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EFFECT OF CERAMIC WASTE ON THE GEOTECHNICAL PROPERTIES OF BLACK COTTON SOIL

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ABSTRACT

This investigation manages improving the designing properties of feeble soil by treating it with tile squander with sodium hydroxide as cover. Powerless soil for the most part swell altogether when interacted with dampness and therapist when the dampness presses out, and this sort of soil will have low bearing limit. Hence it is important to balance out powerless soil, therefore enhancing the heap bearing limit of a sub level to help asphalt and establishment. The feeble soil is gathered locally and blended with changing level of tile squander with sodium hydroxide as fastener. Based on various organization of tile waste and sodium hydroxide as folio, fluid farthest point test, plastic breaking point test, falling head porousness test, standard delegate test, California bearing proportion test(CBR), coordinate shear test were directed on soil test and checked the change in building properties of soil. Soil stabilization utilizing waste clay tidy is one of such technique, which can be utilized to enhance the geotechnical properties of soil. Clayey soils have poor shearing quality and low bearing limit. It is difficult to work with so much soil, as it doesn't have enough quality to help the forced load on them. For palatable execution of the structure put on such soil, the properties of such soil should be made strides. The clay waste can be blended with squander materials to get better outcomes.

Keywords: Ceramic waste, California Bearing Ratio, DFS, Soil Stabilization, Unconfined Compressive Strength.

I. INTRODUCTION

cohesive soils are widespread to the point that it ends up noticeably difficult to dodge them for roadway development. Numerous roadway offices, private associations and investigates are doing broad examinations on squander materials and research ventures concerning their attainability and ecological appropriateness. Swelling of far-reaching soils causes significant issues and delivers damage to many structures. Many research associations are doing broad work on squander materials concerning the feasibility and ecological reasonableness. Broad muds are the most dangerous soils because of their novel interchange swell-shrivel conduct with changes in dampness content. World over, many contextual investigations [1-2] of fizzled structures based on extensive soils have been accounted for. The circumstance in India is additionally the same with broad scope of extensive soils that possess just about one-fifth of the geological land region [3]. Suitable site conditions are not accessible wherever because of wide varieties in the subsoil uniquely the nearness of misleading soils represent a test to the structural designers.

The earlier ceramics were pottery objects made from clay, either by itself or mixed with other materials, hardened in fire. Later ceramics were glazed and fired to create a colored, smooth surface. The potters used to make glazed tiles with clay; hence the tiles are called as "ceramic tiles". The raw materials to form tile consist of clay minerals mined from the earth‟ s crust, natural minerals such as feldspar that are used to lower the firing temperature, and chemical additives for the shaping process. A lot of ceramic tiles wastage is produced during formation, transportation and placing of ceramic tiles. This wastage or scrap material is inorganic material and hazardous. Vitrified tiles are the latest and largest growing industry alternate for many tiling requirements across the globe with far superior properties compared to natural stones and other man made tiles. Hence its disposal is a problem which can be removed with the idea of utilizing it as an admixture to stabilization.

An ideal solution lies for reducing project cost, increasing longevity and reduce accumulation of waste shall be through utilization of industrial waste combined with weak soil for pavement construction. Few types of waste materials namely crusher dust, fly ash and tile waste are popular as admixtures in improving weak soils. From the available literature it is found that limited research has been done to study the effects of tile waste on different geotechnical properties of expansive soil. In the present study has been undertaken to investigate the effects of tile waste on index properties, compaction properties, soaked California Bearing Ratio (CBR) and swelling pressure of an expansive soil .The economy of stabilization has also been studied by strengthening the expansive soil subgrade of a flexible pavement. Thus use of ceramic waste not only improves the soil properties but problem of their disposal can also be solved. In the present study ceramic waste materials have been used to improve the properties of clayey soils and effect of ceramic dust on various soil properties have been evaluated

II. MATERIALS AND METHODS

2.1 Materials

2.1.1 Soil Sample:

The soil used in this study is light grey in colour and is known as black cotton soil, it was obtained along talera, Kota Local Government Area of Rajasthan State using the method of disturbed sampling. The chemical properties of the black cotton soil are given in table 1.

Table-1: Properties of untreated black cotton soil.

Characteristics	Quantity
Percent passing BS No. 200 sieve (%)	89.9
Natural moisture content (%)	26.05
Liquid limit (%)	55
Plasticity index (%)	38.09
Linear Shrinkage (%)	35.41
USCS Classification	CH
AASHTO Classification	A-7-6
Specific gravity	2.26
Ph	7.2
Color	Greyish light black
Dominant clay mineral	Montmorillonite

2.1.2 Tiles waste:

Tiles waste was collected from a local industry near borekhera, kota. A ceramic tile is an inorganic, non metallic, solid material. The earliest ceramics made by humans were pottery objects made from clay either by itself or mixed with other materials like silica. Later ceramics were glazed and fired to create smooth, coloured surfaces, decreasing porosity. The raw materials to form tile consists of clay mineral mined from earth crust, natural mineral such as feldspar.

A lot of tile waste is produced during formation, transportation and placing of ceramic tiles. The disposal of tile waste is a major problem so it is used effectively used for soil stabilization. tile waste is made into powder form by hand ramming and tile waste powder passing 90 micron sieve is replaced with soil.

The tile waste mainly consisting of 1.60% of Cao and 59.12% Silica. The physical properties are OMC-16.1%,MDD-21.34kN/m^3.

2.2 TESTING METHODS

Tiles waste was collected from a local industry near borekhera, kota. These tiles were broken into little pieces by utilizing a sledge. The littler pieces were sustained into a Los Angeles scraped spot testing machines to influence it to advance littler. For directing diverse tests, the extensive soil was blended with the clay tidy from 0 to 30% at an augmentation of 10%. In complete 4 blends were readied. Fluid Limit tests, plastic farthest point tests, standard Proctor compaction tests, drenched CBR tests and swelling weight tests were directed on these blends according to Indian Standard Codes for discovering ideal level of tile squander material. The subtle elements of these tests are given in the accompanying segments.

2.2.1. Index Properties

Standard procedures recommended in the respective I.S. Codes of practice [IS:2720 (Part-5)-1985; IS:2720 (Part-6)-1972],were followed while finding the Index properties viz. Liquid Limit and Plastic Limit of the samples tried in this investigation.

2.2.2. Compaction Properties

Optimum moisture content and maximum dry density of expansive soil with various percentages of tile waste were determined according to I.S heavy compaction test (IS: 2720 (Part VIII).

2.2.3. California Bearing Ratio (CBR) **tests**

Different samples were prepared in the similar lines for CBR test using treated and untreated expansive soil with tile waste. The CBR tests were conducted in the laboratory for all the samples as per I.S.Code (IS: 2720 (Part-16)-1979) as shown in the Fig.1.

Fig: 1 California Bearing Ratio Test Apparatus

2.2.4 Swell Pressure Tests

Different samples were prepared in the similar lines for swell pressure test using treated and untreated expansive soil with tile waste. The swell pressure tests were conducted in the laboratory for all the samples as per IS: 2720 (Part XL1) - 1977 as shown in the Fig.2.

Fig: 2 Swell Pressure Test Apparatus

III.RESULTS

3.1. Index Properties

The aftereffects of liquid limit of confinement tests on sweeping soil treated with various level of tile waste can be seen that with increment in level of tile squander the liquid furthest reaches of soil continues diminishing from 68% to 47%, when tile squander is expanded from 0 to 20% is powerful past additionally there is a lessening in liquid limit as appeared in the fig.3.The consequences of plastic utmost tests on far reaching soil treated with various level of tile squander , it can be seen that with increment in level of tile squander, the plastic furthest reaches of soil goes on diminishes from 31.02 % to 24.94 % when tile squander is expanded from 0 to 20%

3.2. Compaction: All the extensive soil tests were blended with changing rates of tile squander material by weight. From the test outcomes most extreme dry thickness increments from 15.5 kN/m3 to 16.11 kN/m3 at 20% of tile squander, past which it diminishes as appeared. However water content persistently diminishes.

3.3. California Bearing Ratio (CBR): The consequences of doused CBR tests on far reaching soil treated with various level of tile squander are appeared . From the outcomes it can be seen that with increment in level of tile squander, the drenched CBR of soil continues expanding from 2 to 4.1 when tile squander is expanded from 0 to 20%. There is 105% expansion in doused CBR of soil at this level of tile squander when contrasted with untreated soil.

3.4. Swell Pressure

The consequences of swell weight tests on extensive soil treated with various level of tile squander are appeared . From the outcomes it is watched that with increment in level of tile squander, the swelling weight of soil continues diminishing from 104 kN/m2 to 54 kN/m2 when tile squander is expanded from 0 to 20% and almost 48% lessening in swell weight. This occurs because of diminishing in dirt substance of the sweeping soil by substitution of tile squander, which is non-broad in nature and that outcome in diminish in the swelling weight.

It is seen from the test outcomes that the far reaching soil with tile squander has demonstrated better execution when contrasted with sweeping soil without tile squander. It is likewise watched that from CBR and swell weight tests the settled far reaching soil has demonstrated most extreme change contrasted with untreated extensive soil. From the consequences of compaction, CBR, Swell Pressure Tests, the ideal rates of tile squander is 20%.

IV. CONCLUSIONS

In this investigation, Use of solid waste material in soil stabilization improves the geotechnical properties of soil. Different types of waste materials are suitable for different types of soil and they provide different degree of improvement. Solid materials can be used for soil stabilization in place of conventional stabilizer like lime. Ceramic waste with other waste materials can be used for soil stabilization. On the basis of the work conducted by different researchers following conclusions can be drawn:-

- With the addition of ceramic waste liquid limit, plastic limit and plasticity index of the clayey soil decreases.
- Optimum moisture content of the clayey soil decreases as the percentage of ceramic waste increases and maximum dry density obtained at certain optimum content of ceramic waste and decreases beyond this optimum content of ceramic waste.
- California bearing ratio of the clayey soil increases with the increase in the percentage of ceramic waste.

- The unconfined compressive strength of the clayey soil increases as percentage of ceramic waste dust increases.
- The differential free swell of clayey soil decreases as the percentage of ceramic waste increases.

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