

Comparative Study On Soil Stabilization Using Silica Fumes

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Abstract- *Expansive soil is a worldwide problem that creates challenges for civil Engineer. The construction aspects of loose soil & cohesive soil is difficult & UN economy. Stabilization is the process of physical and chemical alternation of soil to increase their engineering properties. And this process used to improving the load bearing capacity for the pavement works. In India expansive soil is popularly known as black Cotton soil. Compared to red soil the Black Cotton Soil is the problematic soil that has high potential for shrinking or swelling due to change of moisture content. Soils are stabilized with various proportion of Additive materials are cement, silica fume have to be added to the soil in ratios as (0%, 5%, 10%, and 15%) up to optimum percentage by Weight. And the properties are compared after the following tests, Specific Gravity Test Sieve Analysis, Plastic Limit and Liquid Limit Test, California Bearing Ratio Test, unconfined compression test, brick test (compression, water absorption).*

I. INTRODUCTION

The soil stabilization is generally used for modify the engineering properties of the soil.. Soil stabilization is broadly used in connection with road, pavement and foundation construction. It improves the engineering properties of the soil in terms of volume Stability, strength, and durability. Soil stabilization occurs over a longer time period of curing. Soil stabilization aims at improving soil strength and increasing resistance to softening by water through bonding the soil particles together, water proofing. The simplest stabilization processes are compaction and drainage (if water drains out of wet soil it becomes stronger). The other process is by improving gradation of particle size and further improvement can be achieved by adding binders to the weak soils, and the stabilization. commonly done in several methods like chemical method, mechanical method, etc. Soil stabilization involves the use of stabilizing agents (binder materials) in weak soils to improve its geotechnical properties such as compressibility, strength, permeability and durability. The components of stabilization technology include soils and or soil minerals and stabilizing agent or binders.

1.1.OBJECTIVE

1. To modify the engineering properties of the soil.
2. To improve the stiffness and the tensile strength of the soil,
3. To decrease the pavement thickness,
4. Improve durability and the resistance to the effect of the water,
5. Life of landfill is extended and natural resource is extended.

1.2 SCOPE OF OUR PROJECT

The scope of the study is used for finding the best pair of chemical to use it in the stabilization method by strength characteristics and compression characteristics. The soil stabilization will increase the soil.

1.3 METHODOLOGY.

Literature collection. Material collection (Red,soil,Black,soil,Silica,fume,Water). Material Testing (physical and chemical properties) Mix Proportion, Strength and Quality characteristics, Result and discussion.

II. MATERIAL PROPERTIES

2.1 MATERIAL USED

- Black cotton soil
- Red soil
- Silica fume
- Distilled water

2.1.1.BLACK COTTON SOIL

The black cotton soil is collected from Kadanthapatty, Namakkal (D.T), Tamil Nadu, and India. In India deposition of Black cotton soil is very good and prosperous for farmers. All the basic amenities of life i.e. Food, clothes and house have been fulfilled by the soil, without soil It is just next to impossible to think about life on the earth. But on the other side in Civil Engineering aspects Black cotton soil is very troublesome and problematic and hazardous due to its characteristics. Because of its high

swelling and shrinkage characteristics, the black cotton soil has been a challenge to the Engineers. The black cotton soil is very hard when dry but loses its strength completely when in wet.



2.1.2.RED SOIL

The red soil is collecting from Kadanthapatty, Namakkal (D.T), Tamil Nadu, and India. Generally this soil visible in red colour, so it is also known as red soil. This kind of soil having the desired cohesiveness. And this soil is generally preferable for the agricultural purposes.



SILICA FUMES

Silica fume is a by-product from the production of elemental silicon or alloys containing silicon in electric arc furnaces. At a temperature of approximately 2000°C the reduction of high-purity quartz to silicon produces silicon dioxide vapor, which oxidizes and condenses at low temperatures to produce silica fume.



DISTILLED WATER

Distilled water is water that has been boiled into vapor and condensed back into liquid in a separate container. Impurities in the original water that do not boil below or near the boiling point of water remain in original container.

MIX PROPORTIONS

For the red soil and CEMENT

- 1.SOIL +0%CEMENT = SAMPLE 1
2. SOIL +5%CEMENT= SAMPLE 2
- 3.SOIL +10%CEMENT= SAMPLE 3
- 4.SOIL +15%CEMENT= SAMPLE 4

For the red soil and SILICA FUME

- 1.SOIL +0%SILICA =SAMPLE 1
- 2.SOIL +5%SILICA =SAMPLE 2
- 3.SOIL +10%SILICA =SAMPLE 3
- 4.SOIL +15%SILICA =SAMPLE 4

For the Black cotton soil and CEMENT

- 1.SOIL +0%CEMENT = SAMPLE 1
2. SOIL +5%CEMENT= SAMPLE 2
- 3.SOIL +10%CEMENT= SAMPLE 3
- 4.SOIL +15%CEMENT= SAMPLE 4

For the Black cotton and SILICA FUME

- 1.SOIL +0%SILICA =SAMPLE 1
- 2.SOIL +5%SILICA =SAMPLE 2
- 3.SOIL +10%SILICA =SAMPLE 3
- 4.SOIL +15%SILICA =SAMPLE 4

TESTING OF SAMPLES

SIEVE ANALYSIS TEST

The sieve analysis is an important test to find the grain size of the soil. In this test the most finer sieve screen is 0.075 mm. The sieve sets are arranged in the order of IS code book provisions.



SPECIFIC GRAVITY TEST

The specific gravity is a unique property to everything But the value may change by their water absorption characteristics And the specific gravity is tested with adding various chemicals with the soil by using the pycnometer and weighing balance.



S.NO	TEST FOR SPECIFIC GRAVITY	VALUE OBTAINED
1	Red soil	1.53%
2	Black cotton soil	2.88%

PLASTIC AND LIQUID LIMIT TEST

This test is conducted to find the optimum moisture content taken by a soil to get the liquidity and the plasticity. The plasticity Index value find by subtracting the Liquid limit value with the Plastic Limit. $I_p = (\text{Liquid limit}) - (\text{Plastic Limit})$ by using this formula we can say the condition of the soil. The plasticity index test is done by IS 1498 codes.



For red soil plasticity index value

S.NO	TEST FOR PLASTIC AND	VALUE OBTAINED
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	LIQUID TEST	LIMIT
1	RED SOIL	31.6%
2	BLACK SOIL	28.54%

CALIFORNIA BEARING RATIO TEST

The California bearing ratio test is used to find the penetration stress The CBR value is determined by the ration of test load to the standard load. The test procedure involves two parts, one is preparing the test specimen and another is penetration test. There is two type of compaction is used by two methods. 1 Static compaction, 2 Dynamic Compaction loading machine having the capacity of of loading The loading value is 125 m minute. In the CBR test penetration sample is taken to design. The CBR test is done by IS2720 PART 16 1979.

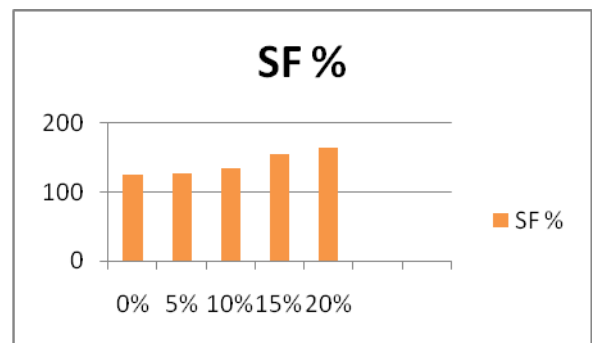
UNCONFINED COMPRESSION TEST

The unconfined compression test is used in the compressive strength of the soil sample The sample is sieved and axot with the chemicals Then added with desire quantity of water and filling in then lubricated oil applied mold with three layer of proper compaction. And then allowed to certain load till the specimen gets failure.

V. RESULT AND DISCUSSION

5.1 SIEVE ANALYSIS

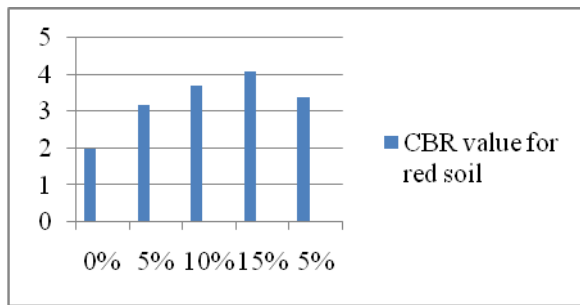
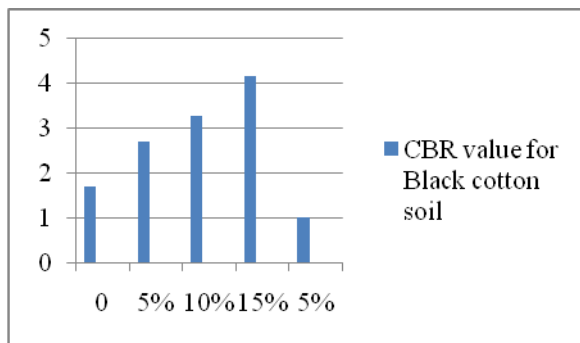
Sieve Analysis result for the black cotton soil.



5.4 CBR TEST FOR RESULTS

The CBR test is conducted on both two soils in two type of condition

- 1) Without Chemicals. ii) With chemicals in the following ranges 5%, 10%, 15% And the test results are shown in the following figures.

CBR value for Red soil**CBR value for Black cotton soil****VI. UNCONFINED COMPRESSIVE STRENGTH TEST**

Unconfined Compressive Strength Test The unconfined compression test is conducted for both soils in various mix designs like 5%, 10%, 15% to find the maximum strength giving mix. The values are graphed for the red soil and the black cotton soil, in three periods (1day, 7 days, 14 days.)

VII. CONCLUSIONS

1. The sieve analysis is having same values compare to chemicals adding Because of the grain size of the pan value and the chemicals value remain same. And the values are shown as graph in the fig
2. The Specific gravity test is conducted with the soil mix of chemicals in the range of 0% 5%, 10%, 15% Compare to all the percentages the 10% is found as the optimum percentage The values are return low range after reaching the 10% The specific Gravity Values of the Red soil and The Black cotton soil are shown in figure
3. The Plasticity index values are finding by subtracting the liquid limit value and the plastic limit. And if the liquid limit increase means, the strength of the soil is reduced By adding the chemicals the Atterberg limit both the liquid limit and the plastic limits are reduced.

4. In the CBR test results, the values are having ups and down after reaching the 10% of chemical mix. The CBR test is generally based on the penetration values. And the Black cotton soil takes the silica fume to reach the strength higher And the California Bearing Ratio test results are shown in fig.
5. The unconfined compressive strength test s conducted both the soils By comparing the test results we can find, which mix is giving high strength. This test is conducted with three stages of soil samples (1 day, 7 days, and 14days) Day by day the strength is increased for both the soil in any kind if mixture.

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