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TO STUDY THE BEHAVIOUR OF STRENGTH GAIN IN CLAYEY SOIL USING QUARRY DUST AS A STABILIZER

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ABSTRACT

Quarry dust is a solid waste material and is generated by its crushing industry about 15 to 20%.Disposal of this waste create a lot of geo-environmental problems. Clayey soil is a soil which possess high swelling & shrinkage properties. It may be cause of damage in various civil engineering projects because of its alternative swelling &shrinkage behavior. This paper presents the environment friendly & cost effective way to deal these problems. The aim of this paper are to conduct an experimental study & to stabilize the soil which is locally collected from village-Dayalpur distt.-kurukshetra (Haryana). Due to mixing of quarry dust from 0 to 25 % @ 5 % increment it become more stable soil. Therefore a number of laboratory experiment are conducted to stabilize the soil and various properties like specific gravity, liquid limit, plastic limit, shrinkage limit, dry density, have been checked with and without addition of this waste. A comparative study has been done. From the analysis of test results it was found that liquid limit, plastic limit, & optimum moisture content decreased and unconfined compressive strength, dry density both increased due to addition of quarry dust.

Keywords: Quarry dust, Stabilization, UCS, OMC, MDD.

1. INTRODUCTION

Clays exhibit generally undesirable engineering properties. They tend to have low shear strengths and to lose shear strength further upon wetting or other physical disturbances. Soil is defined as sediments or other accumulation of mineral particles produced by the physical or chemical disintegration of rocks plus the air, water, organic matter and other substances that may be included. Soil is typically a non-homogeneous porous, earthen material whose engineering behaviour is influenced by changes on moisture content and density. Based on the origin, soil can be broadly classified as organic and inorganic. "Expansive soil" means soil which contains clay and which expands to a significant degree upon wetting and shrinks upon drying. Clay soils contain a high percentage of certain kinds of clay particles that are capable of absorbing large quantities of water. Soil volume may expand 10 percent or more as the clay becomes wet. Stabilizing soil with admixtures like lime, fly ash, quarry dust, cement is now an extremely cost effective method of converting poor quality soil into strong impermeable medium and making it into the constructing material.It cannot be very easily defined in precise terms. The word has a popular and also a series of technical meanings. The Foundation Engineer's concept of clay may be rejected by a potter, a brick manufacturer, an agronomist, or a farmer. Nevertheless, in the popular sense, clay is a finely-grained material which becomes sticky when wet. In a more technical sense, all clay minerals can be considered very fine soil particles having a pronounced basal cleavage. As a consequence, individual clay particles are flat and flake-shaped. In general, the term “clay” implies a natural, earthy, fine-grained material which when mixed with a limited amount of water develops plastic properties. Plasticity, as related to Soil Mechanics, is that property which allows a material to undergo rapid deformation without rupture, volume change, or elastic rebound. Chemical analyses of clays show them to have essentially silica, alumina, iron, alkalis, and alkaline earths. The term "clay" is sometimes used to signify a material that is the product of weathering that formed by hydrothermal action, or that deposited as sediment. As a particle-size term, soil investigators tend to consider two microns as the upper limit of the clay particle size. Recent decades have seen a marked upsurge in industrial and economic growth, contributing to an improved quality of life and well-being for citizens. However, we should not lose sight of the fact that every production system creates by-products and waste products which can affect the environment. These effects may occur at any point in the life-cycle, whether during the initial phase of obtaining raw materials, during the transformation and production phase, during product distribution or when the end user must dispose of products which are no longer required. As a result, recent years have witnessed rising social concern about the problem of waste management in general, and industrial waste and waste from the construction industry in particular. This problem is becoming increasingly acute due to the growing quantity of industrial, construction and demolition waste generated.

II. OVERVIEW OF EARLIER RESEARCH

The quarry dust is obtained as an aggregate waste, during crushing of rubble to obtain aggregates. Sabat and Das (2009) had stabilized expansive soil using quarry dust and lime for strengthening the subgrade of a rural road for low volume traffic. The properties tested were compaction (standard proctor), UCS, soaked CBR and Ps. The stabilizer strengthened road was found to be cost effective for low volume traffic. Sabat (2012) had investigated the effect of lime on Atterberg’s limit, compaction(modified proctor), shear strength parameters and durability of an expansive soil stabilized with optimum percentage of quarry dust (40%).The lime added were 2 to 7 % at an increment of 1%. The effect of 7 and 28 days of curing were also studied on shear strength parameters.

Sabat (2012) had developed statistical models for prediction of Ps of expansive soil (Bentonite) stabilized with quarry dust and lime by correlating the percentage of stabilizers, MDD, OMC, curing period and activity. Models were also developed to predict the Ps of stabilized expansive soil cured at 7 and 28 days from the Ps of the expansive soil cured at 0 day and the Ps of expansive soil cured at 28 days from the Ps of the expansive soil cured at 7 days. The models developed were found to be very accurate in predicting the swelling pressure. Sabat and Bose (2013) had studied the effect of fly ash –quarry dust mixes with fly ash: quarry dust as 1:2, on engineering properties of an expansive soil. The optimum proportion of fly ash –quarry dust mix was found to be Quadri Syed Ghausuddin (2011) conducted studies on evaluation of Soil-Quarry Dust Mixtures Reinforced with Polypropylene Fibres. The objective of this paper is to analyse the replacement of weak earth material with quarry dust using polypropylene fibres as reinforcements and to investigate the influence of selected fibre parameters like fibre content and fibre length on the strength and ductility behaviour of soil-quarry dust mixtures. A series of tests like Compaction test &California bearing ratio tests were carried out. Polypropylene fibres with different fibre length (12mm, 24mm and 40mm) were used as reinforcement. The conclusion drawn from this investigation is that polypropylene fibres of 24mm length showed optimum performance in dosage of

1.00% by weight of soil quarry dust mixtures. Thus, inclusion of randomly oriented fibres greatly influences the performance of soil quarry dust.

Panagiotis Ch. Eskioglou (2009) examined the adequacy of marble dust as a soil stabilizer. The study revealed that the geotechnical parameters of black cotton soils are enhanced significantly by the addition of marble dust. Huge plasticity index reductions happened with marble dust treatment, particularly for high PI soils. Results demonstrated that plasticity decreased by 15 to 30% and strength increased by 25 to 50 %. The most noteworthy strength increase was accomplished at 8% marble dust after 28 days. Increments in the unconfined compressive strength of soil occurred with the addition of marble dust.

III. MATERIALS AND METHODS

3.1 Soil Sample

The soil planned to use in this study was obtained from village-Dayalpur District:Kurukshetra Haryana . The top soil was excavated up to a depth of 1.0m. The samples taken were disturbed soil sample. In the dry state shrinkage-soil has distinct shrinkage cracks having width about 20mm and the cracks are deep. . The index properties of quarry dust determined as per IS codes and are presented in Table 1.

Table 1

Properties	**Value**
Specific gravity	2.5
Liquid limit	51%
Plastic limit	29%
Plasticity index	22
Shrinkage limit	23.6%
Optimum moisture content (%)	24

3.2 Quarry dust

Quarry dust for this study was collected from Shiva building material District of Kurukshtra Haryana. The index properties of quarry dust determined as per IS codes and are presented in Table 2.

Table 2

Properties	**Value**
Specific gravity	**2.71**
Liquid limit	**NIL**
Plastic limit	**Non plastic**
Plasticity index	**Non plastic**

IV. EXPERIMENTAL TESTS

4.1 Standard Proctor Tests

Standard Proctor tests were conducted to determine optimum moisture content and maximum dry density of parent soil and soil stabilized with 3, 6, 9, 12 and 15% of various industrial waste materials passing 425 micron

IS sieve.

These tests were conducted in order to prepare specimens at maximum dry density by adding desired optimum moisture content as per specifications of IS: 2720 (Part 7) (1974).

4.2 Liquid limit test

Liquid limit test was conducted by using casagrandae apparatus as per specifications of IS: 2720 (Part 4) 1970.

4.3 Shrinkage limit test

Shrinkage limit test was conducted as per specifications of IS: 2720 (Part 4) 1972.

4.4 Plastic limit test

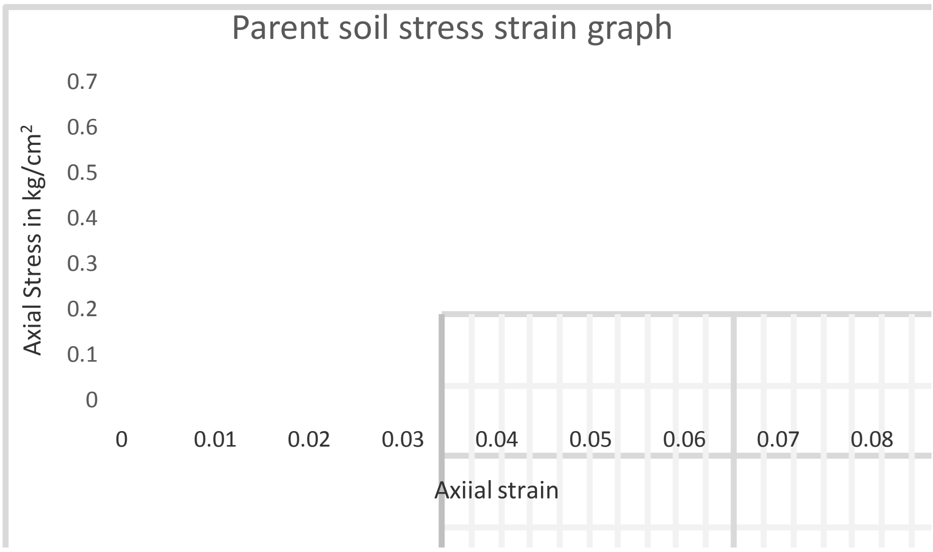
Plastic limit test was conducted as per specifications of IS: 2720 (Part 4) 1970.

4.5 Unconfined compression test

UCS test on scaly treated with different percentage of quarry dust & ceramic dust as per specifications of IS: 2720.The UCS test were conducted on soil sample waste ceramic & quarry dust mixture prepared at OMC & MDD obtained corresponding to that soil.

V. EXPERIMENTAL RESULTS

5.1 PARENT SOIL



Interpretation and reporting

Unconfined compressive strength of the soil = 0.589841

Shear strength of the soil =0.589841/2 =0.2949205

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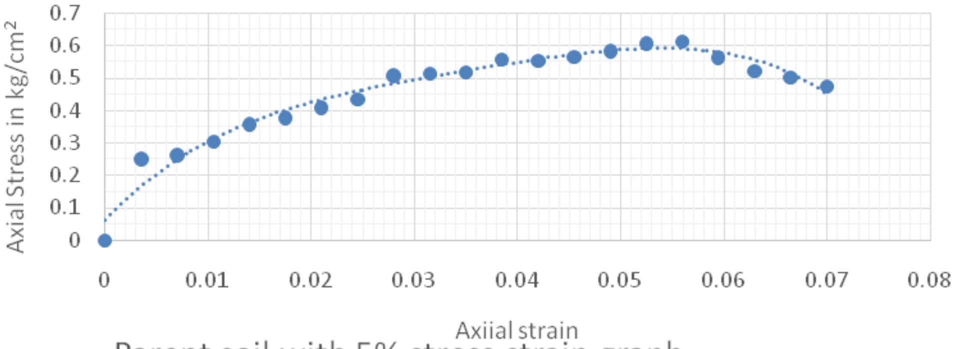
5.2 SOIL WIITH 5% QUARRY DUST



Parent soil with 5% stress strain graph

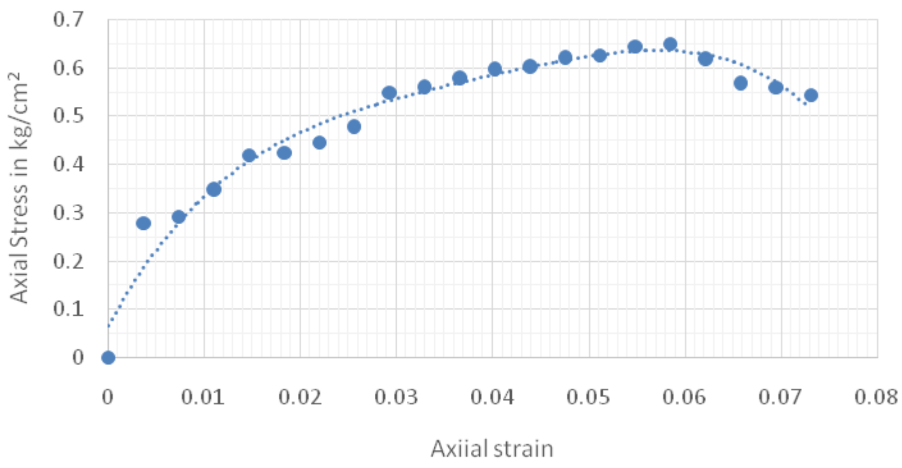
Interpretation and reporting

Unconfined compressive strength of the soil = 0.611088

Shear strength of the soil = 0.611088/2 = 0.3055441

5.3 SOIL WITH 10% QUARRY DUST

Parent soil with 10% stress strain graph



Interpretation and reporting

Unconfined compressive strength of the soil = 0.648054

Shear strength of the soil = 0.648054/2 = 0.324025

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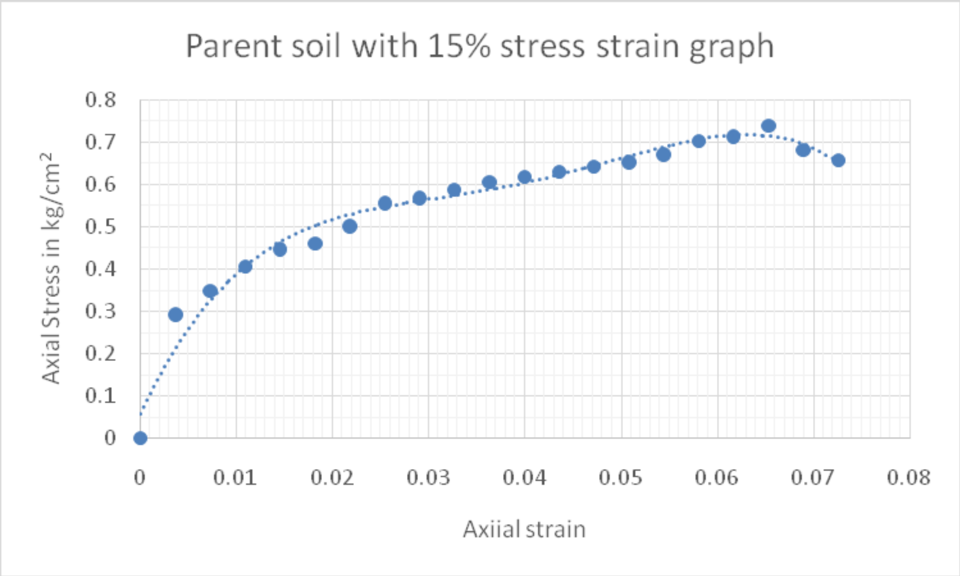
5.4 SOIL WITH 15% QUARRY DUST

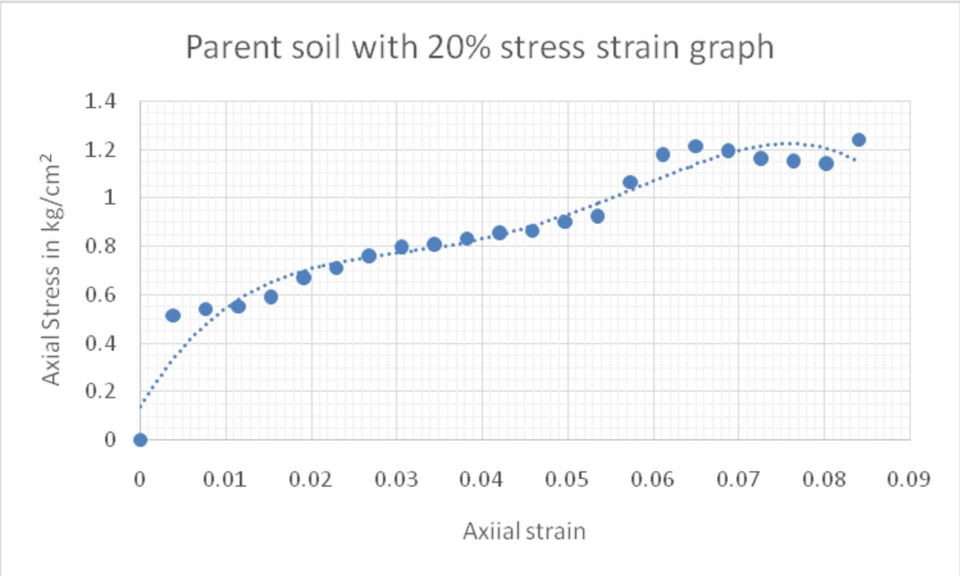


Interpretation and reporting

Unconfined compressive strength of the soil = 0.739177

Shear strength of the soil = 0.739177/2 = 0.369588

5.5 SOIL WITH 20% QUARRY DUST

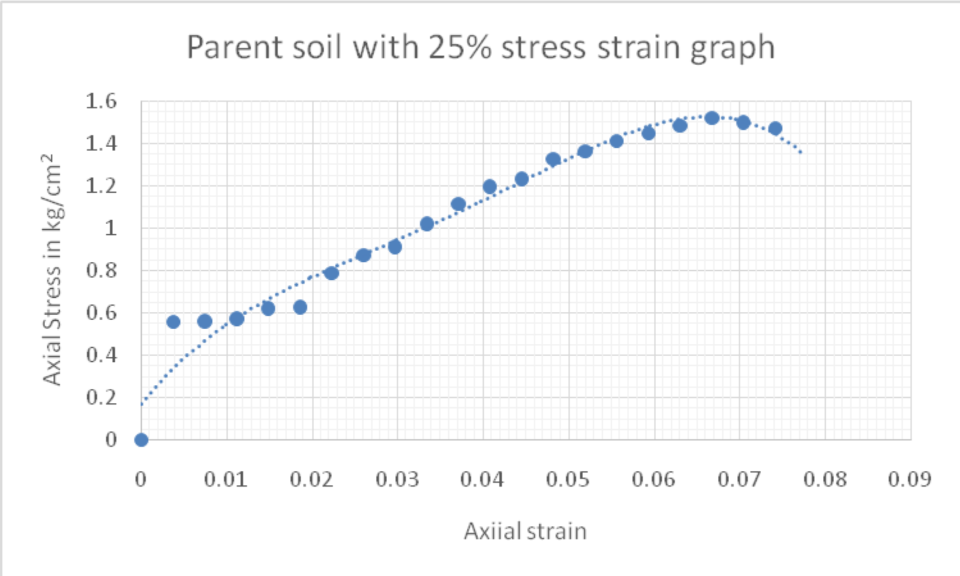


Interpretation and reporting

Unconfined compressive strength of the soil = 1.236901

Shear strength of the soil = 1.236901/2 = 0.61845

5.6 SOIL WITH 25% QUARRY DUST



Interpretation and reporting

Unconfined compressive strength of the soil = 1.517064

Shear strength of the soil = 1.517064/2 =0.758532

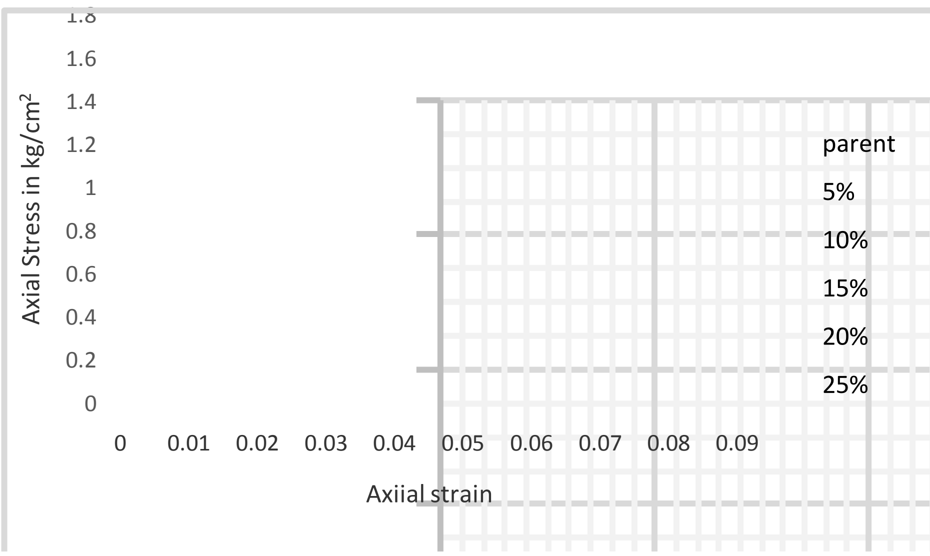
VI. CONCLUSION

1. It was observed that the liquid limit and plastic limit decreasing irrespective of the percentage of addition of Quarry Dust.

2. It was found that the maximum dry density attained at 25% Quarry dust and optimum moisture content goes on decreasing with increasing in percentage of addition of Quarry Dust.

3. The study has been successfully conducted to assess the geotechnical properties of the clay improved the quarry dust and also increased the shear strength.

4. Maximum unconfined compressive strength of sample is = 1.517064 for 25 % of Quarry dust addition.



VII. ACKNOWLEDGEMENT

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