ENHANCING THE STRENGTH OF PAVEMENT SOIL WITH THE HELP FLY ASH REINFORCED MADE BY USING GEOTEXTILE AND FLY ASH

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***Abstract*: Soil reinforcement is defined as a technique to improve the engineering characteristics of soil. In this way, using natural fibers to reinforce soil is an old and ancient idea. Consequently, randomly distributed fiber reinforced soils have recently attracted increasing attention in geotechnical engineering for the second time. The main aim of this paper, therefore, is to review the history, benefits, applications; and possible executive problems of using different types of natural and/or synthetic fibers in soil reinforcement through reference to published scientific data. As well, predictive models used for short fiber soil composite will be discussed. On other words, this paper is going to investigate why, how, when; and which fibers have been used in soil reinforcement projects.**

***Keywords*: Reinforcement, Pavement, Flyash, CBR, Geotextile.**

INTRODUCTION

Soils are complex mixtures of minerals, water, air, organic matter, and countless organisms. Various types of soil available in India like alluvial soils, black cotton soils, laterites soils, mountain soils, desert soils, red soils. Soil is the upper most part of earth and it is cheapest and readily available construction material. Soil is generally categorizes into four basic types (such as): Gravel, Sand, Clay and Silt. Out of them, few possess montmorillonite in high amount resulting in sudden swelling and shrinkage upon contact with water. Such soils are not useful in construction directly but can be made useful after their stabilisation.

Soil is defined as an unconsolidated material, composed of soil particles, produced by the disintegration of rocks and chemical decomposition. On the basis of shear strength, soil can be divided into three types: cohesion less soils, purely cohesive soils and cohesive soils.

Soil stabilisation is used for foundation, embankment and highway construction, airport and village roads to highways or expressway. Soil stabilisation improves the bearing capacity, compressibility, strength, and other properties of soil. Soil stabilisation is the popular method of soil improvement. Various methods of soil stabilisation are used like mechanical method, chemical method, thermal method, additive method (fiber reinforcement).

Prof. J.N. Mandal (1995) highlighted the use of geosynthetics in pavements. He concluded that placement of geosynthetics over subgrade soil can substantially reduce the required fill thickness. Use of geosynthetics ensures 36% improvement in highway quality and 10% saving in cost. Hybrid geosynthetics can be used as good drainage, filtration and reinforcement materials G Venkatappa Rao & P K Banerjee (1997) highlighted in their studies the use of geosynthetics in recent developments. A wide variety of geotextiles and related products were briefly presented along with their functions and applications. A beginning was made to characterize the jute and Coir mattings that are available in India and to develop new products for wider applications.

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 analyzed in the Geotechnical Laboratory by performing geotechnical test.

- **Characterization of geotextile:-** the characterization of collected geotextile was done as to analyze 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

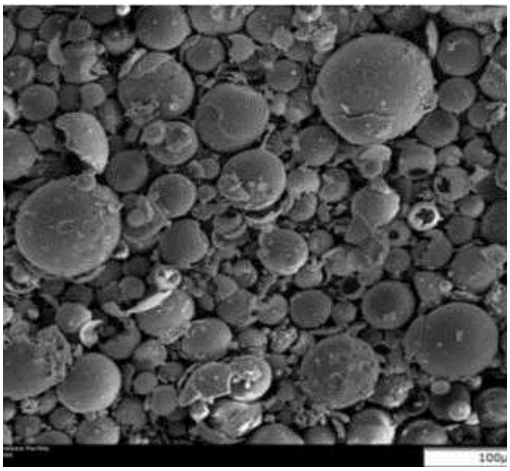
Properties		Value
Specific Gravity		1.28
Bulk Density		1.10
Moisture Content		1.16
Compaction		19.824
Permeability		~5.23× 10^{-4} cm^2
Plastic Limit		16.823
Shrinkage Limit		14.23
Grain Size analysis	D_{10}	0.32
	D_{30}	0.412
	D_{60}	0.57
	Cu	2.33
	Cc	1.009

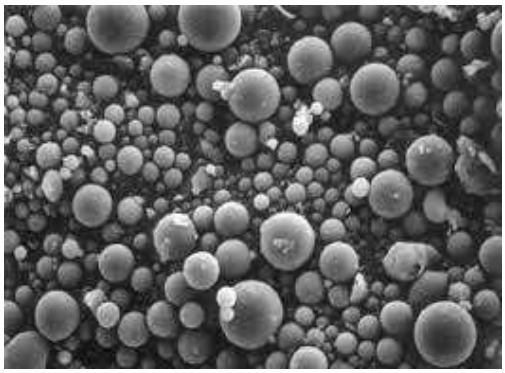
(b) CHEMICAL AND MORPHOLOGICAL ANALYSIS

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

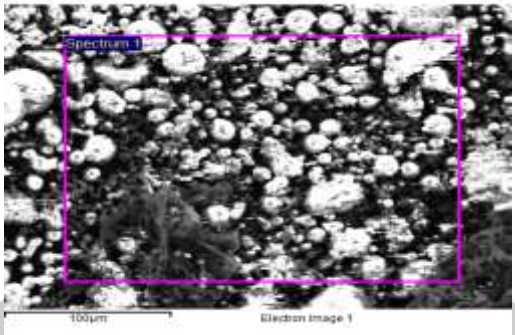
Compound	Percentage (by weight)
SiO_2	50.23
Al_2O_3	24.30
Fe_2O_3	6.31
MgO	0.63
TiO_2	1.86
CaO	0.81
MnO	0.039
Na_2O	0.08
K_2O	1.49
P_2O_5	0.356
Total	86.023

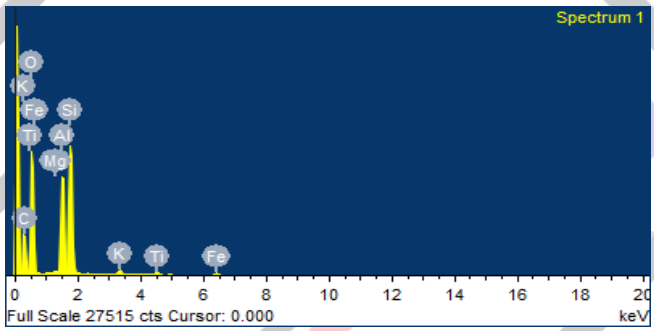
- **FESEM**





- **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

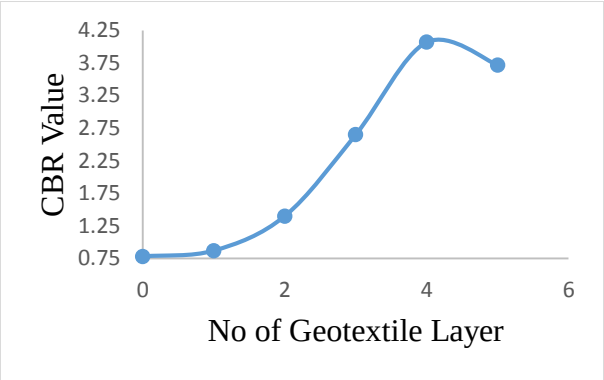


Fig Variation of CBR value with the no of Geotextile layer

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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