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ANALYISIS OF PROPERTIES OF SOIL SAMPLES FROM DIFFERENT ZONES IN PUNE REGION AND EXHORTATION OF TERRAZYME AS A SOIL STABILIZER

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Abstract: The present study provides an effective technique of ground improvement using Terrazyme. Terrazyme is basically organic solution. This is produced by the chemical changes of fruit extracts, vegetable, sugar and water caused due to fermentation. Terrazyme is natural, non-toxic and liquid enzyme. Sugarcane extracts are been fermented for Terrazyme production. It can be used as a soil stabilizer. It can also improve the rate of stabilization of soil in various constructions. The Terrazyme is acidic in nature. The engineering properties of the soil show improvement upon the application of this bio-enzyme. Its amount of dose and type of soil available defines the extent of improvement in the soil sample.

Key Words: - Terrazyme, Atterberg limits, Free Swell Index, Sp. Gravity, Grain Size distribution

1. 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. Many researchers concentrated on improving the properties of expansive soil using traditional chemical stabilizers like lime and fly ash, since chemical stabilizers are mostly preferred to stabilize expansive soils. It is a proven fact that these stabilizers improve the engineering properties of expansive soil significantly. Since construction industry is growing in an exponential order, several other chemicals are commercially available which are used

during construction. One such chemical used for improvement is Terrazyme.

The terrazyme increase the wetting and bonding capacity of the soil particles when added to a soil. The terrazyme is customized in such a manner that it advances a chemical reaction within or between other molecules. However, there's no effect on terrazymes because of these reactions. The soil materials become more easily wet and more densely compacted with the effect of terrazyme. It creates a more permanent structure by improving the chemical bonding between soil particles that are more resistant to weathering, water penetration and wear and tear. Terrazyme's role mainly emphasizes strength, performance and higher resistance towards deformation. Its application requires dilution in water before it can be applied to the soil. The use of Terrazyme enhances the load bearing capacity of the soil. They have the ability to change the connective substance and texture of the soil so that after compaction the soil loses its ability to reabsorb water. Also, the mechanical benefits of compaction are not lost even after water is reapplied to the newly compacted soil.

2. Literature Review:-

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.

Stabilization of Black Cotton Soil Using Terrazyme © 2019 JETIR April 2019, Volume 6, Issue 4 (Issn-2349-5162), from this paper, The Terrazyme stabilization has shown little to very high improvement in physical properties of soils. This little improvement may be due to chemical constituent of the soil, which has low reactivity with Bio-enzyme. Therefore, it is advisable to first examine the effect of Bio-enzyme on soil stabilization in the laboratory before actual field trials.

An Experimental Investigation on Black Cotton Soil using Terrazyme IJE TRANSACTIONS B: Applications Vol. 34, No. 08, (August 2021) 1837-1844, from this paper we conclude that Laboratory experiments were performed on the black cotton soil with and without Terrazyme. Also an effort was made to explain the mechanism for improvements in the engineering properties of the black cotton soil.

3. Objectives:-

- To study the geotechnical properties of black cotton soil.
- To identify the effect of Terrazyme on the soil.
- To find optimum Terrazyme dosage required for selective soils.
- To compare the results obtained from the Terrazyme with virgin soil

4. Methodology:-

STEP 1: PROCUREMENT OF MATERIALS

STEP 2: BASIC TEST ON BLACK COTTON SOIL

i)GRAIN SIZE DISTRIBUTION
ii)SPECIFIC GRAVITY

iii)ATTERBERG LIMITS

iv)FREE SWELL INDEX

STEP 3:RESULT

STEP 4: CONCLUSION

5. Procurement 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 33 km east from the city of Pune in the district of Pune, Maharashtra, India)
- **Sample-II** (Soil Sample Collected from Lohgaon is a neighbourhood 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)

6. 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

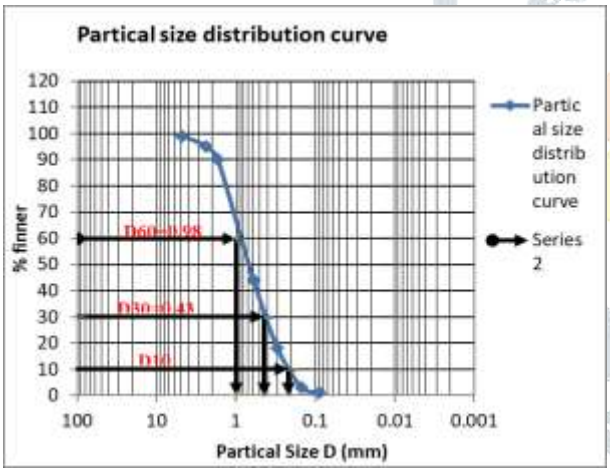
- Plasticity index
- Free swell index

6.1 Grain size distribution:

The grain size analysis test is performed to determine the percentage of each size of grain that is contained within a soil sample, and the results of the test can be used to produce the grain size distribution curve.

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

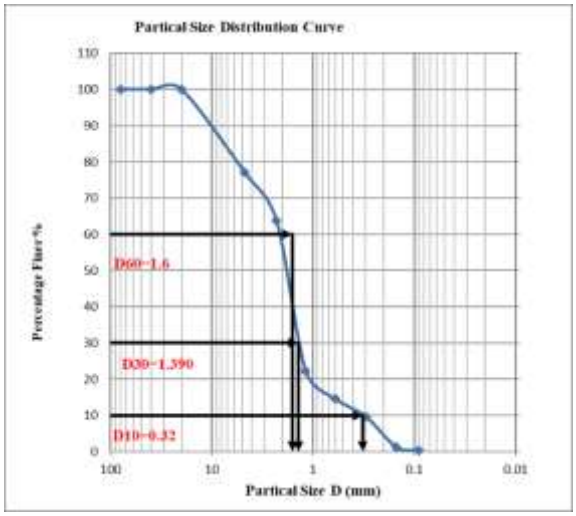
Sieve size	Soil Retain (g)	Accumulative Retain (gm)	%of Mass retain	% Passing
4.75	10	10	1	99
2.36	40	50	5	95
1.7	50	100	10	90
0.6	460	560	56	44
0.3	260	820	82	18
0.15	150	970	97	3
0.09	20	990	99	1
Pan	10	1000		



Conclusory remarks: - From the above graph we can conclude that soil sample-I is well graded soil.

Observation of soil sample-II (Soil Sample Collected from Lohgaon):-

Sieve size	Soil Retained (g)	Accumulative Retain (gm)	%of Mass retain	% Passing
4.75	240	240	22.85	77.14
2.36	140	380	36.19	63.80
1.7	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		



Conclusory remarks: - From the above graph we can conclude that Soil sample- II is of well graded soil.

6.2 Specific gravity test:-

We have performed the specific gravity test as per IS: 2720 (Part 4) – 1985. The specific gravity (Gs) of a material is the ratio of the mass of a unit volume of soil solids at a specific temperature to the mass of an equal volume of gas-free distilled water at the same temperature.

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	1040
3)	Mass of pycnometer+ Dry soil + water	1720
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 2.67.

Observation of soil sample-II (Soil Sample Collected from Lohgaon):-

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	1590
4)	Mass of pycnometer +water	1470

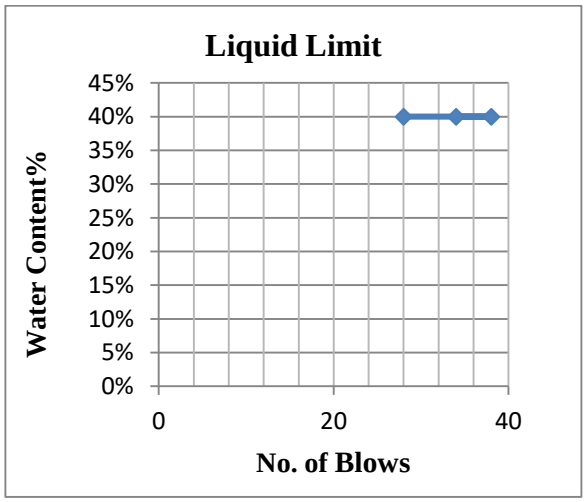
Conclusory remarks:-
From this test we conclude that the Specific gravity of soil sample II is 2.5.

Image: - Pycnometer

6.3 Liquid limit test:-
We perform liquid limit test as per IS 2720-5 (1985): Methods of test for soils, Part 5. Liquid limit is the water content where the soil starts to behave as a liquid.

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

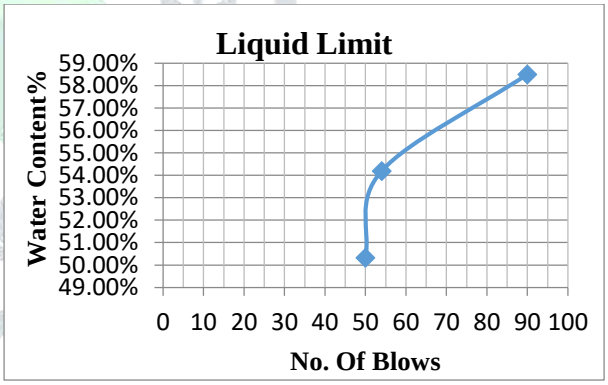
Sr. No.	Observation	1	2	3
1)	Container no.	1	2	3
2)	No. of blows	28	38	34
3)	Mass of empty container (m1)	40	40	40
4)	Mass of empty container +Wet soil(m2)	80	80	80
5)	Mass of empty container +Dry soil (m3)	65	65	65
6)	Mass of water	10	10	10
7)	Mass of Dry soil	25	25	25
8)	Moisture content	40%	40 %	40%



Conclusory remarks:-
From this test we conclude that liquid limit of soil sample I is 40%.

Observation of soil sample-II (Soil Sample Collected from Lohgaon):-

Sr. No.	Observation	1	2	3
1)	Container no.	1	2	3
2)	No.of blows	90	54	50
3)	Mass of empty container (m1)	37	40	50
4)	Mass of empty container +Wet soil(m2)	48.50	72.6	90.2
5)	Mass of empty container +Dry soil (m3)	44.27	61.2	70.1
6)	Mass of water	4.23	11.4	10.1
7)	Mass of Dry soil	7.23	21.2	20.1
8)	Moisture content	58.50 %	54.1 9%	50.3 2%



Conclusory remarks:-
From this test we conclude that liquid limit of soil sample II is 54.33%.

Image: - casagrande Apparatus

6.4 Plastic limit test:

We perform plastic limit test as per IS: 2720 (Part-5) 1985.The plastic limit of a soil is the moisture content, expressed as a percentage of the weight of the oven-dry soil, at the boundary between the plastic and semi-solid states of consistency.

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

Sr. No.	Observation	1	2	3
1)	Mass of Empty container	35.72	37.26	37.36
2)	Mass of Empty container+ Wet soil	40.2	41.99	42.06
3)	Mass of Empty container+ Dry soil	39.40	41.31	41.30
4)	Mass of soil	3.68	3.98	3.94
5)	Mass of water	0.80	0.68	0.76
6)	Moisture content	21.73 %	17.68 %	19.28 %

Conclusory remarks:-

From this test we come to conclude that Plastic limit of soil sample I is 19.56%.

Observation of soil sample-II (Soil Sample Collected from Lohgaon):-

Sr. No.	Observation	1	2	3
1)	Mass of Empty container	35.72	37.26	37.36
2)	Mass of Empty container+ Wet soil	40.65	43.64	42.80
3)	Mass of Empty container+ Dry soil	39.40	42.24	41.30
4)	Mass of soil	3.68	3.98	3.94
5)	Mass of water	1.25	1.40	1.50
6)	Moisture content	33.96 %	35.17 %	38.07 %

Conclusory remarks:-

From this test we conclude that plastic limit of soil sample II is 35.73%

6.5 Plasticity index:-

We determine plasticity index from liquid limit and plastic limit results. Plasticity Index (Ip) of a soil is the numerical difference between its Liquid Limit and its Plastic Limit.

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

Sr.No.	Observation	Reading
1)	Plastic limit	19.56%
2)	Liquid limit	40.00%
3)	Plasticity index	20.44%

Conclusory remarks:-

From this test we found that plasticity index of soil sample I is 20.44

Observation of soil sample-II (Soil Sample Collected from Lohgaon):-

Sr.No.	Observation	Percentage
1)	Plastic limit	35.73%
2)	Liquid limit	54.33%
3)	Plasticity index	18.6 %

Conclusory remarks:-

From this test we found that plasticity index of soil sample II is 18.6%

6.6 Free swell index test

We performed free swell index test as per IS: 2720 (Part XL)-19771. Free swell is the increase in volume of a soil, without any external on straints, on submergence in water. The possibility of damage to structures due to swelling of expensive clays need be identified, at the outset, by an investigation of those soils likely to possess undesirable expansion characteristics.

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

Sr.No.	Observation	Volume (in ml)
1)	The volume of the soil specimen read from the graduated cylinder containing distilled water (Vd)	16
2)	The volume of the soil specimen read from the graduated cylinder containing kerosene	9

Conclusory remarks:-

From this test we conclude that Free swell index of soil Sample I is found to be 77.78%.

Observation of soil sample-II (Soil Sample Collected from Lohgaon):-

Sr.No.	Observation	Volume (in ml)
1)	The volume of the soil specimen read from the graduated cylinder containing distilled water (Vd)	20
2)	The volume of the soil specimen read from the graduated cylinder containing kerosene	13

Conclusory remarks:-

From this test we conclude that Free swell index of soil Sample-II is found to be 53.84%.

Image: - Measuring Cylinder

7. Results

1. The result of grain size distribution of soil sample I and soil sample II is well graded curve of soil.
2. The result of Specific gravity obtained from two soil samples are 2.67 and 2.5. From this result we can say that soil is having low load bearing capacity.
3. The result of liquid limit obtained from two soil samples are 40% and 54.33%. We can say that soil has high swelling potential.
4. The result of Plastic limit obtained from two soil samples are 19.56% and 35.73%. This can say that soil is highly plastic.
5. The result of Plasticity index obtained from two soil samples are 20.44 and 18.6. This can say that soil is less compressible.
6. The result of free swell index test obtained from two soil samples are 77.78% and 53.84 %. From this result we can conclude that this soil sample has very high degree of expansiveness.

Conclusion

We come to conclude that these two soil sample are compressible has clayey texture and highly fertile, which is acceptable for the agricultural purpose. The Zone from where we have collected the soil samples need to improve the stability of soil for the purpose of construction.

We can use Terrazyme to enhance the properties of soil, which enhance the quality of roads too. When TerraZyme is added to soil, it catalyzes the breakdown of organic materials and increases the wetting and bonding capacity of the soil particles.

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4. IS: 2720 (Part XL)-1971: "Determination of Free Swell index."

Links:-

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https://www.sciencelearn.org.nz/resources/957-soil-properties

https://stormwater.pca.state.mn.us/index.php?title=Soil_physical_properties_and_processes

https://landresources.montana.edu/swm/documents/Final_proof_SW1.pdf