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Engineering Properties of Clay Soil Stabilized with Tiles Particles

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Abstract: ***Expansive soils are most affected by different types of problems when it comes to the loose soil having low shear strength and bearing capacity. It becomes swelling when contact to the water and shrinkage when removed the water content. This study is kept to observe the effects of utilization of expansive soils to evaluate the engineering properties of clayey soils when it is mixed with the tile's particles with the different percentage viz. 0.05%,0.075%,0.25%,0.50%,0.75% and 1.0% by weight of admixture. Performance of different tests as standard proctor compaction tests and California bearing ratio tests are done.***
Keywords: Clay Soil, Tiles Particles, California Bearing Ratio tests, Standard Proctor Compaction tests.

I. INTRODUCTION

Expensive soils are so weak, so without any changes in the engineering properties of the clay soils any construction are made on this type of soils. Stabilization and improvement of their properties is necessary. In the stabilization process increasing the soil strength and reducing its permeability and compressibility. There are many methods of stabilization process may include, mechanical, chemical, electrical or thermal processes. These processes are depending on the types of soils and overall cost of the project. In this study stabilization is the process of blending and mixing of waste materials with a clay soil to improving the properties of the soils.
In this study tiles particles are blending in to the clay soils to achieve a desired gradation and improving the engineering properties of soils, thus making it more stable. This study keeps to determine the geotechnical properties of clay soil stabilization with tiles particles.

II. MATERIALS USED FOR STUDY

A. Clay Soils

Geologic clay deposits are mostly composed of phyllosilicate materials containing variable amounts of water trapped in the mineral structure. Clay is a finely-grained natural rock or soil material that combines one or more clay minerals with possible traces of quartz (SiO_2), metal oxides (Al_2O_3, MgO etc.) and organic matter. Clay are plastic due to particle size and geometry as well as water content, and become hard, brittle and non-plastic upon drying. Clay soils contain minerals that are capable of absorbing water. When water is added in the clay soils, they increase in volume. And again, more water added, the more their volume increases of the clay soils. this changing in volume can exerts enough forces on a building or other structure this cause damage the structure. Cracked foundations, floors, and basement walls are typical types of damage done by swelling soils. Clay soils will also be shrinking when they remove the water content. This sample is collected from the local nursery.

B. Tiles Particles

A ceramic tile is an inorganic, nonmetallic solid prepared by the action of heat and subsequent cooling. By the using of ceramic tile waste to reduce the waste materials in earth and economical. 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.
The word tile is derived from the French word tuile, which is, turn, from the latin word tegula, meaning a roof tile composed of fired clay. Tiles are most often made of ceramic, typically glazed for internal uses and unglazed for roofing, but other materials are also commonly used, such as glass, cork, concrete and other composite materials, and stone. The tiles particles are collected from the local shop of tiles from jodhpur city.

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III. EXPERIMENTAL PROGRAMME

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

A. Standard Proctor Compaction test to determine the different dry densities of clay soils and maximum dry density at the optimum moisture content.
B. California Bearing Ratio test to determine the % CBR values of clay soils mixed with different mix composition of admixture (Tiles particles) in unsoaked conditions.

IV. TEST RESULTS

A. Standard Proctor Compaction Test

The maximum dry density (MDD) of the clay soils without any admixture mixed is obtained as 1.83 gm/cc at the optimum moisture content (OMC) equal to 16%. The dry density variation with water content for clay soil is tabulated below in Table 1 and graphically shown below in Figure 1:

Table 1: Dry density variation with water content for clay soil

S. No.	% WATER ADDED (BY WEIGHT)	DRY DENSITY (gm/cc)
1	8	1.76
2	10	1.78
3	12	1.79
4	14	1.81
5	16	1.83
6	18	1.74
7	20	1.71
8	22	1.69
9	24	1.65
10	26	1.64

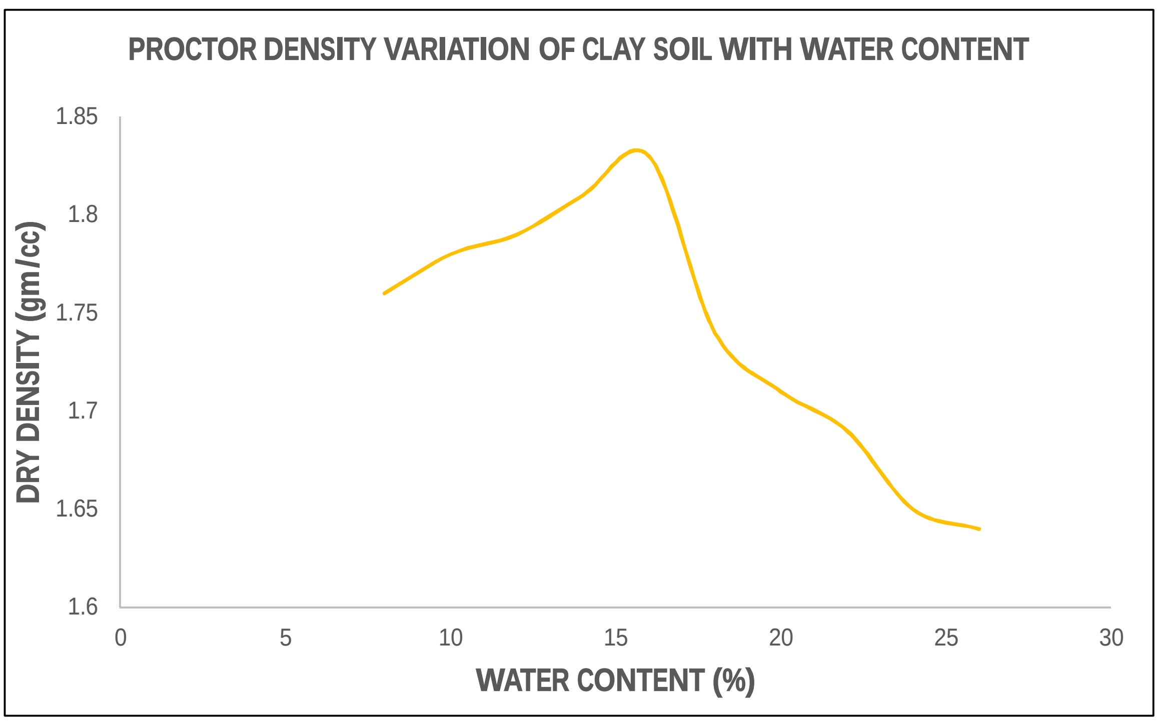

Figure 1: Dry density variation of clay soil with water content

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B. California Bearing Ratio Test

The results of the unsoaked CBR tests conducted at MDD of 1.83 gm/cc, 1.78 gm/cc and 1.69 gm/cc are tabulated below:

TABLE 2: Mix Compositions, Symbols for Unsoaked CBR Test at MDD 1.83 gm/cc and % CBR Value of Clay soil with Each Mix Composition

MIX NO.	MIX COMPOSITION	SYMBOL	% CBR VALUE
1	0.05% Tiles Particles + Clay	CB1	7.153
2	0.075% Tiles Particles + Clay	CB2	7.153
3	0.25% Tiles Particles + Clay	CB3	7.868
4	0.50% Tiles Particles + Clay	CB4	6.795
5	0.75% Tiles Particles + Clay	CB5	6.437
6	1.0% Tiles Particles + Clay	CB6	5.722

TABLE 3: Mix Compositions, Symbols for Unsoaked CBR Test at MDD 1.78 gm/cc and % CBR Value of Clay soil with Each Mix Composition

MIX NO.	MIX COMPOSITION	SYMBOL	% CBR VALUE
1	0.05% Tiles Particles + Clay	CB7	5.722
2	0.075% Tiles Particles + Clay	CB8	6.437
3	0.25% Tiles Particles + Clay	CB9	6.676
4	0.50% Tiles Particles + Clay	CB10	5.961
5	0.75% Tiles Particles + Clay	CB11	5.722
6	1.0% Tiles Particles + Clay	CB12	5.484

TABLE 4: Mix Compositions, Symbols for Unsoaked CBR Test at MDD 1.69 gm/cc and % CBR Value of Clay soil with Each Mix Composition

MIX NO.	MIX COMPOSITION	SYMBOL	% CBR VALUE
1	0.05% Tiles Particles + Clay	CB13	6.795
2	0.075% Tiles Particles + Clay	CB14	7.153
3	0.25% Tiles Particles + Clay	CB15	7.868
4	0.50% Tiles Particles + Clay	CB16	7.153
5	0.75% Tiles Particles + Clay	CB17	6.437
6	1.0% Tiles Particles + Clay	CB18	5.961

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

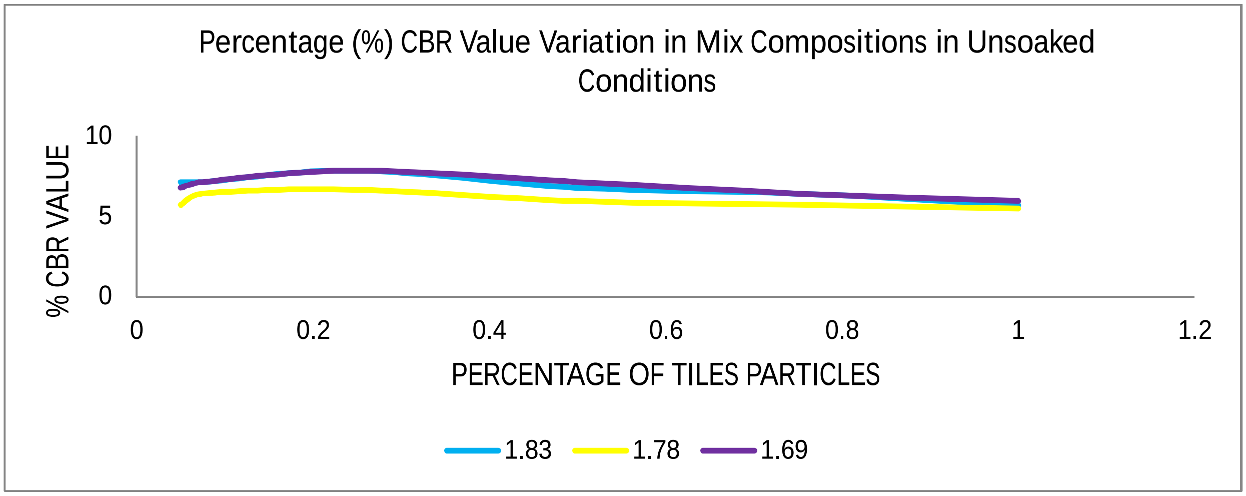

Figure 2: Variation of % CBR values in unsoaked conditions for different mix compositions of admixture with Clay Soil of dry density 1.83 gm/cc, 1.78 gm/cc and 1.69 gm/cc

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 Clay Soil of 1.69 gm/cc. It is also stated here that the maximum CBR value is obtained when the percentage by weight of admixture (Tiles Particles) mixed with the Clay Soil is 0.25%.

V. CONCLUSIONS

The following conclusions can be made from the above study:

A. It is observed that the CBR values first increases when the percentage by weight of admixture (Tiles Particles) mixed with the clay soil increases upto 0.25% and then with the increase in percentage by weight of admixture the CBR values decreases.
B. The above observation is same for all the three samples and thus it is concluded that the variation of CBR values with the percentage by weight of admixture is independent of the dry density of the clay soil.
C. It is also seen here that the maximum CBR value is obtained when the percentage by weight of admixture mixed with the clay soil is 0.25% irrespective of the dry density of the clay soil.
D. It is clear that among the three samples taken for the study, the maximum CBR value is obtained for dry density of clay soil equal to 1.69 gm/cc.
E. Tiles Particles can be used as admixture and thus its recyling helps in reducing environmental problem related to its dumping and/or disposal.

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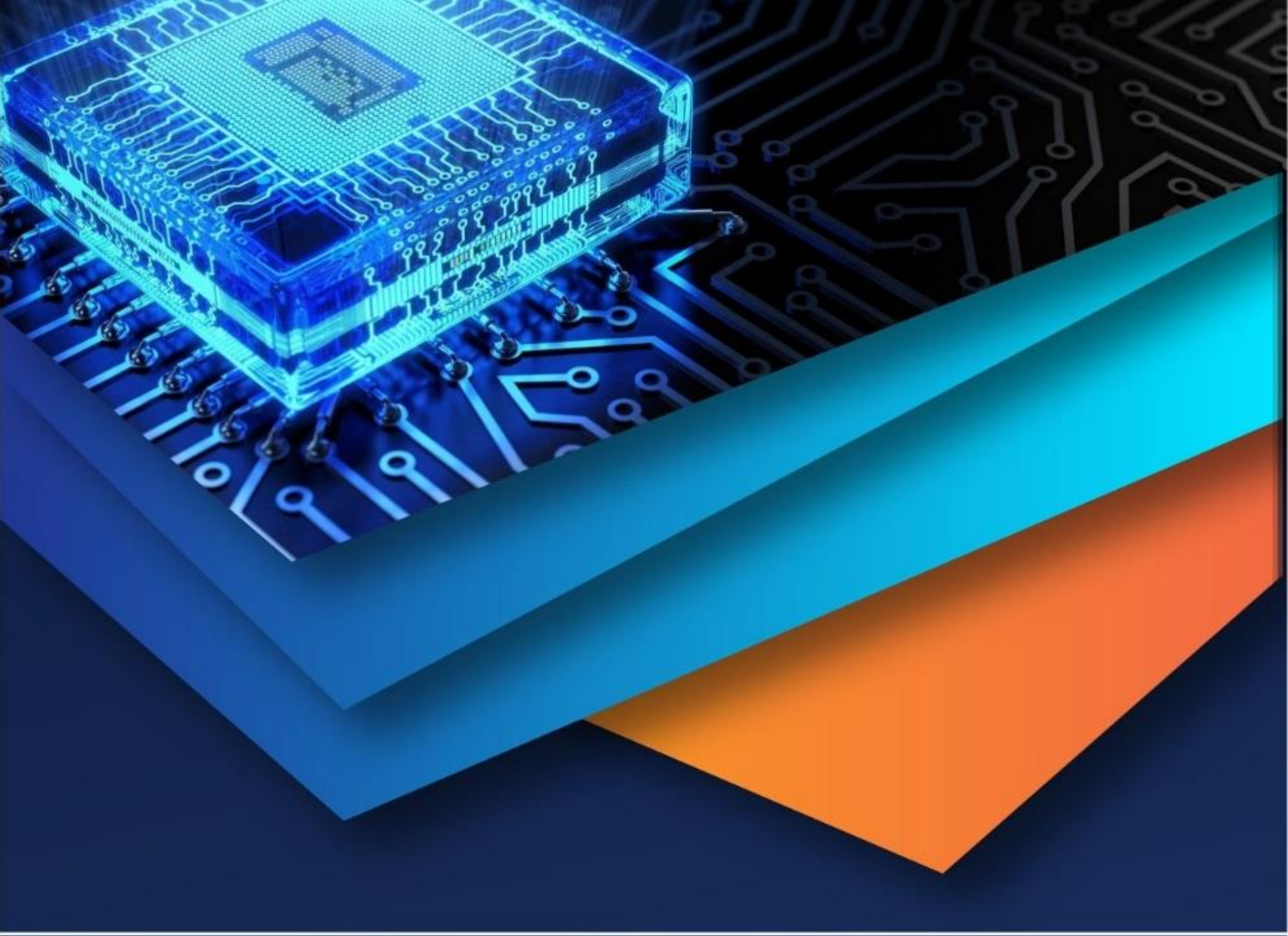

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