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STUDY ON PROPERTIES OF BLACK COTTON SOIL USING TERRAZYME AS A STABILIZATION AGENT

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ABSTRACT

Performances of any civil engineering projects depend upon underlying soils below it. In case of expansive soils, they cause serious damage to the superstructure constructed above it due to its engineering properties. These soils are highly sensitive to moisture with respect to shear strength, settlements and deformations. So it is necessary to modify these engineering properties before starting any constructional activity. The process of modifying these physical/ chemical properties is called stabilization. There are various methods available for stabilizing soils, generally cement, lime, fly ash, Enzyme, TerraZyme etc. are used as a stabilizing agents for black cotton soils. Stabilization of these soils using Terrazyme is one of the best method in recent. TerraZyme is eco-friendly liquid additives that acts on the soil to reduce the voids between soil particles and minimize absorbed water in the soil. In this study, black cotton soil was collected from various regions of newly formed Telangana State, India is stabilized using Terrazyme. Due to rapid industrialization, availability of land is depleting day by day, Because of this scenario it is required to utilize the problematic land for various developmental activities. By modifying these Geo-technical properties with various dosages of TerraZyme with different duration's stabilization had done. It has observed that there is a significant improvement in index properties of soil for e.g. Specific gravity, Plasticity index, Optimum Moisture Content and Maximum Dry Density after stabilization. From this study the optimum dosage of TerraZyme considered for stabilization was 0.5ml for 100ml of water.

I. INTRODUCTION

Soil is an important material in all civil engineering projects, the performance of any building, dam or roads depends on the strength of soil upon which it is built. A subgrade that can transfer huge loads without excessive deformation is considered good and stronger. One of the major problems which civil engineers confront during a project is the poor quality of sub soil. It may not be possible to replace subsoil all the time. By modifying its subsoil by stabilization could solve construction cost and materials availability issues (Degirmenci et al., 2007). In Telangana many areas consist of soils having high clay contents, low shear strength and minimum bearing capacity Suresh and Padmavathi (2009). These soils always create serious problem during construction of major projects. Because of this scenario it is required to utilize the problematic land for various construction activities.

Terrazyme is a liquid enzyme that stabilizes the soils and enhances the properties of the soil significantly (Rajoria and Kaur, 2014; Saini et al., 2015). In this study, black cotton soil collected from various regions of Telangana state are mixed with various dosages of stabilizing agent TerraZyme and their specific gravity, optimum Moisture content and Maximum Dry Density. It is observed from the results that there is a significant improvement in index properties after adding these stabilizing agents with time.

The selection and preparation of materials and the process of stabilization are explained in the next section. Detailed accounts of the testing procedures are also presented in this paper. Results and discussion are clearly explained in the last section of this paper.

II. TERRAZYME

TerraZyme is a natural obtained non-toxic liquid, formulated using vegetable extracts (Gayatri and Shyla, 2016). Generally it is used for modifying the geotechnical properties of soil, initially TerraZyme is diluted in water and

mixed with soil. TerraZyme reacts with the adsorbed water layer of clay particle and reduces the thickness around the soil particle due to which void between the soil particles reduces and the soil particle gets closer orientation with lower compactive effort. This decreases the swelling capacity of the soil particles and also reduces permeability. This formulation has the ability to change the shear strength characteristic of the soil so that after compaction the soil loses its ability to reabsorb water and the mechanical benefits of compaction are not lost even after water is reapplied to this soil. Once the enzyme reacts with the soil, the change is permanent and the product is biodegradable. The properties of TerraZyme are presented in Table 1.

Table 1: Properties of TerraZyme

Property	Value
Specific gravity	1.00 -1.09
pH Value	3.10-5.00
Appearance/ Colour	Liquid/ Brown
Boiling Point	2120F
Solubility	Yes
Flammability	No

Specific gravity:

Specific gravity is an important index property of soils which is relatively important as far as the qualitative behavior of the soil is concerned and useful in soil mineral classification, for example iron minerals have a larger value of specific gravity than silica (Eusterhues et al., 2005). It gives an idea about suitability of the soil as a construction material; higher value of specific gravity gives more strength for roads and foundations. It is also important in calculation of void ratio, porosity, degree of saturation and other soil parameters. In this study specific gravity of Soil is determined using Pycnometer.

There are a total four sets of 0, 25ml, 50ml, 100ml TerraZyme proportions are mixed with collected black cotton soils and their specific gravity are determined. These results are shown in the Figure 1 below. At 0.5 ml TerraZyme, this soil is providing us optimum specific gravity which is 2.049.

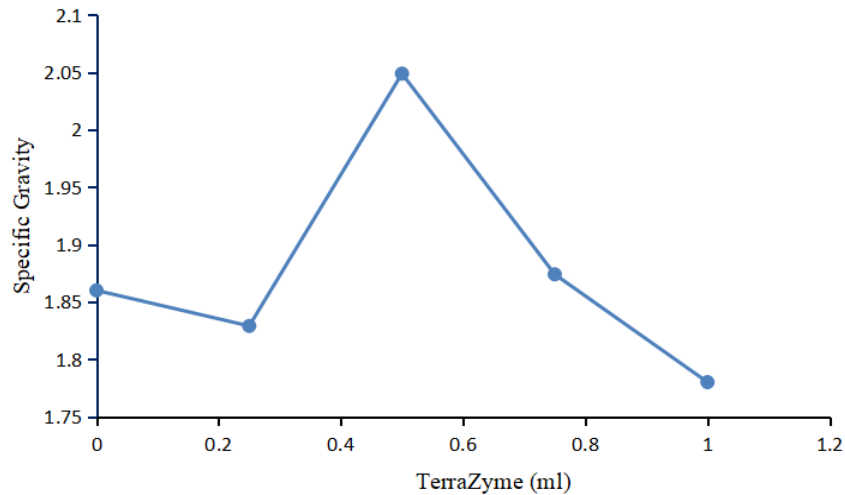


Figure 1: Specific gravity variations of considered soil with TerraZyme dosages

Plastic Index (PI)

Plasticity index is the size of the range of water contents where the soil exhibits plastic properties, which measure of the plasticity of a soil, it is the difference between the liquid limit and the plastic limit ($PI = LL - PL$). Soils with a high PI tend to be clay, those with a lower PI tend to be silt, and those with a PI of 0 tend to have little or no silt or clay. PI is used to relate to that how expansive the clays were. A PI lower than 20 are generally in a safe area, but higher than this value would have swelling conditions. It gives clear indication for swelling and shrinkage of soils which will result in the wetting and drying. For calculation of Plastic Index, Liquid limit and Plastic limit values are need, for this purpose LL and PL tests are conducted in lab by mixing TerraZyme in the soil there are total four sets of 0, 25ml, 50ml, 100ml TerraZyme proportions are mixed with soils and their LL and PL are determined.

Liquid Limit (LL):

The liquid limit is the water content at which the soil behaves practically like a liquid, but has small shear strength. It flows to close the groove in just 25 blows in Casagrande's liquid limit device. In this study Casagrande's liquid limit device is used for calculation of LL values and results are shown in Figure 2.

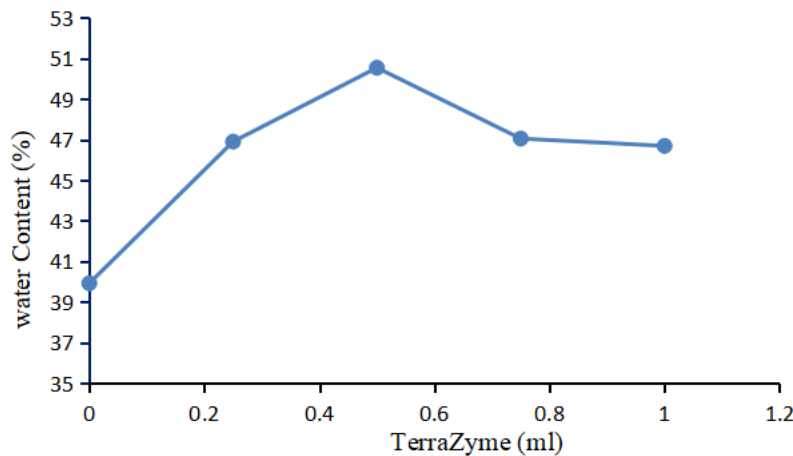


Figure 2: Liquid limit variations for soil with variations of TerraZyme

Plastic Limit (PL):

The plastic limit of a soil is the moisture content at which soil begins to behave as a plastic material. At this water content (plastic limit), the soil will crumble when rolled into threads of 3.2mm(1/8in) in diameter. Rolling Device Method procedure is used for calculation of plastic limit and results are presented in Figure 3.

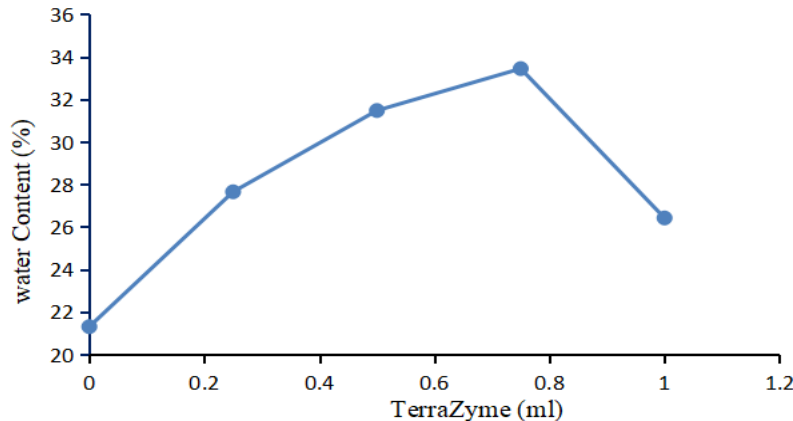


Figure 3: Plastic limit variations for soil with variations of TerraZyme

After calculation of liquid limit (LL) and Plastic limit (PL) for total four sets of 0, 25ml, 50ml, 100ml of TerraZyme proportions, using this expression ($PI = LL - PL$) PI is calculated and shown in the Figure 4, from these results at 0.75 ml PI is reduced drastically and observed it in the safe zone.

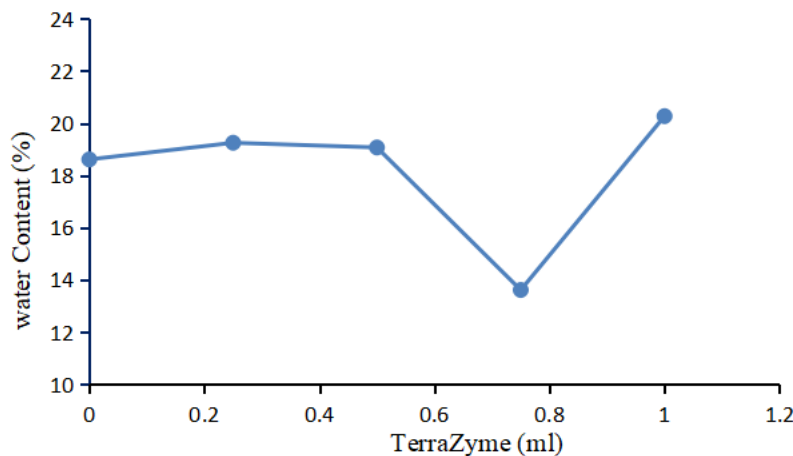


Figure 4: Plastic index variations of the soils

Proctor Compaction Test:

It is a laboratory method of experimentally determining the optimal moisture content at which a given soil type will become most dense and achieve its maximum dry density. It shows that the dry density of a soil for a given compactive effort depends on the amount of water the soil contains during soil compaction. In this study a total 4 sets of samples prepared 0, 25ml, 50ml, 100ml respectively, In each set again moisture content with respect to dry density is determined using standard proctor compaction test. It was observed that at 20% Optimum moisture content (OMC) maximum dry density is observed and these results are shown in Figure 4. A part from this a comparison is done with in these 20% moisture content ranges. It was observed that at 0.25ml TerraZyme is proving more density and this is shown in Figure 6

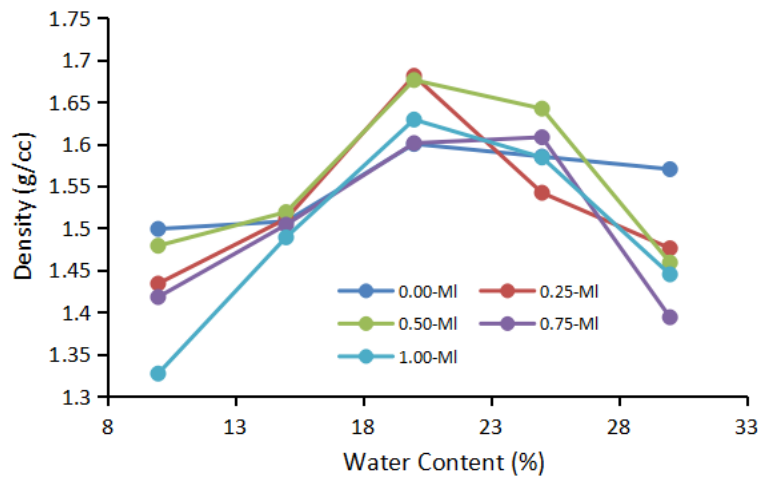


Figure 5: OMC variations of the considered soil with variations in TerraZyme dosages

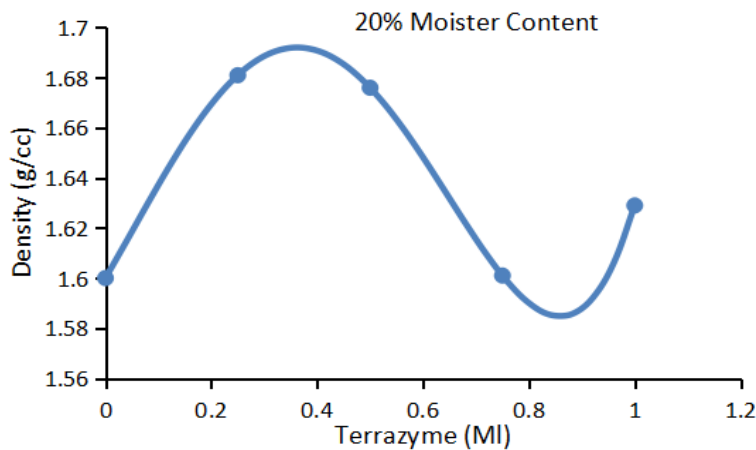


Figure 6: Dry density obtained variations of the considered soil with variations in TerraZyme dosage

III. RESULTS AND DISCUSSIONS

The overall testing programs were conducted black cotton soil was mixed with TerraZyme with different dosages i.e. 0.25 ml per 100 ml, 0.50 ml per 100 ml, 0.75 ml per 100 ml, and 1 ml per 100 ml was mixed subjected to various tests as mentioned. Soils collected from various regions of Telangana are stabilized Specific gravity, plastic index, OMC has studied. The test results indicated that TerraZyme as a stabilization agent will improves these properties of consider black cotton soils to a great extent. TerraZyme stabilized with 0.25Ml is providing Maximum density. Where as at 0.75 ml per 100 ml of water is providing less plastic index (i.e. Swelling), and at 0.5ml specific gravity is maximum. Over all in all the tests TerraZyme is providing great improvement.

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