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STABILIZATION OF SOIL BY USING WASTE PRODUCT LIKE FLY ASH, GGBS AND CCR

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ABSTRACT: Utilization of industrial waste materials in the improvement of problematic soils is a cost efficient and environmental friendly method. It helps in reducing disposal problems caused by the various industrial wastes. However, it is essential to understand the performance of these waste products prior to use. The present paper evaluated the potential of granulated blast furnace (GGBS), Fly ash and calcium carbide residue (CCR) to stabilize a soil. Soil samples were collected from Rajouri village, Dhonora. This soil was classified as per Indian Standard Classification System (ISCS). The performance of GGBS with fly ash and CCR modified soils was evaluated using Direct shear test (DST). Based on these performance tests, optimum amount of GGBS with Fly ash and CCR was determined as 20% GGBS + 20% Fly ash + 9% CCR.. Soil sample was prepared with 5% GGBS, 5% Fly ash and 3% CCR.. Second sample was prepared with 10% GGBS, 10% Fly ash and 5% CCR. Third sample was prepared with 15% GGBS, 15% Fly ash and 7% CCR.. Fourth sample was prepared with 20% GGBS, 20% Fly ash and 9% CCR.

I. INTRODUCTION

Soil stabilization means the improvement of the stability or bearing capacity of a poor soil by the use of compaction, proportioning and the addition of suitable stabilizers or admixtures. Soil stabilization includes chemical, mechanical, physio-chemical methods to make the soil stabilized. The process basically involve excavation of soil, this is an ideal technique for improving soil in shallow depth, as in pavements. Stabilization method may be categorized as two main types (1) Improvement of soil properties of existing soil without using any type of admixture (2) Improvement of soil by using admixtures such as fly ash, fiber reinforced concrete, Ground granulated blast furnace slag (GGBS), Calcium carbide residue(CCR), geo polymer etc

The big challenge before the processing and manufacturing industries is the disposal of the harmful residual waste products. Waste products which are generally toxic, ignitable, corrosive or reactive pose serious health and environmental consequences. This major issue requires an effective, economic and environment friendly method to combat the disposal of the residual industrial waste products. Hence it is common and feasible way to utilize these wastes in construction of roads and embankments, so that the pollution problems caused by the industrial wastes can be greatly reduced. Huge amount of soil is used in the construction of the roads and highways but sufficient amount of soil of required quantity is not available easily. These industrial wastes which are used with natural soil in the construction not only solve the problems of disposal and environmental pollution but also help to preserve the natural soil.

II. LITERATURE REVIEW

Satyanarayana et al (2004) studied the combined effect of addition of fly ash and lime on engineering properties of expansive soil and found that the optimum proportions of soil: fly ash: lime should be 70:30:4 for construction of roads and embankments.

Mercy Joseph Poweth et al. in 2013 investigated on safe and productive disposal of quarry dust, tyre waste and wastes-plastic by using them in the pavements sub grade. In their paper a series of CBR and SPT test were carried out for finding the optimum percentages of waste plastics, and quarry dust in soil sample. The results shows only quarry dust should be mixed with the soil plastic mix, to increase its maximum dry density and is suitable for pavement sub grade. Tyres alone are not suitable for sub grade. They concluded that Soil plastic mixed with quarry dust maintains the CBR value within the required limit. Soil tyre mixed with quarry dust gives lesser CBR value than soil plastic quarry dust mix but it can be used for pavement sub grade.

Rajkumar Nagle et al in 2014 performed CBR studies for improving engineering performance of sub grade soil. They mixed Polyethylene, Bottles, Food packaging and shopping bags etc as reinforcement with black cotton soil, yellow soil and sandy soil. Their study showed that MDD and CBR value increases with increase in plastic waste. Load bearing capacity and settlement characteristics of selected soil material are also improved.

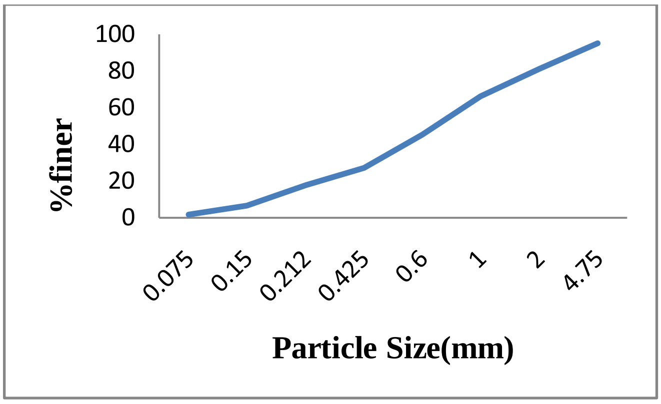
III. TEST RESULTS

3.1 Specific Gravity

It is defined as the ratio of the mass of a given volume of solids to the mass of an equal volume of water. The specific gravity of soil was determined according to IS 2720:Part III: Sec 1: 1980 and was found 2.1.

3.2 Particle Size Analysis

The particle size analysis was done according to IS 2720:Part IV: 1985. The particle size distribution curve is plotted between particle size(mm) as abscissa on log scale and percentage fine as(%) as ordinate. The particle size curve is given below.



Graph 1 Particle size distribution curve.

From the above particle size distribution curve, the uniformity coefficient and coefficient of curvature were found as,

Uniformity Coefficient,

$C_u = D_{60}/D_{10} = 6.2$

Coefficient of Curvature,

$Cc = (D_{30})^2/D_{60}xD_{10} = 1.86$

3.3 Liquid Limit

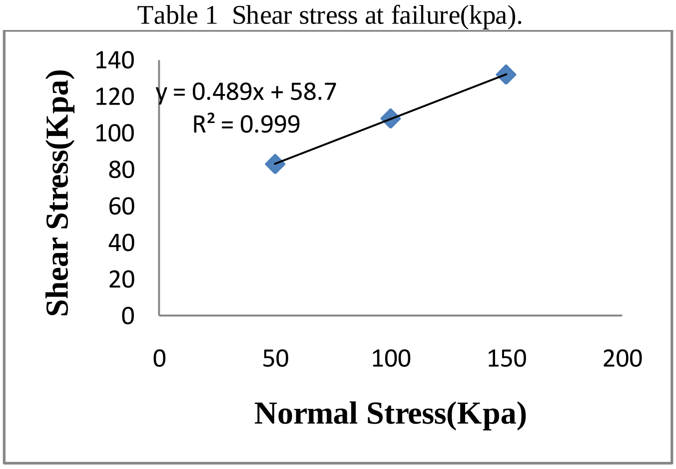
The Liquid Limit of soil was determined by using Casagrande's Apparatus according to IS 2720: Part 5: 1985. The Liquid Limit of soil was found 31.2%.

3.4 Plastic Limit

The Plastic Limit of soil was determined according to IS 2720: Part 5: 1985 and was found 28.1%

Normal Stress (Kpa)	Shear Stress (Kpa)
50	83
100	107.9
150	131.9

Table 1 Shear stress at failure(kpa).



Graph 2 Graph between Normal Stress and Shear Stress.

Here the cohesion(C) of soil is 58.7kpa, the angle of internal friction(ϕ) is 26^o and Regression Coefficient is 0.999.

IV. CONCLUSION

- The addition of GGBS, CCR and Fly ash is effective in increasing in the shear strength of the soil. It was found that the shear strength parameters increase with increase in the GGBS, CCR and Fly ash in the soil.
- It was found that up to addition of 10% GGBS, 10% Fly ash and 5% CCR by mass, the shear strength increases and beyond addition of 15%GGBS, 15% Fly ash and 7% CCR, the shear strength get reduced. So, after further increase of GGBS, Fly ash and CCR the shear strength decreases.
- As we know the population of world is day by day increasing, a lot of GGBS, Fly ash and CCR is produced by industries and we know it is not easy to dump such huge quantity and will require large land. It is necessary to find a solution to solve this problem. Here in this study we see that we can use GGBS, CCR and fly ash as additive in soil to increase its strength properties and this is also economical.

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