STABILISATION OF PAVEMENT SOIL BY USING FLYASH

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***Abstract*: The performance of a pavement is very responsive to the characteristics of the soil subgrade, which provides base for the whole pavement structure. For that reason of utmost significance the performance of pavements is enhanced by adopting proper design and construction schemes. Million tons of fly ash produced from various thermal power plants is low unit weight, non- plastic, very fine and disposed in slurry form into ponds covering huge area. The ash acquired from ponds gets directly air-borne and thus constitutes a serious pollution threat to the society. These materials have a low load carrying capacity, degraded settlement distinctiveness and their utilization in civil engineering works is a tough assignment. On the other hand the performance of these materials can be improved by using soil reinforcement procedure. It can be used as a pavement sub grade with the help of Geotextile sheets as reinforcement. In this study, samples of fly ash compacted to its maximum dry density at the finest moisture content is organized without and with Geotextile layers in the CBR mould.**

***Keywords*: Stabilization; Strength of soil; Fly ash; Coir fiber; engineering properties.**

INTRODUCTION

Soft soil possesses low strength and undergoes excessive volume changes, making its use in the construction activities very difficult. The properties of the soft soils may be altered in many ways viz, mechanical, thermal, chemical and other means. Modification of soft soils by chemical admixtures is a common stabilization method for such soils. Among various admixtures available, lime, fly ash and cement are most widely and commonly used for the stabilization of soft soils. Fly ash contains siliceous and aluminous materials (pozzolans) and also certain amount of lime. When mixed with soft soil, it reacts chemically and forms cementitious compounds. The presence of free lime and inert particles in fly ash suggests that it can be used for stabilization of expansive soils.

Geotextiles have gained a lot of importance in the recent past because of its applications in reinforcing soils, improving drainage, filtration, separation, controlling soil erosion. Presently, manmade Geosynthetics are used for this purpose due to their high strength and durability in soil but they are not economic and eco-friendly. Researches are now showing interest in improving the performance and mechanical properties of natural geotextiles such as jute, coir, flax etc. which have other advantages such as abundant availability, low cost, less abrasiveness, ability to absorb mechanical impact, easy to handle process, and environmental friendliness when compared to conventional Geosynthetics (Chakraborty et al. 2008).

Jute Geotextilesare used for stabilizing bank slopes by reducing the soil erosion. Sanyal and Chakraborty (1994) presented a study in which the slope of Nayachara island, situated in the middle of Hooghly river, was stabilized by bitumen treated jute geotextile. The western bank was protected with a layer of treated jute geotextile covered with riprap of different sizes. After 1.5years no disturbance or damage was observed in geotextile protected part but the tensile strength of geotextile was dropped by 70% due to biological and physical degradation under riprap.

MATERIALS AND METHODS

Materials

The material used in the present research work are:-

- **Fly Ash:-** Flyash is the waste product out form thermal power company. It is found to inorganic in nature and this in the present scenario it is acting as menace for thermal power industry.
- **Geo Textile:-**Geotextile is known as a fibrous material that is used with soil environment and contains non-woven and woven materials with polymers, natural products like jute, fabricated with the use of textile process. Polypropylene: When you polymerize the monomers of propylene with specific catalysts, it gives birth to thermoplastic polypropylene in a crystalline environment.

Methods

- **Sampling:-** Samples of fly ash, soil, geosynthetic material was collected from the different sampling station.
- **Preparation of sample: -** After the collection of samples it was prepared for analysis. It was firstly cleaned and left over night for air dry. Then is was sieve from 4.75 mm sieve as to maintain uniformity in the particle of sample.
- **Characterization of fly ash:-** Analysis of Fly ash was done in two categories namely:-
  - Geotechnical parameter and Chemical and Morphological Parameter
- **Geotechnical analysis of Soil:-** Geotechnical property of the fly ash was analysed in the Geotechnical Laboratory by performing geotechnical test.
- **Characterization of geotextile:-** the characterization of collected geotextile was done as to analyse the compatibility of it geotextile for reinforcement.

- **Preparation of geotextile Reinforcement:-** After the Analysis of characteristics the reinforcement was prepared. Three types of reinforcement sample were prepared. One sample in which single layer of geotextile was used. Second sample in which double layer of geotextile was used and in third sample four layers of geotextile was used
  Reinforcement made was left overnight in order to get air dry in the reinforcement and then it was subjected to analysis.

- **Analysis of Prepared Reinforcement: -** After the making of reinforcement all these reinforcement were subjected to analysis of stability for the use of reinforcement which include California Bearing Ratio Test.

RESULTS
RESULT FOR ANALYSIS OF FLYASH
(a) GEOTECHINICAL ANALYSIS

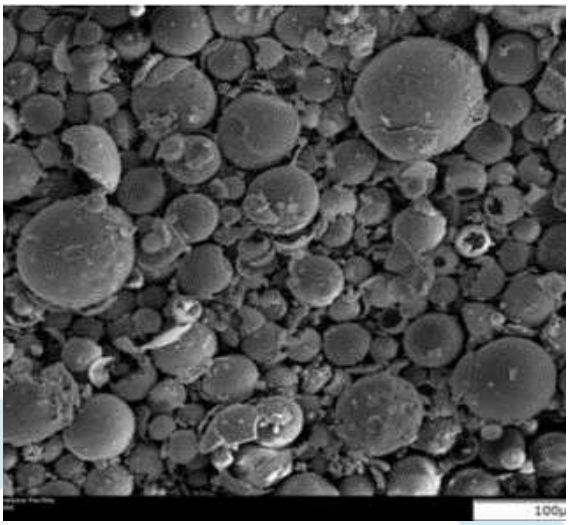
Properties		Value
Specific Gravity		1.28
Bulk Density		1.10
Moisture Content		1.16
Compaction		19.824
Permeability		~5.23× 10^{-4} cm^2
Plastic Limit		16.823
Shrinkage Limit		14.23
Grain Size analysis	D_{10}	0.32
	D_{30}	0.412
	D_{60}	0.57
	Cu	2.33
	Cc	1.009

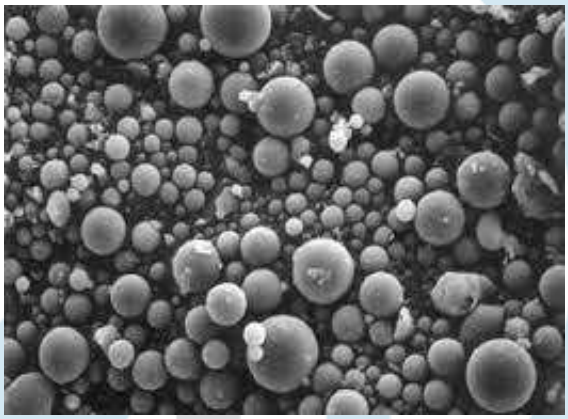
(b) CHEMICAL AND MORPHOLOGICAL ANALYSIS

- **X-Ray Florescence (XRF)**

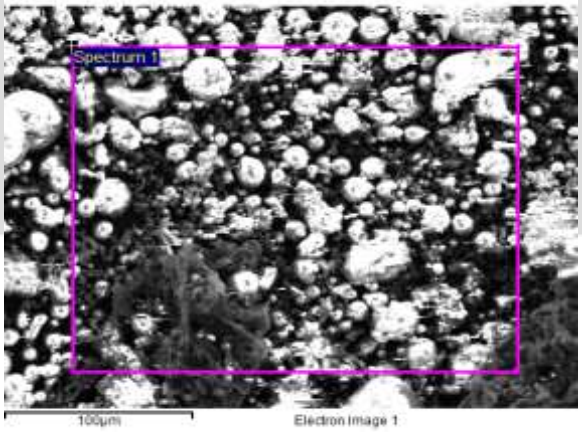
Compound	Percentage (by weight)
SiO_2	50.23
Al_2O_3	24.30
Fe_2O_3	6.31
MgO	0.63
TiO_2	1.86
CaO	0.81
MnO	0.039
Na_2O	0.08
K_2O	1.49
P_2O_5	0.356
Total	86.023

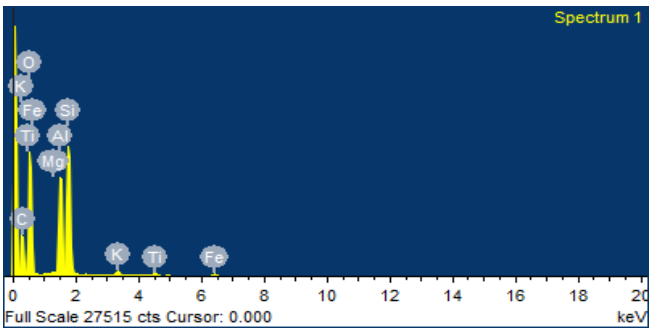
- **FESEM**





- **EDX**





EDX Analysis Table

Element	Weight	Atomic
C	28.86	39.03
O	44.56	44.92
Mg	0.19	0.16
Al	9.02	5.32
Si	14.10	7.98
K	0.84	0.40
Ti	0.89	0.39
Fe	1.67	0.42
Total	100	

- **Atomic Absorption Spectroscopy**

Elements	Concentration (ppb)
Copper	0.62
Cadmium	0.09
Cobalt	0.02
Iron	5.2
Manganese	0.9
Lead	0.04
Nickel	0.4
Zinc	0.7

RESULT FOR ANALYSIS OF SOIL

(a) GEOTECHINICAL ANALYSIS

S. No.	Property	Value
1	Specific Gravity	2.53
2	Bulk Density	1.93
3	Fineness	64.2
4	Moisture Content	15.32
5	Liquid Limit	37.09
6	Plastic Limit	21.85
7	Plastic Index	15.23
8	Gravel	1.7
9	Sand	35.18
10	IS classification	Sandy Silt

CHARACTERISATION OF GEOTEXTILE

S. No.	Property	Value
1	Tensile Strength	6 KN/m
2	Grab Tensile Strength	600 N
3	Roll Width	4 m
4	A.O.S	72 m
5	Trapezoidal Tear Strength	170 N
6	CBR Strength	600

RESULT FOR REINFORCEMENT ANALYSIS

Embedment Ratio	CBR value (%)	Strength Ratio = $\frac{CBR\ (Reinforced)}{CBR\ (Unreinforced)}$
Unreinforced	0.792	-----
0.25	0.868	1.137
0.50	0.956	1.213
0.75	1.051	1.371
1.00	1.159	1.526
1.25	1.127	1.476
1.50	1.079	1.422
1.75	1.046	1.403
2.00	1.38	1.391

No of Geotextile Layer	Embedment Ratio	CBR value	Strength Ratio
0	0	0.78	-
1	0.25	0.87	1.19
2	0.25, 0.50	1.40	3.08
3	0.25, 0.50, 0.75	2.65	3.31
4	0.25, 0.50, 0.75, 1	4.07	5.10
5	0.25, 0.50, 0.75, 1, 1.25	3.72	4.98

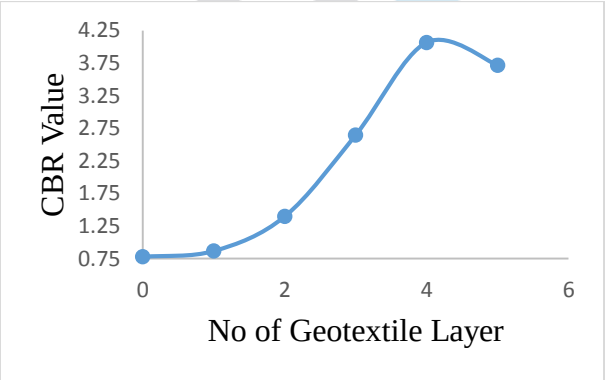


Fig Variation of CBR value with the no of Geotextile layer

CONCLUSION

Based on the testing done and results obtained the followings conclusions were made

- On addition of fly ash in the soil sample increase in the strength were observed.
- On adding the fly ash the difference in the strength were notice by 30% in CBR test.
- In first series of testing done by placing geotextile in single unit the maximum strength ratio that was obtained is 1.76. This was obtained when geotextile was placed just below the middle line of the sample.
- In second series of testing done by placing multiple of geotextile membrane and the maximum strength ratio that was obtained is 5.10 when four layers of geotextile was used in the sample and the strength obtained was far more better than the strength obtained in the first series of testing.
- The value of CBR test for double layer of geotextile was found to be 1.40 which is 44% higher.
- The CBR value for triple layer of geotextile is 2.65 which is 47% higher when compared with single and double layer geotextile.
- The CBR value for four layer of geotextile is 4.07 which is 80% higher when compared with single and double and triple layer geotextile.

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