Black Cotton Soil Stabilization Using Mineral Admixtures

H.B.MOHAMMED BILAL[£1], T.SARAVANAN[*2], S.HEMASRI[*3], G.MOHANASURIYAA[*4]

[# 1]ASSISTANT PROFESSOR, [*2,*3,*4]UG STUDENT

DEPARTMENT OF CIVIL ENGINEERING, SRM TRP ENGINEERING COLLEGE

mdbilalhb@gmail.com

***Abstract*—soil is the base of structure, which actually supports the structure from beneath and distributes the load effectively. If the stability of the soil is not adequate then failure of structure occurs in the form of settlement ,cracks etc. expansive soils like black cotton soils are more responsible for such situations and this is due to presence of montmorillonite mineral which has ability to undergo large swelling and shrinkage. To overcome this problem the properties of soil must be improved. Soil stabilization is an effective technique that addresses this problem by altering the properties of soil. This project deals with the stabilization of black cotton soil fly ash. It is blended with unmodified soil in varying percentages (10, 20and 30) to obtain the optimum percentage of admixture for soil stabilization. some expecting properties to be improved are liquidity index, plasticity index, optimum moisture content, maximum dry density, unconfined compressive strength and bearing capacity obta1ined on expansive soil mixed at different proportions of fly ash is discussed in this project.**

Keywords: Black cotton soil, stabilization, fly ash , OMC, MDD, unconfined compressive strength.

I INTRODUCTION

Soil stabilization is the process of improving the engineering properties of the soil and making it more stable. It is required when the soil available is suitable for the intended purpose. It is used to reduce the permeability and compressibility of the soil mass in earth structure and to increase its shear The principles of soil stabilization are used for controlling the grading of soil and aggregates in the construction of bases and sub bases of the highways and airfields The black cotton soil possess low strength and undergo excessive volume changes, making their use in the construction very difficult. The properties of the black cotton soil may be altered in many ways viz. mechanical, thermal, chemical other means.

Modification Of the black cotton soil by chemical admixtures is a common stabilization for such soil. Among the various admixture available lime, fly ash and cement are the most widely and most commonly used for the stabilization of the black cotton soil. Fly ash contains siliceous and aluminous materials (pozzolans) and also certain amount of lime. When mixed with black cotton soil it reacts chemically and forms cementitious compounds. The presence of those free lime and particles in fly ash suggests that can be used for stabilization of expansive soil.

Roads are having different layers which provide strength for sustaining the heavy the vehicular movement. Among these, subgrade is the most important one provides support to all the above layer. If subgrade soil has it needs modification or stabilization to improve its properties to maintain, alter or improve the performance of soil as a construction material.

II. OBJECTIVES OF THE SOIL STABILIZATION

- Soil stabilization is the way of improving the engineering properties of the soil and thus making it more stable.
- It is required when the soil available for construction is not suitable for the prospective purpose.
- Soil stabilization alters the soil material itself for improvement of its properties.
- To study the effect of varying percentage of fly ash on properties of Black Cotton Soil.
- Soil stabilization is used for city and suburban streets to make them more noise absorbing.

III. STUDY OF FLY ASH

The soil was stabilized with different proportions of fly ash (i.e., 10, 20, 30) and rice husk ash (i.e., 3,6,9).this increases UCS and CBR values but the addition of rice husk ash decrease the maximum dry density not with fly ash. Then the addition of iron powder increases the maximum dry density up to 6% and further decreases also. So further addition of various mineral results cannot given the result fly ash and it increases the strength and increase the shear strength of a soil and/or control the shrink-swell properties of black cotton soil.

IV. CHARACTERISTICS OF BLACK COTTON SOIL

Natural black cotton soil was obtained from Tiruchirappalli district in Tamil nadu state. The soil was excavated at a depth of 1.5m from the natural ground. The soil was dark grey to black in color with high clay content and high compressibility. This soil has a property of high moisture tenacity and develop crack in summer.

Generally, lands with black cotton soil are fertile and very good for agriculture, horticulture sericulture and aquaculture. Expansive soil are the problem of civil engineers in general and for geo technical engineers in particular

Clay is made up of tiny particles less than 0.002mm in diameter these soils are considered to be fine textured, clay is basically a catch all for a family of minerals that are heavy, sticky and dense.

PROPERTIES OF SOIL	***VALUES***
Particle size distribution (sand%, silt%+clay%)	17.9% 82.1%
Liquid limit	30%
Plastic limit	24%
Plasticity index	6%
Differential free swell	71.42%
Optimum moisture content	8%
Maximum dry density(g/cc)	1.89%
Unconfined compression strength (KN/m2)	71.72%
California bearing ratio	5.04

V. MATERIAL USED

A.SOIL

Soil is an accumulation or deposit of earth material, derived naturally from the disintegration of rocks or decay of vegetation that can be excavated readily with power equipment in the field or disintegrated by gentle mechanical means in the laboratory. Compacted sub grade is the soil compacted by controlled movement of heavy compactors. Undisturbed soil beneath the pavement is called natural sub grade.

The desirable properties of sub grade soil as a highway material are
- Stability
- Incompressibility
- Permanency of strength
- Minimum changes in volume and stability under adverse conditions of weather and ground water
- Good drainage, and
- Ease of compaction

B.FLY ASH

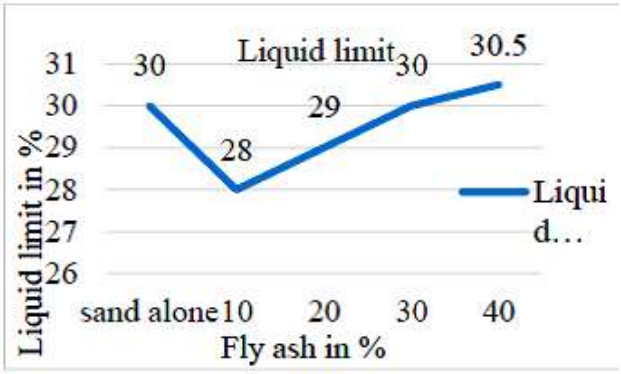
Fly ash is one of the residues generated in the combustion of coal. Fly ash is generally captured from the chimneys of coal-fired power plants, and is one of two types of ash that jointly are known as coal ash; the other, bottom ash, is removed from the bottom of coal furnaces. In consequence, fly ash is a heterogeneous material. SiO_2, Al_2O_3, Fe_2O_3 and occasionally CaO are the main chemical components present in fly ashes. The mineralogy of fly ashes is very diverse. The main phases encountered are a glass phase, together with quartz, mullite and the iron oxides hematite, magnetite.

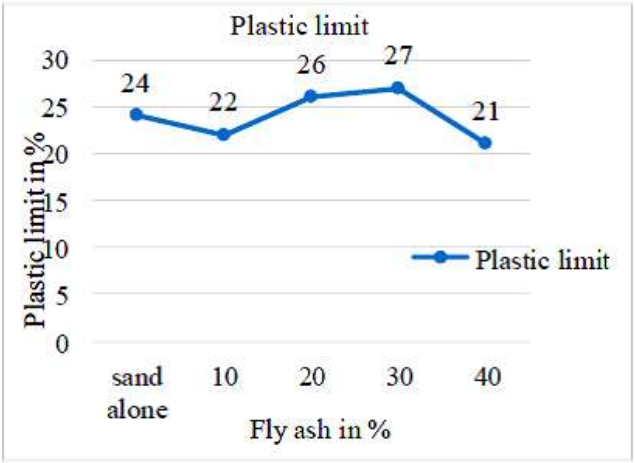
VI. SIEVE ANALYSIS

SOIL GROUP	***% FINES***	***RECOMMENDED NAME***
Clay	<35	Clay of low plasticity
	35-50	Clay of intermediate plasticity
	50-70	Clay of high plasticity
	70-90	Clay of very high plasticity
	>90	Clay of extremely high plasticity

VII ATTERBERG'S TEST RESULT ON SOIL SAMPLE

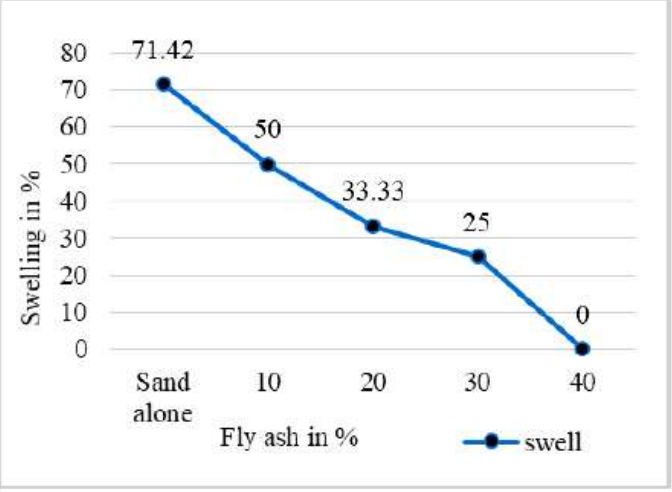
ADDITION OF FLYASH IN %	*LIQUID LIMIT (%)*	*PLASTIC LIMIT (%)*	*PLASTICITY INDEX (%)*
Sand alone	30	24	6
10	28	22	6
20	29	26	3
30	30	27	3
40	30.5	21	9.5





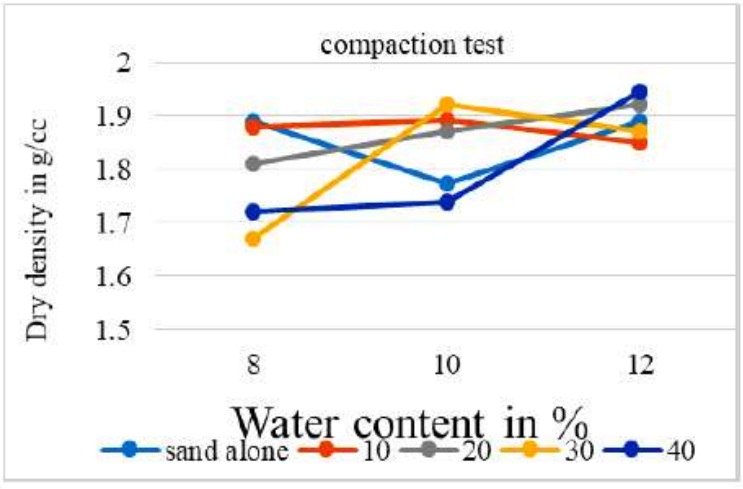
VIII SWELLING TEST RESULT ON SOIL SAMPLE

ADDITION OF FLY ASH IN %	*DIFFERENTIAL FREE SWELL INDEX IN (%)*
Sand alone	71.42
10	50
20	33.33
30	25
40	No swelling



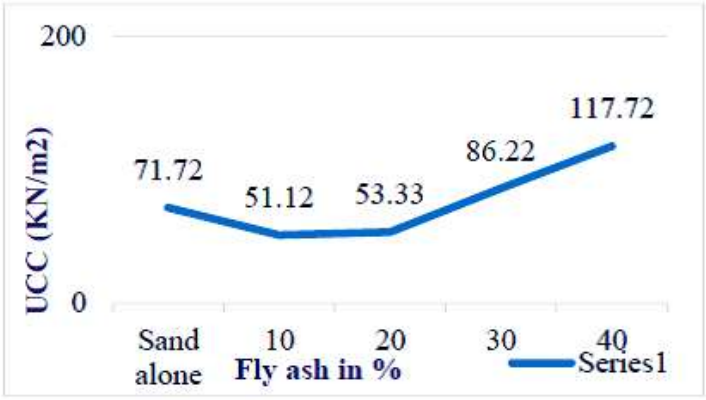
IX PROCTOR COMPACTION TEST RESULTS

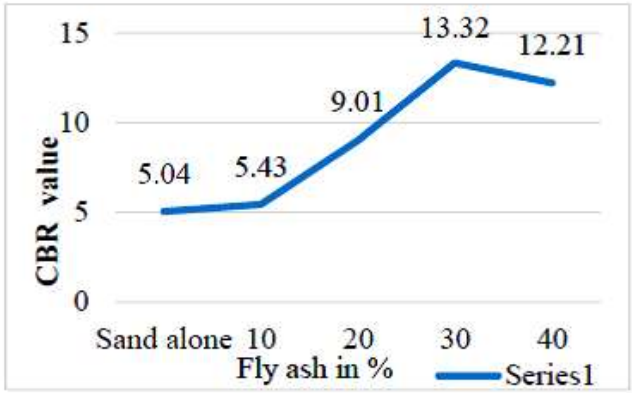
ADDITION OFFLY ASH IN %	*OMC IN (%)*	*MDD(g/cc)*
Sand alone	8	1.89
10	10	1.891
20	12	1.92
30	10	1.92
40	12	1.944



X. UNCONFINED COMPRESSIVE STRENGTH ANDCALIFORNIA BEARING RATIO TEST RESULTS

ADDITION OF FLY ASH IN %	*CBR VALUE*	*UCC (KN/m2)*
Sand alone	5.04	71.72
10	5.43	51.12
20	9.01	53.33
30	13.32	86.22
40	12.21	117.72





XII CONCLUSION

The liquid limit values are increasing with increase in percentage of fly ash as the soil while plastic limit varies. swelling property of a soil sample decreased with increasing percentage of fly ash, hence it reduce the deformations and stresses in the structure resting on the soil and problems in the maintenance of highways and runways. It was also observed that increase in the percentage of fly ash in soil is resulting in higher maximum dry density, unconfined compressive strength California bearing ratio values. By the comparison of the tests conducted(Atterberg's test, sieve analysis ,differential swell test, proctor compaction test ,UCC,CBR) its recommended to replace 40% of fly ash in soil to get high maximumdensity, unconfined compressive strength, california bearing ratio values which are the indicators of strength of a soil.

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