Comparative Study on the Behaviour of Bitumen Coated Jute Geotextile in Flyash and Rice Husk Ash Mixed Soils

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***Abstract* -Soil can be stabilized by using some waste materials such as Fly ash, Rice husk ash, pond ash etc. Physical as well as chemical properties of soil can be increased by the addition of such materials. Some expecting properties to be improved are CBR value, shear strength, liquidity index, plasticity index, unconfined compressive strength and bearing capacity etc. The objective of this work was to study the effect of bitumen coated jute geotextile in fly ash stabilized soils to be used as a subgrade material. A series of Proctor Compaction tests and soaked and unsoaked California Bearing Ratio (CBR) tests have been carried out on soil mixed with different percentage of flyash (5%,10%,15%,20%,25%,30%) to find out the optimal quantity. Addition of Fly Ash resulted in appreciable increases in the CBR of the soil .It was observed that the optimum percentage of flyash to be mixed with this particular soil was 25% .For further improvement of CBR strength bitumen coated jute geotextile sheet are placed at different embedment ratios (Z/D = .25, .5, .75, 1, 1.25, 1.5, 1.75, 2) in optimum fly ash mixed soil. Increment in CBR value is used to reduce the thickness of the pavement and increasing the bearing capacity of soil.**

Keywords: Flyash, Jute geo textile, Soil stabilization, CBR value

I. INTRODUCTION

Soil stabilisation is widely used in connection with road, pavement and foundation construction.
It improves the engineering properties of the soil, e.g:

- Strength - to increase the strength and bearing capacity,
- Volume stability - to control the swell-shrink characteristics caused by moisture changes,
- Durability - to increase the resistance to erosion, weathering or traffic loading.
- To reduce the pavement thickness as well as cost.

The construction of roads, which does not possess sufficient strength to support wheel loads imposed on them during construction or at the service life of the pavement are the problem faced by the Engineers. For that the soils should be provided with a stable subgrade. Certain treatments should be adopted for soil modification or soil stabilization. Purpose of subgrade modification is to enhance the strength, reduce the moisture content, shrinkage and swelling. Subgrade performance mainly depends on CBR value of soil. Forless than a CBR of 10 values, the sub base material will deflect under traffic loadings as that of sub grade. Higher the CBR value of a particular soil, the more will be the strength and thinner will be pavement.

Use of fly ash as a ground improvement soil admixture ,when found viable, will be effective in terms of cost and a good approach to the environment to preserve and minimize accumulation of industrial waste. This study is performed to obtain the properties of fly ash for its application in the stabilization of soil. The properties of fly ash will be evaluated to investigate the feasibility of using flyash in soil stabilization. Construction over soft soil are one of the most frequent problem in many parts of the world. The typical approach in soil stabilization is to remove the soft soil, and substitute it with a stronger of crushed rock. Due to substantial cost of replacement, alternative methods to the problems are assessed. The study of using coal combustion residues, fly ash is carried out to observe the effectiveness of its addition on stabilization of soft soil. This is one of the approaches to overcome the increasing amount of solid waste generated by the population. As land is a very vulnerable commodity and landfills are fast diminishing, the disposal of the ash generate from solid waste incineration poses increasingly difficult problems to the man and environment. A practicable solution to the disposal problems would be the reuse of solid waste ash for civil engineering applications. Scope of this study is to analyze the consequences of the application of fly ash in soil stabilization. FA can be classified as Class C, Class F or Class N (ash that does not meet Class C, Class F specification1). Based on ASTM C 618 standards, Table 1. Class C fly ash can be used as stand-alone material, while Class F is commonly blended with chemical additive. Common binders include cement, lime, and fly ash. Additives reduce both the water content and bind the soil particles, which results in an increase in strength and stiffness. In practice, reducing the water content of highwater content soils to the optimum water content (OWC) is difficult and time-consuming. Therefore, the use of fly ash additive is attractive because fly ash is an industrial by-product that is relatively inexpensive, compared with cement and lime.

TABLE 1: ENGINEERING PROPERTIES OF SOIL

Soil Properties	Value
Natural moisture content	14.5%
Specific gravity	2.66
Maximum dry density(g/cc)	1.71
Optimum moisture content(%)	18.5
Liquid limit(%)	30.4
Plastic limit(%)	25.84
Shrinkage limit (%)	19.4
Plasticity index	4.56
CBR (%)	3.72
Percentage gravel (%)	1.45
Percentage silt and clay(%)	6.2
Percentage sand (%)	92.35

Thus, this work focused on investigating the effect of bitumen coated jute geotextile as reinforcement in fly ash on some geotechnical properties of lateritic soil which are relevant for evaluating the performance of sub-grade soils.

II. MATERIALS AND METHODOLOGY

A. Materials used

1) Soil: The soil used in this study was collected from Pallipuram area of Thiruvananthapuram district, Kerala. The properties of the soil used in this study are tabulated in Table 1. Based on the Unified Soil Classification System (USCS), the soil is classified as MI.

TABLE 2. PROPERTIES OF FLY ASH

Property	Value
Specific gravity	2.18
Liquid limit(%)	48.60
Plastic limit(%)	29.74
Plasticity index	18 .86
Percentage gravel(%)	0
Percentage sand(%)	92
Percentage silt &clay(%)	7.5

2) Fly Ash : It is one of the residues formed in combustion, and consists of the fine particles that rise with the flue gases. Fly ash is captured from the chimneys of coal-fired power plants. It mainly consists of $SiO_2$and Al_2O_3due to which it is pozzolanic in nature. It has a large uniformity coefficient and it consists of clay sized particles. The fly ash is disposed of either in the dry form or mixed with water and discharged in slurry into locations called ash ponds. The quantity of fly ash produced worldwide is huge and keeps increasing every day. Four countries, namely, China, India, United State and Poland alone produce more than 270 million tons of fly ash every year. The fly ash manufacture in India is around 100 million ton per year, which pollutes river water that endangers aquatic and human life. It has pH somewhere between 10 and 12, a medium to strong base. This can also cause lung damage if present in sufficient quantities. In the present study it was collected from Hindusthan newsprint, Kottayam. The properties of collected fly ash are given in table 2

B. Methodology

The soil collected was air dried for a minimum of 3 days and its initial properties were found out. Fly ash was also collected and its properties were determined..Fly ash was mixed with soil at various percentages and compaction test was carried out for each mix to find the optimum moisture content (OMC) and maximum dry density (MDD) and the variations were observed. Soaked and unsoaked CBR tests were carried out for each mix with the optimum moisture content and maximum dry density obtained from compaction tests and the variations were noted. For further improvement of CBR strength, bitumen coated jute geotextile sheet are placed at different embedment ratios(Z/D=.25,.5,.75,1,1.25,1.5,1.75,2) in optimum fly ash mixed soil.

III. RESULTS AND DISCUSSION

A. Variation of OMC and MDD with varying percentage of fly ash

The unit weight of soil fly ash mixture is an important parameter since it controls the strength, compressibility, permeability and densification. The strength of soft soil can be altered by the addition of fly ash in varying percentage and the unit weight of the compacted mixtures depends on the method of energy application, amount of energy applied, grain size distribution, plasticity characteristics, and moisture content at compaction. In the present investigation a series of standard Proctor Compaction tests were carried out by varying fly ash percentage. The different percentage of flyash from 5% to 30% was mixed uniformly in the soil sample. The variation of OMC and MDD was plotted. With that OMC the CBR test was conducted to obtain the strength of subgrade. The variation of water content with dry density for different percentage of fly ash is shown in Fig 1.

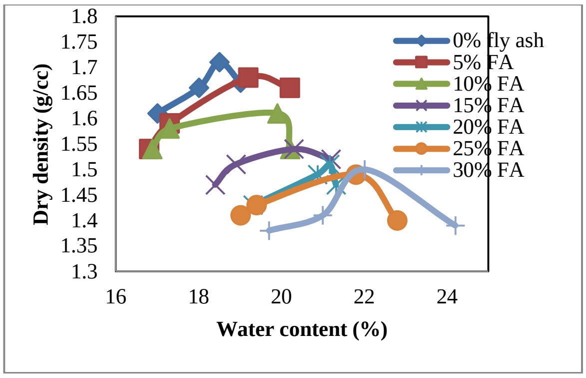

Fig.1. Variation of water content with dry density for different percentage of fly ash

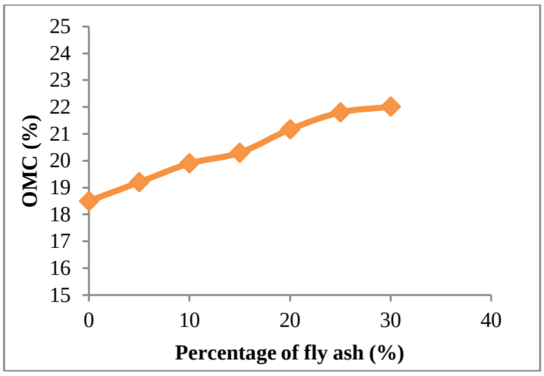

Fig.2.Variation of optimum moisture content with varying percentage of fly ash

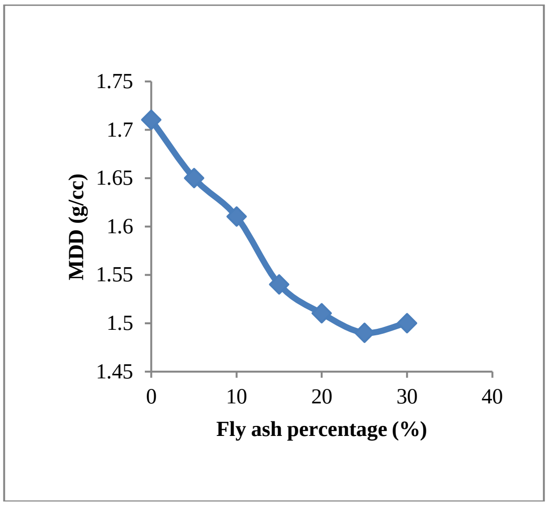

Fig.3.Variation of Maximum dry density with varying percentage of fly ash

Fig.2 and Fig.3 shows the variation of optimum moisture content and maximum dry density with varying percentage of fly ash respectively. From the figures it can be observed that with the increase in flyash percentage optimum water content increases and the maximum dry density decreases. Hence the addition of fly ash to the soil in various percentages affects the compaction characteristic which is primarily due to alteration of gradation of soil mixtures. The decrease of the maximum dry unit weight with the increase of the percentage of fly ash is mainly due to the lower specific gravity of the fly ash compared with the soil and the immediate formation of cemented products by hydration which reduces the density of soil. The increase in optimum moisture content with increasing percentage of fly ash may be due to the extra water required for the hydration of fly ash to takes place. It can also be observed that the optimum fly ash percentage in this particular soil is 25%. The maximum dry density was observed to be about 1.71 g/cc for 100% soil and 0% fly ash mixture and lowest density was about 1.49 g/cc. for 75% soil and 25% fly ash mixture.

B. Variation of CBR value with varying percentage of Fly ash

Soaked and unsoaked CBR tests were conducted with the OMC and MDD obtained from compaction test. The variation in the CBR value with varying percentage of flyash is shown below.

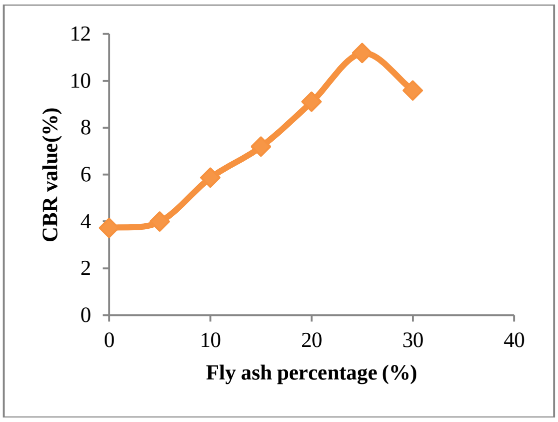

Fig.4. Variation in the CBR (unsoaked) value of soil with varying percentage of fly ash

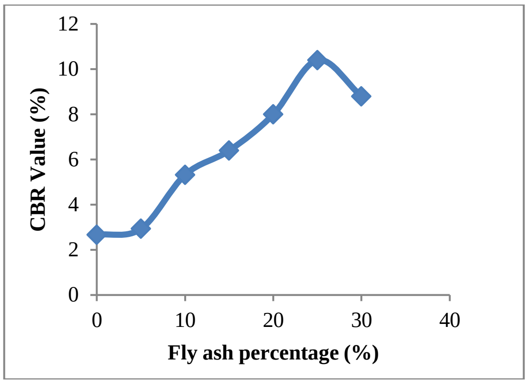

Fig.5. Variation in the CBR (soaked) value of soil with varying percentage of fly ash

From the figures it was observed that both soaked & unsoaked CBR strength increases with increasing fly ash percentage, but beyond a fly ash percentage of 25 the CBR value shows a slight decrease. Improvement of CBR strength may be due to the pozzolanic reaction of flyash. So on the basis of CBR value the optimum percentage of flyash to be mixed with this particular soil is found to be 25%.The load penetration curve of unsoaked and soaked CBR is given below.

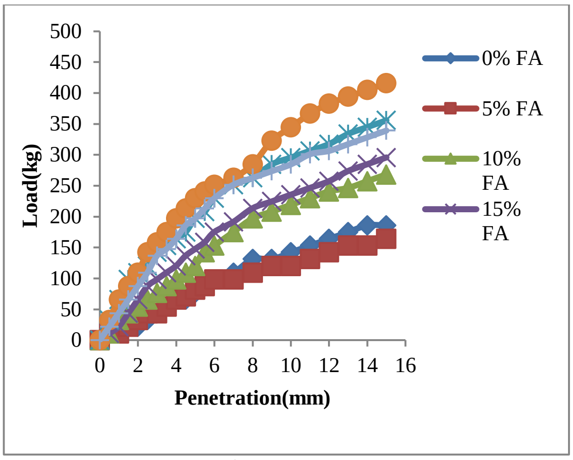

Fig.6.Load penetration curve of unsoaked CBR with varying percentage of FA

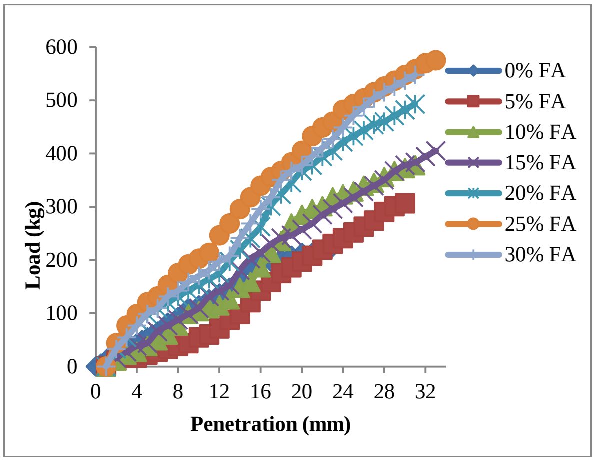

Fig.7.Load penetration curve of soaked CBR with varying percentage of FA

For CBR value less than 10,the sub base material will deflect under traffic loading as that of sub grade. Here the maximum CBR value obtained from flyash mixed soil was not sufficient to be used as subgrade material. So to improve the CBR value, bitumen coated jute geotextiles are placed in optimum fly ash mixed soils at different vertical position from top. The jute sheets are placed on the basis of embedment ratio (Z/d) where d is the diameter of the plunger. The variation of CBR value when jute sheets are place at different embedment ratio in optimum fly ash mixed soils are shown below.

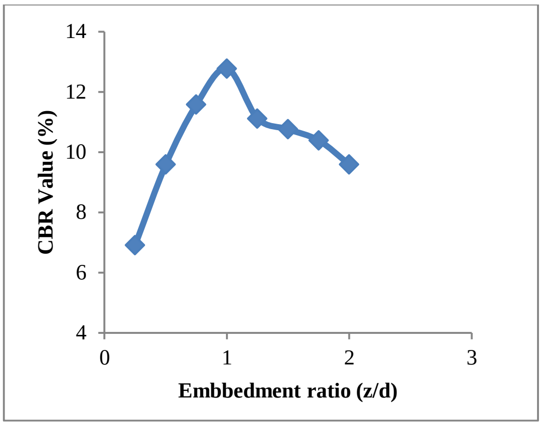

Fig.8.Variation in the CBR value with optimum percentage fly ash and JGT sheets at different embedment ratio.

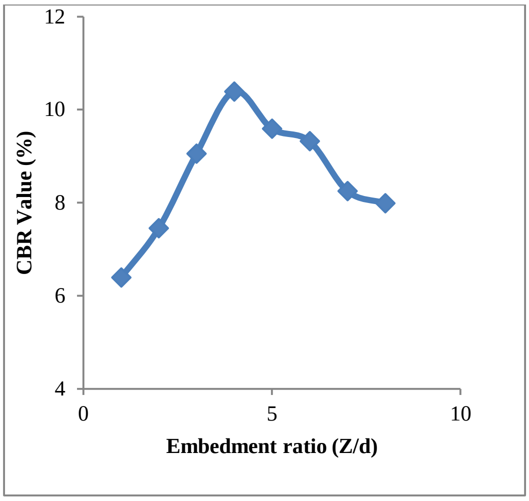

Fig.9.Variation in soaked CBR value with optimum percentage fly ash and JGT sheets at different embedment ratio

From the figures it was observed that both soaked and unsoaked CBR value increases upto the embedment ratio Z/d=1 and beyond that it is decreasing. So the optimum height to which the jute geotextiles to be placed was found to be Z/d=1.The load penetration curves of soaked and unsoaked CBR with jute geotextiles at different embedment ratios are given below.

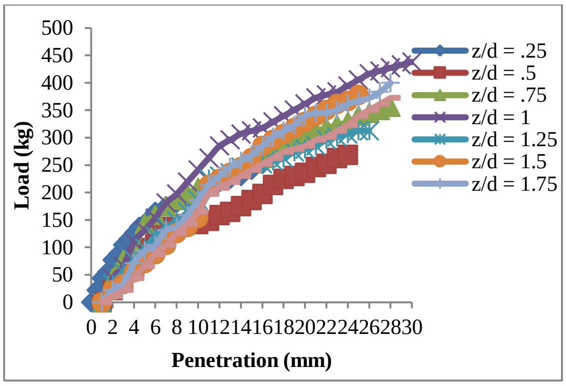

Fig.10. Load penetration curves for 25% fly ash jute geotextile at varying embedment ratio.

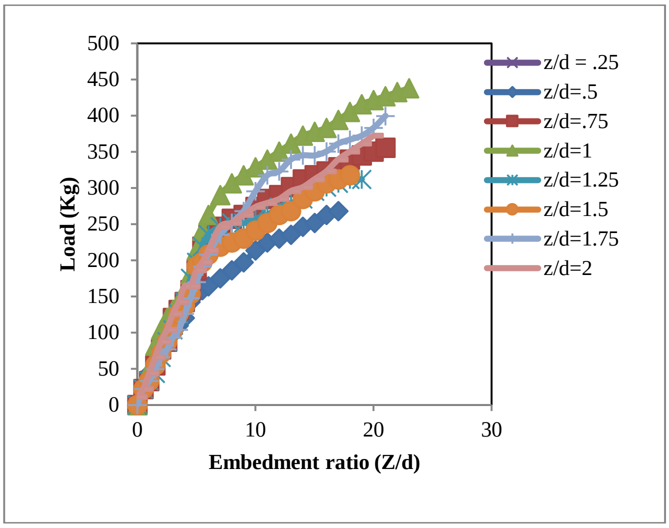

Fig.11.Load penetration curves of soaked CBR with 25% fly ash jute geo textile at varying embedment ratio.

IV CONCLUSION

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- The optimum moisture content increases and maximum dry density decreases when fly ash percentage increases.
- The CBR value increases with increasing percentage of fly ash. The increase in CBR value is only upto 25% fly ash addition and beyond this CBR value decreases.
- The optimum percentage of fly ash to be mixed with this particular soil was found to be 25%.
- The CBR value improved when bitumen coated jute geotextiles are placed at different embedment ratios in optimum fly ash mixed soils and the maximum CBR value was found when Z/d = 1.
- So from the results it is concluded that fly ash can be used with jute geotextile sheets as subgrade material

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