International Journal of Recent Engineering Research and Development (IJRERD)
Volume No. 02 – Issue No. 04, ISSN: 2455-8761
www.ijrerd.com, PP. 139-144

EFFECT OF JUTE GEOTEXTILE ON THE PROPERTIES OF FLYASH STABILIZED SOIL

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Abstract: Some waste material such as fly ash, rice husk ash, pond ash may use to make the soil to be stable. Addition of such materials will increase the properties of the soil. Tests were conducted on soil-Fly ash mixtures prepared at optimum moisture content. Addition of fly ash resulted increases in the CBR of the soil. CBR's of the soils are found in varying percentage such that 5, 10, 15 and 20. The optimum CBR value of the soil is 15%. The CBR test shows that the performance is improved with the inclusion of woven jute geotextile.
Keywords: Stabilization, Fly ash, Jute geotextile, unconfined compressive strength, CBR value

1. Introduction

Generally strength of the sub-grade soil is expressed as California Bearing Ratio (CBR) value. To increase the CBR value so many methods are available such as replacement of existing soil, compaction, pre-wetting, moisture barriers, stabilization and using geo-synthetics are best methods. Stabilization can be done by using lime, fly ash, Portland cement, bitumen etc. The strength attained by the fly ash stabilization may not be constant throughout the life of the project. The effect of chemicals may be reduced by the presence of water. Use of geosynthetics made of polymeric materials like polypropylene and polyester to improve the performance of soil is a well tried and accepted concept all over the world. Stabilization of soil by fly ash with geosynthetic is very effective.

Soil stabilization is used to reduce the permeability and compressibility of the soil mass in earth structures and to increase its shear strength. Soil stabilization is required to increase the bearing capacity of foundation soils. However, the main use of stabilization is to improve the natural soils for the construction of highways and airfields. The principles of soil stabilization are used for controlling the grading of soils and aggregates in the construction of Soil stabilization is also used to make an area trafficable within a short period of time for military and other emergency purposes. Sometimes, soil stabilization is used for city and suburban streets to make them more noise-absorbing.

Civilization also produces waste products. Disposal issue of the waste products is a challenge. Some of these materials are not bio gradable and often leads to waste disposal crisis and environmental pollution.

2. Previous Research

Petal *et al.* (2012) studied the feasibility of copper slag – fly ash mix at different proportions for the use in sub base course of flexible pavements. UCC, CBR and tri axial tests were conducted on different mixes after 0, 7, 14 and 28 days of curing and the geotechnical properties were studied. It was noted that 30% fly ash + 70% copper slag mix was found to be optimum for use in sub-base layers of flexible pav Basu *et al.* (2009) studied the benefit of use of jute- synthetic fibre union fabric geotextile for construction of medium traffic-volume unpaved roads. The test result had shown that this woven geotextile could be suitable for use as a separation layer as well as a reinforcing material. The construction of the unpaved lateritic road over sandy clay subgrade using the geotextile showed an even surface without any significant marks of subsidence or rutting even after 18 months where geotextile was used. However for the rest of the road constructed without the geotextile, 5mm to 35mm deep ruts were visible clearly. The earthen sub-base was covered with black granite granules as filling course before laying the geotextile. It was then covered with a layer of laterite gravels and then compacted by rolling. CBR tests conducted after 11 months and 18 months of road construction also showed a notable improvement (67% and 73% respectively) in the road due to placing of jute-synthetic geotextile, compared to the parts where geotextiles were not used.

Phanil kumar and Sharma (2004): the ash blended expansive soil with fly ash contents of 0, 5, 10, 15, and 20% on a dry weight basis and they inferred that increase in fly ash content reduces plasticity characteristics. The un drained shear strength of the expansive soil blended with fly ash increases with the

increase in the ash content, here there will be additional puzzolanic reaction forming cementations compounds resulting in good binding between soil and fly ash particles.

3. Materials and Methodology

3.1 Materials

A. Soil

Soil sample was collected from Puzhakkal, Thrissur, Kerala and it is classified as CH soil. The sample of soil shown in Figure 1 and properties was tabulated in Table 1.

Figure 1: Soil sample

Table 1: Properties of soil

Sl. No	Properties	Values
1	Natural moisture content of soil (%)	11.5
2	Specific gravity	2.67
3	Particle size distribution 1) Gravel (%) 2) Sand (%) 3) Silt (%) 4) Clay (%)	 0.4 40 27.40 32.20
4	Free swell index (%)	25.00
5	Liquid Limit (%)	54.00
6	Plastic Limit (%)	25.00
7	Plasticity Index (%)	29.00
8	Shrinkage Limit (%)	14.30

9	Maximum Dry Density (kN/m^3)	17.60
10	Optimum moisture content (%)	18
11	California Bearing Ratio (%)	1.32
12	Unconfined Compressive Strength (kN/m^2)	46
13	IS classification	CH

B. Fly ash

Fly ash is a waste material produced burning anthracite, bituminous, lignite and sub bituminous coal etc. Fig.2 shows the fly ash collected from Alan Hydraulic Bricks, Angamali.

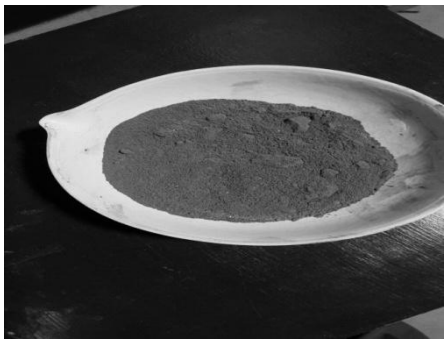

Figure 2: Fly ash

Properties of Fly ash as given in Table 2

Table 2: Properties of Fly ash

Properties	**Values**
Specific gravity	2.20
Grain size analysis Percentage of Gravel Percentage of Sand Percentage of Silt	 0 8 92
Optimum moisture content (%)	42
Maximum dry density	1.03g/cc

C. Jute geotextile

Jute geotextile was collected from Green Cocomat, Alappuzha. It was shown in Figure 3

Figure 3: Jute geotextile

3.2 Methodology

Soft soil was collected from the paddy field. Fly ash and geotextile were collected. Experiments have done to determine properties of soil and fly ash. The engineering properties of natural soil and strength characteristics of stabilized soil were determined. A parametric study of the properties was conducted by varying the stabilizing agent and its percentage. Strength behavior of the soil is characterized in terms of unconfined compressive strength and California bearing ratio value at varying percentage of stabilizing agents. Then introducing geosynthetics into optimum mix of fly ash stabilized soil at different depth as ¼, ½ and ¾ from surface.

4. Results and Discussion

The summary of the test results of treated soils as compared with the raw soils is presented in the Table 3.

Table 3 : Variation of properties by adding fly ash to soil

Properties	Percentage of fly ash				
	0%	5%	10%	15%	20%
MDD (kN/m^3)	17.6	16.9	15.0	14.4	14
OMC (%)	20.0	23	25	29	35
UCC strength (kN/m^2)	46	85.5	108	116	121
CBR value (%)	1.32	4.13	4.2	4.67	4.45

4.1 Standard proctor test (IS 2720: part – VIII, 1979)

Standard proctor tests were conducted on 5 %, 10%, 15 % and 20 % fly ash were mixed to the soil. Optimum moisture content increased and maximum dry density decreased with addition of fly ash upto 15 %.

4.2 Unconfined Compressive Strength of Soil
(IS 2720: Part X, 1991)

Unconfined strength of soils with different percentage of fly ash was conducted, it was found that 15% is optimum percentage of fly ash for maximum strength of soils. The variation of the UCS of the soils with varying proportions of fly ash as shown in Fig. 4.

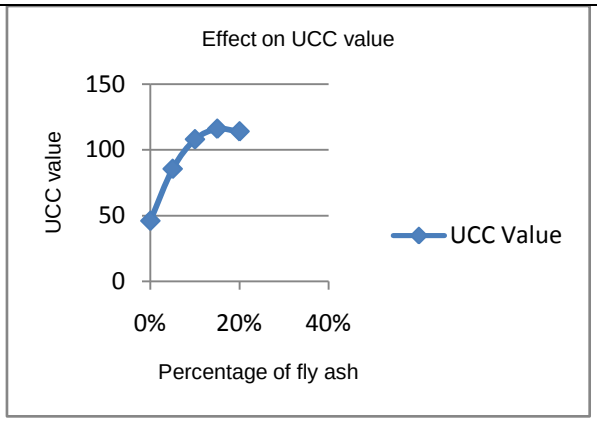

Fig. 4. Variation of UCS with addition of fly ash to soil

4.3 California Bearing Ratio test (IS 2720: part-XVI, 1987)

California bearing ratio tests were conducted on 5 %, 10 %, 15 % and 20 % fly ash were mixed to the soil. The CBR value increases upto the optimum and then decreases.

Table 4 : CBR value of soil with different percentage of fly ash

% of fly ash	CBR value (%)
5	4.13
10	4.2
15	4.67
20	4.45

4.4 California Bearing Ratio test with jute geo-textile

The polypropylene geo-textiles is placed in different layers (¼, ½, ¾, ¼) in optimum sample. The summary of the test results of CBR with polypropylene geo-textile in optimum mix is presented in the Table 5. It was found that ¼th depth is maximum value for CBR.

Table 5 : CBR test results with jute geotextile

Position of jute geotextile	CBR value (%)
¼	8.10
½	7.88
¾	7.20

5. Conclusions

When soils is treated with fly ash an increase in Optimum moisture content and decrease in maximum dry density is observed. It was found that the ratio of decrease in density and increase in optimum moisture

content with increase in percentage of additive fly ash. The results from the UCS test for soils for varying proportions such as 5, 10, 15, 20 percentages fly ash increased to better strength. It was found that 15% is optimum percentage of fly ash for maximum strength of soil. The result from the CBR test, the CBR value increases up to the optimum percentage of fly ash and then decreases in soil. The maximum value of CBR in soil is 4.67. Hence fly ash can be used as a good stabilizer in clay. The extent of improvement depends on the embedment ratio. Maximum CBR value of the soil was obtained when the depth of insertion of jute geotextile was $1/4^{th}$ depth from top.

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