of terrazyme and different length of plastic bag strips.

3 MATERIAL USED

3.1 Sub-grade Soil

The sub-grade soil sample used in this analysis is obtained from a village named Meghaul, in Madhubani district, Bihar. The site is located in the Koshi basin. The soil was collected after extracting the top 200 mm depth of soil. This soil sample is investigated for index properties and also tested with combination of terrazyme and Waste plastic Cement bag strips at various percentage. As per I.S Classification (IS 1498,1970) the Soil is Classified as Inorganic low Compressible Silt (ML)

3.2 Terrazyme (a biological enzyme)

The Terrazyme sample is purchased from Abhijeet Agency Chennai (India). The amount of terrazyme mixed with water for per 200 ml of terrazyme for 1 to 3 m3 of soil which vary according to the type of soil. I have taken terrazyme solution with water at different percentage such as 0.2% 0.3% and 0.4%.

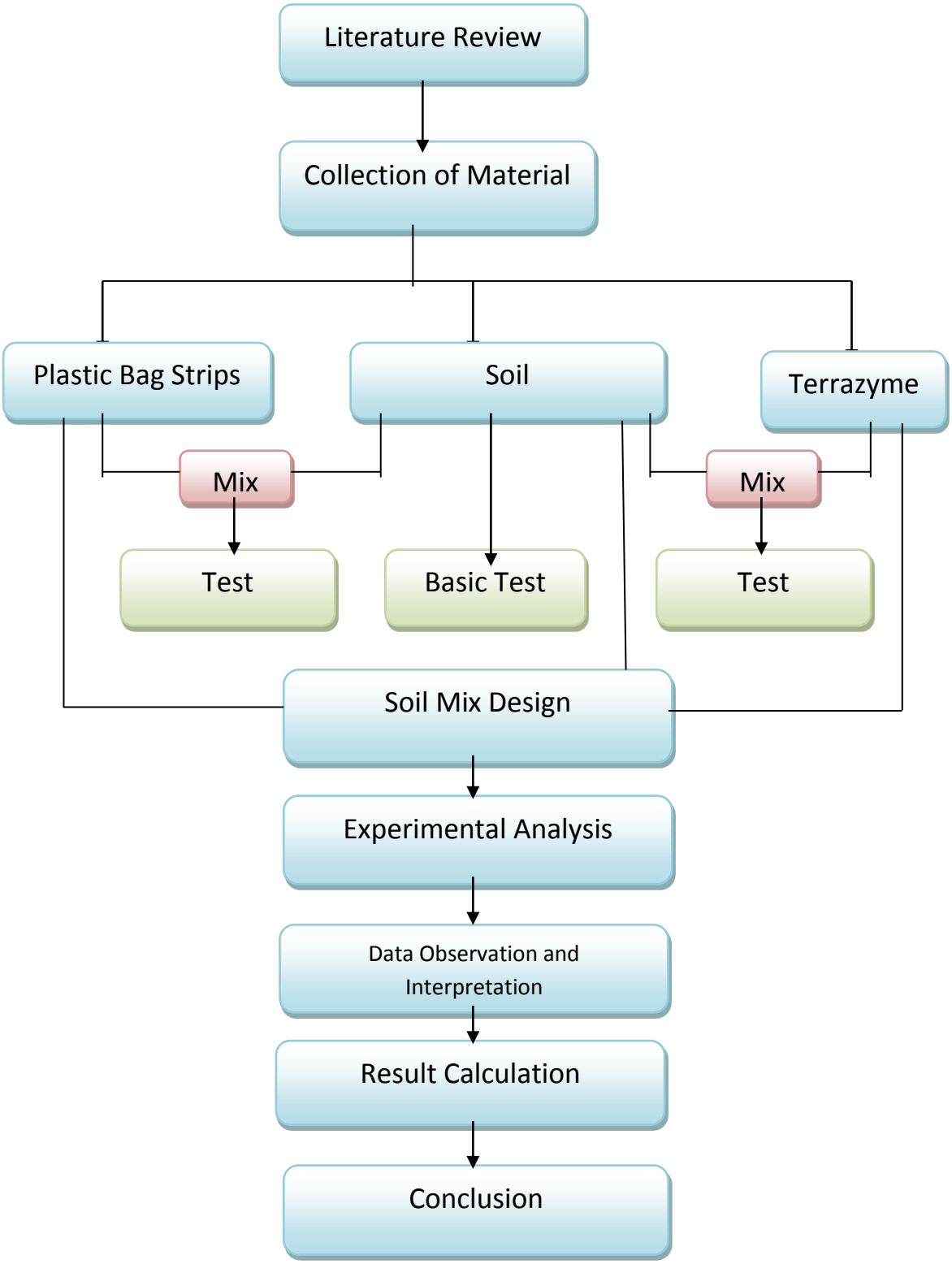
3.3 Plastic Bag Strips

Plastic bag threads are cut into strips of 1cm, 2 cm and 3 cm length. Plastic bags were collected from Madhucon Construction Private Limited (Darbhanga). It is used in soil sample with different percentage such as 0.3%, 0.4%. 0.5% and 0.6% of weight of soil sample

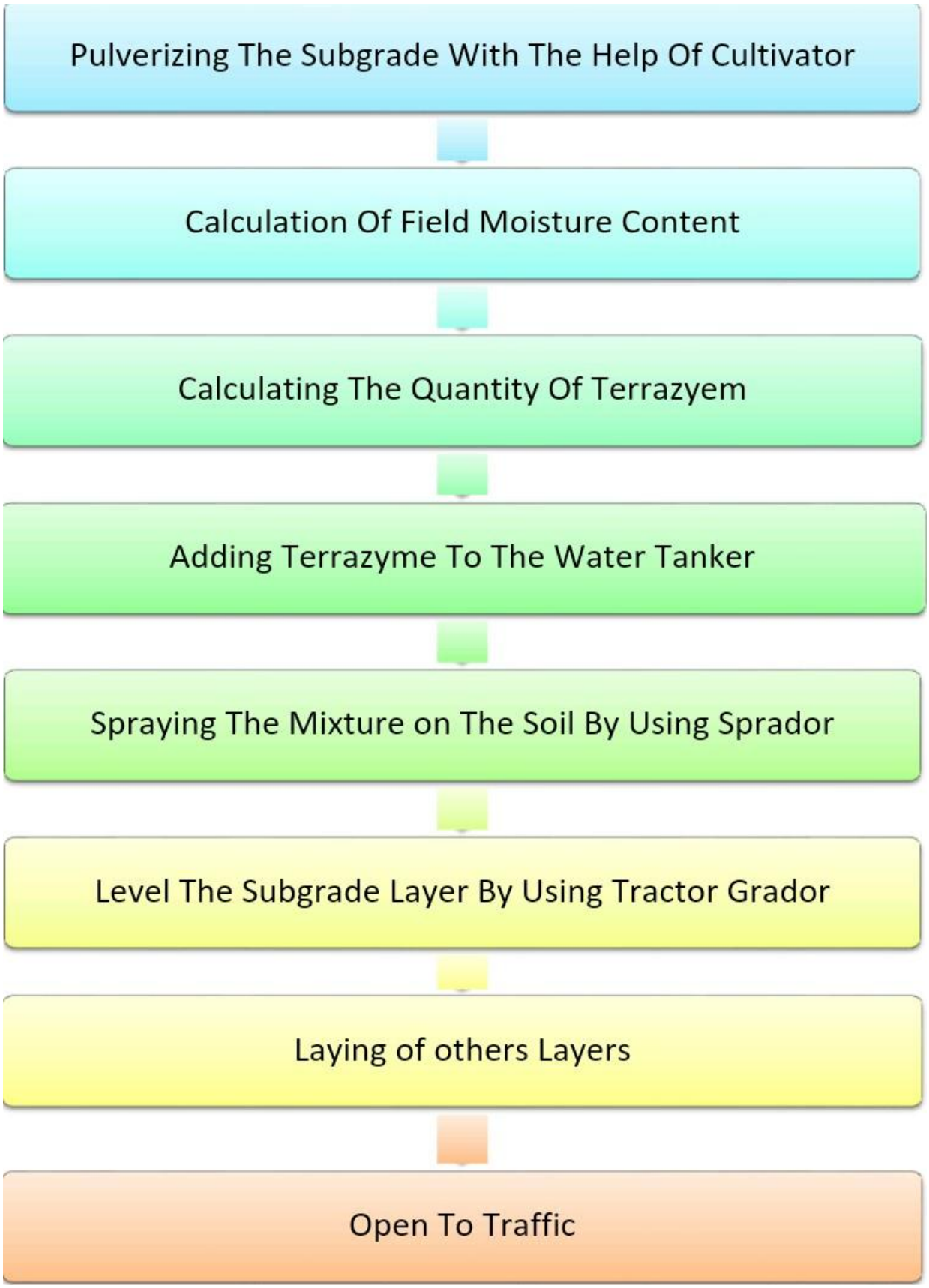
4 METHODOLOGY

In this study the effect of inclusion of waste plastic cement bag strips and terrazyme (a biological enzyme) on index properties and CBR value of typical soil have been investigated. To find the index property and CBR value on treated and untreated soil with terrazyme (a biological enzyme) with different percentage such as 0.2%, 0.3%, and 0.4% which is reinforced plastic bag strips of different length such as 1 cm, 2 cm, and 3 cm and different percentage such as 0.3% 0.4% 0.5% and 0.6%. All experiments are performed as per the IS:2720 – 1985

Flow Chart for Methodology :-



Application of Terrazyme in Pavement Construction



5. RESULTS AND ANALYSIS

All the test results which are obtained from experiments are represented in this chapter. Interrelationship between various parameters like optimum moisture content, maximum dry density and California bearing ratio at different % of terrazyme treated soil with reinforcement of plastic bag strips are presented in tabular and graphical form. This chapter also contains the result obtained from test of untreated soil.

5.1 RESULTS

This table shows the physical characteristic of untreated soil sample.

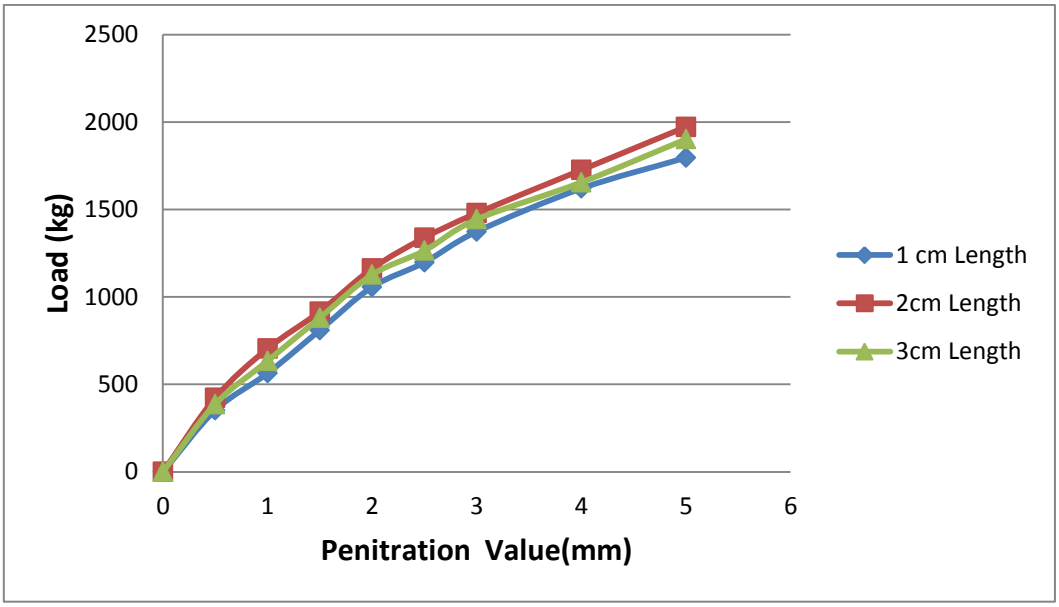
TABLE 5.1.1 Physical Properties of Untreated Soil

S. No	Properties	Test Result
1	IS Classification	ML
2	Natural Water Content(%)	10.22
3	Specific Gravity	2.50
4	Liquid Limit(%)	32.8
5	Plastic Limit(%)	21.09
6	Plasticity Index(%)	11.71
7	Liquidity Index(%)	-0.928
8	Consistency Index(%)	1.928
9	Flow Index(%)	17.74
10	Toughness Index (%)	0.660
11	OMC (%)	14.5
12	MDD (gm/cc)	1.82
13	CBR (%)	4.69

The below table shows comparison between MDD, OMC and CBR value of soil sample at different length of plastic bags strips with various % of strips with soil weight.

TABLE 5.1.2 Test Result Comparison in MDD, OMC and CBR Tests

Plastic bag strips length (cm)	Percentage of plastic bag strips	Soil		
		MDD (gm/cc)	OMC (%)	CBR (%)
1	0.3	1.787	14.7	7.56
	0.4	1.79	14.9	8.08
	0.5	1.811	15.3	8.86
	0.6	1.75	15.5	8.86
2	0.3	1.789	14.8	8.6
	0.4	1.79	15.4	9.128
	0.5	**1.814**	**15.5**	**9.87**
	0.6	1.77	15.7	9.65
3	0.3	1.756	15.2	8.34
	0.4	1.76	15.5	8.6
	0.5	1.782	15.9	9.4
	0.6	1.771	16.2	9.128



GHAPH 5.1.1: Combined CBR Test Result for Soil Mixed with 0.5% Plastic Bag Strips

TABLE 5.1.3 Soil Mixed With Various % Of Terrazyme

% Of terrazyme	MDD (g/cc)	OMC (%)	CBR (%)
0.2	1.955	14.01	9.901
0.3	**1.97**	**13.5**	**10.434**
0.4	1.96	13.1	10.201

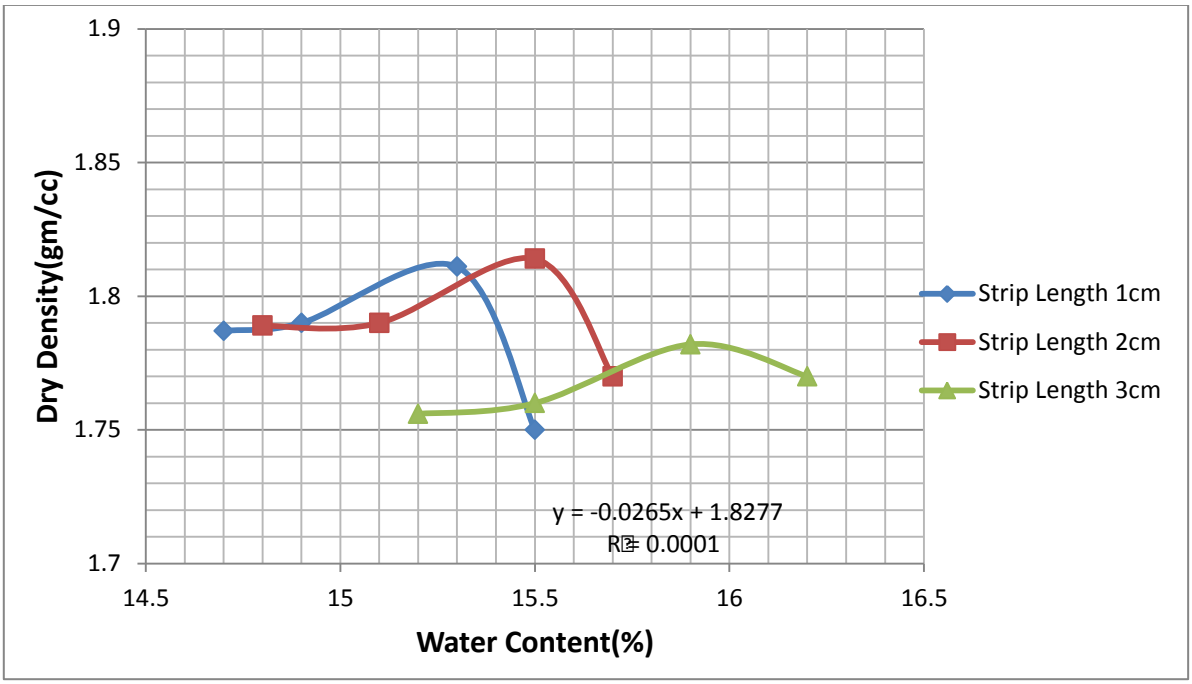
From table 5.1.2 the maximum result obtained at 0.5% and 2cm plastic bag strips, these values are kept fix and terrazyme is added at different percentages i.e. 0.2%, 0.3% and 0.4%. Physical properties are calculated for each percentage of terrazyem. The test results are shown in following tables

TABLE 5.1.4: Physical Properties of Soil treated with Different % of Terrazyme

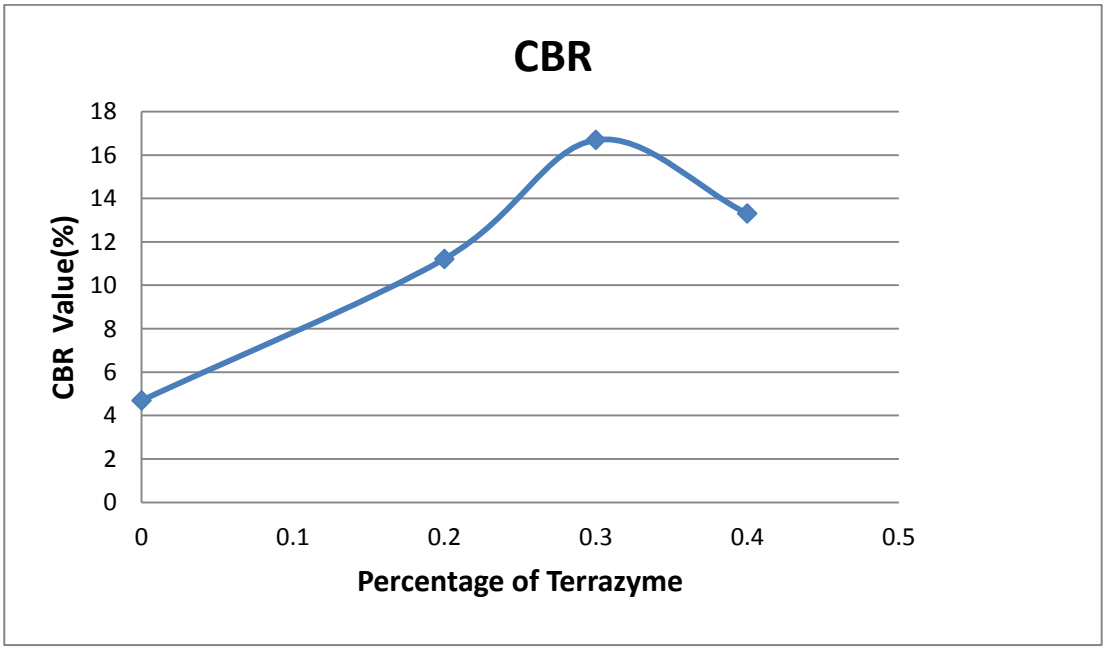
S No	Properties	Test Results for Different % of Terrazyme		
		0.2%	0.3%	0.4%
1	IS Classification	ML	ML	ML
2	Natural Water Content(%)	10.22	10.22	10.22
3	Specific Gravity	2.50	2.50	2.50
4	Liquid Limit(%)	31.5	30.8	29.1
5	Plastic Limit(%)	22.35	23.17	23.8
6	Plasticity Index(%)	9.15	7.63	5.3
7	Liquidity Index(%)	-1.325	-1.697	-2.562
8	Consistency Index(%)	2.325	2.697	3.562
9	Flow Index(%)	12.524	12.943	15.27
10	Toughness Index (%)	0.730	0.550	0.274
11	OMC (%)	13.01	12.8	12.71
12	MDD (gm/cc)	1.923	1.95	1.934
13	CBR (%)	13.82	16.692	13.30

5.2 ANALYSIS OF RESULT

From this table we plotted the graph below which show the optimum result at 0.5% plastic bag strips of length 2cm.

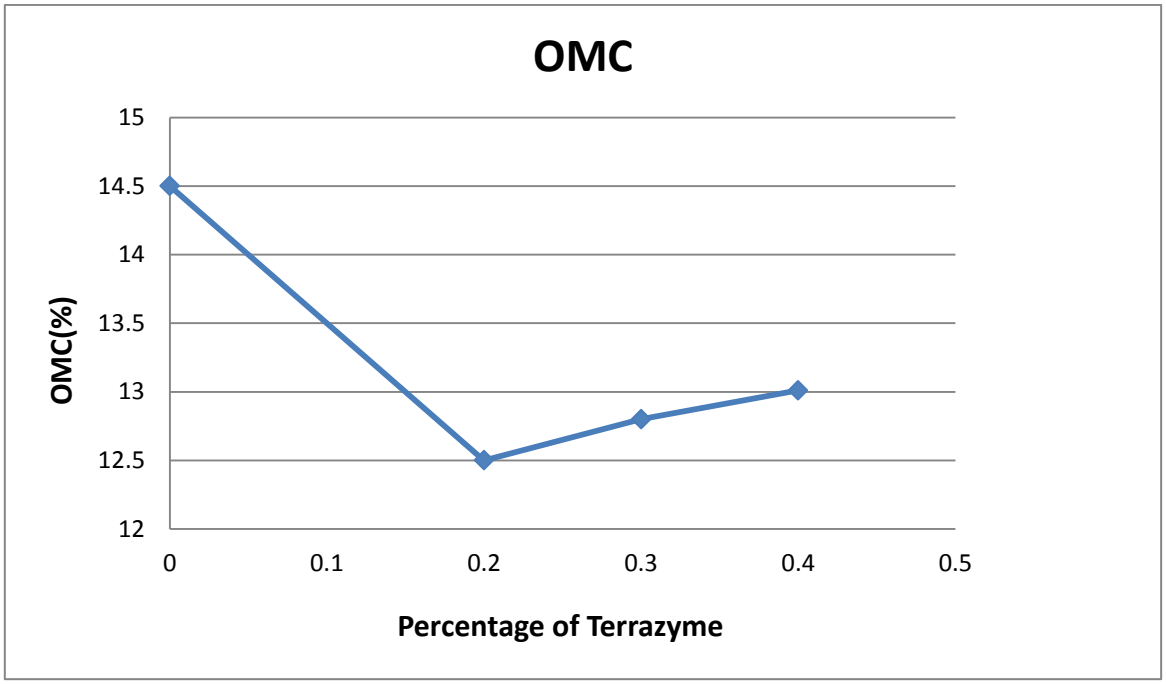


GRAPH 5.2.1: OMC vs MDD Curve for Soil Treated with 0.5% Plastic bag Strips



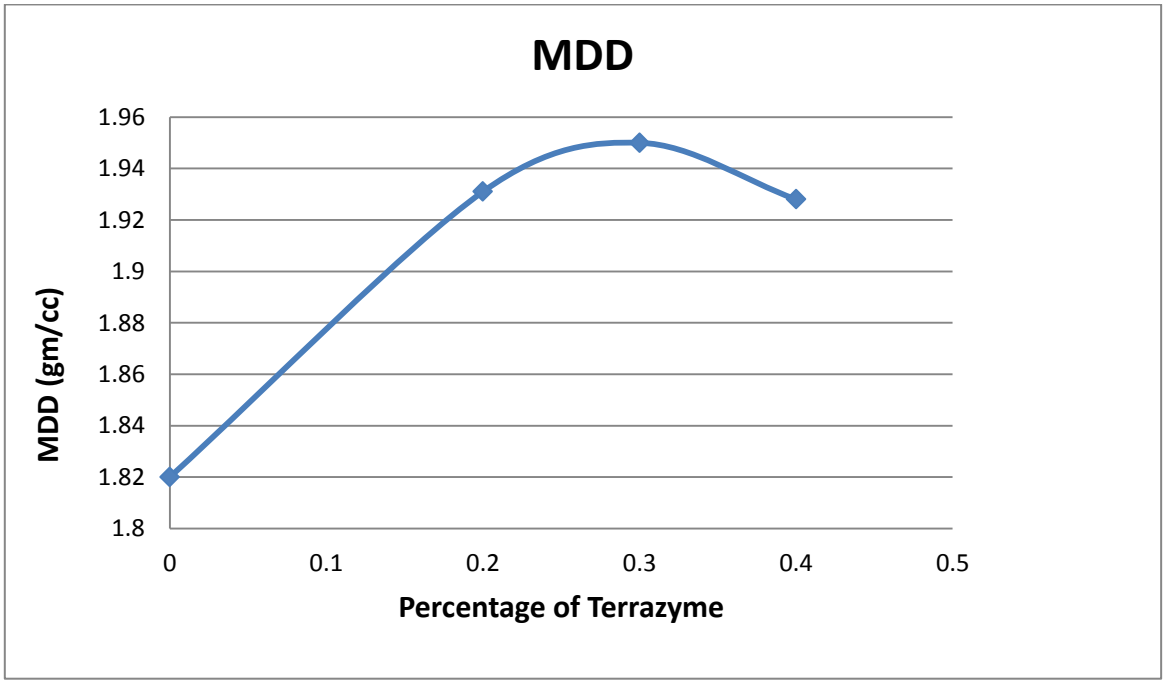
GRAPH 5.2.2: Variation in CBR Value for Different Percentage of Terrazyme

From the above graph it can be seen that the maximum CBR value is 16.692% for the soil mixed with 0.5% plastic bag strips of length 2cm and 0.3% terrazyme. After that the value of CBR is gradually decreases with increasing the percentage of terrazyme.



GRAPH 5.2.3: Variation in OMC Vlaue for Different Percentage of Terrazyme

From the above graph it can be seen that the OMC is minimum value obtained for the soil mixed with 0.5% plastic bag strips of length 2cm and 0.2% terrazyme. After that the value of moisture content is gradually increasing with increasing the percentage of terrazyme.



GRAPH 5.2.4:Variation in MDD Value for Different Percentage of Terrazyme

From the above graph it can be seen that the maximum dry density is 1.95gm/cc for the soil mixed with 0.5% plastic bag strips of length 2cm and 0.3% terrazyme. After that the value of dry density is decreases with increasing the percentage of terrazyme.

TABLE 4.6: Finale Result Comparison

Percentage of Terrazyme	MDD (gm/cc)	OMC (%)	CBR (%)
Percentage of Terrazyme	MDD (gm/cc)	OMC (%)	CBR (%)
0	1.82	14.5	4.69
0.2	1.923	12.5	11.215
0.3	**1.95**	**12.8**	**16.692**
0.4	1.934	13.01	13.301

6. CONCLUSIONS

On the basis of results obtained by the experimental analysis carried in the present dissertation work following conclusion may be inference:-

1. As per the results of Atterberg's limits for consistency, the sample of soil is of low compressible silty soil.

2. This soil, when treated with 0.3% terrazyme, the liquid limit (L_L) is decreases by 7.62% as compared to untreated soil.

3. Terrzyme increases the plastic limit by 9.86 % when used at concentration of 0.3% of dry soil (by weight).

4. Consistency index (I_c) is increased by 46% due to terrazyme.

5. The MDD of soil is calculated as 1.82 gm/cc and corresponding OMC is 14.5%. When soil treated with plastic bag strips (0.5%, 2cm length), the MDD becomes 1.814gm/cc with corresponding 15.5% OMC.

6. When soil treated with 0.3% terrazyme the MDD obtained, is 1.97gm/cc and corresponding OMC is 13.5%.

7. When soil treated with 0.5% plastic bag strips of length 2cm and 0.3% terrazyme both, the MDD reaches to 1.95gm/cc and OMC 12.8%. Thus, the maximum dry density of soil is increased by 7.14%, as compared to untreated soil. The CBR value of untreated soil is 4.69%.

8. The CBR value of soil treated with 0.5% plastic bag strips (by weight) of length 2cm is obtained as 9.87%. It shows the increment of 109.16% as compared to untreated soil.

9. The CBR value of treated soil with various percentage of terrazyme (0.2%, 0.3% and 0.4%) is calculated. The maximum value of CBR obtained at 0.3%, is 10.43% which shows the raise in CBR value 122.43% as compared to untreated soil.

10. The maximum increment in CBR value is 255.86%, which is obtained when soil is treated with 0.5% plastic bag strips of length 2cm and 0.3% terrazyme as compared to untreated soil.

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