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STABILIZATION OF BLACK COTTON SOIL OF VARIOUS REGION FROM PUNE BY USING TERRAZYME

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Abstract: Many Bio-enzymes have emerged as cost effective stabilizers for soil stabilization. One such type of bio-enzyme, Terazyme, has been used in the present work. It is proposed to conduct tests for varying dosages and curing periods in order to understand the long term effects of bio-stabilization on treated soil. The practical applications of expansive soil or the contaminated soil with improved engineering properties includes increased stiffness of soil which can reduce settlement and lateral deformations,enhancement of slope stability, enhancement of bearing capacity of foundation and to facilitate tunneling, canal lining, embankment construction etc. The Terazyme effect on the unconfined compressive strength and on the atterberg limits were studied. The enzyme treated soil showing significant improvement in unconfined compressive strength values.

Key Words: - Terrazyme, Black cotton soil, Unconfine compression Strength, Standard compaction test.

1. Introduction:-

Black cotton soil is an expansive soil that generally available in the tropical zones. Their appearance varies from black colour to brown colour. In our country black cotton soil occupies nearly 20% of the available land. Expansive soil major portion generally found in central part and some places in south India. Expansive soils known by black cotton soil are available in the Deccan plateau fields (Deccan Trap) including Madhya Pradesh, Maharashtra, Gujarat, Andhra Pradesh and in some parts of Odisha, in the Indian sub-continent. Black cotton soil available in the valley of river Tapti, Narmada, Godavari and Krishna. A liquid chemical products are actively marketed for stabilizing soils on pavement projects. Normally supplied as concentrated fluids, these additives are mixed with water on the field and splashed on the soil to be dealt with before compaction. Pressure injection is sometimes used to treat deeper soil layers

There are majorly 4 types of bio-enzymes till date are Renolith, Permazyme, Fujibeton and Terazyme. In the present investigation an attempt is made to stabilize the black cotton soil with bio Enzyme (Terazyme). Detailed laboratory tests were carried out to ascertain the benefits in terms of engineering properties..

2. Literature Review:-

Stabalization of soil using terrazyme for road construction international research journal of engineering and technology (irjet) e-issn: 2395-0056 volume: 07 issue: 04 | apr 2020 p-issn: 2395-0072: Major finding from said study, that Terrazyme eliminates the use of granular sub-base, base course and surface course also in case of low traffic. The benefits of using Terrazyme is that the maintenance cost is almost zero, making this approach economically cost effective.

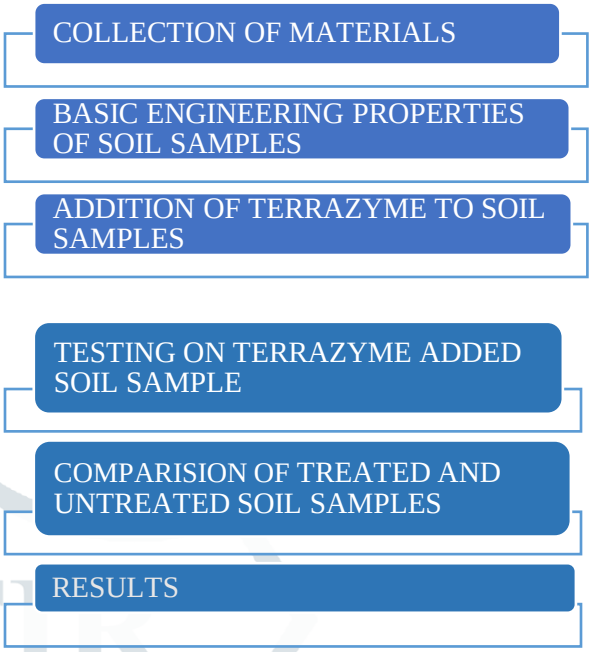
Stabilization of black cotton soil by using bio-enzymes for pavement construction issn: 2455-2631 © july 2020 ijsdr | volume 5, issue 7: From this research paper we come to conclusion that, it was observed that the geotechnical properties of online purchased black cotton soil was effectively improved by using different dosages of terra-zyme that is 250ml/2m3 , 250ml/1.5m3 , 250ml/1.0m3 and 250ml/0.5m3 respectively.

Soil stabilization using terrazyme for road construction, international journal of engineering research & technology (ijert) issn: 2278-0181 ijertv6is030515. vol. 6 issue 03, march-2017, major findings from the said study, there was increase in CBR value as days of curing were increased. As per the paper 139.32% increase was observed at 28th day curing for treated soil when compared to the 0th day untreated.

3. Objectives:-

- To study change in the properties by stabilizing with Terrazyme.
- To optimize use of local materials in the design and construction of roads by improving their engineering properties..
- To optimize the quantity of Terrazyme to be used as a stabilizing agent.
- To increase the durability, strength and stiffness of soil, improve workability and constructability of the soil and reduce the plasticity index.

4. Methodology:-



4.1.Collection of materials :-

Soil Sample has been collected from different area in Pune city, the details of area from where soil sample collected are as: -

- **Sample-I** (Soil Sample Collected from Uruli Kanchan, is a village east from the city of Pune in the district of Pune, Maharashtra, India)
- **Sample-II** (Soil Sample Collected from Lohgaon is in northeast Pune, in the district of Pune, Maharashtra, India)
- **Terrazyme** (TerraZyme is a natural, non-toxic, liquid enzyme formulation that alters the physical and chemical features of soil, collected from Chennai, India)

4.2. Addition Of Terrazyme To Soil Samples:-

Calculation of Terrazyme Dosage:-

First we determine the properties like OMC of the local soil mixed with gravel.

Then taking the water content less than 1% of OMC for mixing the water with Terrazyme.

The OMC Of soil samples is found out to be:

1) Sample I [Uruli Kanchan]:14%

2) Sample II [Lohegaon]:10%

Then as per user manual of Avijeet Agency The local soil needs to be treated in the ratio of 200ml of TerraZyme for 2.2 Cu.mt of soil.

So for Sample I and Sample II the soil taken for testing purpose is 0.0063m^3.

Calculation for determining terrazyme content:

200ml converted to lit. for determining terrazyme in ml.

200ml. = 0.2lit.

2.2 cu.mt. for 0.2 lit.

so we have to find for 0.0063cu.mt. [Volume of tray]

(0.0063*0.2)/2.2=5.7ml

So terrazyme content we are going to use is 5.7ml for both the samples.

Water content that need to mix with terrazyme is found out as follows:

For sample I [Uruli Kanchan] (14-1=13)/100*27888=3625ml

For sample II [Lohegaon] (10-1=9)/100*27888=2509ml.

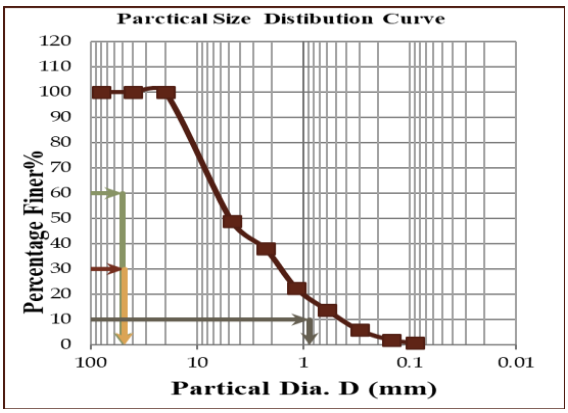
4.3. Basic Tests on Soil Samples:

Following test has been performed on the collected sample of soil from the above said region

- Grain size distribution
- Specific gravity
- Liquid limit
- Plastic limit
- Plasticity index
- Free swell index

- **TEST RESULTS ON TREATED SOIL SAMPLE:**

Sr. No.	Content	Sample1	Sample2
1.	Sieve Analysis		
2.	Specific Gravity	2.67	2.5
3.	Liquid Limit	40%	54%
4.	Plastic Limit	19.56%	35.73%
5.	Plasticity Index	20.44%	18.6%
6.	Free Swell index	77.8%	53.84%



- **TEST RESULT ON TREATED SOIL SAMPLE:**

1.Grain size distribution:

Observations of soil sample-I (Soil Sample Collected from Uruli Kanchan):-

Sieve size (mm)	Soil Retained (g)	Accumulative Retain (gm)	% of Mass retain	% Passing
80	0	0	0	100
40	0	0	0	100
20	0	0	0	100
4.75	520	520	50.96	49.03
2.3	110	630	61.75	38.24
1.18	160	790	77.43	22.56
0.6	90	880	86.25	13.74
0.3	80	960	94.09	5.90
0.15	40	1000	98.01	1.98
0.09	11.22	1011.22	99.11	0.88
Pan	9	1020.22		

Observations of soil sample-II(Soil Sample Collected from Lohegoan):-

Sieve size (mm)	Soil Retained (g)	Accumulative Retain (gm)	% of Mass retain	% Passing
80	0	0	0	100
40	0	0	0	100
20	0	0	0	100
4.75	240	240	22.85	77.14
2.3	140	380	36.19	63.80
1.18	437	817	77.80	22.19
0.6	80	897	85.42	14.57
0.3	52	949	90.38	9.61
0.15	88	1037	98.76	1.23
0.09	9	1046	99.61	0.38
Pan	4	1050		

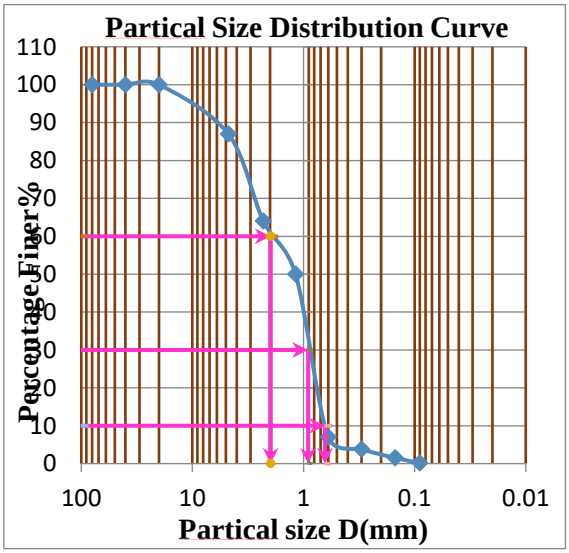
2. Specific gravity test:-

Observations of soil sample-I (Soil Sample Collected from Uruli Kanchan):-

Sr. No.	Observation	Readings (in gm)
1)	Mass of pycnometer	640
2)	Mass of pycnometer+ Dry soil	840
3)	Mass of pycnometer+ Dry soil + water	1620
4)	Mass of pycnometer +water	1470

Conclusory remarks:-

From the said test on soil sample we conclude that Specific gravity of soil sample I is 4.



Observations of soil sample-II(Soil Sample Collected from Lohegoan):-

Sr.No.	Observation	Readings (in gm)
1)	Mass of pycnometer	640
2)	Mass of pycnometer+ Dry soil	840
3)	Mass of pycnometer+ Dry soil + water	1610
4)	Mass of pycnometer +water	1470

Conclusory remarks:-

From the said test on soil sample we conclude that Specific gravity of soil sample I is 3.33.

3.Liquid limit:-

Observations of soil sample-I (Soil Sample Collected from Uruli Kanchan):-

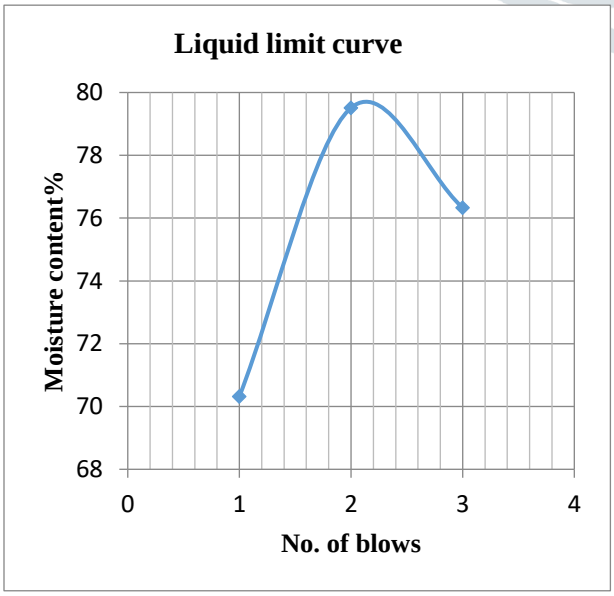
SR.NO	Observation	1	2	3
1)	Container no.	1	2	3
2)	No. of blows	102	340	118
3)	mass of empty container (m1)	38	38	38
4)	Mass of empty container + wet soil (m2)	53.18	64	62
5)	Mass of empty container + Dry soil (m3)	47.48	54.78	53.65
6)	Mass of water	5.7	9.22	8.35
7)	Mass of dry soil	9.48	16.78	15.65
8)	Moisture content	60.13	54.95	53.35

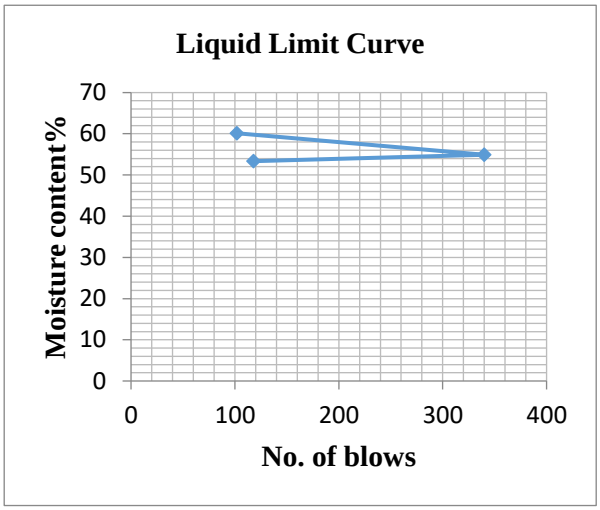
Conclusory remarks:-

From this test we conclude that liquid limit of soil sample I is 56.14%.

Observations of soil sample-II(Soil Sample Collected from Lohegoan):-

Sr.NO	Observation	1	2	3
1)	Container no.	1	2	3
2)	No. of blows	93	128	193
3)	mass of empty container (W1)	37	37	37
4)	Mass of empty container + wet soil (W2)	55.6	56.8	60.7
5)	Mass of empty container + Dry soil (W3)	47.92	48.03	50.44
6)	Mass of water	7.68	8.77	10.26
7)	Mass of dry soil	10.92	11.03	13.44
8)	Moisture content	70.32	79.51	76.33





Conclusory remarks:-

From the said test on soil sample we conclude that liquid limit of soil sample I is 75.38.

4.Plastic limit:

Observations of soil sample-I (Soil Sample Collected from Uruli Kanchan):-

Sr.No.	Observation	1	2	3
1.	Mass of Empty container (W1)	36.9	36.9	38.2
2.	Mass of Empty container + Wet soil (W2)	41.1	41.1	41.1
3.	Mass of Empty container + Dry soil(W3)	39.9	40.1	40.4
4.	Mass of soil	3	3.2	3.5
5.	Mass of water	1.2	1	0.7
6.	Moisture content	40%	31.25%	20%

Conclusory remarks:-
From the said test on soil sample we conclude that Plastic Limit of soil sample I is 30.41%

Sr.No.	Observation	Volume(in ml)
1.	The volume of the soil specimen read from the graduated cylinder containing distilled water (Vd)	7
2.	The volume of the soil specimen read from the graduated cylinder containing kerosene.	16

Observations of soil sample-II(Soil Sample Collected from Lohegoan):-

Sr.No.	Observation	Volume(in ml)
1.	The volume of the soil specimen read from the graduated cylinder containing distilled water (Vd)	8
2.	The volume of the soil specimen read from the graduated cylinder containing kerosene.	13

Sr. No.	Observation	1	2	3
1.	Mass of Empty container (W1)	38	38.4	37.3
2.	Mass of Empty container+ Wet soil (W2)	41.40	41.70	41.30
3.	Mass of Empty container+ Dry soil(W3)	40.52	40.78	40.25
4.	Mass of soil	2.25	2.38	2.95
5.	Mass of water	0.88	0.92	1.05
6.	Moisture content	34.92 %	38.65 %	35.6 %

Conclusory remarks:-
From the said test on soil sample we conclude that Plastic Limit of soil sample I is 36.39%.

5. Plasticity index:

Observations of soil sample-I (Soil Sample Collected from Uruli Kanchan):-

Sr.No.	Observation	Reading
1.	Plastic limit	30.41%
2.	Liquid limit	56.14%
3.	Plasticity index	25.73%

Conclusory remarks:
From the said test on soil sample we conclude that Plasticity index of soil sample I is 25.73%.

Observations of soil sample-II(Soil Sample Collected from Lohegoan):-

Sr.No.	Observation	Reading
1.	Plastic limit	36.39%
2.	Liquid limit	75.39%
3.	Plasticity index	39%

Conclusory remarks:-
From the said test on soil sample we conclude that Plasticity index of soil sample I is 39%.

6. Free swell index:

Observations of soil sample-I (Soil Sample Collected from Uruli Kanchan):-

Conclusory remarks:-
From the said test on soil sample we conclude that Free swell index of soil sample I is 56.25.

Observations of soil sample-II(Soil Sample Collected from Lohegoan):-

5. Results
1. We can see the results of specific gravity after adding terrazyme of 6ml for 7days curing becomes almost double. The result rise for sample I from 2.67 to 4 and for sample II 2.5 to 3.

2. Liquid limit shows results variation for sample I are from 40 to 56.14, and for sample II are from 54.33 to 75.38.

3. In Plastic limit results we can see increase in percentage of plastic limit. For sample I it increase from 19.56 to 30.41 means almost double the result percentage, and for sample II it increase from 35.73 to 36.39 it shows only slight changes in this sample.

4. As we previously seen as the liquid limit and plastic limit increase simulatanously Plasticity index is also increase.

5. We see the decrease in swelling properties of sample I and sample II. It decreases for sample I from 77.78 to 56.25 and for sample II 53.84 to 38.46.

Conclusion

As per the sample of soil collected from the region [**Sample I**: Soil sample I is collected from Uruli Kanchan. It is a village 33km east from the city of Pune in the district of Pune, Maharashtra, India and **Sample II**: Soil sample collected from Lohegaon is a neighbourhood in northeast Pune, in the district of Pune, Maharashtra, India.], we found that the test results obtained with and without addition of Terrazyme are different.

We have conducted 8 Nos. of tests on collected soil sample as per the test result obtained.

We have concluded that the properties of collected soil samples has been increased when we added the terrazyme. We have also conclude that the terrazyme reduces the void spaces in the soil and thus, increase in the compaction and the density of soil. And it decreases the swelling property . It also reduces the maintenance cost and increase the life cycle due to higher strength. Consistency limit and OMC soil is decreased due to action of Terrazyme.

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