STABILIZATION OF BLACK COTTON SOIL USING GRANITE WASTE

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Abstract *The design basis on black cotton soil (expansive soil) has continually been a difficult task for the engineers as the structure resting on black cotton soil will fail without any caution. Black cotton soil is located in M.P, Karnataka, Maharashtra and Andhra Pradesh in our country. Soil proportion changes relying upon their constituents, i.e. water content , density, bulk density, angle of friction, shear strength and so forth. The properties of black cotton soil can be modified with the aid of stabilizing the soil by way of mechanical means. In this project a try has been made to stabilize the soil using Granite waste. Experimental work has been completed with 5 %, 10%, 15%, 20% and 25% of Granite waste.*

The experimental work is based totally on percentage changes of Granite waste content in soil on tests for soil Liquid limit, O.M.C., M.D.D, Bulk density, Dry density and Grain size analysis. The purpose is to enhance the engineering properties of the black cotton soil such that the structure constructed in this soil can be correctly withstand the load applied.

Key Words: Granite waste, soil, black cotton soil.

1. INTRODUCTION

Soil improvement is of major concern in the construction activities due to rapid growth of urbanization and industrialization. The term soil improvement is used for the techniques which improve the index properties and other engineering characteristic of weak soils. In India expansive soil cover about 0.8x106 km2 area which is approximately one-fifth of its surface area. These soils contain montmorillonite mineral due to this they swell and shrink excessively with change of water content. Such tendency of soil is due to the presence of fine clay particles which swell, when they come in contact with water, resulting in alternate swelling and shrinking of soil due to which differential settlement of structure takes place. Expansive soils can be stabilized by the addition of a small percentage of admixtures. These techniques have been used for many construction purposes, notably in highway, railroad and airport construction to improve subgrades and sub-bases.

The Granite waste is a by-product produced in granite factories while cutting huge granite rocks to the desired shapes. About 3000 metric ton of granite waste is produced per day as a by-product during manufacturing of granite tiles and slabs from the raw blocks.

Granite belongs to igneous rock family, is a very hard, crystalline. The composition of granite consists of quartz and feldspar with small amounts of mica, amphiboles, and other minerals. The Granite dust is a byproduct of cutting industries, about 3000 metric ton of granite dust/slurry is produced per day. All the waste produced from granite industry are disposed in dumping yards, nearly occupying 25% area of granite industry. This leads to environmental pollution and occupation of vast area of land especially after the slurry dries up.

The shear strength of unsaturated soil appeals more research in the geotechnical engineering and practice from last few decades. The shear strength of unsaturated soil governs main parameters of geotechnical engineering such as bearing capacity, earth pressure, slope stability etc. In India, engineers are mostly come across with the unsaturated clayey soils. The shear strength of unsaturated clayey soil is strongly influenced by the physico-chemical interaction between water and clay minerals. Therefore, it is necessary to study the shear strength

behavior of unsaturated clayey soil. The thought process to study shear strength behavior of unsaturated clayey soils started from last five decades.

Numerous experimental programs were conducted by various researchers to understand the shear strength behavior of unsaturated soils from different countries. A series of consolidated drained tests were performed with modified tri axial cell using axis translation technique to study the shear strength behavior of unsaturated clay.

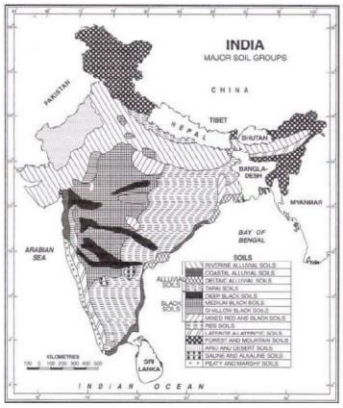


Fig 1: Major soils in INDIA

Granite waste

The structure of granite comprises of quartz and feldspar with limited quantities of mica, amphiboles, and different minerals. The Granite dust is a byproduct of cutting businesses, around 3000 metric ton of granite dust/slurry is obtained every day. All the waste created from granite industry is dumped in dumping yards, which cover 25% of the total territory of granite industry. This prompts natural contamination and loss of tremendous territory of land particularly after the water in the slurry evaporates. This residue is conveyed by cooling water to Sedimentation Lake.

Granite dust which is taken from lake, is utilized in soil stabilization. Granite dust was utilized in road development as an stabilization material .Potential impact of granite dust on geotechnical properties of expansive soils was inquired about. And it was found that liquid limit and plasticity index diminished. Apart from that, Maximum dry density increased and optimum water content diminished CBR, angle of shear resistance expanded and cohesion diminished.

Objectives of the study

In this present study an experimental investigation was conducted on soil with the help of six types of soils collected from three different locations and the following are the basic objectives considered in this study.

1. To study the liquid limit and plastic limit for sub grade soil.
2. To find out the optimum moisture content and maximum dry density for soil.
3. To finding the unconfined compressive strength for sub grade soil. 4. To study the shear strength of soil with the help of tri axial shear test.

2. LITERATURE REVIEWS

Rama varaprasad et al (2020) the description of expansive soils treated with Lignosulfonate was investigated. Amaravati and Vijayawada, both in the state of Andhra Pradesh, were the locations where soil samples were obtained for this study. The percentages were taken at completely distinct rates of 0.5, 1, 2, and 4 percent. Tests in the laboratory were performed on the atterberg limits, standard compaction, CBR, and UCS parameters. When Lignosulfonate is added to the soil, the UCS of the soil increases.

Geethu Vijayan et al (2019) the use of Lignosulfonate in the stabilization of clayey soil was researched and tested. Clayey soils will be considered stable for this evaluation of the literature. There are several tests that are carried out, including the standard compaction test, the unconfined compressive strength test, the C.B.R. limit, and the Atterberg limit. In conjunction with the addition of Lignosulfonate, the maximum wet density will be reduced while the maximum dry density will be increased, as previously stated. The addition of Lignosulfonate increases the shear strength characteristics of the material, while the liquid limit decreases and the plastic limit increases with the presence of the compound.

3. MATERIALS USED IN THE STUDY

Black cotton soil

Black soils are formed by lava basaltic rocks. Hence they are very dark in color. They develop cracks during dry period and swell if got moisture, hence they are self- tilling in nature, that's why they are fertile and can hold water for long time. This capacity is used for Cotton cultivation; hence they also called Regular Black Cotton Soil.

Fig 2: Black Cotton Soil

Granite waste

Granite waste was obtained from granite polishing industries at Dupadu of Kurnool district in Andhra Pradesh, India. The specific gravity of granite waste was 2.98 respectively and its size was less than 90 microns. The fineness modulus of granite waste was 2.83 respectively.

Experimental study

The following are the various trials used in this investigation

1. 0% Granite waste
2. 5% Granite waste
3. 10% Granite waste
4. 15% Granite waste
5. 20% Granite waste

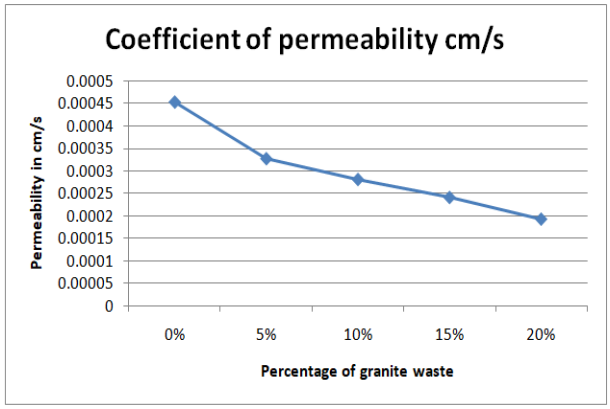
The following are the experimental study carried out in this investigation with various granite waste percentages

1. Permeability test
2. California Bearing Ratio Test
3. Unconfined Compression Test
4. Standard Proctor test

4. RESULTS AND ANALYSIS

Soil with different amount percentage of granite waste is used for soil stabilization. Here we are discussing test results of shear test, permeability and compaction test on soil with 0%, 5%, 10%, 15% and 20% granite waste. As granite waste is varying in percentage, properties of soil are also varying. Here we are discussing results of shear strength, permeability and compaction of soil with different percentage of granite waste through test reading and graphs plotted for comparison of results.

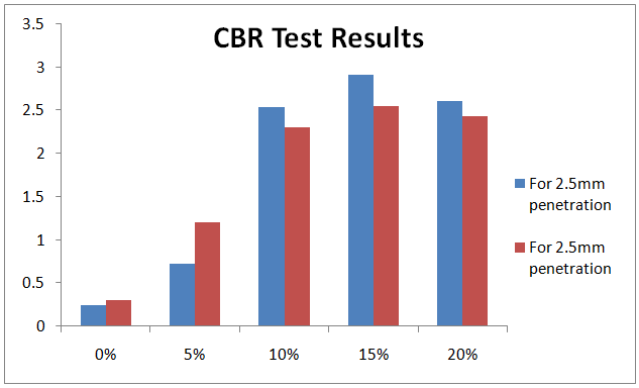
Permeability test



Graph 1: Permeability of concrete

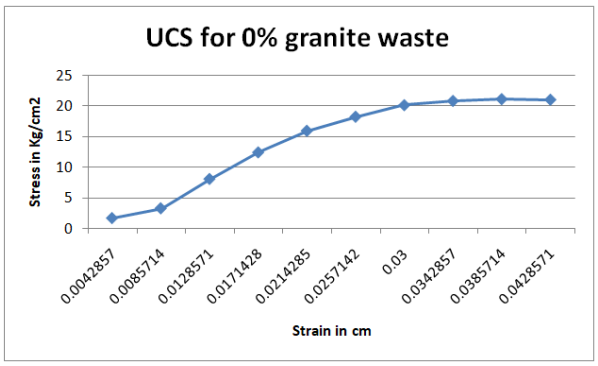
At 0% of waste addition i.e. soil without ash gives Permeability as 4.516×10^{-4} cm/sec. As granite waste content increases in soil, permeability of soil decreases as 2.801×10^{-4} cm/sec at 10%. After 10% addition of granite waste, permeability of soil continues to decrease. Accumulation of fine ash particles in soil voids results in blockage of pore path hence permeability of soil decreases.

California Bearing Ratio Test

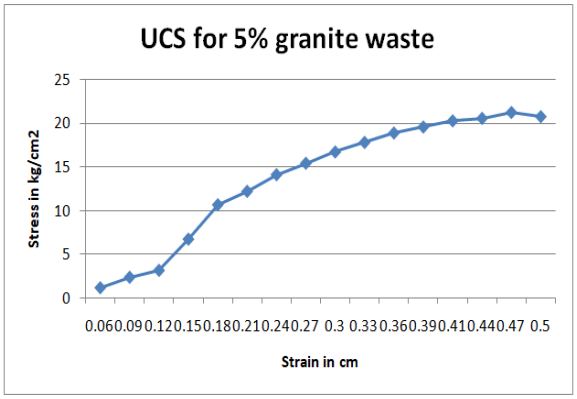


Graph 2: California Bearing Ratio

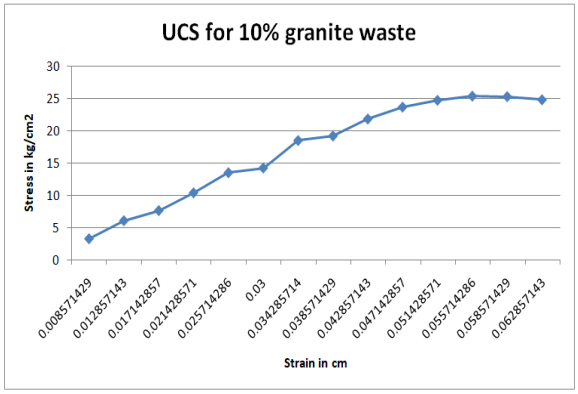
UCS Test



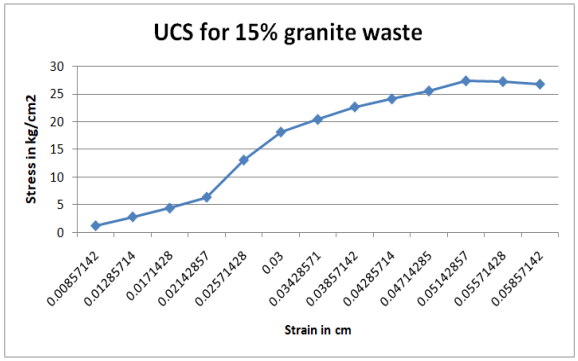
Graph 3: UCS for 0% granite waste



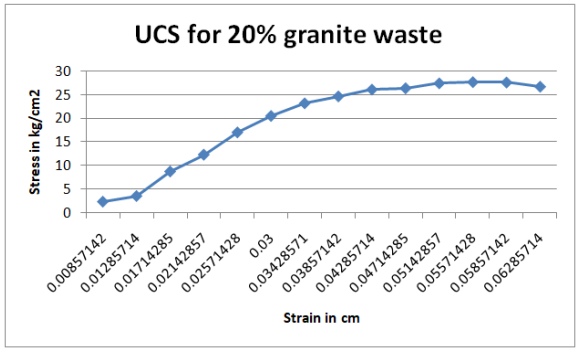
Graph 4: UCS for 5% granite waste



Graph 5: UCS for 10% granite waste

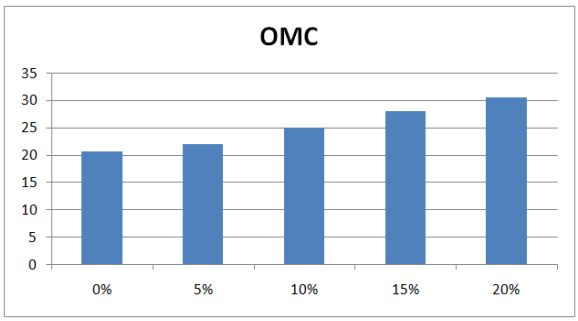


Graph 6: UCS for 15% granite waste

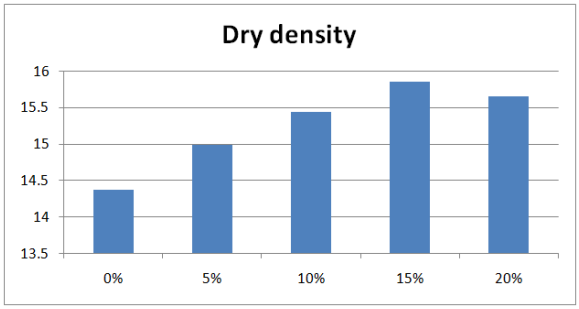


Graph 7: UCS for 20% granite waste

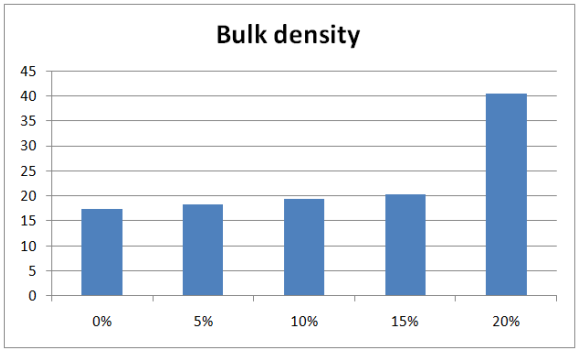
Standard Proctor test



Graph 8: Comparison of OMC



Graph 9: Comparison of Dry density



Graph 1:0 Comparison of bulk density

CONCLUSIONS

Study of soil stabilization by using granite waste in soil stabilization which definitely reduces the

environmental pollution level as well as enhances the soil properties.

1. Experimental study of soil stabilization with granite waste shows use of Municipal granite waste in 10% with soil enhances soil properties viz. Shear strength, permeability and compaction.
2. This study shows instead of having simply disposal of granite waste, which is also not possible due to lack of land availability, we can improve soil properties by using waste.
3. As soil and waste is variable material in characteristics from place to place, this experimental work is only applicable to our Panvel region soil with particular type of granite waste. For different area‟s soil and different waste, we can have different Optimum percentage of waste which will enhance soil properties.
4. Using waste as stabilizing material is cheap as well as eco-friendly method of soil stabilization, which solves the waste disposal problems as well as enhances soil properties.

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