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An Experimental Study on Stabilization of Clayey Soil Mixed with Tiles Particles

Saraswati Chand Dhariwal[1], Dr. D.G.M Purohit[2]
[1]*Ph.D. Scholar, Dept. of Civil Engineering, M.B.M. Engineering College, J.N.V. University, Jodhpur, Rajasthan, India*
[2]*Professor, Dept of Civil Engineering, M.B.M Engineering College, J.N.V University, Jodhpur, Rajasthan, India*
Corresponding Author: Saraswati Chand Dhariwal

ABSTRACT: For any pavement, the subgrade layer is very important and it has to be strong to support the entire wheel load. To work on soils, we need to have proper knowledge about their properties and factors which affect their behavior. Swelling of expansive soils causes serious problems. By merging under burden and changing volumetrically alongside occasional dampness variety, these issues are showed through expanding, shrinkage and inconsistent settlement. In this paper the trial study is intending to do on far reaching soil with treated tile squander. A study is planning to check the improvements in the properties of clayey soil with tiles particles in varying percentages by adding an increment of 0.05%, 0.075%, 0.25%, 0.50%, 0.75%, and 1.0%.

KEYWORDS: Clayey Soil, Tiles Particles, California Bearing Ratio tests, Modified Proctor Compaction tests, Direct Shear Test.

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I. INTRODUCTION

Broad soils are far reaching to such an extent that it ends up difficult to stay away from them for roadway construction. Many thruway offices, private associations and investigates are doing broad examinations on squander materials and research ventures concerning their feasibility and environmental suitability. Growing of broad soils causes significant issues and creates damage to numerous structures. Far reaching dirt's are the most hazardous soils because of their extraordinary exchange swell-recoil conduct with vacillations in dampness content. World over, many case studies of failed structures built on expansive soils have been reported. The circumstance in India is additionally the same with broad inclusion of far reaching soils that possess very nearly one fifth of the topographical land zone. Suitable site conditions are not accessible wherever because of wide varieties in the subsoil extraordinarily the nearness of slippery soils represent a test to the civil engineers. To set the framework in place, there is no other-go however to improve the sub soil for expected loads and make them reasonable for the kind of development arranged. The clay soil properties are thus improved along with utilization of waste tiles particles. The problem of disposal of waste tiles particles can be solved by using this waste in clay soil stabilization.

II. OBJECTIVE OF INVESTIGATION

- To study the effect of tile waste on the properties of soil.
- To determine the suitable material for the soil samples collected.
- To study the subgrade strength characteristics of stabilized clayey soil by studying the variations of California Bearing Ratio (CBR) values under un-soaked conditions.
- To study the shear strength of clay soil with different mix composition.

III. MATERIALS USED FOR STUDY

A. Clay Soil

Expansive soils contain minerals such as clays that are capable of absorbing water. When they absorb water, they increase in volume. The more water they retain the more their volume increments. This adjustment in volume can apply enough power on a structure or other structure to cause harm. Far reaching soils will likewise shrivel when they dry out. This shrinkage can expel support from structures or different structures and result in harming subsidence. Fissures in the soil can also develop. These crevices can encourage the profound infiltration of water when wet conditions or overflow happens. This produces a cycle of shrinkage and swelling that places repetitive stress on structures. Soils with a high level of growing earth have a high fondness for water somewhat in view of their little size and mostly as a result of their positive particles. Soils with a high level of growing earth have a high fondness for water somewhat in view of their little size and mostly as a result of their positive particles. The clayey soils are collected from the local field in jodhpur city.

B. Waste Tiles Particles

The prior earthenware production were ceramics articles produced using dirt, either independent from anyone else or blended with different materials, solidified in fire. Later pottery was coated and terminated to make a hued, smooth surface. The potters used to make coated tiles with earth; henceforth the tiles are called as “earthenware tiles”. The crude materials to frame tile comprise of dirt minerals mined from the world’s outside, regular minerals, for example, feldspar that are utilized to bring down the terminating temperature, and chemical additives for the shaping process. A great deal of clay tiles wastage is created during development, transportation and putting of earthenware tiles. This wastage or scrap material is inorganic material and perilous. 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. A ceramic tile is an inorganic, nonmetallic solid prepared by the action of heat and subsequent cooling. Artistic materials may have crystalline or mostly crystalline structure, or might be formless. The tile squander mostly comprising of Cao and Silica.

In This Study the Tiles waste was collected from a local Tile Shop in Jodhpur City. Ceramic tile waste is cheap and non-reusable material, it is shown in all construction area and easy to collect. By the utilizing of earthenware tile waste to decrease the waste materials in earth and affordable.

Figure 1 waste tiles particles

IV. METHODOLOGY OF EXPERIMENT

The materials used in this study is clayey soil which is taken from the local field in Jodhpur City. Tiles Wastes are used throughout this Study to reinforce the soil. Tile waste was obtained from Local Tiles Shop in Jodhpur City. The natural water content of the given expansive soil is obtained. The soil samples are compacted using Modified proctor test. About 6 kg of soil passing through 4.75 mm sieve is compacted in a mould of 150 mm diameter and 127.3 mm height using a rammer of 4.89 kg with a free drop of 450mm. The Optimum Moisture Content (OMC) of the clayey soil sample was determined.

Figure 2: CBR Test Mix Composition in Mould

California bearing ratio test under unsoaked condition was done using the obtained optimum moisture content (OMC) to evaluate the suitability of subgrade soil. A graph was plotted between penetration (mm) and load (kg) using the obtained values. California bearing ratio (CBR) values corresponding to 2.5mm and 5 mm penetration was calculated. The higher of these values was taken as the CBR value.

Sample was prepared by replacing the expansive soil by hand rammed tile waste of 4.25mm passing and 75 microns retained. The rammed tile waste replacing in percentage of 0.05%, 0.075%, 0.25%, 0.50%, 0.75%, and 1.0%. Each sample is compacted using Modified proctor test and Optimum Moisture Content (OMC) of each soil sample was determined. California bearing proportion test was finished by supplanting sweeping soil with tile squander. The California bearing ratio (CBR) values were noted.

V. EXPERIMENTAL PROGRAMME

The following tests were conducted to determine the Engineering properties of the clayey soils mixed with tiles particles:

- Modified Proctor Compaction test to determine the different dry densities of clayey soils and maximum dry density at the optimum moisture content.
- California Bearing Ratio test to determine the % CBR values of clayey soils mixed with different mix composition of admixture (Tiles particles) in unsoaked conditions.
- Direct shear test to determine shear strength of clayey mix composition with tiles waste.

VI. TEST RESULTS

A. MODIFIED PROCTOR COMPACTION TEST -

The maximum dry density (MDD) of the clayey soils without any admixture mixed is obtained as 1.67 gm/cc at the optimum moisture content (OMC) equal to 18%. The dry density variation with water content for clayey soil is tabulated below in Table 1 and graphically shown below in Figure 3:

Table 1: Dry density variation with water content for bentonite

S. No.	% WATER ADDED (BY WEIGHT)	DRY DENSITY (gm/cc)
1	8	1.56
2	10	1.57
3	12	1.61
4	14	1.63
5	16	1.65
6	18	1.67
7	20	1.62
8	22	1.6
9	24	1.52
10	26	1.5

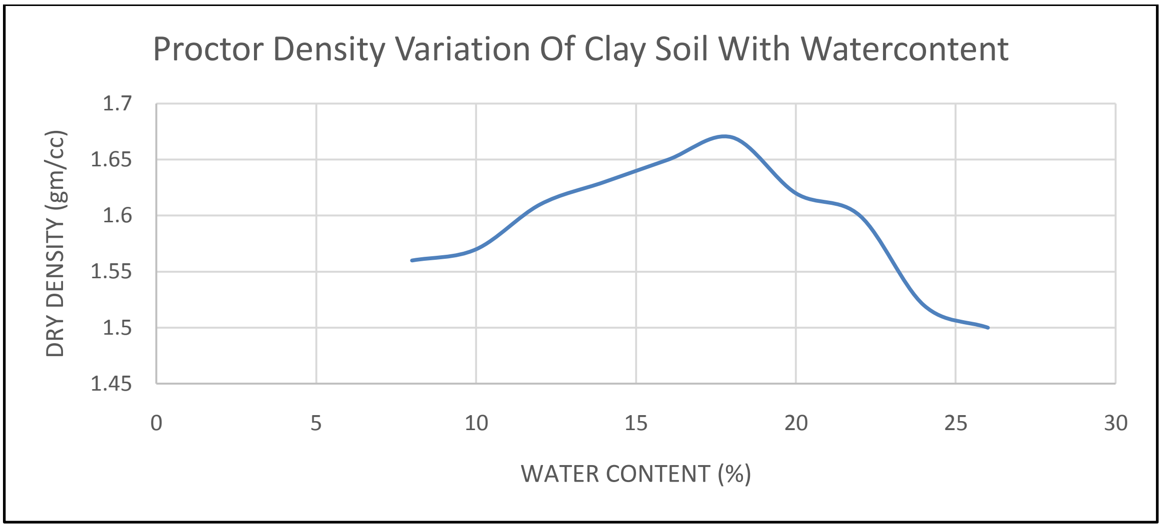

Figure 3: Dry density variation of clayey soil with water content

B. CALIFORNIA BEARING RATIO TEST –

The results of the unsoaked CBR tests conducted at MDD of 1.67 gm/cc, 1.61 gm/cc and 1.52 gm/cc are tabulated below:

TABLE 2: Mix Compositions, Symbols for Unsoaked CBR Test at MDD 1.67 gm/cc and % CBR Valueof Clayey soil with Each Mix Composition

MIX NO.	MIX COMPOSITION	SYMBOL	% CBR VALUE
1	0.05%Tiles Particles + Clay	CA1	5.723
2	0.075% Tiles Particles + Clay	CA2	5.961
3	0.25% Tiles Particles + Clay	CA3	7.392
4	0.50% Tiles Particles + Clay	CA4	5.246
5	0.75% Tiles Particles + Clay	CA5	4.768
6	1.0% Tiles Particles + Clay	CA6	4.530

TABLE 3: Mix Compositions, Symbols for Unsoaked CBR Test at MDD 1.61 gm/cc and % CBR Valueof Clayey soil with Each Mix Composition

MIX NO.	MIX COMPOSITION	SYMBOL	% CBR VALUE
1	0.05%Tiles Particles + Clay	CA7	5.007
2	0.075% Tiles Particles + Clay	CA8	5.484
3	0.25% Tiles Particles + Clay	CA9	6.199
4	0.50% Tiles Particles + Clay	CA10	5.007
5	0.75% Tiles Particles + Clay	CA11	4.530
6	1.0% Tiles Particles + Clay	CA12	4.530

TABLE 4: Mix Compositions, Symbols for Unsoaked CBR Test at MDD 1.52 gm/cc and % CBR Valueof Clayey soil with Each Mix Composition

MIX NO.	MIX COMPOSITION	SYMBOL	% CBR VALUE
1	0.05%Tiles Particles + Clay	CA13	5.484
2	0.075% Tiles Particles + Clay	CA14	6.199
3	0.25% Tiles Particles + Clay	CA15	6.914
4	0.50% Tiles Particles + Clay	CA16	5.245
5	0.75% Tiles Particles + Clay	CA17	5.000
6	1.0% Tiles Particles + Clay	CA18	5.000

The graphical variation of the percentage CBR values in unsoaked conditions for different mix compositions of admixture with Clay Soil is shown below.

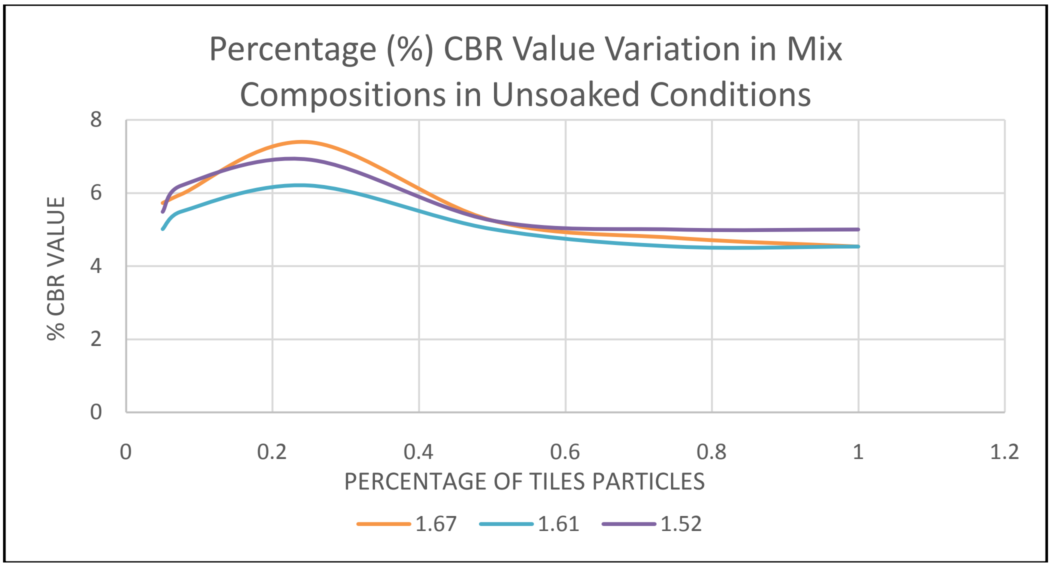

Figure 4: Variation of % CBR values in unsoaked conditions for different mix compositions of admixture with Clayey Soil of dry density 1.67 gm/cc, 1.61 gm/cc and 1.52 gm/cc

From the above graph it is clear that among the three samples taken for the study, the maximum CBR value is obtained for dry density of Clayey Soil of 1.67 gm/cc. It is also stated here that the maximum CBR value is obtained when the percentage by weight of admixture (Waste Tiles Particles) mixed with the Clay Soil is 0.25%.

C. DIRECT SHEAR TEST –

The results of Direct Shear test at MDD 1.67 gm/cc of Clayey Soil mix with percentage of waste tiles particles are shown in tabular below:

TABLE 5: Variation of φ with Percentage of Tiles Particles at MDD 1.67 gm/cc

S. No.	MIX COMPOSITION	Φ (DEGREE)
1	DA1	11.63°
2	DA2	11.64°
3	DA3	13.42°
4	DA4	15.28°
5	DA5	11.43°
6	DA6	9.94°

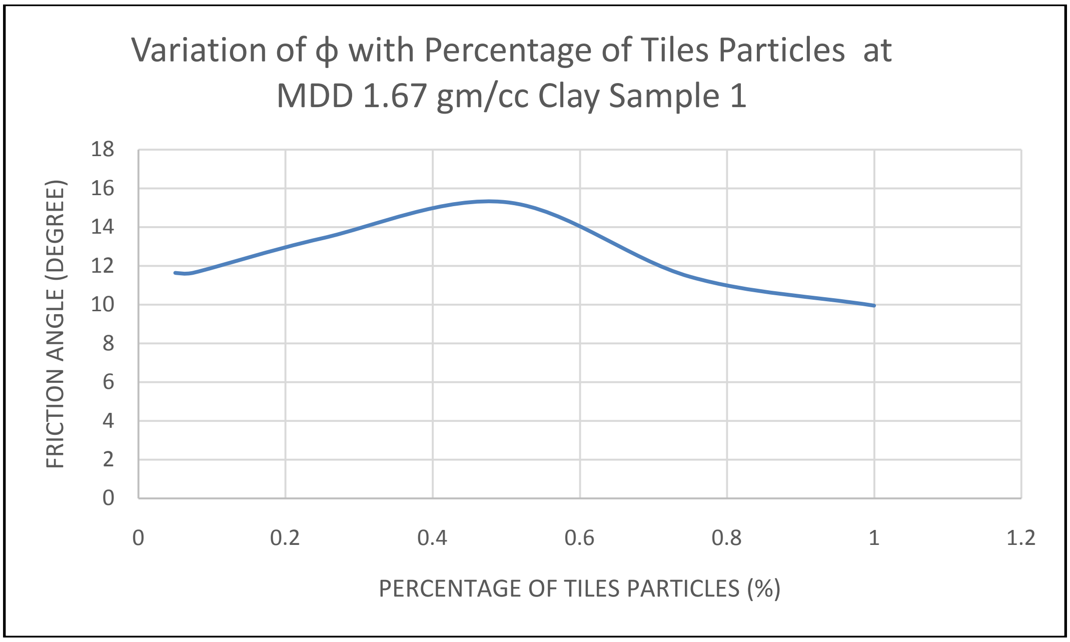

Figure 5: Variation of φ with Percentage of Tiles Particles at MDD 1.67 gm/cc

TABLE 6: Variation of Shear Stress with Normal Stress for All Mix Composition at MDD 1.67gm/cc

Shear Stress (kg/cm^2) for each mix composition at MDD 1.66 gm/cc	Normal Stress (kg/cm^2) 0.5	1.0	1.5
Clay + 0.05% Tiles Particles(DA1)	0.339	0.440	0.531
Clay + 0.075% Tiles Particles(DA2)	0.3575	0.440	0.5591
Clay + 0.25% Tiles Particles(DA3)	0.4308	0.550	0.6691
Clay + 0.50% Tiles Particles(DA4)	0.495	0.6416	0.770
Clay + 0.75% Tiles Particles(DA5)	0.366	0.4675	0.5683
Clay + 1.0% Tiles Particles(DA6)	0.330	0.4125	0.5041

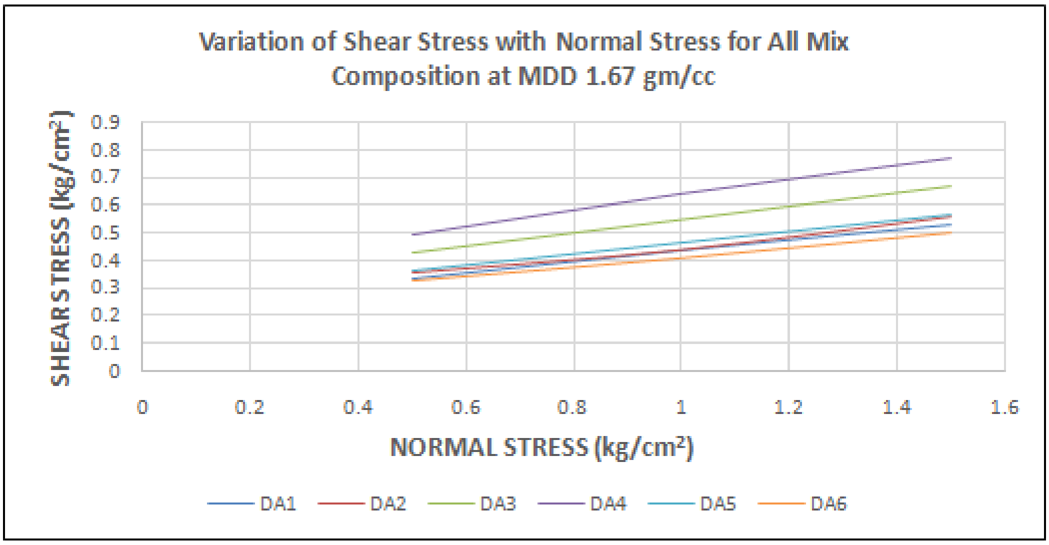

Figure 6: Variation of Shear Stress with Normal Stress for All Mix Composition at MDD 1.67 gm/cc

VII. CONCLUSION

After analysis of the test results presented in the tables and figures of plotted graphs, the following conclusion are drawn regarding the performed experimental study:

1. According to test results it can be seen that on increment of dry density, the CBR value of the mix composition increases. On increasing the percentage of tiles particles firstly the CBR value of the mix composition also increases and then starts to decrease for more percentage of tiles particles. The maximum results have been obtained at low percentage of tiles particles (0.25%) and minimum results at 1.0% tiles particles for all the three dry densities. Hence it can be concluded that to use the mix compositions in base and sub base construction, the CBR values can be increased or decreased as needed.
2. The study indicates that the Angle of internal friction (Φ) increases with increase of percentage of tiles particles content in the mix composition. Less percentage of tiles particles content optimum values. Those values for clayey soil at MDD are 15.28^0.
3. The values of friction angle increase as the dry density of clay increases. The increase in strength in soil is due to increase in friction between soil and tiles particles waste and development of tensile stress in the tile's particles.
4. Waste Tiles Particles can be used as admixture and thus its recycling helps in reducing environmental problem related to its dumping and/or disposal.

REFERENCES

[1]. Ajay Upadhyay, et al., (2016), "Review on Soil Stabilization Using Ceramic Waste", International Research Journal of Engineering and Technology (IRJET), Volume 03; Issue 07; July 2016, PP 1748-1750.

[2]. Sumayyak.p et al., (2016), "Stabilization of Expansive Soil Treated with Tile Waste", SSRG International Journal of Civil Engineering (SSRG-IJCE) volume-3, Issue 3, Pp 67-75.

[3]. Ameta N.K. and Abhay ShuvajiWayal, "Effect of Bentonite on Permeability of Dune Sand", E.J.G.E., Vol. 13-Bund. A, 2008 [9]

[4]. Dr. A.S. Wayal, Dr. N.K. Ameta, Dr. D.G.M. Purohit, "Mountain Soil Stabilization Using Bentonite and Lime" JERS.DSV Prasad et al., (2014), "Quality Behavior of Expansive Soil Treated with Tile Waste", International Journal of Engineering Research and Development (IJERD).

[5]. Alam Singh Basic Soil Mechanics and Foundation (CBS Publishers and distributors, India 2009).

[6]. K.R Arora, Soil Mechanics and Foundation Engineering (Geotechnical Engineering) 2016.

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