

ESTIMATION OF RESILIENT MODULUS FOR STABILIZED SUBGRADE USING FLYASH

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Abstract- Generally, civil Engineers are in search of new competitive materials, The fly ash is one of the waste materials of thermal power stations and it is an important industrial by-product of coke combustion, The utilization of the waste besides treating the problematic soil will also solve the dumping issue of the waste itself and will reduce the environmental hazards. In the present study, clay soil was stabilization for the construction of durable urban roads is investigated using fly ash. and are also used as various percentages to improve the strength of locally available highly compressible clay soil and to determine the soil bearing capacity with and without groundnut shell ash by plate load test. This was achieved by subjecting the soil to one dimensional consolidation. Other tests such as Atterberg's limits, specific gravity and particle size distribution were also carried out on the soil sample. Expansive clays are one of the most widely found soil type across the globe known for their low strength behaviour. The effect of abundantly available fly ash, on the index properties namely liquid and plastic limits, and free swell of natural deposits of Indian black cotton soil. And the compaction characteristics and unconfined compressive strength of an artificially-mixed soil were examined, the addition of binder was shown to bring about a significant improvement in these soil properties. And concerted efforts have been initiated in the laboratory to understand the effect of fly ash addition on the California Bearing Ratio (CBR) values of black cotton soil both for un soaked and soaked conditions. The soil stabilization or modification of soil-fly ash mixes is of great importance and hence the compaction behaviour of soil-fly ash mixes is studied in detail from the economical side of the material

I. INTRODUCTION

At present 110-150 million tons of coal fly ash is generated from 120 existing coal based TPP in India. Presently the annual production of fly ash in India is about 112 million tons with 6500 acres of land being occupied by ash ponds and it was crossed 125 million

tons by the year 2017-18FY. And also, it is expected 150 million tons by the year 2020. The demand of power supply has exponentially heightened these days due to increasing urbanization and industrialization phenomena.

Fly ash is generally considered as a waste material, that is produced as a by-product of coal combustion process. Fly ash production has increased up to 900 million tonnes per year by 2008 and it is anticipated to increase up to about 2000 million tonnes in year 2020 (Malhotra 2008). In Australia alone, about 12 million tonnes of fly ash is produced annually by both brown coal and black coal combustion (Morrison et al. 2005). About 43 percent of this ash is re-used for various applications while the rest is being dumped as waste.

Expansive clayey soils with high potential of swelling are mostly found in arid and semi-arid regions all over the world. These soils are highly susceptible to the variation of their water content and cause huge problems to pavements, embankments, drinking water networks, irrigation open canals, railways, mining structures (e.g., overland conveyors), and light residential buildings for excessive settlement and expansion.

II. LITERATURE REVIEW

Pallavi¹, Pradeep Tiwari², Dr P D Poorer (2016): The conclusions drawn from these studies are as follows: The consistency indices value of the black cotton soil reduces with mixing of fly ash. Initially the LL, PL and PI values of raw soil are 71.20%, 30.50 % and 40.70 % respectively which on mixing fly ash in ranges from 10 % to 40 % gradually decreased. With 40 % addition of fly ash to the soil, the LL, PI and PI values are obtained as 45.50%, 23.60 % 21.90 % respectively. Thus, the soil

plasticity is reduced on mixing of fly ash and the soil became less problematic.

Swati Sucharita Rout, et.al., (November 2017): In this study the current review, the appropriateness of fly ash and coir fiber blend as a soil stabilizer for soft soil was studied. The accompanying conclusions can be drawn from observations. I. OMC increase with increases of fly ash and percentage of coir fiber. Percentage of fly ash increases with the increase of MDD value. MDD estimation of soil decreases, when the percentage of fiber increments.

Tan Teing et. Al., (Jan2019): In this study, the use of alkali-activated binders for soil stabilization enabled the researchers to utilize locally available by-products in an efficient way in order to fully eliminate traditional cementitious binder (i.e., cement and lime), thus significantly reducing energy consumption while protecting the environment. Primarily, this study investigated the effectiveness of alkaline activation reaction on residual soil with different percentages of fly ash with a concentration of 10 molar of potassium hydroxide.

Farzad Habibbeygi and Hamid Nikraz (FEB 2018): In this study, the following conclusions were drawn: Adding MgCl₂ as a stabilizer to the clayey soil decreases the consistency limits (i.e. liquid limit and plastic limit). However, the tendency is decreasing for both of consistency limits, the decreasing effect is greater for the liquid limit rather than the plastic limit.

C. C. Ikeagwuani (2016): Investigation into the compressibility characteristics of black cotton soil has indicated that it can achieve an optimum performance in its useful life if admixed with a combination of 6%SDA and 4% lime by weight of the black cotton soil. The result obtained from this research work agreed with that of [16] for the stabilization of black cotton for use as subgrade material. Further test carried out included the specific gravity, which improved from 2.34 to 2.37, liquid limit, which decreased from 84.2 to 40.6% and plastic limit, which increased from 28.0 to 33.3%. Thus, the overall plasticity index was down from 56.2 to 7.3%. The differential free swell also improved with a decreased from 79 to 25.2%.

III. EXPERIMENTAL STUDY

The various experimental investigations are carried out on the soil samples and also on fly ash samples in order to assess the properties materials. All the laboratory tests were conducted as per IS code of practice.

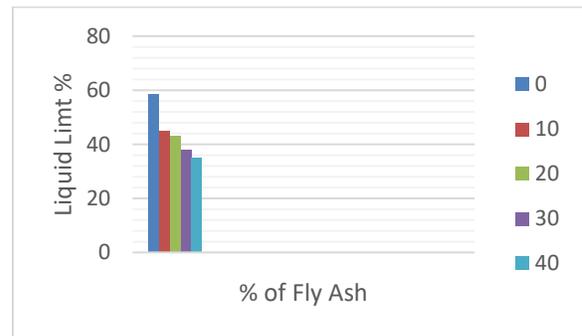
The following tests were conducted on the materials:

- Specific Gravity Test
- Hydrometer Analysis
- Free Swell Index Test
- Atterberg Limits
- Standard Proctor Test
- Unconfined Compressive Strength (UCS)
- California Bearing Ratio Test
- Resilient Modulus Test

IV. RESULTS

Table 1: Variation of Liquid Limit with Flyash

S.No	% of Fly Ash	Liquid Limit
1	0	58.5
2	10	45
3	20	43
4	30	38
5	40	35

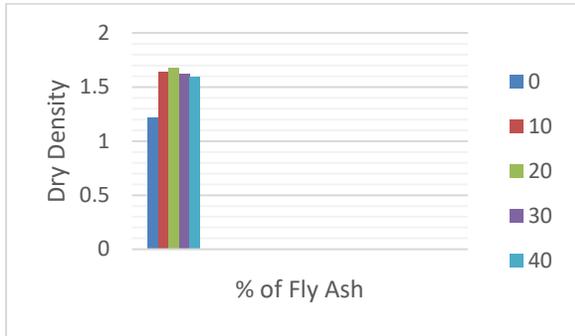


Graph 1: Variation of LL with Flyash

Standard proctor test was conducted on the soil sample by adding different percentages of flyash and a graph is drawn between Dry density on X axis and Fly ash on Y axis

Table 2 Variation of Dry Density with Fly Ash

S.No	% of Fly ash	Dry Density
1	0	1.217
2	10	1.641
3	20	1.678
4	30	1.62
5	40	1.6



Graph 2 Variation of Dry Density with Flyash

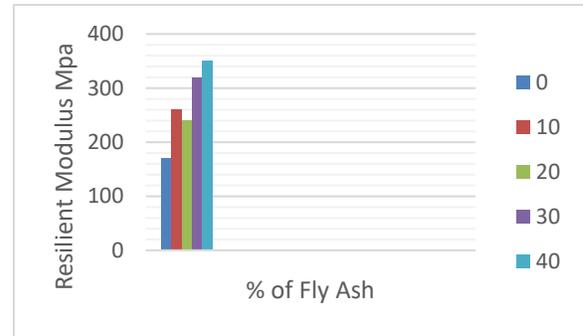
The Resilient modulus is a fundamental material property used to characterize unbound pavement materials. It is a measure of material stiffness and provides a mean to analyse stiffness of materials under different conditions, such as moisture, density and stress level.

Resilient modulus is the elasticity modulus of a material under repeated loads and is a measure of the distribution of the loads through pavement layers. The pavement materials are normally not elastic, each load repetition produce a small amount of plastic (permanent) deformation

The sub grade which is needed to be stabilized undergoes various tests in Geo Technical lab by adding successive amounts of fly ash to different samples of same BCS sub grade and favorable amount of fly ash is found. Then for this stabilized sun grade resilient modulus is found and the values are optimized using GA and ANN.

Table 3 Variation of Resilient Modulus With Fly Ash

S. No	% Fly Ash	Resilient Modulus Mpa
1	0	170
2	10	260
3	20	240
4	30	320
5	40	350



Graph 3:Variation of Resilient Modulus with Fly Ash

V. CONCLUSIONS

Based on the Experimental work conducted on the soil samples the following results were drawn.

1. The liquid limit of the soil was reduced from 68.5% to 35 % with the addition of the % of Fly Ash
2. The Dry Density value was increased with the increase in percentage of Fly ash
3. The OMC values are decreased with increase in percentage of fly ash
4. The resilient modulus of sub grade soil id increased from 170 Mpa to 350Mpa with increase in percentage of Flyash.

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