ID: 2016-ISFT-253

Combined Effect of Addition of Marble Dust and Fly Ash on Expansive Soil

Jayanti Prabha Bharti[1], Waqar Khan[2], Parvesh Kumar[3], Dileep Kumar Gupta[4]

[1]*Faculty of VGI*
[2]*UPTU*
[3]*faculty of Golgotia College of engg, Gr. Noida*
[4]*DTU research scholar*
[1]*bhartijayanti@gmail.com*

Abstract: *Due to the concern about improvement in strength of expansive soils, an alternative is used as mixing of small percentage of admixtures like cement, lime, fiber, stone dust, fly ash and many more. My recent focus is to observe the combined effect of mixing of fly ash and marble dust on the properties of expansive soil. It is observed that Maximum Dry Density begins to increase with the addition of stone dust and fly ash. However at fixed percentage of fly ash if we add stone dust, then there is slow increase in Maximum Dry Density. This shows that MDD is more dependent on Fly ash. We also observe that Compressive strength of soil increases with the addition of admixtures and Liquid Limit of the soil decreases with the addition of admixtures continuously. Hence, addition of fly ash and stone dust is a good option for soil stabilization.*

Keywords: *fly ash, stone dust, expansive soil, UCS test*

1. INTRODUCTION

1.1 EXPANSIVE SOILS

The stability and bearing power of the soil is considerably improved by soil stabilization through controlled compaction, proportioning and the addition of suitable admixtures. Swelling soil is not suitable for the construction work on account of its volumetric changes.

It swells and shrinks excessively with change of water content. Such tendency of soil is due to the presence of fine clay particles which swell, when they come in contact with water, resulting in alternate swelling and shrinking of soil due to which differential settlement of structure takes place. Stabilization of black cotton soil has been done in this project by using lime and stone dust as admixture.[1]

David Rogers, Robert Olshansky, and Robert B. Rogers J. (1998), Stated that Expansive soils in many parts of the United State pose a significant hazard to foundations for light buildings. Korana & Ali (2011)**,** Stated that the term expansive soil applies to soils that have the tendency to swell when their moisture content is increased and shrink when their moisture content is decreased [2].

1.2 GEOTECHNICAL PROPERTIES OF FLY ASH AND STONE DUST

Fly ash is a fine, glass powder recovered from the gases of burning coal during the production of electricity. These micron-sized earth elements consist primarily of silica, alumina and iron. When mixed with lime and water the fly ash forms a cementitious compound with properties very similar to that of Portland cement. Because of this similarity, fly ash can be used to replace a portion of cement in the concrete, providing some distinct quality advantages. As according to According to ASTM C 618-03(2003a) two major classes of fly ash are recognized. These two classes are related to the type of coal burned and are designated as Class F and Class C in most of the current literature. [3]

Stone dust is nothing but a fine particle of marble dust. Its specific gravity is about to 2.725 found in lab.

2. METHODOLOGY

First, materials are arranged for performing different geotechnical tests. The materials are

(1) Black Cotton Soil (expansive soil) obtained from Kota (Rajasthan)

(2) Fly ash obtained from Power Plant near Kota

(3) Marble Dust obtained from Kota (Rajasthan

Then we perform different tests to determine the index properties of original black cotton soil

a) Specific gravity of soil

b) Determination of soil index properties (Atterberg Limits)

   i) Liquid limit by Casagrande‟s apparatus
   ii) Plastic limit

c) Particle size distribution by sieve analysis

d) Determination of the maximum dry density (MDD) and the corresponding optimum moisture content (OMC) of the soil by Proctor compaction test

Then we determine the index properties of stone dust. After that, we prepare reinforced soil sample by mixing fly ash and stone dust simultaneously.

Following proportions of stone dust & fly ash are to be used for all the tests.

1. 3% fly ash with 5% stone dust, 10% stone dust and15% stone dust
2. 6% fly ash with 5% stone dust, 10% stone dust and15% stone dust
3. 9% fly ash 5% stone dust, 10% stone dust and15% stone dust.

Then we perform index properties tests, consistency test and shear strength tests like UCS and direct shear test and obtained results are observed.

3. RESULTS

3.1 INDEX PROPERTIES OF ORIGINAL SOIL

Clay soils are those soils which have particle size below 2 micron so by the hydrometer analysis we have seen about 40% particles are below 2 micron.

Specific gravity of black cotton soil found by density bottle = 2.72

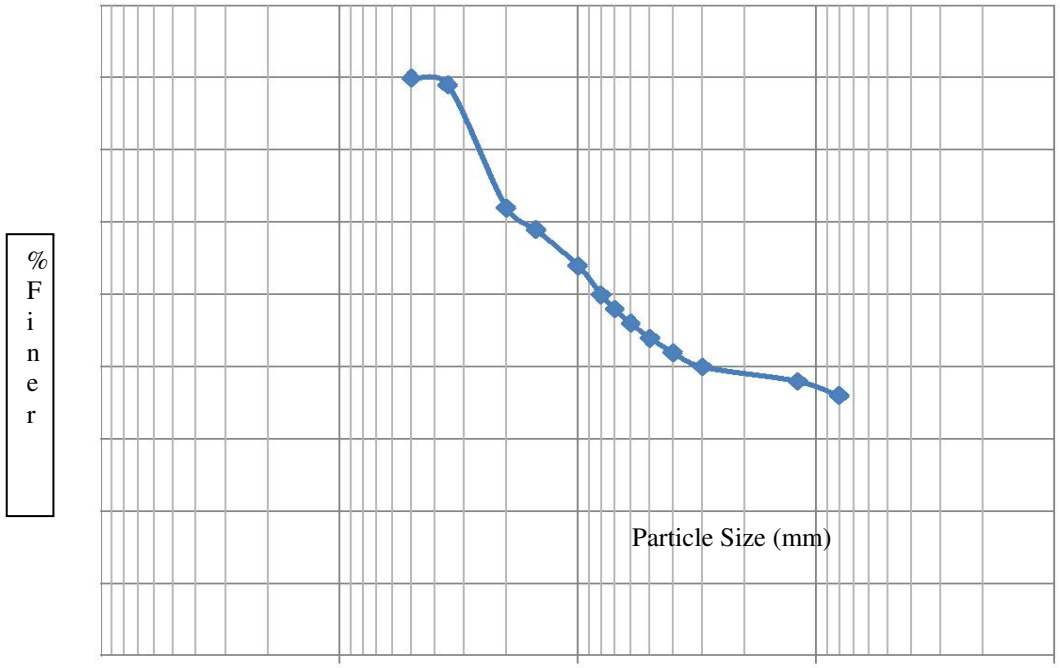

Fig. 1. Grain size analysis of original soil

3.2 CONSISTENCY LIMITS OF ORIGINAL BLACK COTTON SOIL

Liquid Limit = 55%, Plastic limit = 29.43%, Plasticity Index = 25.57%.

Hence, according to Unified Soil Classification System (USCS) clay is classified as inorganic clays of high plasticity.

3.3COMPACTION TEST (STANDARD PROCTOR TEST)

From graph, we get the value of OMC and MDD

Optimum Moisture Content (OMC) = 19.0 %

Maximum Dry Density (MDD) = 1.67 g/cc

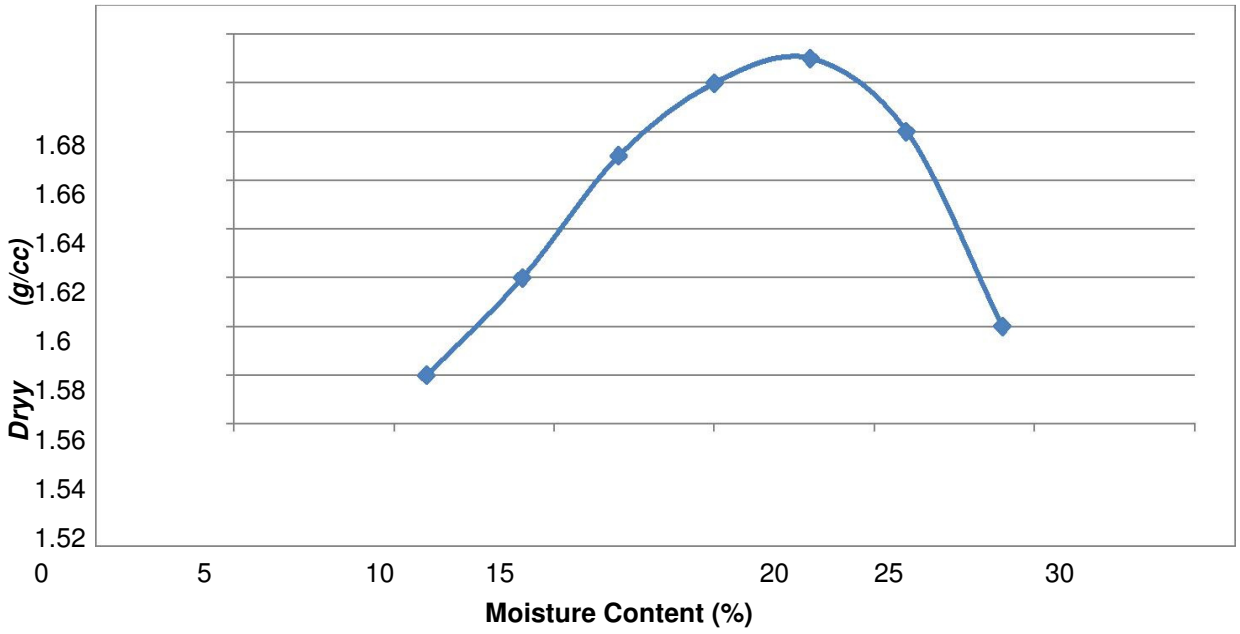

Fig. 2. Compaction Curve

3.4 UNCONFINED COMPRESSION STRENGTH (UCS) TEST

From graph we get the UCS value for Black Cotton Soil as 0.182 N/mm$^{2.}$

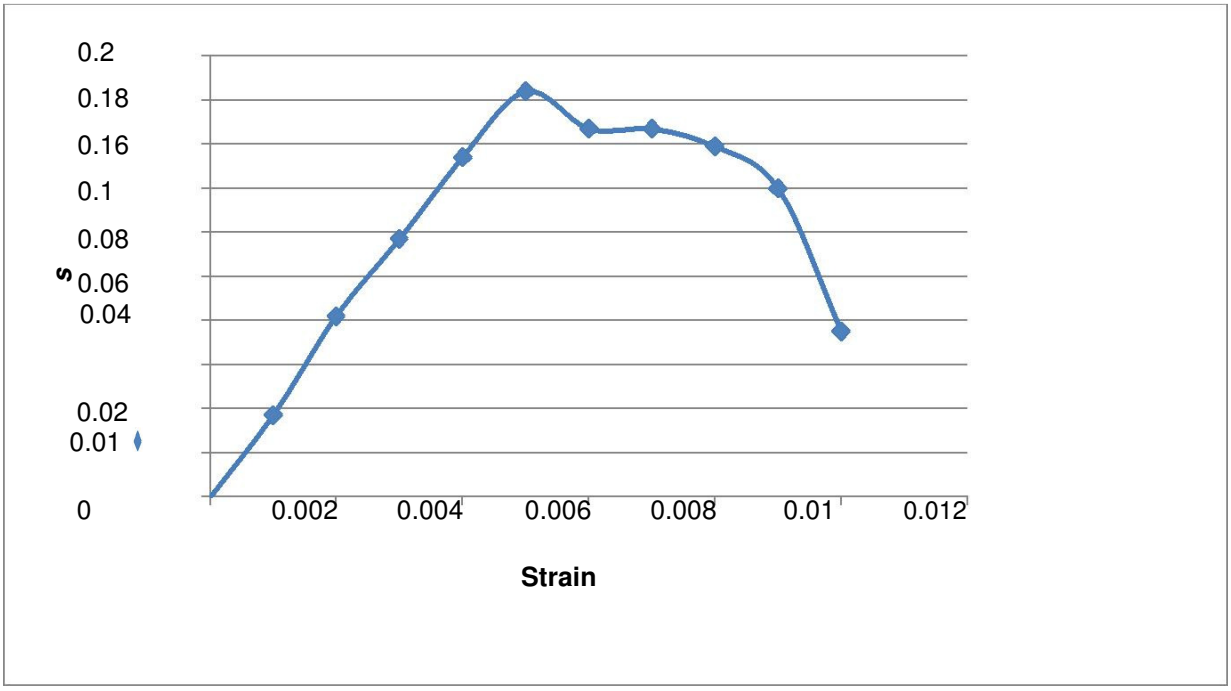

Fig. 3. UCS Curve

3.5 GEOTECHNICAL PROPERTIES OF STONE DUST

The specific gravity of stone dust was found by density bottle. It was found 2.725

Optimum Moisture Content (OMC) = 14%

Maximum Dry Density (MDD) = 1.835 g/cc

3.6 RESULTS OF REINFORCED SOIL (AFTER MIXING OF STONE DUST AND FLY ASH)

3.6.1 CONSISTENCY LIMIT RESULTS

TABLE 1

S No.	Percentage of Fly ash (%)	Percentage of Stone Dust (%)	Liquid Limit	Plastic Limit	Plasticity Index
1	0	0	55	29.43	25.57
2	3	5	51	34.42	16.58
3	3	10	49	33.89	15.11
4	3	15	48	34.12	13.88
5	6	5	51	34.33	16.67
6	6	10	48	34.17	13.83
7	6	15	45	33.76	11.24

3.6.2 PROCTOR COMPACTION RESULTS

TABLE 2.

S. No.	Percentage of Fly ash (%)	Percentage of Stone dust (%)	OMC (%)	MDD (g/cc)
1	0	0	19.0	1.67
2	3	5	18.5	1.72
3	3	10	18.0	1.75
4	3	15	17.0	1.76
5	6	5	18.5	1.75
6	6	10	18.0	1.78
7	6	15	17.0	1.80

3.6.3 COMPRESSIVE STRENGTH RESULT

TABLE 3.

S No.	Percentage of Fly Ash (%)	Percentage of Stone Dust (%)	Compressive Strength (N/mm^2)
1	0	0	0.18
2	3	5	0.21
3	3	10	0.22
4	3	15	0.24
5	6	5	0.28
6	6	10	0.35
7	6	15	0.37

4. CONCLUSIONS

The conclusions are based on the tests carried out on various clay-stone dust and fly ash mixes. It is observed that Optimum Moisture Content was gradually decreasing with the addition of Stone Dust and Fly ash because lime present in stone dust reacts with moisture. Also maximum Dry Density begins to increase with the addition of stone dust and fly ash. However at fixed percentage of fly ash if we add stone dust, then there is slow increase in Maximum Dry Density. Dry Density increases steeply with the increase in fly ash content. This shows that MDD is more dependent on Fly ash. It is also observed that Compressive strength of soil increases with the addition of admixtures. Maximum Strength was obtained with the addition of 6% fly ash along with 15% stone dust. Liquid Limit of the soil decreases with the addition of admixtures continuously. This is because lime present in marble dust reacts with the moisture to form other compound. There was very little change in the plastic limit of the soil with the addition of admixtures. Hence final conclusion has been drawn that the combination of equal proportion of stone dust and fly ash is more effective than the addition of stone dust/fly ash alone to the expansive soil in controlling the swelling nature.

REFERENCES

[1] Punamia, B.C et al, "soil mechanics and foundations", 16th edition

[2] Ali; Koranne; Sunil. Performance Analysis of Expansive Soil Treated with Stone Dust and Fly ash, 2011, 16 Bund. I.

[3] Pandian, N.S. Fly ash characterization with reference to geotechnical applications. J. Indian Inst. Sci., 2001, 84, 189–216.