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Soil Stabilization using Natural Sand

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Abstract: -- The **soil is a most commonly used material in civil engineering construction works. There are different types of soil present on earth according to material property, size, texture; Black cotton soil (Expansive soil) is very fragile as compared to other soils. So to make the soil stable, soil stabilization is required to improve the engineering properties of soil, like to improve load-bearing capacity, shear strength and to reduce permeability and compressibility of the soil mass because the black cotton soil is not suitable to carry the structural load. The aim of this experiment is to determine the strength of soil by conducting following test: Liquid limit, Plastic limit, Shrinkage limit, Compaction test, unconfined compressive test, sieve analysis. Soil will be stabilizing by varying percentage of natural sand (5%, 10%, 15%). By conducting these Experiment we can obtain the optimum water content, maximum dry density, reduce permeability and low compressibility.**

Key Words- **Black cotton soil, Stabilization, permeability, compressibility, liquid limit, plastic limit, shrinkage limit, compaction, unconfined compression test, sieve analysis, natural sand, optimum water content, maximum dry density.**

I. INTRODUCTION

A. General

Soil is produced by the natural or chemical disintegration of rock or any other substances. Black cotton soil is very largely found in Deccan part of India. It is very sticky material. When water is added to this soil it will shrink or swells. This soil expands during rainy season and shrinks during the dry season. This soil is easily available. Expansive soil is not good for any type of construction so improvement of expansive soil is required to do so soil stabilization is necessary. Here, black cotton soil properties improved by stabilizing with natural sand at different proportion and observing the basic properties of modified soil by different test.

B. Soil Stabilization

Soil stabilization is the process of improving the engineering properties of soil. It increase the load bearing capacity of soil and shear strength.

C. Properties of soil stabilization

1. It increases the shear strength of soil.
2. It increase the load bearing capacity

II. OBJECTIVE

1. To improve the engineering properties of black cotton soil by blending it with natural sand by different proportions.
2. Comparison of blended soil by different proportions.
3. To evaluate the test results of blended soil.

III. LITERATURE REVIEW

A. According to researcher V.Ramesh Babu, et al, (2016) they conducted experiments by using sand and cement as a stabilizing agent on black cotton soil. Minimum quantity of cement i.e., 2% and sand i.e., 10% was added to soil from 10% to 30% at 10% intervals.[1] The following test were taken : Mechanical properties, Atterberg limits, Proctor compaction, UCC and CBR. They concluded that the specific gravity of the stabilized soil increased with increase in fly ash content. As well as plastic and liquid limit of stabilized soil decrease in increase in sand and cement content. Also there is decrease in OMC and in increase in MDD when sand and cement is added about 30%.[1] There is increase 20% unconfined compressive strength and decrease in 30% . In CBR test results there is decrease of CBR value for 20% and increase value for 30%.[1]

B. According to the author Dr. Robert M. Brooks he experimented by using fly ash and rice husk ash as a

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stabilizer to improve the soil properties he Concluded that when RHA content was increased by 47 % the optimum RHA content was found at 12% for USC and CBR test.[2] He also told that there is a reduction of swelling of expansive soil. Stress strain behavior of unconfined compressive strength showed that failure stress and strain increased by 106% and 50% respectively. When the fly ash content was increased from 0 to 25%.[2]

C. According to the writer Ankit singh Negi et al, he experimented by using lime as a stabilizing agent to alter the soil properties. he concluded that lime is very excellent soil stabilizing agent which is very important for highly active soil and it goes through shrinkage and expansion it also, improves the properties of soil such as reduction in plasticity index , increase in the compression and resistance to shrinkage during different weather condition. This chemical reaction is very fast and stabilization takes time[3].

D. According to the researcher Neeta B. Ramteke et al,They conducted experiment by using sand and cement as a stabilizing material for black cotton soil to be used as a sub-grade for pavement. They found out that the CBR value increased . when tandhe sand content is increased. The soil result in the improvement of CBR value from 1.93% to 7.39%.[4] The maximum CBR value is 40% for sand and 2% for cement with the black cotton soil. The atterbarg limit goes on content decreases and maximum dry density increases with increase in sand percentage decreasing with increase in percentage of sand as well as the moisture

IV. RESULTS AND DISCUSSION

A. Sieve analysis

Table no. 1 Sieve Analysis for different soil.

Sieve size in (mm)	% finer (100% soil)	% finer (soil + 5% sand)	% finer (soil + 10% sand)	% finer (soil + 15% sand)
4.75	77%	54.75%	61.55%	62.15%
2.36	68.40%	47.05%	53.25%	54.25%
2	64.45%	43.35%	49.20%	50.80%
1.18	53.45%	29%	34.75%	36.15%
0.85	43.75%	20.80%	25.85%	27.50%
0.6	38.45%	17.15%	21.70%	23.55%
0.3	10.05%	5.70%	7.25%	9.25%
0.25	2.95%	4.85%	5.95%	7.85%
0.15	1.30%	2.05%	2.45%	3.35%
0.075	0.25%	0.90%	0.90%	1.20%

It shows the percentage variation of different blended proportions.

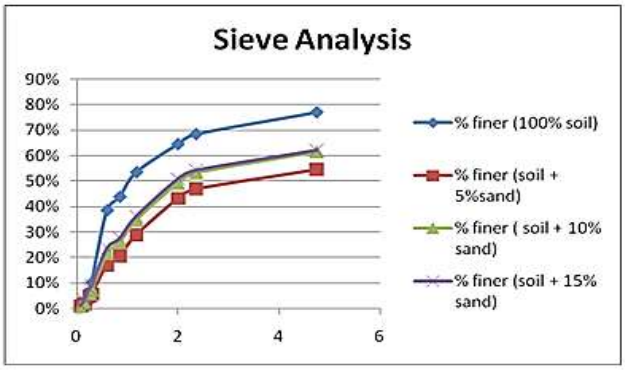

Fig no 1: Sieve analysis for different percentage of blend with natural sand.

Fig no. 1 shows the variation in of different curves of soil like 100% soil, soil + 5% sand, soil + 10% sand, soil + 15% sand.

B. Atterberg limits.

1. Liquid limit

Table no. 2: Liquid limit test result for 100% natural Soil.

No. of blows	Moisture content (%)
20	55.55%
32	15.91%
56	50%

This are the different moisture content of 100% soil sample with their no. of blows

Table no.3: Liquid limit test result for Soil + 5% Sand.

No. of blows	Moisture content (%)
14	57.14%
30	60%
50	66.67%

This are results of soil and mixture of 5% sand and their moisture content does not vary.

Table no 4: Liquid limit test result for Soil + 10% Sand.

No. of blows	Moisture content (%)
26	75%
35	11.11%
55	45.45%

This sample shows variations in moisture content because of the blend.

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Table no5: Liquid limit test result for Soil + 15% Sand.

No. of blows	Moisture content (%)
15	50%
25	40%
40	43%

As the below table has similarity in moisture content. They are in range of 40 to 50%

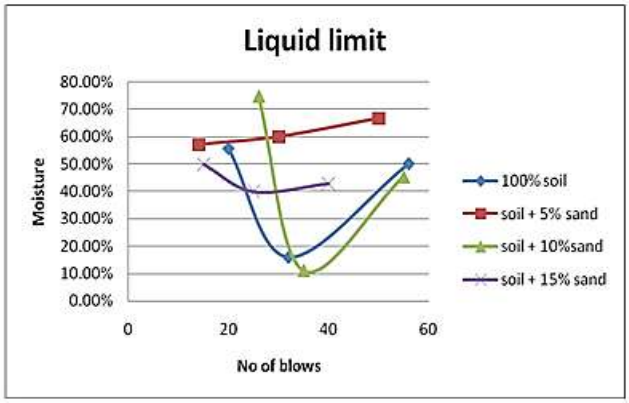

Fig no 2 : Liquid limit graph for different percentage of blend with natural sand.

Fig. no. 2 shows the graph of liquid limit as no. of blows to the moisture content of their soil sample.

2. Plastic limit.

Table no.5: Plastic limit test for black cotton soil different blend with natural sand.

Mixture	Water content
100% Soil	56.25%
Soil + 5% sand	51.12%
Soil + 10% sand	38.28%
Soil + 15% sand	21.4%

Table shows gradual increase in water content and direct decrease at 15% sand.

3. Shrinkage limit.

Table no.6: Shrinkage limit test for black cotton soil different blend with natural sand.

Mixture	Shrinkage limit
100% Soil	51.87%
Soil + 5% sand	40.72%
Soil + 10% sand	37.65%
Soil + 15% sand	39.17%

This show decrease in shrinkage when proportion of sand is increased.

C. Unconfined compression test.

Table no.7: Unconfined compression test result for 100% soil.

Strain	Stress
0	0
0.0107	0.08
0.023	0.084
0.033	1.43
0.043	2.85
0.055	4.28
0.077	4.98
0.089	5.69
0.099	5.7
0.111	6.4
0.12	5.7

Table no.8: Unconfined compression test result for Soil + 5% sand.

Strain	Stress
0	0
0.01	0.17
0.02	0.3
0.04	0.7
0.05	0.8
0.06	0.84
0.07	0.75

Table no.9: Unconfined compression test result for Soil + 10% sand

Strain	Stress
0	0
0.011	0.17
0.02	0.59
0.03	0.75
0.04	0.92
0.34	0.92
0.07	0.84

Table no.10: Unconfined compression test result for Soil + 15% sand

Strain	Stress
0	0
0.01	0.09
0.02	0.25
0.036	0.34
0.045	0.43
0.055	0.51
0.079	0.68
0.09	0.681
0.1	0.5

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This shows the increase in stress which affects the soil by deforming it. The table shows strain and stress relation. Same in table no.8, 9, 10.

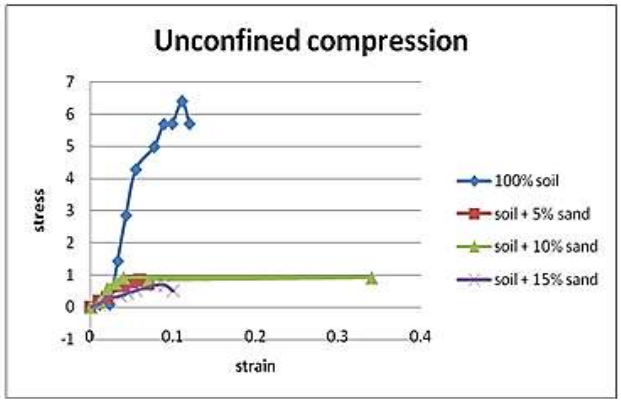

Fig no 3: Unconfined compression graph for different blend with natural sand

Fig. no. 3 shows the curves of unconfined compression test which is carried on soil by varying proportion.

D. Standard proctor test

Table no.11: OMC and MDD for different percentage of blend with natural sand.

OMC	MDD
0.24	0.062
0.262	0.0718
0.21	0.1176
0.11	0.155

Table no. 11shows the decrease in moisture content as we increase the percentage of sand and at a same time there is increase in dry density.

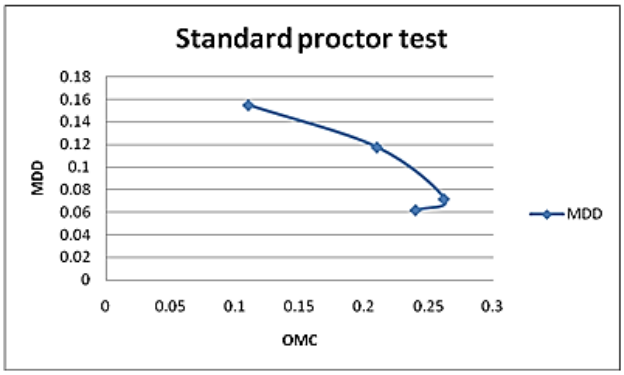

Fig no 4: OMC and MDD graph for different percentage of blend with natural sand.

Fig. no. 4 Graph shows decrease in moisture content and considerable increase in dry density as the proportion of sand is increased in soil.

V. CONCLUSION

Based upon the test results by the experimental work following conclusion are drawn:

1. Soil permeability has been improved by blending the natural sand with black cotton soil.
2. It has been observed from the experiment that the unconfined compression strength has been improved therefore compressibility has been increased.
3. Resistance is increased as blend percentage is increased against permeability.
4. Even pavement thickness will reduce if we blend the natural sand effectively.

IV. FUTURE SCOPE

1. Increasing the proportion of blend.
2. Performing the flexible pavement design for modified black cotton soil.
3. To study of microstructure of black cotton soil by electronic microscope.

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