International Journal of Engineering Technology Science and Research
IJETSR
www.ijetsr.com
ISSN 2394 – 3386
Volume 5, Issue 5
May 2018

Comparative Study on Effect of Various Mineral Admixtures on Index Properties of Expansive Soils

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ABSTRACT

Mineral admixtures are proven to have typical influence on soil properties. Individual utilization of the specific ingredients is a well practice in this category. An attempt is made to evaluate the individual and blended effects of different mineral admixtures on the geotechnical characteristics of expansive soils. The materials viz., Lime, fly ash, combination of Marble Powder and wood ash was a very first in this regard, added in varying percentages to the expansive soils respectively by dry unit weight of soil. Testing specimens in standard specifications were prepared and examined for Atterberg's Limits. The experimental results shows that the Atterberg's limits decreases as the percentage of mentioned mineral admixtures increases. Studies taken place at different incremental concentrations and from the data it is revealed that the index properties of expansive soils were found to be optimum for the blend of Marble powder and wood ash when compared to the other two mineral admixtures.

Key words: stabilization, expansive soil, lime, fly ash, marble powder and wood ash

1.0 INTRODUCTION

Expansive soils are a type of soils which has the ability to swell and soften when their moisture content is increased and shows the tendency to shrink and dry cracked when the moisture content is decreased. Soils containing the clay mineral montmorilonite generally exhibit such properties. The mica like group, also exhibits expansive nature, but generally does not cause significant problems. Problems associated with expansive soils, which located in many parts of India are well known. During the last few decades, the damages of civil engineering structures have been a significant problem due to the swelling and shrinkage action of expansive soils.

One influential method to control the volume changes of black cotton soils is to stabilize it with mineral and chemical admixtures that prevent the changes or isolate the changes. Lime and Cement have been used to stabilize the expansive soils to relatively shallow depths under footings and subgrade.

The index properties of the expansive soil, lime admixed soil, fly ash admixed soil and marble powder and wood ash admixed soil were investigated and reported. This article reports the details and results of the study.

2.0 EXPERIMENTAL INVESTIGATION

2.1 Materials

The expansive soil i.e., black cotton soil was collected from the local area Venkatanagaram of Rajahmundry Rural in east Godavari district. The lime was obtained from the local market. Fly Ash was obtained from VTPS, Vijayawada, Quarry dust was collected from local quarry and wood ash from local source.

2.2 Characteristics of Black Cotton Soils

Black cotton soils are generally black in color and occur from 0.5m to 10m deep and have high compressibility. The generally observed characteristics of black cotton soils are recorded in table below :

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Table1 : Characteristics of Black Cotton Soils

S.No	Property	Obtained Value	Limits
1.	Liquid Limit (L.L)	50	40-120%
2.	Plastic Limit (P.L)	45.83	20-60%

2.3 Sample preparation

The expansive soil and lime, fly ash and marble powder + wood ash were separately oven dried for 24 hrs at 60^0 C**.** The proportions of mineral admixtures and expansive soil content in soil, admixture-soil were defined as the ratio of their respective dry weight to the total mixed dry weight of lime and expansive soil respectively. Table 2 gives the details of different mixtures and the notations used for them.

The designations used are : S for expansive soil(black cotton soil), L for lime, FA for fly ash, (M+W) for marble powder and wood ash . The contents of expansive soil and lime in a mixture are indicated by percentages before their symbols. The percentages among the black cotton soil and lime are their respective by parts by dry weight.

Table 2 : Mix Designation & Composition

S.No	Mix Composition for Mixes	Mix Designation
1.	100% S	M1
2.	90% S+ 10% L	M2
3.	80% S+ 20% L	M3
4.	70% S+ 30% L	M4
5.	60% S+ 40% L	M5
6.	50% S+ 50% L	M6
7.	90% S+ 10% FA	M7
8.	80% S+ 20% FA	M8
9.	70% S+ 30% FA	M9
10.	60% S+ 40% FA	M10
11.	50% S+ 50% FA	M11
12.	90% S+ 10% (M+W)	M12
13.	80% S+ 20% (M+W)	M13
14.	70% S+ 30% (M+W)	M14
15.	60% S+ 40% (M+W)	M15
16.	50% S+ 50% (M+W)	M16

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In the preparation of all types of samples, the required amounts of mineral admixtures and expansive soil were measured and mixed together in the dry state first. Then the dry mixtures were admixed with the required amount of water that depends on their consistency. All the mixing process was done manually and proper care was taken to prepare homogenous mixtures at each stage of mixing.

3.0 TEST RESULTS

The aim of the experimental work is to investigate the effect of addition of mineral admxitures on the index properties of the expansive soil. The results were tabulated as below:

Table 3 Average value of Test results of samples of expansive oil by adding various percentages of lime

S.No	Mix Designation	Liquid Limit (%)	Plastic Limit (%)	Shrinkage Limit (%)
1.	M1	50	45.83	44.22
2.	M2	40.4	38.18	42.10
3.	M3	35.1	30.30	39.82
4.	M4	32.8	25.00	36.14
5.	M5	31.00	21.5	38.00
6.	M6	27.18	19.10	41.00

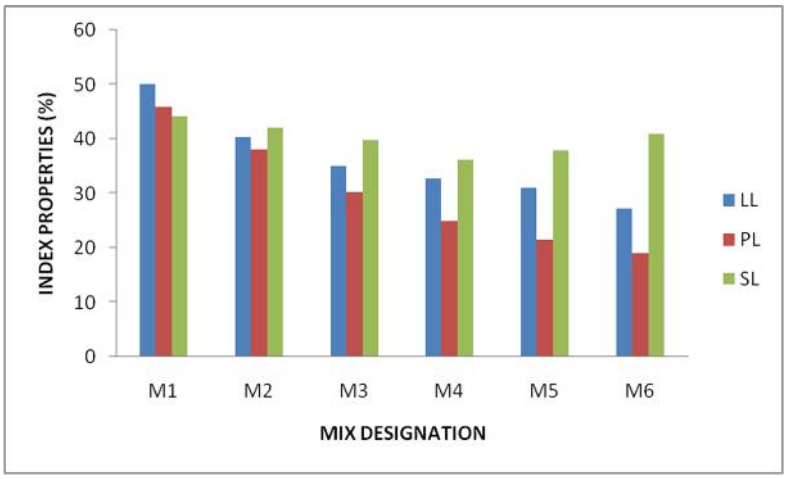

Fig. 1 showing variations in index properties with variation of addition of lime content

Table 4 Average value of Test results of samples of expansive oil by adding various percentages of fly ash

S.No	Mix Designation	Liquid Limit (%)	Plastic Limit (%)	Shrinkage Limit (%)
1.	M1	50.00	45.83	44.22
2.	M7	48.50	45.00	36.59
3.	M8	39.00	32.50	29.46
4.	M9	37.00	30.95	24.54
5.	M10	34.00	24.285	20.28
6.	M11	29.00	22.50	12.52

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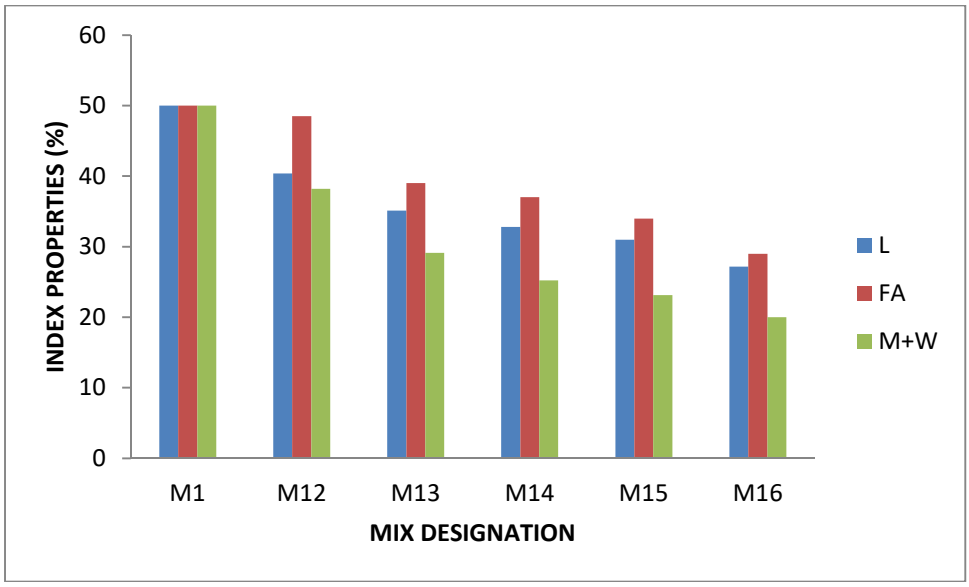

Fig. 2 showing variations in index properties with variation of addition of fly ash

Table 5 Average value of Test results of samples of expansive oil by adding various percentages of Marble powder and wood ash

S.No	Mix Designation	Liquid Limit (%)	Plastic Limit (%)	Shrinkage Limit (%)
1.	M1	50.00	45.83	44.22
2.	M12	38.18	36.24	34.00
3.	M13	29.11	28.92	29.45
4.	M14	25.21	22.14	27.89
5.	M15	23.14	20.00	31.15
6.	M16	20.00	18.54	28.00

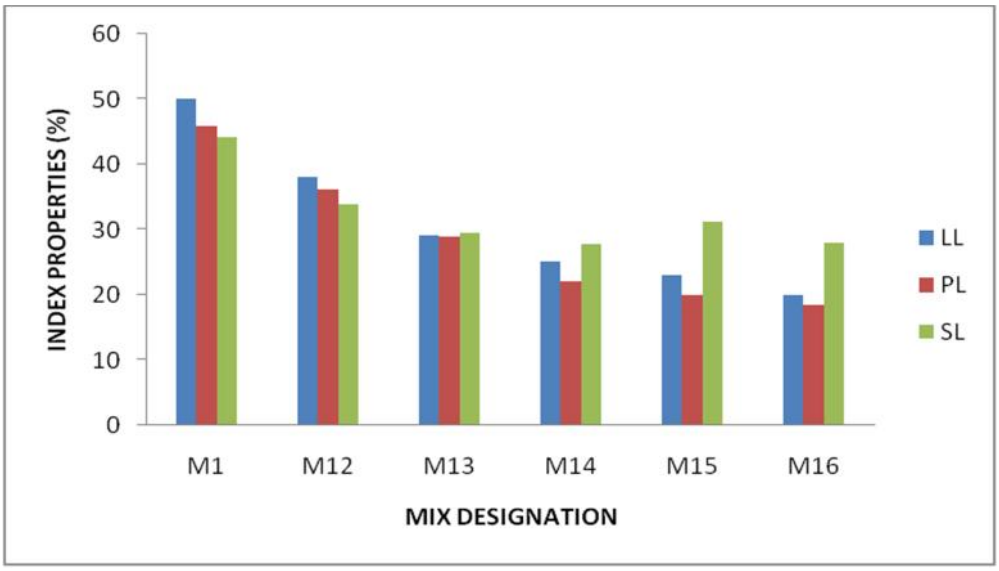

Fig. 3 showing variations in index properties with variation of addition of combination of marble powder and wood ash

4.0 DISCUSSION

From fig.1, it was found that as the percentage of lime content increases, the index properties were found to be decreased and regarding to shrinkage limit at 50% addition of lime of expansive soil, it was found to be decreased. From fig.2, it was found that as the percentage of fly ash content increases, the index properties were found to be decreased . From fig.3, it was found that as the percentage of combination of marble powder and wood ash content increases, the index properties were found to be decreased.

While comparing the three mineral admixtures used in the study, it was found to be the addition of marble powder and wood ash to the expansive soils shown better enhancement regarding the index properties.

5.0 CONCLUSIONS

Comparing three groups used in this study, combination of marble powder and wood ash provides substantial benefits when used as stabilizing agent for BC Soil, based on results observed and descried in this study. Other two groups have also favorable results but selecting among three, combination of marble powder and wood ash is recommended for the specific soil with prior tests in laboratory before use. Further scope in this study is to check the effect of Plasticity Index and UCS on CBR value of BC Soil.

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