STABILIZATION OF BLACK COTTON SOIL BY USING BIO-ENZYMES

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Abstract:

Engineers are responsible for selecting or specifying the correct stabilizing method, technique and quantity of material required. The key to success in soil stabilization is soil testing. The method of soil stabilization selected should be verified in the laboratory before construction and preferably before specifying or ordering materials. Various techniques are being used for stabilization of soil. Stabilization of soil with Bio-Enzyme is an innovative method to improve the geotechnical properties of the soil. The Bio-Enzyme when added to water and mixed with soil alters the engineering properties depending upon the type of the soil and dosage of enzyme. These enzymes are liquid additives, which act on the soil to reduce the voids between soil particles and minimize absorbed water in the soil for maximum compaction. The enzymes react with the organic matter (humid matter) in the soil to form cementatious material. This reaction commences almost immediately and it is verified that under the right environmental conditions about 90% of the reaction may be complete within the first 96 hours. Initial reaction product is a formation of a gel, which crystallizes to form bonds, which hold together particles. Loss of moisture by evaporation is essential for the crystallization of gels. The reaction is at micron level and the presence of finely divided humid matter and clay -sized particles is essential. Presence of clay is essential as the bonds formed bind this size of particles. In this present project, the effectiveness of bio-enzyme in stabilizing the high swelling soil was investigated through laboratory experiments. These tests have been conducted with different curing period and with different dosages of enzyme. The laboratory tests have shown much improvement in its fatigue behaviour. To verify the laboratory results, field study has been done by construction a stretch of flexible pavement with enzyme stabilized soil as sub base. Its long term effect on CBR strength is also evaluat ed by conducting the field test at regular interval after the road is open to the traffic. The field results have shown promising results in terms of strength of the stabilized soil. The road stabilized with Bio -Enzyme after one year clearly indicates the effectiveness of Bio- Enzyme as a stabilizing agent. The locally available high swelling soil was procured from the field

and was used for the investigation. Bio -Enzyme namely TerraZyme has been used as stabilizer.The soil was tested for geotechnical properties and treated with variable enzyme dosages. The tests were carried out to determine the consistency limits ,Stanadard Proctor Test,specific gravity and California Bearing Ratio.

INTRODUCTION:

Engineers are often faced with the problem of constructing facilities on or with soils, which do not possess sufficient strength to support the loads imposed upon them either during construction or during the service life of the structure. Many areas of India consist of soils with high silt contents, low strengths and minimal bearing capacity. These negative soil performance characteristics are generally attributed to the nature and quantity of the fines present in the material. For better performance of structures built on such soils, the performance characteristics of such soils need to be improved. The poor engineering performance of such soils has forced Engineers to attempt to improve the engineering properties of poor quality soils. There are various methods that could be used to improve the performance of poor quality soils. These methods range from replacing with a good quality soil to methods that involve complex chemical process. The choice of a particular method depends mainly on the type of soil to be improved, its characteristics and the type and degree of improvement desired in a particular application. 1.2 SOIL STABILIZATION Soil stabilization is the permanent physical and chemical alteration of soil properties to improve their engineering performance. Stabilization can increase the shear strength of a soil and control the shrink-swell properties of a soil, thus improving the load bearing capacity of a sub-grade to support pavement and foundations. Stabilization can be used to treat a wide range of sub-grade materials from expansive clay to granular materials. It should be noted that Soil Stabilization is only one of several techniques available to the geotechnical engineer and its choice for any situation should be made only after a comparison with other techniques which indicates it to be the best solution to the problem. In every site feasibility study the main geotechnical design criteria that have to considered during site selection

OBJECTIVES:

1.Design load and function of the structure.

2.Type of foundation to be used.

3. Bearing capacity of soil 2 Soil stabilization Methods Soil stabilization aims at improving soil strength and increasing resistance to softening by water through bonding the soil particles together, water proofing the particles or

combination of the two. Usually, the technology provides an alternative provision structural solution to a practical problem. The simplest stabilization processes are compaction and drainage (if water drains out of wet soil it becomes stronger). The other process is by improving gradation of part icle size and further improvement can be achieved by adding binders (additives) to the weak

MATERIALS AND METHODOLOGY:

Materials Black Cotton Soil

The required amount of soil is collected from the trial pit at a depth of 3.5m below the ground level, since the top soil is loose and is likely to contain organic matter and other foreign materials. Sufficient care has been taken to see that the collected soil samples are fairly homogeneous. The soil so obtained is air dried, crushed with wooden mallet and passed through 4.75mm sieve. This soil so obtained is kept in polythene bags and stored in steel drum for further testing. The 'Soil' is classified as 'SC' (Clayey Sand) as per I.S .Classification (I.S. 1498:1970) indicating that it is Sand with inorganic Clay. Its degree of expansiveness is high based on Liquid Limit, Plasticity Index and Free Swell Index

Fig:-1 black cotton soil

TerraZyme TerraZyme is a natural, non-toxic liquid, formulated using vegetable extracts. Apart from being a concept accepted the world over as a sound and resourceful road building practice, which completely replaces the conventional granular base and granular sub-base, it emphasizes on strength, performance and higher resistance towards deformation. Organic Enzymes come in liquid form. They are perfectly soluble in water brown in colour and smell of molasses. The specific weight is similar or equal to that of water. The pH level is between 4.3 and 4.6. Their aroma has no effect. There is no risk of decay. The enzymes react with oxidizing agents. TerraZyme is specially formulated to modify the engineering properties of soil. Once the enzyme reacts with the soil, the change is permanent and the product is bio - degradable

• It facilitates higher soil compaction densities, and increases soil strength and stability for lasting roads.

• TerraZyme replaces Soling and WBM of conventional road structure.

• TerraZyme also reduces the crust thickness of asphalt layers. TerraZyme also proves t o increase the road quality and decreases the maintenance

Fig 2 terrazyme

METHODOLOGY:

• First we have collected the black cotton soil from selected area.

• After, we purchased some quantity of bio-enzyme from market.

• Then we made preliminary test for black cotton soil without addition of bio enzyme.

• The terrazyme is mixed with water depending on the optimum moisture content of soil.

• Then we mixed black cotton soil with different dosages of terrazyme and tests are carried out.

FLOW CHART

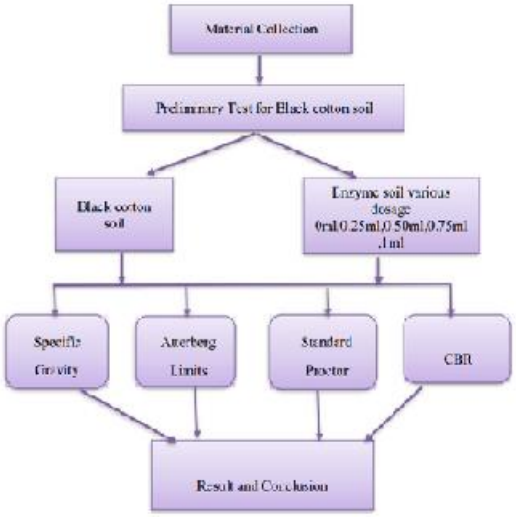
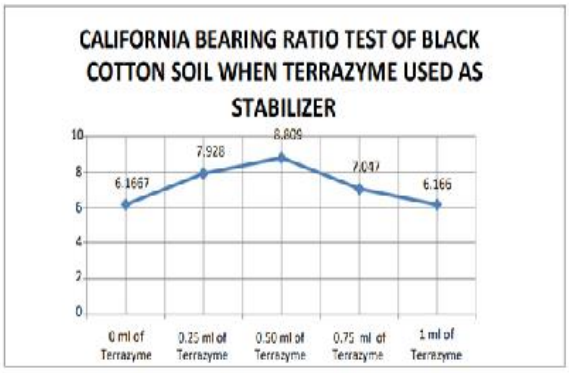


Fig 3 flow chart

RESULTS:

1 ML OF TERRAZYME

S.NO	DISPLACEMENT GAUGE(MM)	PENETRATION GUAGE (KN)	CONSTANT VALUE	CBR VALUE
1	0.5	4	0.0592	24.138
2	1.0	6	0.0592	36.207
3	1.5	8	0.0592	48.277
4	2.0	10	0.0592	60.346
5	2.5	14	0.0592	84.485
6	3.0	16	0.0592	96.554
7	4.0	18	0.0592	108.623
8	5.0	20	0.0592	120.693
9	7.5	22	0.0592	132.762
10	10.0	24	0.0592	144.831
11	12.5	24	0.0592	144.831
12	15.0	24	0.0592	144.831



graph: 1 california bearing ratio test of black cotton soil when terrazyme used as stabilizer

CONCLUSION :

1. silty soil to sandy soil, the effect of stabilization has improved the CBR and unconfined compression strength. Pavement design thickness also reduces to 25 to 40 percent. Moreover, in case of scarcity of granular material, only stabilized surface with thin bituminous surfacing can fulfil the pavement design requirement with more than 10 percent saving in cost component.

2. In the present As a result of soil stabilization, the bearing capacity of the foundation of the structure is increased and its strength, water tightness, resistance to washout, and other properties are improved. Soil stabilization is widely used in the construction on sagging soils of industrial and civil buildings.

3. 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. In some cases where the soil is very weak like highly clay to moderate soil, like study various geotechnical experiments were performed on virgin soil and enzymatic soil.

4. Bio- Enzymatic soil showed significant improvement in consistency limits, standard proctor test, unconfined compressive strength and California bearing ratio of local soil with different dosages. Duration of treatment of Bio-Enzymatic soil played a vital role in improvement of strength

FUTURE SCOPE:

This study can be extended further as mentioned below for understanding

• The behaviour of enzymatic soil.

• The effect of Terrazyme on soil with different dosages and in different Stabilizing periods.

• The effects of other types of Bio-Enzymes can be investigated.

• Effect of Terrazyme can be studied on blended soil.

• More geotechnical parameters e.g. Permeability test, direct shear box test, specific gravity and dynamic behaviour of soil can be studies to understand the

• Modification or improvement of geotechnical properties of s

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