STABILIZATION OF FLY ASH USING SAND

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Abstract: Fly ash is a waste product from thermal power station. The only way to reduce the pollution of fly ash disposal efforts is recycled and reused in a variety of engineering applications. Properly managed, fly ash can be put in beneficial reuse, reducing the environmental footprint that it produces. The quality of fly ash can affect the quality and strength on engineering applications. In this paper to gain strength fly ash is replaced by sand at different proportion as 10%, 20%, and 30%. In these proportion mixture some laboratory tests as compaction tests, CBR tests, and direct shear tests are conducted. As results found that adding sand by replacing fly ash have better results.

***IndexTerms* - Fly ash, sand, angle of internal friction, shear strength, CBR.**

I. INTRODUCTION

The main objective of this study is to utilize Fly ash, so that minimize the effect on the environment on an account of dumping of such large quantities and in the construction of roadways, embankments and many more will be economical. And to achieve the strength of fly ash which is replaced by sand. To satisfy this objective, an experimental study was carried to investigate the influence replacing sand at different proportion 10%, 20% and 30% inclusion on the geotechnical behavior of fly ash.

Paper is organized as follows. Section II describes literature reviews. Section III having properties of material used in this study. Section IV presents experimental programme used for this study. Section V presents experimental results showing results of images tested. Finally, Section VI presents conclusion.

II. LITRATURE REVIEWS

a) **EmillianiAnak Geliga1 and Dygku Salma Awg Ismail2:** UNIMAS E-Journal of Civil Engineering, Vol. 1: Issue 2/ April 2010: "**Geotechnical properties of Fly Ash and its Application on Soft Soil Stabilization**": This paper briefly describes the suitability of local fly ash to be used in the local construction industry in a way to minimize the amount of waste to be disposed to the environment causing environmental pollution. Several civil engineering laboratory tests are conducted to study the geotechnical properties of fly ash and strength gain when mixed with local clay sample. A different proportion of fly ash sample cured for 7 days results in as strength gain. A better understanding of properties of fly ash is gained from study and the tests indicate improvements strength and better properties of soft soil sample when stabilized.

b) **Ratna Prasad, R.1, Darga Kumar, N.2**: International Journal of Engineering Research and General Science Volume 3, Issue 4, July-August, 2015 ISSN 2091-2730***:* "CBR and Strength Aspects of Fly Ash-Granular Soil Mixtures":**The study of granular sub base stabilized at 25% fly ash showed better results in CBR and strength aspects. As the percentage of fly ash increases from 0% to 25%, the CBR values are decreasing for both the unsoaked and soaked conditions. For the fly ash content beyond 15% addition to soil is causing about 50% to 65% reduction in the CBR values for both the unsoaked and soaked conditions. The percentage of fly ash increases from 0% to 25%, the angle of internal friction of gravel soil is decreasing. This decrease in angle of internal friction is marginal up to about 10% of fly ash and. From 15% to 25% of fly ash, the angle of internal friction observed is almost constant and its value is in the range of 360 to 380. Up to 25% of fly ash can effectively be utilized along with the granular subbase in the pavement construction.

c) **Kamal Khetarpal#1, Bharat Bhushan Jindal*2**: *SSRG International Journal of Civil Engineering (SSRG-IJCE) – EFES April2015: "***Effect of Fly Ash on CBR Value of Sandy Soil":** In this paper, California Bearing Ratio (CBR) test has been carried out on sandy soil samples mixed with varying percentage of fly ash in the laboratory. It is concluded that the CBR value of the soil is increasing when fly ash is mixed with it and it further goes on increasing with the increase in the amount of fly ash.

d) **Mahesh G. Kalyanshetti, Satish BasavarajThalange:** International Journal of Scientific & Engineering Research Volume 4, Issue 5-May-2013: "**Effect of Fly Ash on the Properties of Expansive Soil":**In the present work an attempt is made to understand the effect of fly ash on various properties of expansive soil.For this study locally available soil is used which is highly expansive. Fly ash is mixed in various proportions in a parent soil. For these variousproportions of fly ash different properties of soil are determined in laboratory and compared with the parent expansive soil properties. The study iscarried out on various properties i.e. compaction properties, Atterberges limits, free swell index, swelling pressure, C.B.R (Soaked and Unsoaked).Thestudy reveals that there is an appreciable reduction in the swelling characteristics of soils. This is upto extent of 40% to 50%. CBR value is improved by 70% to 75% with addition of fly ash. It is also observed that addition of fly ash beyond 20% is not significant on many of above properties.

III. MATERIAL USED

a) FLY ASH

The fly ash produced from Kota super thermal power plant. The material was by product from coal thermal electricity production power plant dumping area. Index properties of fly ash are following in table 1:

Table 1: Index properties of fly ash

S.NO.	PROPERTIES	RESULTS
1	Specific Gravity	1.8096
2	Average Grain Size (D50)	0.021
3	Liquid Limit	24.5
4	Plastic Limit	Non-Plastic
5	Grain Size Distribution	
	Gravel	0.16%
	Sand	29.18%
	Silt + Clay	70.22%
6	Coefficient of Uniformity (Cu)	6.2
7	Coefficient of Curvature (Cc)	1.26
8	OMC (%)	18.817
9	MDD (gm/cc)	1.363
10	CBR unsoaked (%)	3.0871
11	C	0.26
12	Φ (in degree)	25.6410

b) SAND

Sand is used in test was obtained from the Banas River, Rajasthan. Suitable amount of the sand was sieved on sieve 4.75mm, to have a suitable particle size, for better workability conditions. Index properties of sand are following in table 2:

Table 2: Index properties of sand

S.NO.	PROPERTIES	RESULTS
1	Specific Gravity	2.5879
2	Average Grain Size (D50)	1.5mm
3	Grain Size Distribution	
	Gravel	0.12%
	Sand	99.82%
	Silt + Clay	0%
4	Coefficient of Uniformity (Cu)	1.8918
5	Coefficient of Curvature (Cc)	0.9652
6	OMC (%)	11.310
7	MDD (gm/cc)	1.690
8	CBR unsoaked (%)	16.4476
9	C	Non-cohesive
10	Φ (in degree)	40.2979

IV. EXPERIMENTAL PROGRAMME

a) STANDARD PROCTOR TEST (COMPACTION PARAMETERS)

A soil sample is compacted in a mould having a capacity of 1/30 of a cubic foot and having an internal diameter of 4 inches. The soil in the mould is compacted in three layers with 25 blows per layer from a 5.5 pound hammer dropped from a height of 310mm; the blows should be uniformly distributed over the surface of each layer. The density and moisture content of the compacted specimen is plotted on curves and a maximum dry density and optimum moisture content obtain. Based on the Results of Standard proctor test classification is done as per IS 2720 (Part 7) (1980).

b) CALIFORNIA BEARING RATIO TEST (CBR) (UNSOAKED)

It is a load deformation test performed in the laboratory or the field whose results are then used with an empirical design chart to determine the thickness of flexible pavement, base and other layers for a given vehicle loading. In order to study the effect on CBR value of fly ash and sand, CBR test were conducted in accordance with IS (Part-16) (1987) and IRC 37 (1970).

c) DIRECT SHEAR TEST

In order to know the Shear Strength Parameters (C and Ø) of Reinforced Fly Ash and Sand, Direct Shear Test (UU test) in Accordance with IS 2720 (Part-13) (1986) were conducted in laboratory for each selected proportion of fly ash and sand.

IV. RESULTS AND DISCUSSION

A. EFFECT ON COMPACTION TEST

It is observed that maximum dry density is increases with increases in proportion of fly ash-sand mixture and the optimum moisture content is decreases with increases in proportion of fly ash-sand mixture. When mixture of fly ash and sand is prepared then the MDD was found to increase from 1.363gm/cc to 1.451gm/cc and OMC is decreases from 18.817% to 17.808% with increases in proportion of fly ash-sand mixture.

Table 3: Comparison of OMC & MDD of Fly Ash 100%

S.NO.	Fly Ash	Sand	OMC(%)	MDD (gm/cc)
1	100%	0%	18.817	1.363
2	90%	10%	18.631	1.386
3	80%	20%	18.340	1.419
4	70%	30%	17.808	1.451

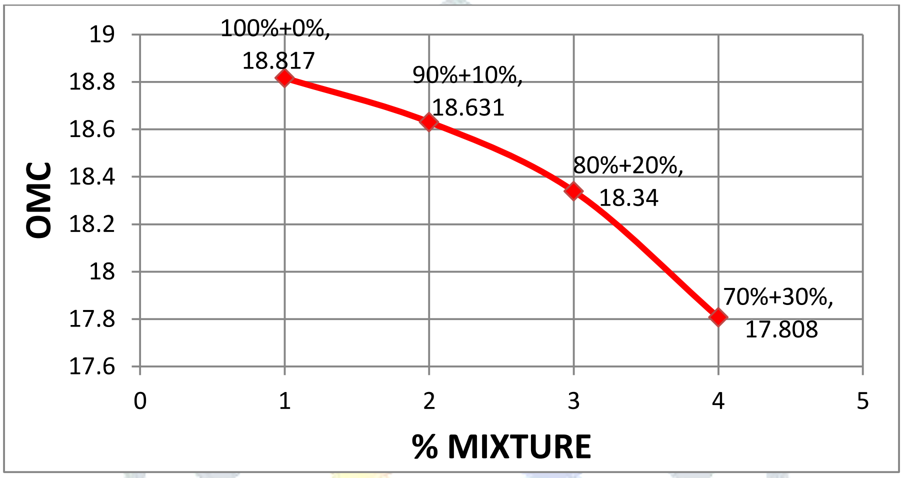

Figure 1: Variation of OMC vs different fly ash- sand mixtures

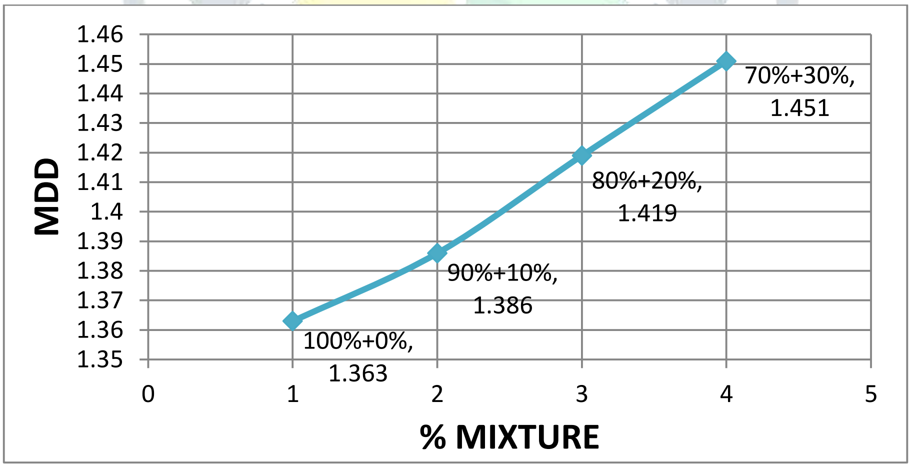

Figure 2: Variation of MDD vs different fly ash-sand mixtures

B. EFFECT ON CBR TEST

It is observed that CBR value is proportionally increasing with increasing in proportion of fly ash-sand mixture. The CBR value is increases from 3.0871 to 10.6277 with increase in proportion of fly ash-sand mixture.

Table 4: Comparison of CBR value of Fly Ash 100%

S.NO.	Fly Ash	Sand	CBR Value (%)
1	100%	0%	3.0871
2	90%	10%	7.8442
3	80%	20%	8.3503

4	70%	30%	10.6277

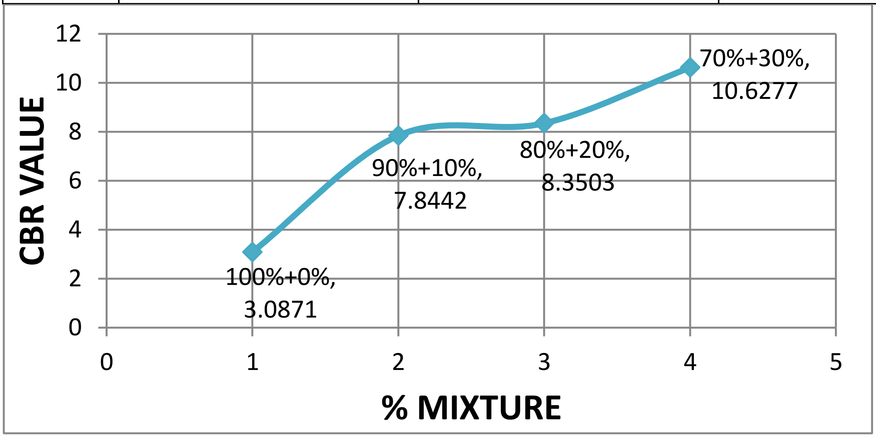

Figure 3: Variation of CBR value vs different fly ash-sand mixture

C. EFFECT OF ON DST TEST

It is observed that Φ is increases with increases in proportion of fly ash-sand mixture. The angle of internal friction (Φ) is increases from 25.6410˚ to 31.1320˚ with increases in proportion of fly ash-sand mixture.

Table 5: Comparison of angle of internal friction (Φ) of Fly Ash 100%

S.NO.	Fly Ash	Sand	Angle of Internal Friction (Φ) (in degree)
1	100%	0%	25.6410
2	90%	10%	28.7227
3	80%	20%	29.7264
4	70%	30%	31.1320

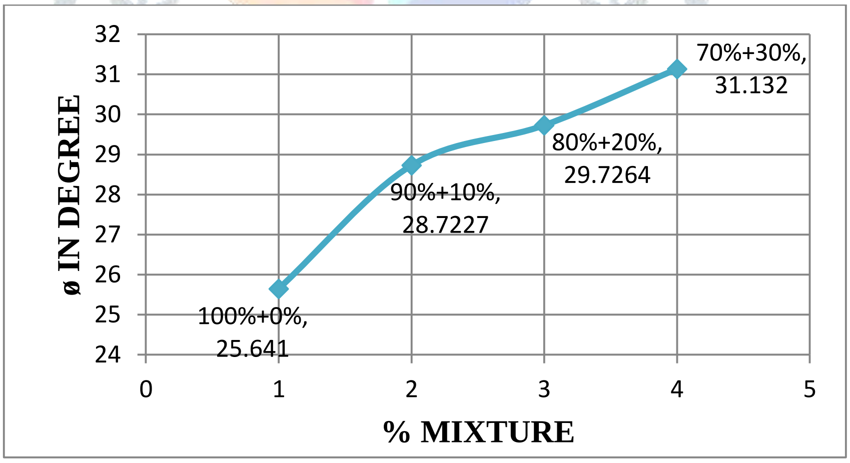

Figure 4: Variation of Φ value vs different fly ash-sand mixture

V. CONCLUSIONS

A. Moisture-Density relationship of fly ash significantly affected by adding sand in fly ash. The maximum increase in MDD and maximum decrease in OMC were found with 70% fly ash and 30% sand mixture which are 1.451gm/cc and 17.808% respectively.

B. By adding sand with fly ash, the CBR value is significantly improved. The maximum increased CBR value is 10.6277 which was found with 70% fly ash and 30% sand mixture

C. In direct shear test, angle of shearing resistance (Φ) of fly ash is consequentially improved by adding sand. Adding 30% sand with 70% fly ash gives the maximum increment in Φ is 31.1320˚.

Hence, on the basis of experiments we can conclude that maximum performance can be achieved by using 30% sand with 70% fly ash instead of fly ash in sub grades.

VI. ACKNOWLEDGMENT

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[9] IS 2720 (Part-13) (1986), "Methods of Direct Shear Test".