International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES)
Impact Factor: 5.22 (SJIF-2017), e-ISSN: 2455-2585
Volume 4, Issue 6, June-2018

EXPERIMENTAL INVESTIGATION ON SILTY SAND STABILIZED WITH FLYASH

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Abstract— Subgrade is an important component in the pavement structure. It takes all the self-load of the pavement and traffic load and transfers the load over a larger area. The performance and durability of pavement also depends on type of subgrade soil and its engineering properties. During construction we come across different types of soil among that silty sand is one of the problematic soil. Under such unavoidable situations, improving the mechanical properties of the soil is very much essential. Stabilization is one of the methods of ground improvement techniques. It this present study stabilization of silty sand has been carries out using class-C fly ash. Addition of fly ash resulted in increase in dry unit weight. The unconfined compressive strength of class-C fly ash treated silty sand was found to be increased with % of class-C fly ash and curing period and also the substantial increase in CBR value has been observed.

Keywords— Subgrade, silty sand, class-C fly ash, unconfined compressive strength, CBR

I. INTRODUCTION

Weak soils are causing severe damages to the structures particularly buildings and pavements. In construction of a pavement if weak sub grade is encountered then sub grade undergoes some during wet and dry seasons this leads to formation of cracks on the top surface of the pavement, poor strength, poor load deformation properties, heave induced structural distress, finally failure of the pavement. Thus, for safe design this formation needs improvement before construction. So, as to utilize these soils in an effective way, proper treatment is required. Due to increase in freight traffic there is a demand for strong and long lasting pavement for better transportation of freight and passengersStabilization is one of the conventional and widely used method to strengthen the weak subgrade soils. In this research stabilization of black cotton has been carried out using flyash. Several researchers [1-8] concluded that there was substantial increase in strength of soil when treated with fly ash. In this study fly ash has been used as stabilizers and introduced in varying percentage to study the strength properties of soil. Engineering properties of soil has been found out as per specifications. UCS test was carried out by varying percentage of flyash and cured for different period and test was carried out in both soaked and unsoaked condition and CBR test was carried out after seven days of curing.

A. Need for Study

Ground improvement techniques are available such as Mechanical Stabilization, Stabilization using aggregates, Bituminous Stabilization, Flyash Stabilization, Cement Stabilization and Chemical Stabilization. Out of these chemical stabilization becoming more popular these days due to their resistance to seasonal fluctuation, resistance to compression, consequent strength development increases with increasing curing time and longer serviceability. The present investigation is taken up with a view to improve the engineering properties of Silty sand by stabilizing with FLYASH.

B. Objective of the Study

Objective of the study is to evaluate the effectiveness of fly ash on the physical and mechanical properties of the selected soil and understand the mechanism involved in fly ash stabilization. .

II. EXPERIMENTAL INVESTIGATION

Materials used in this study are silty sand, fly-ash. Silty sand was brought from Jigini near Electronic city, Bengaluru, Karnataka. Tests conducted on silty sand include Atterberg's limits, compaction characteristics, chemical composition of the soil, UCS and CBR. The tests were conducted as per relevant IS Codes. The engineering properties of soil is given in table 1 and table 2.

A. Compaction Characteristics

Fig 1 shows the comparison of compaction characteristics untreated and flyash treated silty sand. It can be observed that, there was marginal variation in maximum dry density and optimum moisture content remains almost the same with addition of flyash . Particles are surrounded by a diffuse hydrous double layer and this is due to the ion exchange of calcium. This reaction alters the density of the electrical charge around the fine particles and the particles are attracted closer to each other to form flocks (flocculation). The soil particles are slowly cemented increasing the particle resistance compactive effort leading to marginal variation in the unit weight of the soil.

TABLE I
ENGINEERING PROPERTIES OF SILTY SAND

Sl No.	Property	Value
1	**Grain Size Distribution**	
	Gravel (%)	0
	Sand (%)	20
	Silt (%)	70
	Clay (%)	10
2	**Atterberg's Limits**	
	Liquid limit (%)	27.2
	Plastic limit (%)	15.18
	Plasticity index (%)	12.02
3	**IS Soil Classification**	ML
4	**Specific Gravity**	2.61
5	**Compaction Characteristics**	
	Light Compaction	
	Maximum dry unit weight (kN/m^3)	16.31
	Optimum moisture content (%)	14.28
	Heavy Compaction	
	Maximum dry unit weight (kN/m^3)	17.28
	Optimum moisture content (%)	12.58
6	**Unconfined Compressive Strength**	
	Unsoaked (kPa)	240
	Soaked (kPa)	110
7	**California Bearing Ratio**	
	Unsoaked (%)	4
	Soaked (%)	< 2

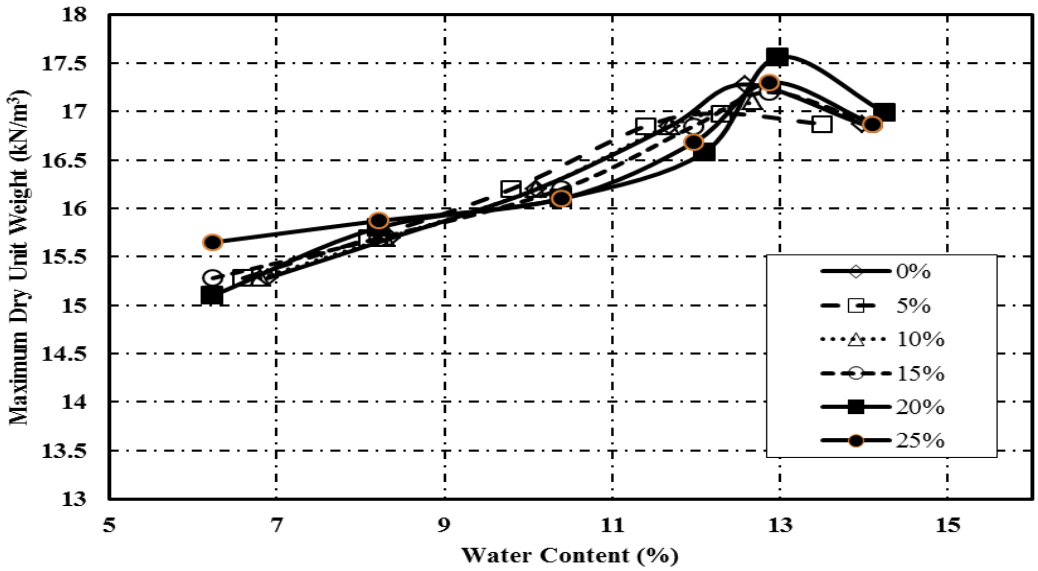

Fig. 1 Compaction curves of silty sand under unstabilized and fly ash stabilized conditions

B. Unconfined Compressive Strength

A series of unconfined compressive strength tests were carried out on untreated and flyash treated silty sand under both unsoaked and soaked conditions. Flyash dosage was varied between 0 to 25% in an increment of 5%. The samples of 38mm diameter and 76mm height were prepared by static compaction. The prepared samples were tested under unsoaked and soaked conditions. The treated samples were cured for a period of 3, 7, 14 and 28 days in a desiccator to maintain 100% relative humidity. Under unsoaked condition, the samples were directly subjected to testing soon after curing. Under soaked condition, the cured samples were covered by a membrane with porous stone placed at top and bottom of the sample. These samples were placed in a water bath such that the water enters from bottom and the samples get saturated by capillary action. The samples were subjected to soaking for a period of about 24 hours. At the end of 24 hours, the samples were taken out and subjected for air drying for about 30 minutes and test was carried out.

Fig 2 and 3 shows the variation of unconfined compressive strength of flyash treated silty sand with curing period and % of flyash respectively under both unsoaked and soaked conditions. The unconfined compressive strength is found to be increased with an increase in % of flyash and it decreased after 20%. The strength increased from 240kPa to 840 kPa and 110 kPa to 630 kPa under unsoaked and soaked condition respectively with a curing period ranging from 3 to 28 days and further decreased after optimum dosage of 20%.

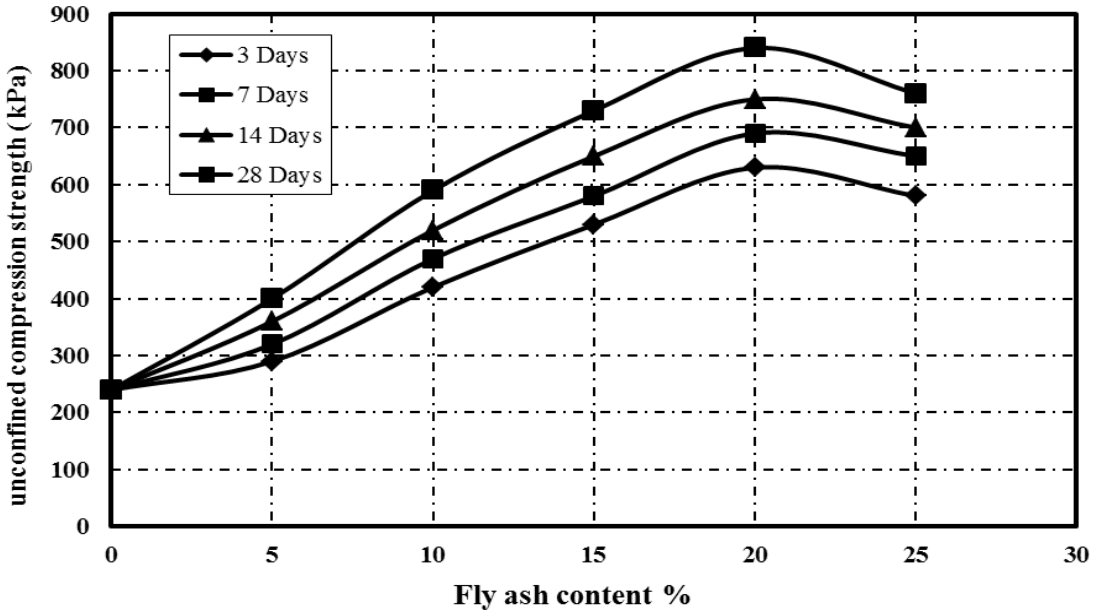

Fig. 2 Variation of unconfined compressive strength with fly ash content and curing period under unsoaked condition

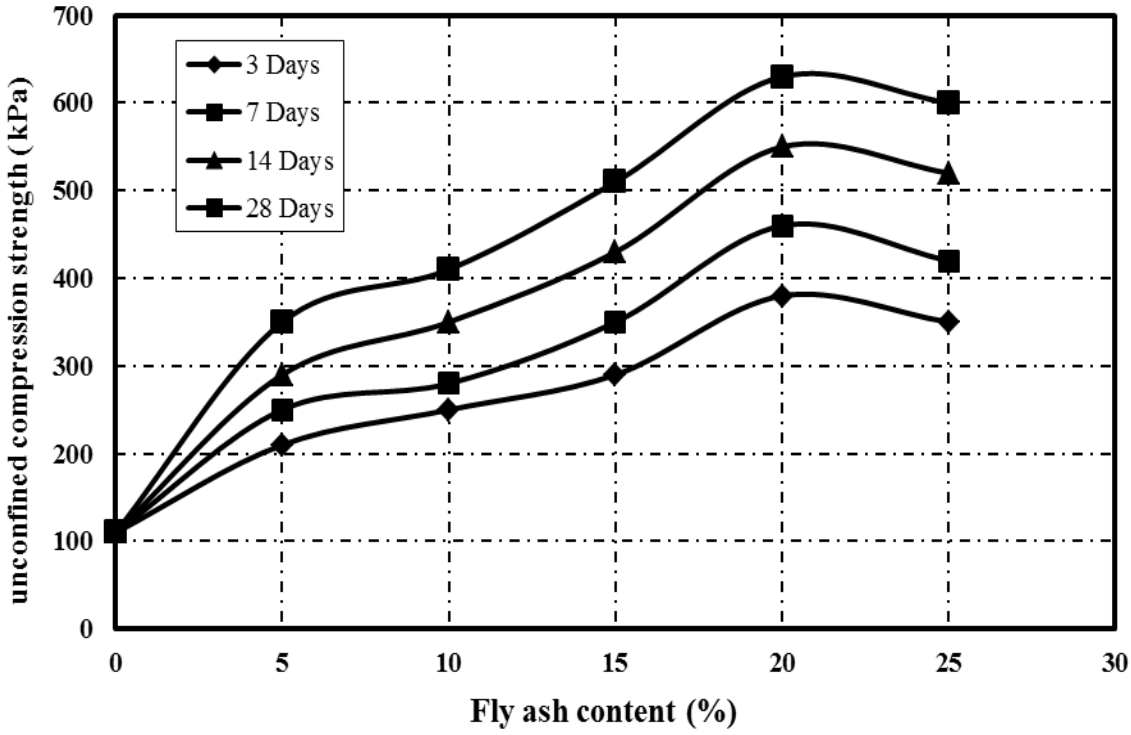

Fig. 3 Variation of unconfined compressive strength with fly ash content and curing period under soaked condition

C. California Bearing Ratio (CBR)

Fig 4 shows the variation of CBR with % of flyash. The CBR samples treated with 5 to 25 % of flyash were cured for 7 days and then subjected to soaking for 4 days followed by air drying and testing. The CBR value was found to be increased.

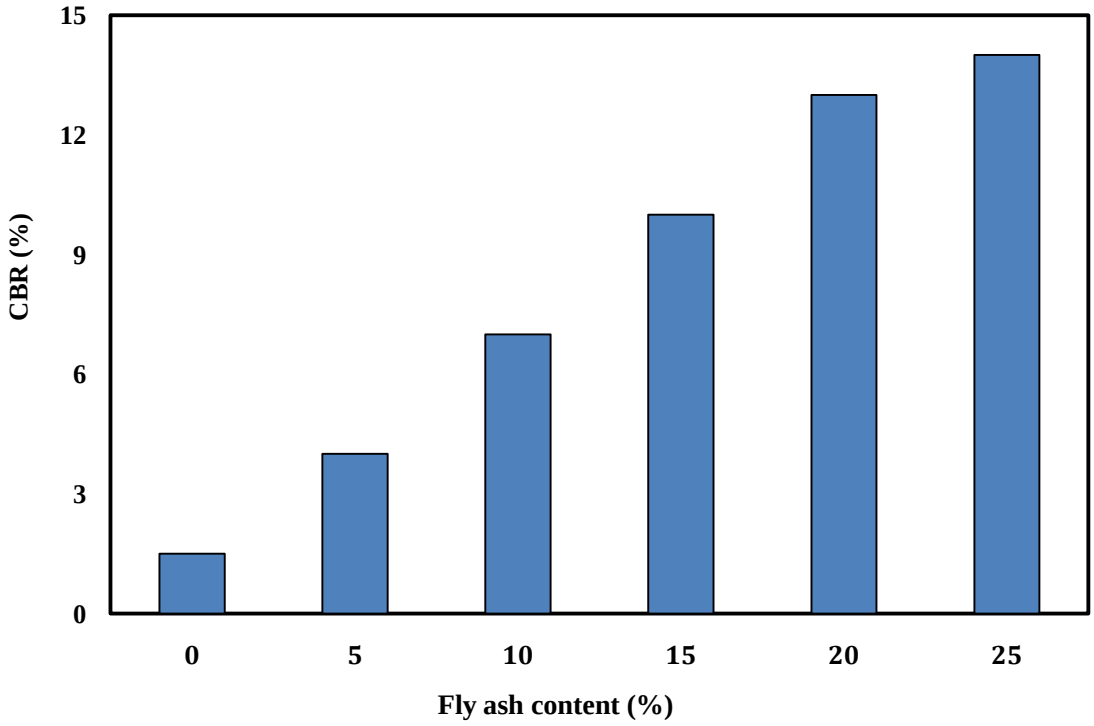

Fig. 4 Variation of CBR with fly ash content for unstabilized and fly ash stabilized (7 day cured) silty sand under soaked condition

III. CONCLUSIONS

A detailed experimental investigation was carried out on untreated and Flyash treated silty sand. The compaction characteristics, unconfined compressive strength test, CBR of both untreated and Flyash treated silty sand were investigated. Based on the test results, following major conclusions were drawn.

- The addition of Flyash leads to marginal variation in the maximum dry unit weight when compared with the natural soil and this is due to the resistance offered by the flocculated structure of the soil – Flyash mix against impact.
- The unconfined compressive strength of the silty sand treated with Flyash increased with an increase in the % of Flyash up to 20% and curing period.
- The strength increased by 3.5 times with a curing period of 28 days under unsoaked condition and in soaked conditions and strength increased by 5.7 times when compared with the untreated silty sand.
- The CBR of the flyash treated silty sand increased when compared to untreated silty sand. and with % of flyash, the CBR of 14% in soaked condition was observed with a curing period of 7 days.

ACKNOWLEDGEMENT

The author would like acknowledge Ashish Kumar Das, Ashish Kanwal, Rabindra Prasad Yadav and Sunil K Chaudhary, the final year students for their involvement and enthusiastic work in the research.

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