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Research paper

Impact of crushed sand on the properties of black cotton soil.

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Abstract

Black cotton soil is generally found in western and southern parts of India. Nowadays inefficient properties of soil are critical issues in highway projects. In that case, improve the characteristics of unsuitable soil is fundamental step for the construction. Pavement structure on poor soil subgrades shows distress causing the failure of pavements. Clayey soil usually have the potential to demonstrate and desirable engineering behavior such as load bearing capacity, high shrinkage, swelling characteristics and high moisture susceptibility. Stabilization of Clayey soil is usual practice for improving strength. Soil Stabilization performed the use of technique to adding a binder to the soil in order to improve the engineering properties of soil. This research work reports the improvement in the locally available clayey soil by addition of crushed sand. In this paper the experimental results obtained in the laboratory on black cotton soil treated with lost cost material such as crushed sand. A study is carried out to check the improvement in the properties of black cotton soil with crushed sand in varying percentage. The test results such as Sieve Analysis, Atterbergs limits, Specific gravity, Compaction test and Unconfined compression test at different proportions of crushed sand. The result shows that stabilized black cotton soil has improved the bearing capacity, lesser swelling and reduction in shrinkage has been observed.

Keywords: *Sieve Analysis; Atterbergs Limits; Specific Gravity; Compaction; Crushed Sand; Pavement Design.*

1. 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 Crushed sand at different proportion and observing the basic properties of modified soil by different test. For improving the engineering properties of black cotton soil we are using Crushed sand as a stabilizer. As the natural sand supply is getting exhausted and there is shortage of good natural sand for civil engineering construction. Crushed sand is best option for all construction purpose.

b) Soil Stabilization

Soil stabilization is the process of improving the engineering properties of soil. It increases 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

2. Objective

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

3. 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 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 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

4. Results and discussion

a) Sieve analysis

Table 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	60.3%	68.4%	71.85%	75.4%
2.36	52.5%	60.1%	63.7%	67.9%
1.18	35.95%	41.8%	42.4%	46.85%
0.85	28.75%	33.65%	33.95%	37.65%
0.6	25.3%	29.85%	29.85%	33.4%
0.3	12.05%	14.4%	14.4%	16.95%
0.15	5.75%	7.35%	7.25%	8.9%

It shows the percentage variation of different blended proportions.

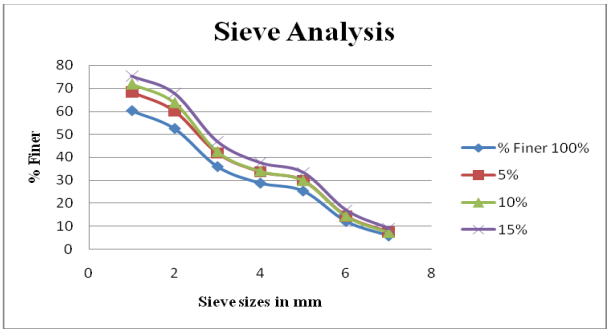

Fig. 1: Sieve Analysis for Different Percentage of Blend with Crushed Sand.

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

b) Atterberg limits.

1) Liquid limit

Table 2: Liquid Limit Test Result for 100% Natural Soil

No. of blows	Moisture content (%)
19	55.30%
23	53.10%
35	50.50%

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

Table 3: Liquid Limit Test Result for Soil + 5% Crushed Sand

No. of blows	Moisture content (%)
20	50.80%
34	46%
45	39.20%

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

Table 4: Liquid Limit Test Result for Soil + 10% Crushed Sand

No. of blows	Moisture content (%)
18	45.60%
30	41.50%
40	41.40%

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

Table 5: Liquid Limit Test Result for Soil + 15% Crushed Sand

No. of blows	Moisture content (%)
19	41.70%
30	39.50%
42	38.60%

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

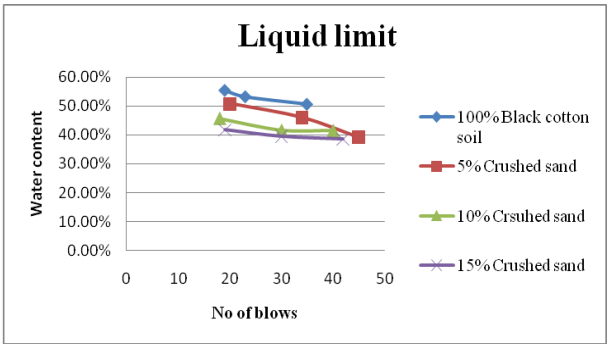

Fig. 2: Liquid Limit Graph for Different Percentage of Blend with Crushed Sand.

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 5: Plastic Limit Test for Black Cotton Soil Different Blend with Crushed Sand

Mixture	Water content
100% Soil	35.72%
Soil + 5% Crushed sand	34.38%
Soil + 10% Crushed sand	37.83%
Soil + 15% Crushed sand	39.51%

3) Shrinkage limit.

Table 6: Shrinkage Limit Test for Black Cotton Soil Different Blend with Crushed Sand

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

c) Standard proctor test

Table 11: OMC and MDD for Different Percentage of Blend with Crushed Sand

OMC	MDD
0.85	0.92
0.79	0.923
0.81	0.91
0.7857	0.907

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.

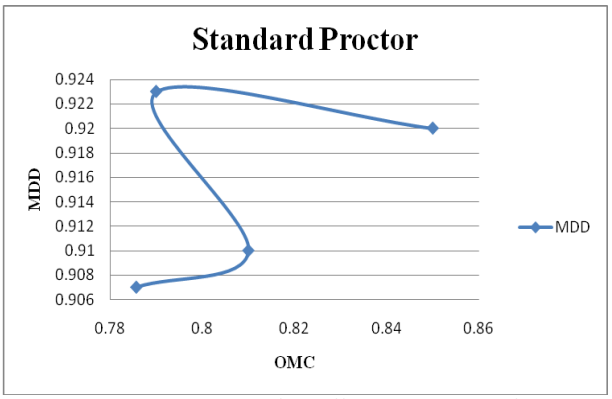

Fig. 4: OMC and MDD Graph for Different Percentage of Blend with Crushed Sand.

5. Conclusion

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

1) Soil permeability has been improved by blending the Crushed sand with black cotton soil.
2) Resistance is increased as blend percentage is increased against permeability.
3) Black cotton soil with crush sand blend can be used for pavement subgrade.

6. 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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