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Stabilization of Soil with Lime For Rural Roads

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***Abstract* – The objective of the project is to use industrial wastes in place of natural soil in the construction of road and highway after increasing its strength, stability and durability by the method of stabilization using lime and RBI grade 81.Traditionally soil, st one aggre gat es , sand, bitumen, cem ent et c . are used for road construction. Natural materials being exhaustible in nature, its quantity is declining gradually. Huge amount of soil is used in the construction of road and highway but sufficient amount of soil of required quality is not available easily. For that reason large amount of trees are being cut which cause deforestation, soil erosion and loss of fertile soil which hampers in the agricultural productivity. Also, cost of extracting good quality of natural material is increasing. Concerned about this, the scientists are looking for alternative materials for highway construction, and industrial waste product is one such category. If these materials can be suitably utilized in highway construction, the pollution and disposal problems may be partly reduced. Stabilization is the method used in this project to increase the inherent strength of wastes like fly ash and blast furnace slag (BFS) using lime and RBI grade 81. The present project work aims at evaluating the effectiveness of lime and RBI Grade 81 in stabilizing the waste products like fly ash and BFS mixes and its suitability in road construction. This will save the natural soil in addition to addressing the disposal problems of industrial solid wastes in a great way. Fly ash was collected from the captive power plant (CPP-II) and BFS from the dump pad of Rourkela steel plant (RSP). The collected samples were oven dried and mixed thoroughly to get homogeneity in the Geotechnical Engineering laboratory. The samples were then kept in different air tight container for the project work. Samples were then prepared mixing fly ash and BFS with different percentage at an interval of 10% and standard proctor test was carried out to get optimum moisture content (OMC) and maximum dry density (MDD). Stabilized samples were prepared mixing fly ash and BFS with different percentage at an interval of 10% and with stabilizing agent lime and RBI grade 81 with increasing percentage as 0%, 2%, 4%, 6%, and 8%. The samples were then subjected to unconfined compressive test after 7, 14, 28 and 60 days of curing. The above samples were prepared using constant volume mould by static compression method.**

***Keywords* – Soil, Lime, Rural Roads.**

I. INTRODUCTION

Since the outset of the industrial revolution the greatest challenge before the processing and manufacturing industries is the disposal of the residual waste products. Waste products which are generally toxic, ignitable, corrosive or reactive pose serious health and environmental consequences. Thus disposal of industrial wastes is a measure issue of the present generation. This measure issue requires an effective, economic and environment friend method to combat the disposal of the residual industrial waste products. One of the common and feasible ways to utilize these waste products is to go for construction of roads, highways and embankments. If these materials can be suitably utilized in construction of roads, highways and embankments then the pollution problem caused by the industrial wastes can be greatly reduced. Huge amount of soil is used in the construction of roads and highways but sufficient amount of soil of required quality is not available easily. For that reason large amount of trees are being cut which cause deforestation, soil erosion and loss of fertile soil which hampers in the agricultural productivity. Also, cost of extracting good quality of natural material is increasing. These industrial wastes which are used as a substitute for natural soil in the construction not only solve the problems of disposal and environmental pollution but also help to preserve the natural soil. The challenge for the present and future of road construction is the appropriate implementation of waste or industrial by-products as constructing materials. This will provide a number of significant benefits to the constructing industry as well as to the country as a whole by conservation of natural resources, by reduction of volume of waste to landfills, by lowering the cost of construction materials, by lowering waste disposal costs, and the last but not the least by promoting a „clean and green" image. The industrial wastes used in this project are blast furnace slag (BFS) and fly ash. Stabilization is the method used in this project to increase the inherent strength of industrial wastes blast furnace slag (BFS) and fly ash using lime and RBI grade 81. The present project work aims at evaluating the effectiveness of lime and RBI Grade 81 in stabilizing the waste products BFS and fly ash and its suitability in road construction. Fly ash was collected from the captive power plant (CPP-II) and BFS from the dump pad of Rourkela

steel plant (RSP). The collected samples were oven dried and mixed thoroughly to get homogeneity in the Geotechnical Engineering laboratory.

II. PROBLEM STATEMENT

The purpose of the project is to use industrial wastes blast furnace slag (BFS) and fly ash collected from Rourkela steel plant in place of natural soil in the construction of road and highway after increasing its strength, bearing capacity, volume stability and durability by the method of stabilization using lime and RBI grade 81. The present project work aims at evaluating the effectiveness of lime and RBI Grade 81 in stabilizing the waste products BFS and fly ash and its suitability in road construction.

III. METHODOLOGY

The stabilization of soil with lime for rural roads involves several key steps and methodologies aimed at improving the engineering properties of the soil to enhance its load-bearing capacity and durability. Here's a concise overview of the typical methodology applied:

Site Investigation: Begin by conducting a thorough site investigation to assess the soil's properties, including its composition, moisture content, plasticity, and bearing capacity. This investigation helps in determining the appropriate lime content and mixing procedures.

Lime Selection: Select the appropriate type of lime based on the soil conditions and project requirements. Generally, quicklime (calcium oxide) or hydrated lime (calcium hydroxide) is used for soil stabilization due to their effectiveness in modifying soil properties.

Mix Design: Develop a mix design by determining the optimum lime content required to achieve the desired soil stabilization goals. This involves laboratory testing, such as Proctor compaction and California Bearing Ratio (CBR) tests, to evaluate the mechanical properties of lime-treated soil at different lime concentrations.

Soil Preparation: Prepare the soil by grading and compacting it to the desired density and moisture content. This ensures uniform mixing and distribution of lime throughout the soil mass.

Lime Mixing: Apply lime to the prepared soil using either a dry or slurry mixing method. In the dry mixing method, lime is spread evenly over the soil surface and mixed using mechanical equipment such as graders or rotavators. Alternatively, in the slurry mixing method, hydrated lime is mixed with water to form a slurry, which is then blended with the soil using mixing equipment.

Curing: Allow sufficient time for the lime-treated soil to cure and react with the soil particles. During this curing period, the lime chemically reacts with clay minerals in the soil, resulting in improved soil stabilization and strength development.

Quality Control: Implement quality control measures throughout the construction process to ensure compliance with specified standards and requirements. This may involve regular testing of soil-lime mixtures for strength, density, and durability characteristics.

Construction of Road: Finally, construct the stabilized soil layer as part of the rural road pavement structure, followed by the application of additional pavement layers as per the design specifications.

By following these methodologies, the stabilization of soil with lime can effectively enhance the performance and longevity of rural roads, providing cost-effective and sustainable transportation infrastructure for rural communities.

Fig. 1 Methodology

IV. RESULTS

Comparison of UCS value for RBI and Lime at 2% and 6% for different composition of BFS and fly ash for 60 days curing

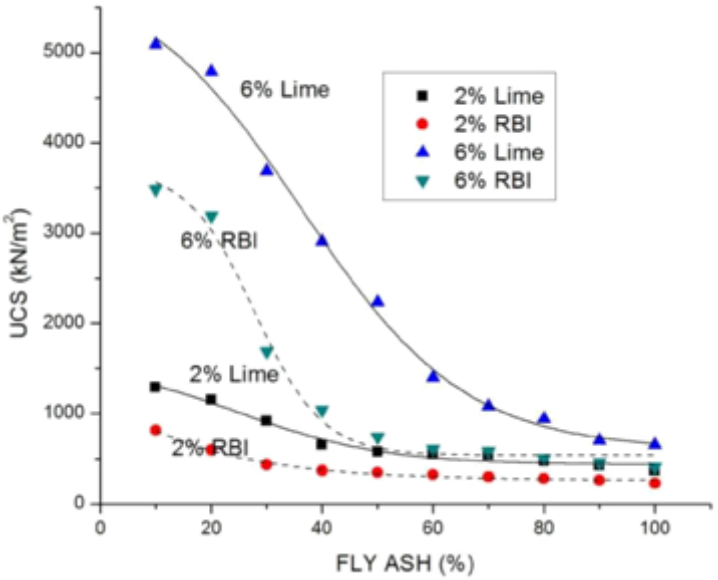

Fig.2 UCS v/s Fly ash

V. CONCLUSION

The present project can serve as an effective method to utilize industrial wastes fly ash and BFS in the construction of road and highway. Based on results of standard proctor test and UCS test the following conclusions are drawn. The conclusions are based on the tests carried out on samples selected for study. The conclusions cannot be generated. The users are advised to conduct separate tests to determine the unconfined strength of stabilized samples of a particular site.

1. The OMC of BFS and fly ash mixes increases with increase in percentage of fly ash.
2. The MDD of BFS and fly ash mixes decreases with increase in percentage of fly ash.
3. The OMC of BFS and fly ash mixes decreases with increase in percentage of BFS.
4. The MDD of BFS and fly ash mixes increases with increase in percentage of BFS.
5. The unconfined compressive strength of stabilized samples increases with increase in percentage of lime and RBI grade 81. The rate of increase is more in case of lime.
6. The unconfined compressive strength of stabilized samples increases with increase in days of curing.
7. The unconfined compressive strength of stabilized samples is more for lime than RBI grade 81 after 7, 14, 28 and 60 days of curing.
8. The unconfined compressive strength of stabilized samples increases with increase in blast furnace slag (BFS) percentage. i.e. 90% BFS + 10% fly ash has highest strength and 100% fly ash has lowest strength.

Thus the present analysis and results can serve the purpose of using BFS and fly ash in road construction. Hence the blast furnace slag and fly ash stabilized by lime and RBI Grade 81 can be used effectively in construction of road.

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