TO ANALYZE THE STANDARD PROCTOR TEST ON BLACK COTTON SOIL STABILISATION USING SOME CHEMICALS USED FOR ROAD BUILDING

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ABSTRACT

The black cotton soil is a form of soil that expands rapidly and begins to inflate when it gets moist. Because of this, the soil's strength and several other attributes are severely lacking. ' With varied quiet stabilizers, expansive soil behaves in an unexpected way. Soil stabilization is also a method for treating soil in order to care for, change, or enhance soil performance. In this study we have discussed about the stabilization, need for stabilization, black cotton soil, properties of black cotton soil, terrazymeasaB.Csoil stabilizer in road construction, standard proctor test for soil which conclude that in addition to reducing swelling, Hypo sludge and Terrazyme strengthen black cotton soil, making it an excellent Sub-base for a road pavement construction.

Keywords: Black cotton soil, stabilize, standard proctor, road building

INTRODUCTION

Good roads are needed because of the growing population which necessitates better and more efficient vehicle operation, which necessitates well-maintained and conditioned roadways. As a result of silty, weak soils and inadequate carrying capacity in many parts of India, the underlying soils are weakened over time. Unstable soils are a constant trencher, and they may cause significant issues for the pavement or for the building structure. Toxic soils are chemically transformed into useable construction materials by the application of lime and cement treatment. Pavement systems may, in fact, influence the structural strength of stable soils. There is less use of treatment for drying and changing soils. It establishes a construction platform or a temporary road for the purpose of building. A bigger treatment, backed by testing, design, and suitable building procedures, is needed to ensure that soils remain stable over time. Before beginning any building, the project's designs and specifications must be finalized. Motorway pavement specifications will take into consideration traffic volumes, weather conditions, the location, and material needs. For all structural designs, laboratory testing and cost- effective designs should be used to justify the design. A highway is a public route that connects two or more destinations. The terms "highway system," "highway transport

network," and "highway transport system" all refer to a network of interconnected roads. A look at the development of roads across time offers us a sense of the past. Roads in Rome were built on aenormous scale and extended in all directions to assist military activities. Because of this, they are considered pioneers in the road building. Macadam construction, bituminous concrete, and cement are the most notable advances in urban roadways. A variety of cutting-edge and cost-effective housing technologies are being implemented.

Necessity For Stabilization

- It is the long-term physical and chemical change of soils to improve their physical qualities.
- A permanent reduction in the soil's permeability to water may be achieved by the use of shear and UCS improvements.
- Stabilization of the soil aids in increasing the current soil's strength and, as a result, the structure's ability to handle more weight.
- The foundation's bearing capacity, strength, water tightness, and resistance to washout are all improved by soil stabilization.

Black Cotton Soil

Water is able to be captivated by minerals like clays found in black cotton soils. They expand in size as they take in water. Because of the amount of water they ingest, their volume will grow. This change in volume is strong enough to cause damage to a building or other structure. After drying off, black cotton soils will shrink. It's possible that buildings or other structures might collapse as a result of this shrinking. Fissures in the soil are also possible. When rainy circumstances or runoff occur, these fractures will allow water to penetrate deep into the ground. Repetitive stress is placed on tissues as a result of this cycle of shrinking and swelling. As a result of their small size and positive ions, swelling clay-rich soils are particularly water- retentive. Swelling clay soils have a higher affinity for water because of their tiny size and the presence of specific ions.

Characteristics of Black Cotton Soil

Mineral research shows that Black cotton soil has a high concentration of montmorillonite. Having a large proportion of montmorillonite increases the expansiveness of the rock. Cracks develop in the soil without notice because of these properties. Typically, these fissures may be as large as 1/2" and as deep as 1/2" broad and 12" deep. As a result, if the weather changes, a structure built on this soil might sustain significant damage.

In order to adequately stabilize road bases for large wheel masses on black cotton soils, it is necessary to combine lime and cement, since the increase in lime content reduced the malleability index and linear shrinkage. These findings are compared to those previously obtained from African and Indian black cotton soils.

LITERATURE REVIEW

Athira S, B K Safana (2017)The Department of Civil Engineering. Better and more efficient automobile operations have necessitated the construction of better and more efficient roads. The sub-base acts as a stress-transmitting medium and distributes the wheel load so that shear and accumulated deformation are prevented. Soil from Aduvaserry in Ernakulam district was combined with

Terrazyme in varied doses and curing periods to evaluate the impact on the soil. Terrazyme has been shown to have a considerable influence on soil Unconfined compressive strength (UCC) and California bearing ratio (CBR).

Nandini D N, Y Ramalinga Reddy (2010)This study describes a project to improve the subgrade soil's strength characteristics. Lithomarge soil covers the majority of Dakshin Kannada. The soil's engineering qualities are so poor that it is unsuitable for building roads. Using bio enzymes and hypo sludge to stabilize soil is the primary goal of this research. When combined with soil, bio enzymes are plant extracts that have a high strength value. 2 percent, 4 percent, and 6 percent hypo sludge is put to the soil. UCC tests are performed on both untreated and additive-treated soils after 0, 7, 14, 21 and 28 days of curing. When it comes to both soaking and not soakingCBR testing, the same doses are used. We can determine the optimal additive concentrations by looking at the findings of UCC and CBR analysis. A study found that compression and CBR values of soil treated for compactionwere much higher than those of untreated soils.

METHODOLOGY

The combinations of terrazyme 0.25 ml, 0.5 ml, 0.75 ml, 1 ml,

and 1.25 ml and Hypo-sludge of 10%, 20%, 30%, 40%, and 50% were used in the investigation. Particle size distribution and specific gravity measurements, compaction tests, unconfined compressive strength tests and the California Bearing Ratio measurements were among the terrazyme samples tested for physical qualities in this research. Based on IS 1377:1990, all of the testing was completed.

TerrazymeasAB.C soil stabilizer in road construction

Terrazyme stabilisation of base and sub-base soils used in pavement construction is made possible by Bio-road products, an important fermentation and formulator of soil treatment solutions. Terrazyme stabilisation has shown to be strong when the soil includes a significant remarkable grained component based on extensive international experience. Smooth sands and gravels see little to no growth at all, if any at all. Toll road managers in the United States discovered that using appropriately graded aggregates and higher clay concentrations (2 percent to 15 percent < 0.002mm) resulted in remarkable universal overall performance while testing Terrazyme's performance on over 40 miles of avenue surface. Cat ion exchange, clay water and Terrazyme stabilising effects may be found in Bioroad products. Aside from municipal, state and a few federal projects, Terrazymes are definitely being employed in the non-public sector in Brazil. Application criteria for the selection of materials for road manufacture have been developed based on laboratory and field testing, with the result that manufacturing materials currently meet those requirements. Natural, non-toxic biodegradable liquid pay attention Terrazyme from Australia may be mixed with water for large water spraying devices without difficulty. Bio- Terrazyme is a low-cost supplement that has long-term benefits. Bio-Terrazyme improves the soil's physical and chemical properties, resulting in improved performance and a longer lifespan for products treated with it. You may raise the MOD and Bio-Terrazyme was used to calculate the UCS values of a marginal material. Terrazyme, a product made in the Netherlands and the United States, may raise the California Bearing Ratio (CBR) of sub-grade soil. Terrazyme stabilised 2 soil components such as sandy clay, silty clay, sandy silt, plastic clay, non-plastic clay, sandy loam, particularly good

Black Cotton Soil's properties:

loam, and loam combined with clay during testing. DependiAngtt Atterberg's limitations are utilized to compute the plasticity

on the soil type, soil inclinations, and product attention, the Terrazyme dose levels vary from 1 to 5 liters per 5 m3 of soil. The amount of water needed for dilution depends on how dry the soil is. It's important to know the difference between actual soil moisture content (percent) and the maximum reliable moisture level (percent) to apply water for maximum compaction in the field. Terrazyme stabilizers have lower use costs than traditional chemical stabilizers in the countries that use them. Because their value has decreased, their use has become easier and less costly, and shipment has become more affordable, they are now more widely available. Even if the street balance increases by a little amount, the price- effectiveness of the product increases.

MATERIALS:

Black cotton soil:

This kind of soil, known as black cotton soil (BC soil), has a high clay content. This soil's dark color is due to a low quantity of titanium oxide. The clay in Black Cotton Soil (BC Soil) is mostly montmorillonite in structure and black or index of the black cotton soil employed in the research. The IS light compaction test is used to measure compaction qualities, whereas the California bearing ratio (CBR) test is used to determine strength characteristics. Inorganic clays with medium to high compressibility, such as those found in black cotton soils, are a common occurrence in India. They have a tendency to shrink and swell a lot. About 20 percent of India's land surface is covered with black cotton soils, which are particularly common in the country's central and western regions. The Black Cotton Soils (BC Soils) have presented a problem to roadway engineers because to their significant swelling and shrinkage properties. When dry, the Black Cotton Soil is very hard, but when wet, it becomes entirely brittle. When the black cotton soil dries, it forms a variety of fissures of varied depths. Vertical mobility occurs in the soil mass as a consequence of the soaking and drying process. Settlement, deep depression, cracking, and unevenness are all signs of pavement breakdown as a result of these motions. We'll look at a real-world example of highway building on Black Cotton Soils (BC Soils) in this post.

Terrazyme:

It is It is a dark transparent liquid that is organic in origin and made blackish grey in color, making it a clay with a high content. This is a term used to describe black cotton soils, which expand when they are wetted. Montmorillonite clay is the primary cause of soil's black cotton appearance. It is also known as black cotton soils or swelling soils.

Table: 1 Properties of Black Cotton Soil

Property	Value
Specific gravity	2.63
Grain size distribution	
Clay (%)	20.2
Gravel (%)	0.0
Sand (%)	11.8
Silt (%)	68.0
Atterberg's limits	
Plastic limit (%)	35.71
Liquid limit (%)	54
Plasticity index (%)	18.29
Free Swell index	Sometimes > 50%
Maximum dry density (Kn/m^3)	14.32
Optimum moisture content (%)	24
C B R (%)	
Un soaked	5.3
Soaked	1.10
Unconfined compressive strength (Kn/m^3)	101

from fruit and vegetable extracts. Terrazyme A reaction between clay and organic cat-ion forms a protective covering around clay particles and makes clay particles water resistant, which is the result of terrazyme's influence on soil. Because cationic interexchange occurs, the thickness of the absorbed layer is reduced.

Figure2: Terrazyme

Table2: Properties of Terrazyme

Property	Value
Specific gravity	**1.05**
pH value	**3.50**
Appearance	Dark brown
Hazardous content	**None**
Total dissolved salts	19.7ppm
Boiling point	**212^0F**
Solubility in water	**complete**
Reactivity data	**stable**
Evaporation rate	**Same water**

Chemical composition	Hypo Sludge	Cement (in %)
Lime(Ca O)	46.2	62
Silica(SiO_2)	09	22
Alumina	3.6	05
Magnesium	3.33	01
Calcium sulphate	4.05	04

Figure3: Hypo sludge

RESULTS AND DISCUSSIONS

An increase in soil strength is the most telling sign of a job well done when it comes to stabilizing the soil. Prior research used uniaxial compression or CBR tests to measure the strength increase of treated soil. Some of the Hypo Sludge is utilized in soil stabilization applications to boost soil compressive and shearing strength. We used the Hypo Sludge in the following.

Hypo Sludge (Paper Waste):

Figure shows Hypo Sludge, also known as Paper Waste, a byproduct of the pulp and paper industry and a component of the category of organic waste. They may be classified as either suspended or dissolved based on their current physical condition. There are several problems with effluent contamination resulting from this trash since it is constituted proportions: 10%, 20%, 30%, 40%, and 50%. 1.25 ml of Terrazyme is also available. Hypo Sludge was put to the B.C. soil in order to stabilize and strengthen the soil. The addition of Hypo Sludge and Terrazyme may help strengthen the soil.

Standard proctor test for soil – Hypo Sludge and Terrazyme mixture:

Mostly of fibre and other organic material. Its chemical Soil density may be increased by compressing air gaps in the composition and specific gravity were listed in the table below.

Table3:Hypo Sludge's physical properties

soil bulk. Laboratory compaction tests are used to determine the amount of water needed to achieve the maximum weight of soil grains per cubic meter of compacted soil. The Optimum Moisture Content is the amount of water. After compaction, various moisture contents and subsequent dry densities may be measured in the lab and displayed on an arithmetic scale, as can be seen above. They're like abscissa and ordinate, respectively. Curves are created by connecting the observed locations.

Figure4: Standard Proctor Test;

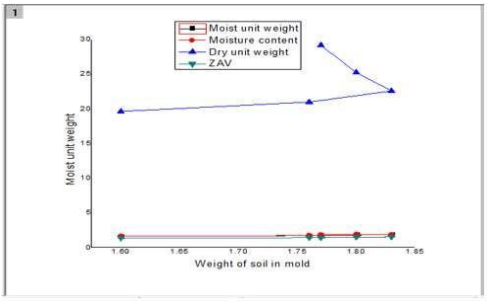
black cotton soil + 10% Hypo Sludge+ Terrazyme 0.25 ml	Weight of soil in mold (kg)	Moist unit weight (g/?? ??)	Moisture content (%)	Dry unit weight (g/?? ??)	ZAV (g/?? ??)
1	1.64	1.64	15.12	1.43	1.78
2	1.76	1.76	18.96	1.48	1.67
3	1.86	1.86	21.27	1.53	1.60
4	1.87	1.88	24.71	1.50	1.52
5	1.82	1.82	28.13	1.42	1.44

blackcottonsoil + 10% Hypo Sludge+ Terrazyme 0.25 ml	Weight of soil in mold (kg)	Moist unit weight(g/c *m3*)	Moisture content (%)	Dry unit weight (g/c *m3*)	ZAV (g/c *m3*)
1	1.60	1.60	15.18	1.39	1.78
2	1.76	1.76	19.09	1.48	1.66
3	1.83	1.83	22.13	1.50	1.58
4	1.80	1.81	27.96	1.41	1.45
5	1.77	1.77	32.71	1.33	1.35

Table 4:Standard proctor test for black cottonsoil + 10% Hypo Sludge+ Terrazyme 0.25 mlmixture

black cotton soil + 10% Hypo Sludge+ Terrazyme 0.25 ml	Weight of soil in mold (kg)	Moist unit weight (g/?? ??)	Moisture content (%)	Dry unit weight (g/?? ??)	ZAV (g/?? ??)
1	1.60	1.62	1.62	19.6	1.36
2	1.76	1.72	1.72	20.95	1.42
3	1.83	1.86	1.86	22.56	1.52
4	1.80	1.87	1.88	25.21	1.50
5	1.77	1.82	1.82	29.13	1.41

Table5:The standard proctor test for black cotton soil + 20% Hypo Sludge + Terrazyme 0.5 ml combination



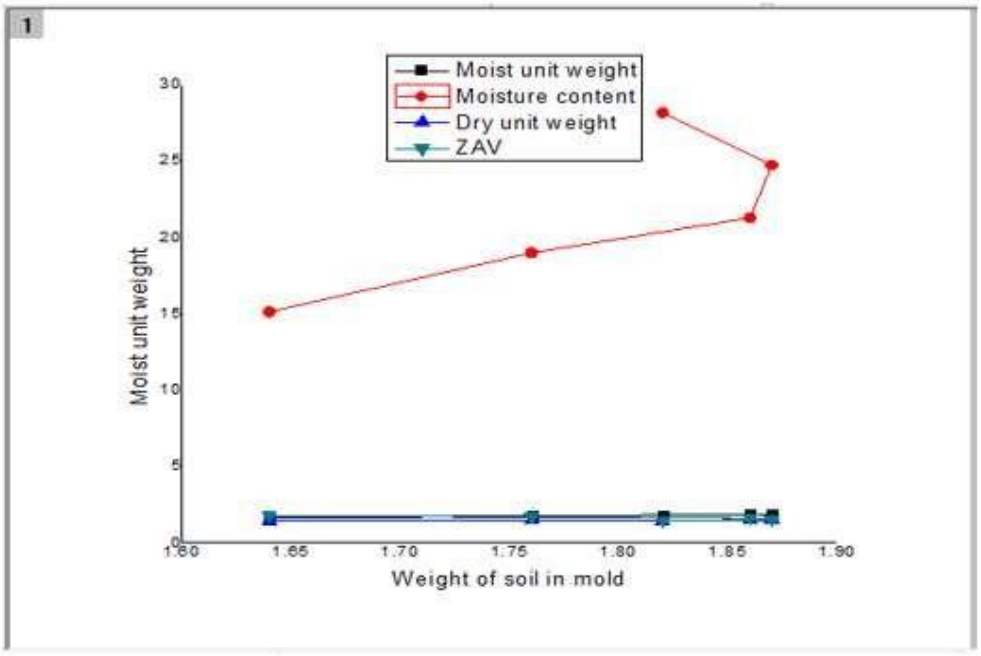


Figure 5: black cotton soil + 20% Hypo Sludge+Terrazyme0.5mlmixture

Figure 5:black cotton soil+30%Hypo Sludge+Terrazyme0.75mlmixture

CONCLUSION

During unsoaked California Bearing Ratio (CBR) testing of soil, the CBR grew steadily with increasing Hypo Sludge and Terrazyme concentration until it reached 20% by weight of the overall combination; it then declined. CBR testing of soil with changing Hypo Sludge and Terrazyme concentrations, on the other hand, showed an unequal shift. First, it dropped to 10% of the combination, and then it rose to 30% by weight until Hypo sludge and Terrazyme content topped out at 30% by weight of the overall mixture. After then, the numbers started to fall. The free swell ratio decreased as the amount of Hypo sludge in the soil-Terrazyme combination increased. The plasticity index values also decreased in response to this. Swelling behavior of the B.C. soil-Hypo sludge combination is influenced by the plasticity index values of the black cotton soil. As a result, the black cotton soil's swelling is reduced while its strength is increased by the use of Hypo sludge and Terrazyme as an adjuvant.

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