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Improving CBR of Soil With Fly Ash

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Abstract: ***As fly ash is freely available, for projects which are exbhited from Thermal Power Plants, it can be used for stabilization of expansive soils for various uses. Our case study carried out to check the improvements in properties of expansive soil with fly ash in varying percentages. Laboratory tests like 1) grain size analysis 2) atterberg limits 3) standard compaction 4) permeability test have been carried out on soil and CBR (California bearing ratio) test is conducted on soil sample mixed with fly ash in various proportions and results are reported in this paper.***

Keywords: Fly ash , Atterberg Limits, Standard Compaction Test, C.B.R Value

I. INTRODUCTION

Black Soils are highly retentive in moisture extremely compacted and tenacious when wet, considerably contracted developing deep wide cracks on drying and self ploughing. Black soils are credited with high fertility. The black color is attributed to the presence of titaniferous magnetite, compounds of iron and aluminium, accumulated humus and colloidal hydrated double iron and aluminium silicate.

The aim of the research is to improve the C.B.R value of the black soil Guntur with the addition of fly ash in different proportions to determine the improvement in California Bearing Ratio of the soils. California Bearing Ratio (CBR) test was developed by the California Division of Highways. The Bureau of Indian Standard (IS: 2720-Part 16, 1987) has also adopted the modified procedure. By improving the bearing ratio of soil the pavement crust can be reduces and the cost will be minimized.

II. EXPERIMENTAL PROGRAMME

In this project the C.B.R of soil by mixing with fly ash was observed by adding the fly ash percentages of 10%, 20%,30%,40%,50%,the optimum moisture content was chooses as 12% for the further study after finding the Maximum dry density of soil . the strength of the soil with fly ash are compared with that of normal soil which does not contain any fly ash.

III. EXPERIMENTAL PROCEDURE

In this study we have used Black Cotton Soil and fly ash taken from thermal power station in Vijayawada.

IV. RESULTS AND TABLES

Specific Gravity test (G_s):

Specific gravity is the ratio of the density of a substance to the density of a reference substance From the Specific Gravity tests the soil which we have chosen is Organic Soil. Organic soils are typically highly compressible and low strength. The specific gravity of fly ash is 1.646.

Atterberg Limits:

Liquid limit:

The result shows the effect of varying percentages of fly ash on the liquid limits of selected black cotton soil sample are presented in. The liquid limit decreases with the addition of fly ash. The results show a considerable decrease in the liquid limit up to 30% increase in the fly ash then after the decrease are observed. The decrease of liquid limit is observed at 40-50 % of fly ash. This is due to the increased dilution effect.

Plastic limit:

We can observe that the plastic limit curve variation. On addition of fly ash the plastic limit of soil increase flocculation owing to presence of fly ash. But in this the curve varies it depends upon the soil content and fly ash properties composition

% OF FLY ASH	LIQUID LIMIT	PLASTIC LIMIT
SOIL WITH OUT FLY ASH	98.01	52.77
SOIL +10% FLY ASH	72.22	55
SOIL +20% FLY ASH	67.87	69.83
SOIL +20% FLY ASH	76.66	38.8
SOIL +20% FLY ASH	50	80.5
SOIL +20% FLY ASH	50	38.8

Standard Proctor Test:

The Proctor compaction test is a laboratory method of experimentally determining the optimal moisture content at which a given soil type will become most dense and achieve its maximum dry density. The dry density is maximum at the optimum water content. The optimum dry density is 12 % . It is noticed that at 0% fly ash the M.D.D value was found to be

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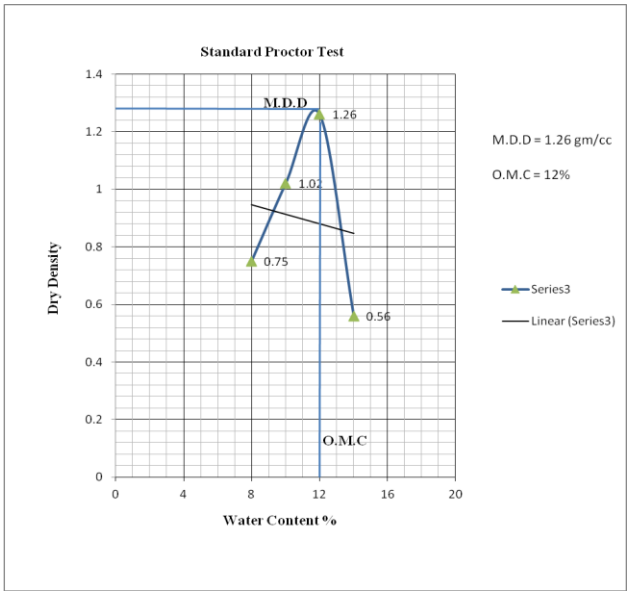
1.26 gm/cc when the amount of fly ash increased the M.D.D value decreased to a minimum M.D.D value of 0.56 gm/cc at 14% fly ash. The decrease in Maximum Dry Unit weight with increase in percentage of fly ash is primarily a result of the lower specific gravity of fly ash as compared with soil.

SOIL WITHOUT FLY ASH DRY DENSITY VS WATER CONTENT GRAPH



SOIL WITH FLY ASH DRY DENSITY VS WATER CONTENT

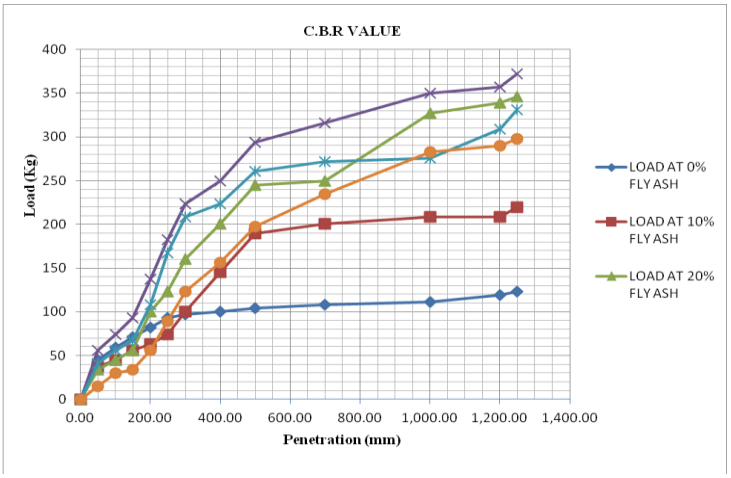
SL.NO	OBSERVATIONS	WATER CONTENT (O.M.C) (12%)
1	**SOIL SAMPLE + 10% FLY ASH MAXIMUM DRY DENSITY (ρ_d)**	**1.05**
2	**SOIL SAMPLE + 20% FLY ASH MAXIMUM DRY DENSITY (ρ_d)**	**1.11**
3	**SOIL SAMPLE + 30% FLY ASH MAXIMUM DRY DENSITY (ρ_d)**	**0.62**
4	**SOIL SAMPLE + 40% FLY ASH MAXIMUM DRY DENSITY (ρ_d)**	**1.17**
5	**SOIL SAMPLE + 50% FLY ASH MAXIMUM DRY DENSITY (ρ_d)**	**0.60**

California Bearing Ratio:
From the test we infer that

CBR value for the fly ash and soil mixture (10% fly ash) is 5.43.

CBR value for the fly ash and soil mixture (20% fly ash) is 9.01.
CBR value for the soil and fly ash mixture (30% fly ash) is 13.32.
CBR value for the soil and fly ash mixture (40% fly ash) is 12.21.
CBR value for the soil and fly ash mixture (50% fly ash) is 6.51

Depending upon on the composition of the fly ash that is added to the soil its stability varies accordingly. Here we notice that stability of our soil sample increases with addition of 30% fly ash and then gradually decreases beyond it. Hence the optimum composition of fly ash to be considered is 30% by its weight.



V. CONCLUSION

The stability of the pavement solely depends on the stability of the embankment. In case we encounter an embankment consisting of the expansive soils; its tendency to imbibe water weakens the stability of pavement.

Hence, we are improving the existing strength of the sub grade by which we are actually increasing the bearing capacity of the pavement. With reference to all the laboratory tests that are performed on the soil, we conclude that the plain soil stability i. e the CBR value of the normal soil sample was initially 5.97 after by adding 10%, 20%, 30%, 40% and 50% fly ash are 5.43, 9.01, 13.32, 12.21 and 6.51 respectively by which we came to know that the optimum composition of the fly ash that should be added to the soil to improve the strength is 30% by its weight.

Ultimately, the main aim of the project is to increase the characteristic strength of the soil by reducing the economy as much as possible. This purpose is achieved here by using the by-product from the thermal industry (Fly ash), which does not cost too much. Hence this way the project becomes efficient as well as economical.

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