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Stabilization of Leachate Effected Laterite Soil using Bio-Enzyme(Terrazyme)

S.Sameer, T.Sai Krishna, K.Sai Abhinav, K.Narasimhulu

Abstract: ***The present study provides an effective technique of improving properties of leachate effected soil using bio-enzyme named TERRAZYME.Soil pollution is an consequence especially in a country like INDIA unscientific disposal and dumping of solid waste leads to generation of leachate. High concentration of leachate has less pH value (i.e., acidic in nature) which reduces the particle size. Due to reduction in particle size the properties of soil are also effected. A laboratory testing program was carried out on soil to determine the behavior of leachate effected soil and terrazyme. For that we performed particle size analysis, compaction and California bearing ratio tests on 5% 10% and 15% leachate effected soil to vary the degree of contamination.Terrazyme is a natural non-toxic, non-flammable, non-corrosive liquid enzyme formulated fermented from vegetables that improves the engineering qualities of soil, facilitates higher soil compaction densities and increases stability. It can be used as soil stabilizer and also improve CBR value, durability and decreases the omc, plasticity index of soil. Terrazyme on soil is permanent and soil becomes bio-degradable in nature.So we used terrazyme as a stabilizing agent to improve the properties of leachate effected soil. By using this enzyme we can improve the strength effectively, mainly California bearing ratio.***

Key Words: ***Laterite soil, Leachate,Terrazyme,CBR***

I. INTRODUCTION

Unscientific disposal of waste creates a very important supply of soil pollution. Soil pollution leads to modification of the physical, chemical and biological properties of soil. Leachate is generated in landfill sites by chemical reaction processes (products of organic chemistry changes in organic substances) or is that results of water penetration. Its composed of enormous amounts of each organic and inorganic compounds, associated their concentration depends to the age of a landfill siteLeachate from an improperly created landfill results an intensive contamination of soil to a lower place and adjacent to the dumping space. In reference to any potential application, information of the geotechnical characteristics of leachate contaminated soil is needed. Although this current landfill engineering stress on pollution reducing technology (by victimization appropriate liner material to avoid the migration of leachate/hazardous waste chemicals generated during landfill), open dumping is extensively practiced in republic of India. The leachate generated from such landfill sites cause serious environmental risks to the surroundings by causing contamination of soil. Leachate from a lowland varies wide in composition depending on the age of the landfill and also the kind of waste that it contains. It will typically contain each dissolved and suspended material. The generation of leachate is caused in the main by precipitation percolating through waste deposited during a landfill. Once in reality with decomposing solid waste, the percolating water becomes contaminated and if it then flows out of the stuff its termed leachate. Extra leachate volume is created throughout this decomposition of element material manufacturing a good vary of different materials including methane, carbon dioxide and a fancy mixture of organic acids, aldehydes, alcohols and straightforward sugars. during a landfill that receives a combination of municipal, commercial, and mixed industrial waste, however excludes important amounts of focused specific chemical waste, landfill leachate could also be characterized as a water-based resolution of four teams of contaminants; dissolved organic matter (alcohols, acids,aldehydes, short chain sugars etc.), inorganic macro elements (common cations and anions as well as sulfate, chloride, iron, aluminium, zinc and ammonia), significant metals (Pb, Ni, Cu, Hg), and organic compounds like halogenated organics, (PCBs, dioxins, etc.). The physical look of leachate once it emerges from a typical landfill site may be a powerfully odoured black, yellow or orange colored cloudy liquid. The smell is acidic and offensive and should be terribly pervasive because of hydrogen, nitrogen and sulphur. The process of rising the strength and durability of soil is thought as soil stabilization. It is the method of mixing and mixing materials with soil to enhance bound properties of soil. A perfect soil stabilizer ought be simply available, economical and ecofriendly. Terrazyme is an efficient and non-corrosive liquid protein that extensively enhances the properties of the soil used for construction of roads. It is a wetting agent and its application assists within the expulsion of water from soils, and also helps within the lubrication of soil particles and will increases the compatibility of the many forms of soils. Its reaction of with several of those materials is especially owing to the ion-exchange capability of clay minerals. Terrazyme is used for various forms of soil starting from black cotton soils to hard murram soils. It is used for all those forms of soil that includes a minimum 10% of clay particles. Soils once being treated with terrazyme begin behaving sort of a semi rigid pavement structure with abundant reduced porousness. Terrazyme is also designed to improve soil strength by increasing the density of the initial compaction and facilitating the removal of pore water, which helps in minimizing the destructive impact of water under load

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II. LITERATURE REVIEW

Manoj Shukla et al. (2003) dispensed take a look at on 5 totally different form 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.

Little to high improvement is seen in the physical properties of soil with Bio Enzyme. The reason behind this little improvement is the chemical composition of soil which is less reactive with the Bio Enzyme. Sandy to silty type soil showed improvement in the CBR and UCS. 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[3]

Lacuoture and Gonzalez (1995) conducted study on the results of TerraZyme on sub- base and sub- grade. The reaction of the soil treated with Bio catalyst was observed and compared with soil while not Bio catalyst. It had been complete that soil showed improvement in breif period of your time however the cohesive soils showed improvement successively. Bergmann (2000) complete from his study on bio catalyst that for transmission strength to the soil, bio enzyme needs some clay content. He declared that for successful stabilization of soil minimum 2% clay content is required and 10 to 15 % after clay content provides sensible results. Compared to 28 % of untreated soil CBR after 1, 2, 3, 14 week was found as 37, 62, 66 and 100 severally.[1]

III. MATERIALS AND METHODOLOGY

The various materials employed in our project are :

Laterite soil
Leachate
Terrazyme

Laterite is a soil and rock sort wealthy in iron and aluminium and is often thought about to possess formed in hot and wet tropical areas. These soils have a high clay content, that mean they need higher ion exchange capability and water holding capability than sandy soils. The lateritic soils behave a lot of like fine particles sands, gravels and soft rocks

Fig 3.1 Collection of laterate soil

A **Leachate** is any liquid that, within the course of passing through matter, extracts soluble or suspended solids, or the other element of the material through that its passed. Solid waste landfills may cause severe environmental impacts if leachate and gas emissions are not controlled. Leachate generated in muncipal landfill contains large amounts of organic and inorganic contaminants.The chemical properties of leachate as shown below table

Table 3.1 Chemical properties of leachate

Property	Recent Waste	Aged Waste
pH value	6.2	7.5
COD	23800	1160
BOD_5	11900	260
Sodium	960	1300
Magnesium	252	185
Potassium	780	590
Calcium	1820	250

NOTE : All values in mg/litre except pH

Fig:3.2 Land fill area

Terrazyme is a liquid enzyme which is organic in nature and is formulated from the vegetable and fruit extract. It improves the quality of soil like CBR, durability and decreases the OMC, plasticity index of soil. The effect of terrazyme on soil is permanent and the soil becomes bio degradable in nature..The properties of terrazyme tabulated below[6][7]

Table 3.2 Properties of terrazyme

Boiling point	212 F
Specific gravity	1.000 to 1.090
Melting point	Liquid
Vapour density	1
pH value	4.30 to 4.60
Appearance	Brown clear liquid
Total dissolved solids	19.7ppm
Cation exchange capacity	3.87%
Evaporation rate	Same as water

IV. METHODOLOGY

The scientific approach towards the research is a combination of various methods collectively to attain necessary data through the experimental approach. We have obtained the results from the experiments mentioned below.

- Particle size analysis
- Compaction test
- California bearing test

Leachate Preparation

There is no active source of leachate effected soil near by locality and also it is difficult to obtain leachate from that soil. The leachate used in the present study was prepared in the laboratory with different composition. The proportions of the properties of the synthetic leachate are similar to natural leachate.

- 0.15M Sodium Acetate
- 0.15M Acetic Acid
- 0.05M Glysine
- 0.008M Pyragallol
- 0.024M Ferrous Sulphate

Terrazyme Dosage Preparation

The dosage of terrazyme is based on the plasticity index and percentage of fines in the soil. For effective results proper dosage have to be selected. The dosage is based on the dilution ratio which we employed. So we used the corresponding dilution ratios 1:50, 1:100 and 1:150 respectively[4]

Terrazyme Applied Leachate Effected Soil

In this project, the main focus is to improve the CBR value of the leachate effected soil using terrazyme. So we performed California bearing ratio test on different percentages of leachate effected soil by applying terrazyme dosage.

Curing period

An appropriate curing period is required for stabilization benefits to develop after terrazyme treatment. Standard practice must be altered to allow curing under appropriate conditions. Compacted samples should be placed within a plastic bag that remains sealed during at least the first two weeks of the 30-day curing period. A 2-3 cm slit can be made in the bag after the first two weeks of curing to allow gradual moisture loss during the final days of the curing period. Samples should retain moisture during the curing period. Rapid drying of the compacted samples does not mimic actual road conditions and will eliminating the moisture needed for enzyme action to continue. For unsoaked CBR, the compacted samples may be allowed to rest uncovered after the 30-day curing period, until sample moisture levels approach the prevailing humidity conditions. For soaked CBR, compacted and 30-day cured samples may be immersed in the water bath after the curing

V. EXPERIMENTAL INVESTIGATION

4.1CALIFORNIA BEARING RATIO

Fig 4.1 CBR Machine

Generally, the CBR value at 2.50mm penetration will be greater than that at 5.00mm penetration and in such case take the value at 2.50mm as the CBR value. If the CBR value corresponding to a penetration of 5.00mm exceeds that of 2.50mm,repeat the test. If the identical results follow, take the value corresponding to 5.00mm as the CBR value.[10]

4.2 COMPACTION TEST

To determine the maximum dry density and the optimum moisture content of soil using heavy compaction.

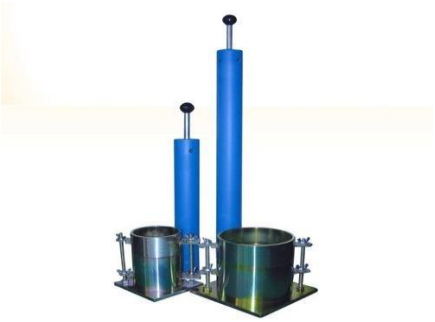


Fig 4.2 Compaction mould

The percentage moisture content corresponding to the maximum dry density on the moisture content/dry density curve should be reported as the optimum moisture content and quoted to the nearest 0.2 for values below 5 percent, to the nearest 0.5 for values from 5 to 10 percent and to the nearest whole number for values exceeding 10 percent.[8][9]

VI. RESULTS

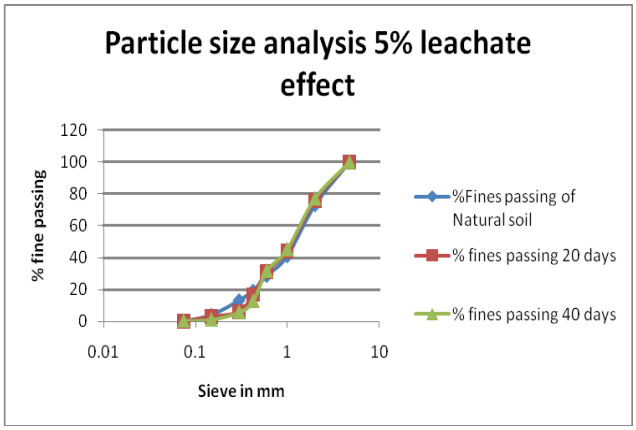
Effect of leachate with 5%, 10% amd 15% on laterate soil properties

5.1. 5% LEACHATE EFFECTED SOIL

5.1.1.Particle size analysis

Table 5.1: Particle Size Analysis of 5% Leachate effected soil

s.no	Is sieve no.	%Fines passing of Natural soil	% fines passing	
			20 days	40 days
1	4.75 mm	100	100	100
2	2.00 mm	73	75.8	77.2
3	1.00 mm	41.09	44.2	45.3
4	600 microns	28.79	31.4	31.8
5	425 microns	19.39	17	12.8
6	300 microns	13.38	6.2	5.9
7	150 microns	4.18	3.1	1.2
8	75 microns	0.18	0.2	0.4



Graph:5.1 Particle Size Analysis Soil

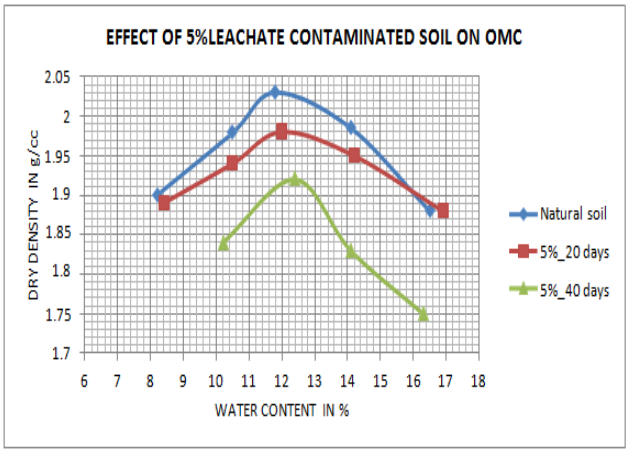
From graph,

It is shown that with increase in duration the percentage of fines increases i.e., the particle size curve of leachate effected soil moves leftwards with respect to particle size curve of natural soil

5.1.2.Compaction test

Table:5.2 compaction observations of 5% Leachate effected soil

Natural Soil		5% Leachate Effected Soil 20 Days		5% Leachate Effected Soil 40 Days	
Water Content In %	Dry Density In g/cm3	Water Content In %	Dry Density In g/cm3	Water Content In %	Dry Density In g/cm3
8.2	1.9001	8.4	1.89	10.2	1.84
10.5	1.979	10.5	1.94	12.4	1.92
11.8	2.03	12	1.98	14.1	1.83
14.1	1.985	14.2	1.95	16.3	1.75
16.5	1.88	16.9	1.88	10.2	1.84



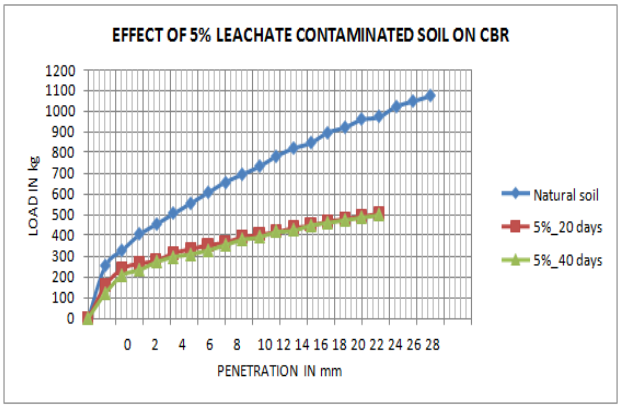
Graph:5.2 OMC of 5% leachate effected soil

From graph,
For 20 days,Maximum dry density =1.98g/cm^3
Optimum moisture content =12.0%
For 20 days,Maximum dry density =1.92g/cm^3
Optimum moisture content =12.4%

5.1.3. California bearing ratio

Table:5.3 CBR observations 5% Leachate effected soil

Penetration In mm	Load In Kg		
	Natural Soil	20 Days	40 Days
0	0	0	0
1.25	252	157.5	119.7
2.5	327.6	239.4	207.9
3.75	403.2	264.6	233.1
5	453.6	277.5	270.9



Graph:5.3 CBR of 5% leachate effected Soil

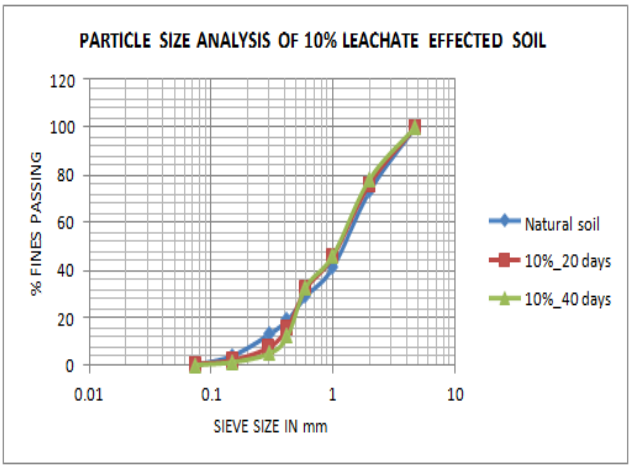
From graph,
For 20 days, CBR value at 2.5 mm penetration is = 17.47%
CBR value at 5.0 mm penetration is = 13.48%
For 40 days, CBR value at 2.5 mm penetration is = 15.17%
CBR value at 5.0 mm penetration is = 13.18%

5.2. 10% LEACHATE EFFECTED SOIL

5.2.1.Particle Size Analysis

Table:5.4 Particle size analysis of 10% Leachate effected soil

s.no	Is sieve no.	% fine passing of natural soil	% fines passing	
			20 days	40 days
1	4.75 mm	100	100	100
2	2.00 mm	73	76.1	78.1
3	1.00 mm	41.09	45.6	46.1
4	600 microns	28.79	32.2	32.9
5	425 microns	19.39	16	12.4
6	300 microns	13.38	7.6	5
7	150 microns	4.18	2.2	1.4
8	75 microns	0.18	0.6	0.2



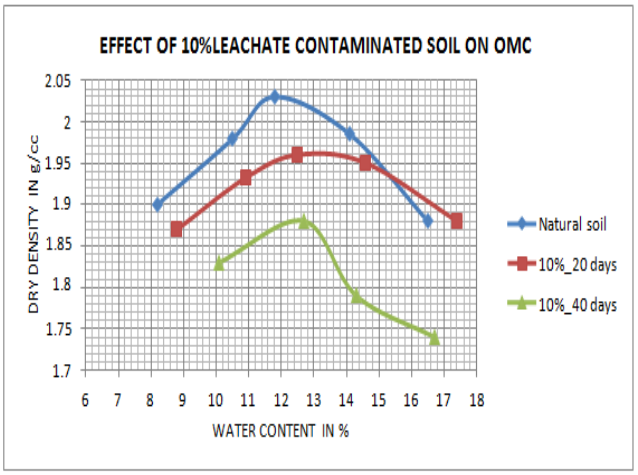
Graph:5.4 Particle Size Analysis Soil

From graph,
It is shown that with increase in duration the percentage of fines increases i.e., the particle size curve of leachate effected soil moves leftwards with respect to particle size curve of natural soil.

5.2.2.Compaction test

Table:5.5 compaction observations of 10% Leachate effected soil

Natural Soil		5% Leachate Effected Soil 20 Days		5% Leachate Effected Soil 40 Days	
Water Content In %	Dry Density In g/cm3	Water Content In %	Dry Density In g/cm3	Water Content In %	Dry Density In g/cm3
8.2	1.9001	8.8	1.87	10.1	1.83
10.5	1.979	10.9	1.932	12.7	1.88
11.8	2.03	12.5	1.96	14.3	1.79
14.1	1.985	14.6	1.95	16.7	1.74
16.5	1.88	17.4	1.88	10.1	1.83



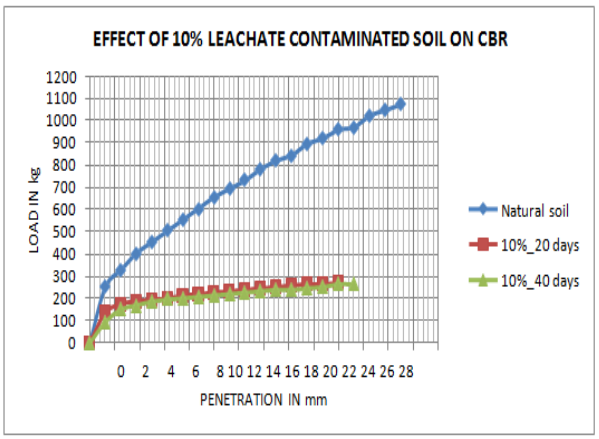
Graph:5.5 OMC of 10% leachate effected soil

From graph,
For 20 days,Maximum dry density =1.96g/cm^3
Optimum moisture content =12.5%
For 20 days,Maximum dry density =1.83g/cm^3
Optimum moisture content =12.7%

5.2.3.California bearing ratio

Table:5.6 CBR observations 5% Leachate effected soil

Penetration In mm	Load In Kg		
	Naural Soil	20 Days	40 Days
0	0	0	0
11.25	252	138.6	94.5
22.5	327.6	176.4	151.2
33.75	403.2	189	170.01
5	453.6	195.3	186.4



Graph:5.6 CBR of 10% leachate effected Soil

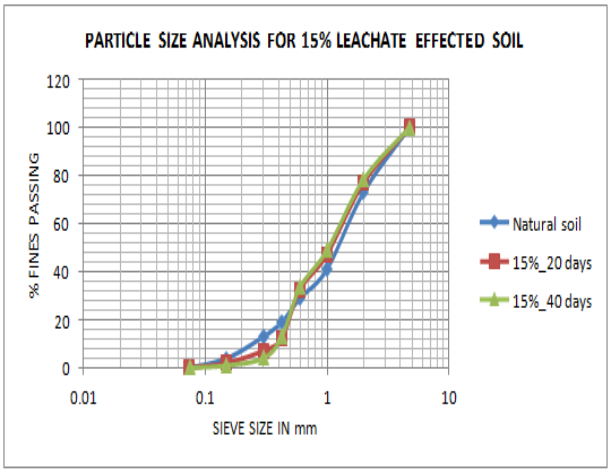
From graph,
For 20 days, CBR value at 2.5 mm penetration is = 12.87%
CBR value at 5.0 mm penetration is = 9.5%
For 40 days, CBR value at 2.5 mm penetration is = 11.03%
CBR value at 5.0 mm penetration is = 8.9%

5.3.15% LEACHATE EFFECTED SOIL

5.3.1.Particle size analysis

Table:5.7 Particle size analysis of 10% Leachate effected soil

s.no	Is sieve no.	% fine passing of natural soil	% fines passing	
			20 days	40 days
1	4.75 mm	100	100	100
2	2.00 mm	73	76.9	78.4
3	1.00 mm	41.09	47.1	48.9
4	600 microns	28.79	32.5	33.4
5	425 microns	19.39	12.1	12.9
6	300 microns	13.38	7.2	4.1
7	150 microns	4.18	2.1	1.1
8	75 microns	0.18	0.2	0.1



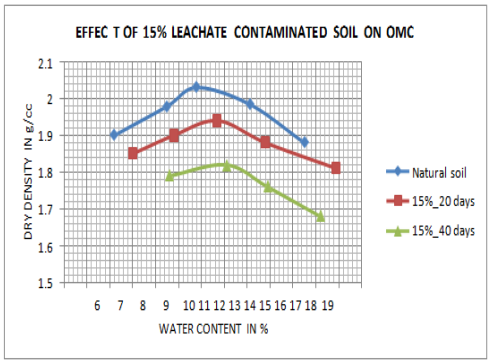
Graph:5.7 Particle Size Analysis soil

From graph, It is shown that with increase in duration the percentage of fines increases i.e., the particle size curve of leachate effected soil moves leftwards with respect to particle size curve of natural soil.

5.3.2.Compaction test

Table:5.8 compaction observations of 10% Leachate effected soil

Natural Soil		15% Leachate Effected Soil 20 Days		15%% Leachate Effected Soil 40 Days	
Water Content In %	Dry Density In g/cm3	Water Content In %	Dry Density In g/cm3	Water Content In %	Dry Density In g/cm3
8.2	1.9001	9	1.85	10.6	1.79
10.5	1.979	10.8	1.9	13.1	1.82
11.8	2.03	12.7	1.94	14.9	1.76
14.1	1.985	14.8	1.88	17.2	1.68
16.5	1.88	17.9	1.81	10.6	1.79



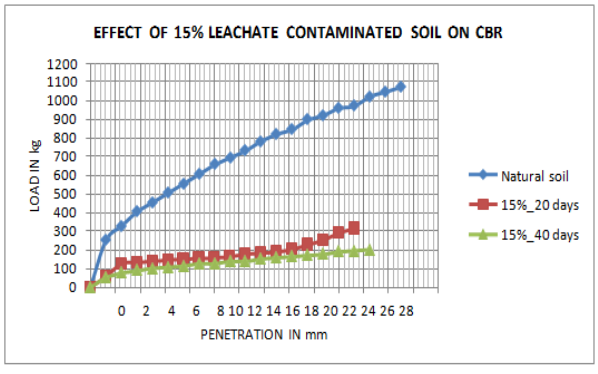
Graph:5.8 OMC of 10% leachate effected soil

From graph,
For 20 days,Maximum dry density =1.94g/cm^3
Optimum moisture content =12.7%
For 20 days,Maximum dry density =1.82g/cm^3
Optimum moisture content =13.1%

5.3.3. California bearing ratio

Table:5.9 CBR observations 5% Leachate effected soil

Penetration In mm	Load In Kg		
	Natural Soil	20 Days	40 Days
0	0	0	0
1.25	252	56.7	51.2
2.5	327.6	126	75.6
3.75	403.2	132.3	88.2
5	453.6	138.6	100.8



Graph:5.9 CBR of 15% leachate effected Soil

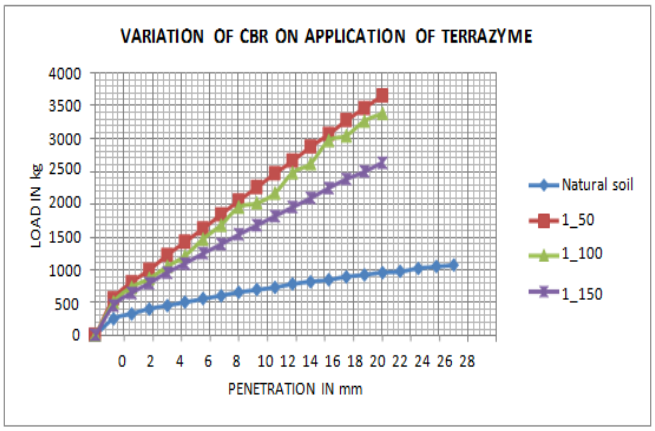
From graph,
For 20 days, CBR value at 2.5 mm penetration is = 9.19%
CBR value at 5.0 mm penetration is = 6.75%
For 40 days, CBR value at 2.5 mm penetration is = 5.51%
CBR value at 5.0 mm penetration is = 4.90%

5.4.TERRAZYME APPLIED TO NATURAL SOIL

5.4.1 California bearing ratio

Table:5.10 CBR observations of terrazyme applied soil

Penetration In mm	Load In Kg			
	Natural Soil	01:50	0.111111	0.145833
0	0	0	0	0
1.25	252	554.4	501.2	453.6
2.5	327.6	806.4	732.3	642.6
3.75	403.2	995.4	865.6	793.8
5	453.6	1222.2	1047.8	957.6



Graph:5.10 variation of CBR values on application of terrazyme to Natural soil

From graph,
For 1 : 50, CBR value at 2.5 mm penetration is = 59.47%
CBR value at 5.0 mm penetration is = 58.0%
For 1 : 100, CBR value at 2.5 mm penetration is = 51.62%
CBR value at 5.0 mm penetration is = 50.48%

For 1 : 150, CBR value at 2.5 mm penetration is = 46.90%
CBR value at 5.0 mm penetration is = 45.60%

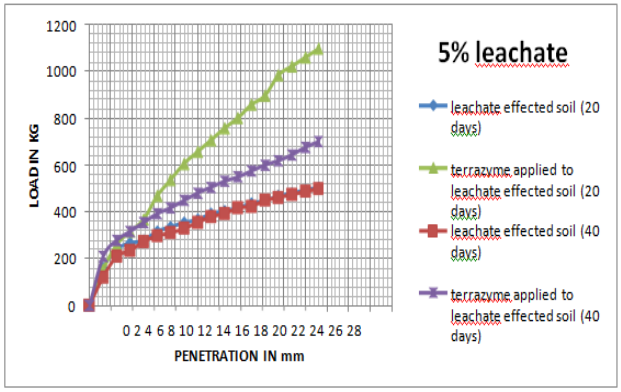
The effective dilution ratio is 1:50 at which the CBR value is appreciable. So we adopt 1: 50 dosage for leachate effected soil.

5.5.TERRAZYME APPLIED TO LEACHATE EFFECTED SOIL (5% 10%& 15%) FOR CURING PERIOD OF 20 DAYS & 40DAYS

5.5.1Terrazyme Applied to 5% Leachate Effected soil

Table:5.11 CBR observations of terrazyme applied to 5%lechate effected

Penetration In mm	Natural Soil	Leachate Effected soil		Terrazyme Applied to Leachate Effected Soil	
		20 Days	40 Days	20 Days	40 Days
0	0	0	0	0	0
1.25	252	157.5	119.7	151.2	207.9
2.5	327.6	239.4	207.9	258.3	277.2
3.75	403.2	264.6	233.1	315	315
5	453.6	277.5	270.9	365.4	352.8



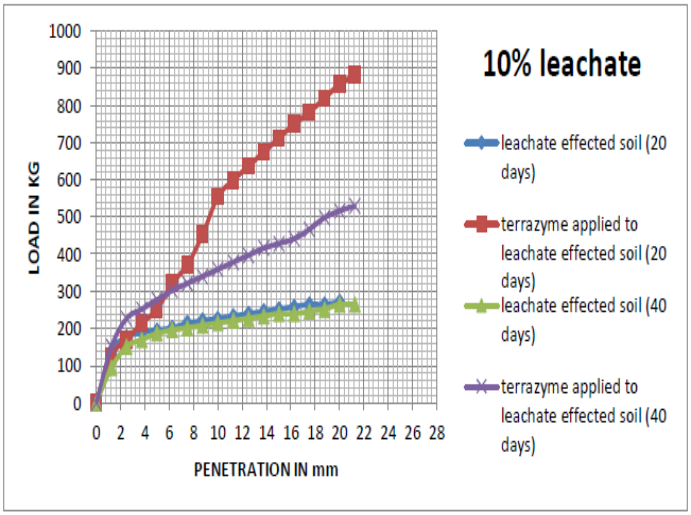
Graph:5.11 variation of CBR values on application of terrazyme to 5% leachae effected soil

From graph,
For 5% Leachate Effected Soil
@ 20 days, CBR at 2.5mm =17.47%,CBR at 5.0mm = 13.48%
@ 40 days, CBR at 2.5mm =15.16%, CBR at 5.0mm = 13.18%
For Terrazyme Applied to 5% Leachate Effected Soil
@ 20 days, CBR at 2.5mm =20.23%,CBR at 5.0mm = 17.16%
@ 40 days, CBR at 2.5mm =18.85%,CBR at 5.0mm = 17.78%[2][5]

5.5.2 Terrazyme Applied to 10% Leachate Effected soil

Table:5.12 CBR observations of terrazyme applied to 10% leachate effected soil

Penetration In mm	Load In Kg				
	Natural Soil	Leachate Effected soil		Terrazyme Applied to Leachate Effected Soil	
		20 Days	40 Days	20 Days	40 Days
0	0	0	0	0	0
1.25	252	138.6	94.5	126	151.2
2.5	327.6	176.4	151.2	170.1	226.8
3.75	403.2	189	170.01	214.2	252
5	453.6	195.3	186.4	252	277.2



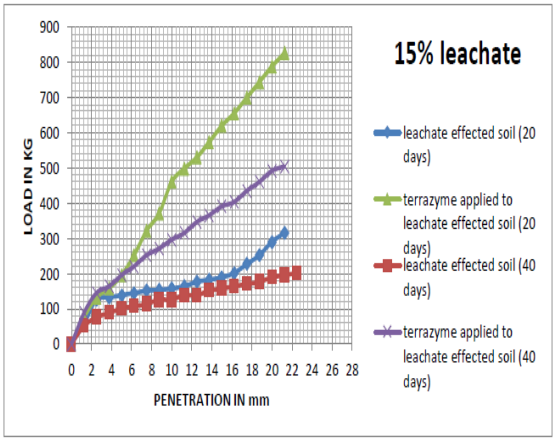
Graph:5.12 variation of CBR values on application of terrazyme to 10% leachae effected soil

From graph,
For 10% Leachate Effected Soil
@ 20 days, CBR at 2.5mm =12.87%,CBR at 5.0mm = 9.50%
@ 40 days, CBR at 2.5mm =11.03%, CBR at 5.0mm = 8.90%
For Terrazyme Applied to 10% Leachate Effected Soil
@ 20 days, CBR at 2.5mm =16.55%,CBR at 5.0mm = 13.48%
@ 40 days, CBR at 2.5mm =12.41%,CBR at 5.0mm = 10.42%[2][5]

5.5.3.Terrazyme Applied to 15% Leachate Effected soil

Table:5.13 CBR observations of terrazyme applied to 10% leachate effected soil

Penetration In mm	Load In Kg				
	Natural Soil	Leachate Effected soil		Terrazyme Applied to Leachate Effected Soil	
		20 Days	40 Days	20 Days	40 Days
0	0	0	0	0	0
1.25	252	56.7	51.2	75.6	88.2
2.5	327.6	126	75.6	132.3	144.9
3.75	403.2	132.3	88.2	157.5	163.8
5	453.6	138.6	100.8	195.3	195.3



Graph:5.13 variation of CBR values on application of terrazyme to 15% leachae effected soil

From graph,
For 15% Leachate Effected Soil
@ 20 days, CBR at 2.5mm =9.19%,CBR at 5.0mm = 6.75%
@ 40 days, CBR at 2.5mm =5.51%, CBR at 5.0mm = 4.90%
For Terrazyme Applied to 15% Leachate Effected Soil
@ 20 days, CBR at 2.5mm =10.57%,CBR at 5.0mm = 9.50%
@ 40 days, CBR at 2.5mm =9.65%,CBR at 5.0mm = 9.2%[2][5]

VII. DISCUSSIONS

6.1.Particle size Analysis

From the particle size analysis of leachate effected soil, it is shown that with increase in percentage of leachate and duration, the soil becomes finer due to chemical reaction between the soil and leachate. It means that with the effect of leachate the soil properties gets modified

6.2 Compaction

Table:6.1 OMC & MDD observations of leachate effected soil

% Of Leachate By Weight	Optimum Moisture Content In %		Maximum Dry Density In g/cm3	
	20 Days	40 Days	20 Days	40 Days
5%	12	12.4	1.98	1.92
10%	12.5	12.7	1.96	1.83
15%	12.7	13.1	1.94	1.82
Natural soil	11.80%		2.03	

The results obtained from the compaction test are tabulated in the above table. The results shows that for increase in degree of contamination and duration, the particle size becomes finer. By the nature of soil, with percentage of increase in fines the soil absorbs more water. So the optimum moisture content value increases. It results in decrease in maximum dry density.
The results we evaluated shows that with increase in degree of contamination optimum moisture content increases and corresponding dry densities decreases.

6.3.California Bearing Ratio

6.3.1.CBR values of terrazyme applied to natural soil

Table:6.2 CBR observations terrazyme applied to natural soil

Dosage	California bearing ratio value in %
Natural soil	24.07
01:50	59.47
1:100	51.62
1:150	46.9

For the original soil on application of terrazyme dosage, the results obtained are mentioned in the above table. The effective dilution ratio is 1:50 at which the CBR value is appreciable. So we adopted the dilution ratio as 1:50[2]

6.3.2.CBR values of leachate effected soil and terrazyme applied to leachate effected soil

Table:6.3 CBR values of leachate effected & terrazyme applied to leachate effected soil

% Of Leachate By Weight	Leachate Effected Soil		Terrazyme Applied to Leachate Effected Soil	
	20 Days	40 Days	20 Days	40 Days
5%	17.47	15.17	20.23	18.85
10%	12.87	9.5	16.55	12.41
15%	9.19	6.75	10.57	9.65

The results obtained from the California bearing ratio test are tabulated in the above table. For leachate effected soi, it is observed that for increase in degree of contamination and duration, the CBR value decreases.
On application of dosage of terrazyme to the leachate effected soil, it is observed that for 20 days curing period the CBR value is increased favorably.
For natural soil with application of terrazyme the CBR values increased more than twice of that natural soil. But for leachate effected soil, the CBR values increases just favorably.[2]

VIII. CONCLUSION

An extensive laboratory testing program was carried out to study the effect of leachate contamination and terrazyme application on compaction characteristics and CBR values of lateritic soil.
The following conclusions are made based on the experimental results :
1) The soil properties varies with the age of leachate. As the age progresses the soil particle size becomes more finer.
2) As the degree of contamination increases, the water content increases which leads to reduction in strength of soil i.e., MDD decreases.
3) The results of the study indicates that the CBR value decreases with increase in degree of contamination and age of leachate.
4) On application of terrazyme, OMC decreases and MDD increases. Because the terrazyme removes the water and air present in the soil and forms a cementing bond between soil particles.
5) With increase in dosage of terrazyme the soil attains more strength with minimum compaction effort. So that CBR value increases.

6) Terrazyme is ideal in nature because it is ecofriendly, economical and effective.
7)For chemically effected soil terrazyme showed favourable results. If the curing period increases the results may be more favourable.
Hence further investigation is required.

FUTURE SCOPE

Effect of leachate on different types of soils with varying percentage of leachate contamination.
Terrazyme effect on the soil with varying dosage and in varying stabilizing duration.
Other bio enzymes and their effect on chemical effected soil can be studied.
Further tests can be performed for permeability, direct shear test and dynamic behavior of soil can be observed on application of terrazyme.

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