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IMPROVING STRENGTH OF BLACK COTTON SOIL BY USING ADMIXTURE – FLYASH AND IRON POWDER

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ABSTRACT

Stabilization of Black Cotton Soil (BC soil) is studied by using iron powder and Fly ash. BC soils are highly clayey soils (Montmorillonite clay mineral). The moisture changes in BC soils, compressibility and plasticity nature can be greatly improved with the addition of iron powder and Fly ash. Aim of project is the evaluation of soil properties like Optimum moisture content, dry density, and strength parameter (California Bearing ratio value). Different quantities of iron powder and Fly ash (% by weight) are added to the BC soil and the experiments conducted on these soil mixes. The result shows that the use of iron powder and Fly ash ``increases the California Bearing Ratio values i.e. the strength of soil to a great extent.

Keywords: Stabilization, Black Cotton Soil, California Bearing Ratio, Iron powderand Fly Ash.

I.INTRODUCTION

The term 'soil' has various meanings, depending upon general professional field in which it is being considered. To an agriculturist, soil is the substance existing on the earth's surface, which grows and develops plant life. To the geologist also, soil is the material in the relatively thin surface zone within which roots occur, and all the rest of the crust is grouped under the term rock irrespective of its hardness. To an engineer, soil is the un-aggregated or un-cemented deposits of minerals and organic particles or fragments covering large portion of the earth's crust. It includes widely different materials like boulders, sands, gravels, clays and silts, and the range in the particle sizes in a soil may extend from grains only a fraction of micron (10cm) in diameter up to large size boulders. Soil is considered by the engineer as a complex material produced by the weathering of the solid rock. The formation of the soil is as a result of the geologic cycle continually taking place on the face of the earth.

The cycle consists of weathering or denudation, transportation, deposition and upheaval, again followed by weathering, and so on. Weathering is caused by the physical agencies such as a periodical temperature changes, impact and splitting action of flowing water, ice and wind and splitting actions of ice, plants and animals. Cohesion less soils are formed due to physical disintegration of rocks. Soil is defined as sediments or other accumulation of mineral particles produced by the physical or chemical disintegration of rocks plus the air, water, organic matter and other substances that may be included. Soil is typically a non-homogeneous, porous, earthen material whose engineering behavior is influenced by changes on moisture content and density. Based on the origin, soil can be broadly classified as organic and inorganic. Organic soils are mixture derived from growth and decay of plant life and also accumulation of skeleton or shell of small organism. Inorganic soils are derived from the mechanical or chemical weathering of rocks. Inorganic soil that is still located at the place where it was formed is referred to residual soil. If the soil has been moved to another location by gravity, water or wind, it is referred to as transported soil. Black cotton soils are highly clay soil grayish to blackish in color. They contain montmorillonite clay mineral which has high expensive characteristics. BC soils have low shrinkage limit and high optimum moisture content. It is highly sensitive to moisture changes, compressible subgrade material. Hence the subgrade and its undesirable characteristics to be modified using a suitable stabilization technique.

Stabilization involves the methods used for modifying the properties of a soil to improve its engineering performance. In the construction pf road and airfield prevents the main objective of stabilization is to increase the strength or stability of soil and to reduce the construction cost by making best use of the locally available materials. Lime has been widely used either as a modifier for clayey soil or as a binder. When clayey soils with high plasticity are treated with lime, the plasticity index is decreased and soil becomes friable and easy to be pulverized, having less affinity with water. Lime also imports some binding action. In developing countries like India the biggest handicap is to provide a complete network of road system in the limited finances available to build road by conventional method. Therefore there is a need to go for suitable method of low cost road construction, followed by a process of stage development of the roads, to meet the growing needs of road traffic. thus apart from affecting economy in the initial construction cost of lower layers of the pavement such as sub-base course it should be possible to upgrade the low cost roads to higher specification at a later date without involving appreciable wastage, utilizing the principle of pavement construction in stages.

The construction cost can be considerably decreased by selecting local materials including local soils for the construction of the lower layers of the pavement such as the sub-base course. If the stability of local soil is not adequate for supporting wheel loads, the properties are improved by soil stabilization technique. Stabilization of course-grained soils having little or no fines can often be accomplished by the use of LF combination. Lime and Fly ash in combination can often be used successfully in stabilizing granular materials. LF stabilization is often appropriate for base and sub-base course materials. The water content of the fly ash stabilized soil mixture affects the strength. The maximum strength realized in soil-fly ash mixtures generally occurs at moisture contents below optimum moisture content for density. For silt and clay soils the optimum moisture content for

strength is generally four to eight percent below optimum for maximum density. For granular soils are the optimum moisture content for maximum strength is generally one to three percent below optimum moisture for density. Therefore, it is crucial that moisture content be controlled during construction. Moisture content is usually measured using a nuclear density measurement device. Fly-ash reduces the potential of a plastic soil to undergo volumetric expansion by a physical cementing mechanism, which cannot be evaluated by the plasticity index.

Fly ash controls shrinks well by cementing the soil grading together much like a Portland cement bonds aggregates together to make concrete. By bonding the soil grains together, soil particle movements are restricted. Fly ash is a pozzolan. It has been successfully used with granular and fine grained materials to improve soil characteristics, providing adequate support for pavements and improving working conditions where undesirable soils are encountered.

II.OBJECTIVES

Objective of the study Soil is an important construction material vastly used in every type of construction. All types of structures are constructed on foundation which is ultimately rested on soil. Remember, foundation does not carry the load it simply transfer the load to the soil. Entire load is to be taken up by soil only. If the soil is not capable of bearing the load, there will be no use of heavily deigned, heavily reinforced foundation. Black cotton soil is an expensive soil which undergoes swelling and shrinkage on addition and removal of water content. It may cause danger to any structure constructed on such type of soil.

1. To study Characteristics Behavior of Admixture and Black cotton soil.
2. To increase Bearing Capacity of soil.
3. To decrease voids Ratio and Drainage.
4. To know Optimum value of OMC and MDD of soil.

III. MATERIALS AND METHODOLOGY

curing periods of 7, 14 and 28 days were considered.

MATERIALS:

The properties of the materials used and the details of the methods of testing are as follows. a) Materials used;

1. Black cotton soil:-

Twenty natural black cotton soil samples were collected from different locations of Hubballi-Dharwad Municipal Corporation (HDMC) area were studied for their expansive characters. These samples have been identified for their swell potential and have been broadly grouped into three categories based on their degree of expansiveness and problematic nature as,

- Highly expansive and problematic group,

- Moderately expansive and problematic group and
- Least expansive and problematic group (Hakari and Puranik, 2010). In the present work, one sample from each of the above category has been considered for the stabilization study**.**

2. Fly ash:-

The fly ash used in this work is procured from "The West Coast Paper Mills, Dandeli, Karwar District, and Karnataka. It is located reasonably near at about 60 kms. fromHubballi-Dharwad twin city. The fly ash sample is designated as DFA (Dandeli Fly Ash).

3. Black cotton soil and DFA mixes

The black cotton soil samples were mixed with DFA on dry weight basis in varying percentages of 10%, 20%, 30%, 40%, 50% and 60%. The corresponding mixes have been designated as M-10, M-20, M-30, M- 40, M-50 and M-60 respectively. M-0 indicates virgin soil sample. The finely blended mixes were then kept for oven drying for 24 hours and tests were conducted immediately after wet mixing with water in required quantity depending on the test. For the strength test,

4. Iron powder:-

Iron is the second most metallic element in the earth's crust and accounts for 5.6% of the lithosphere. The level of per capita consumption of Iron is treated as an important index of the level of socioeconomic development and living standards of the people in any country. The usage of large quantities of iron in the present days is resulting in the generation of large amount of Iron waste. Few attempts were made in the past to stabilize the expansive soils using Iron powder. Barazesh et al., (2012) made an attempt to improve of properties of soil using Iron powder. However, the study was carried out only on the Atterberg limits.

IV.METHODOLOGY

1. Moisture content determination

The condition resulting from having been dried to essentially constant weight in an oven at a temperature that has been fixed, usually 221°F and 230°F (105°C and 115°C).

2. specific gravity

The ratio of the density of a substance to the density of some substance (such as pure water) taken as a standard when both densities are obtained by weighing in air.

3. Liquid limit

The water content at which soil passes from the plastic to the liquid state under standard test conditions. The limit is expressed as a percentage of the dry weight of the soil. See also Atterberg limits.

4. plastic limit

The water content at which a soil will just begin to crumble when rolled into a thread approximately 1/8" (3 mm) in diameter. Squeeze and roll a 0.3 oz. (8 g) test sample into an ellipsoidal shaped mass. Roll this mass between the fingers or palm of hand and the ground glass plate or satisfactory paper on a smooth horizontal surface with just sufficient pressure to roll the mass into a thread of uniform diameter throughout its length. The rate of rolling should be between 80 and 90 strokes/min, counting a stroke as one complete motion of the hand forward and back to the starting position again.

5. *shrinkage limit*

The water content at which a reduction in water content will not cause a decrease in volume of the soil mass but an increase in water will increase the volume. See also Atterberg limits. Determines the volume of shrinkage dish which is evidently equal to volume of the wet soil as follows. Place the shrinkage dish in an evaporating dish and fill the dish with mercury till it overflows slightly. Press it with plain glass plate firmly on its top to remove excess mercury. Pour the mercury from the shrinkage dish into a measuring jar and find the shrinkage dish volume directly.

6. *grain size*

The average diameter or expressed dimension of the grains or crystals in a sample of metal or rock. Also particle size

7. *compaction test*

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.

8. *unconfined compressive strength (UCS)*

The primary purpose of this test is to determine the unconfined compressive strength, which is then used to calculate the unconsolidated test undrained shear strength of the clay under unconfined conditions. According to the ASTM standard (Qu) is defined as compressive stress at which an unconfined cylindrical specimen of soil will fail in a sample compression test. In addition, in this test method, the unconfined compressive strength is taken as the maximum load attained per unit area, or the load per unit area at 15% axial strain, whichever occurs first during the performance of the test.

V.RESULT

Sr	Properties	Normal Values	BCS+Fly ash	BCS+Iron Powder

1	Moisture Content	18.06%	26.19	15.4
2	Specific Gravity	02.54	2.65	2.6
3	Plastic limit	21.21	39	21
4	Liquid Limit	42.50	24	40
5	Plasticity Index	21.29	15	19

VI. CONCLUSION

The results of liquid and plasticity limits of the soil which is stabilized with different percentages of Iron powder are tabulated. From the results, it can be observed that liquid limit values are decreasing with the percentage increase of Iron powder in soil. The Plastic limit remained constant at different soil & iron powder proportions. The Plasticity Index (P.I) decreased with increase in percentage of Iron powder.

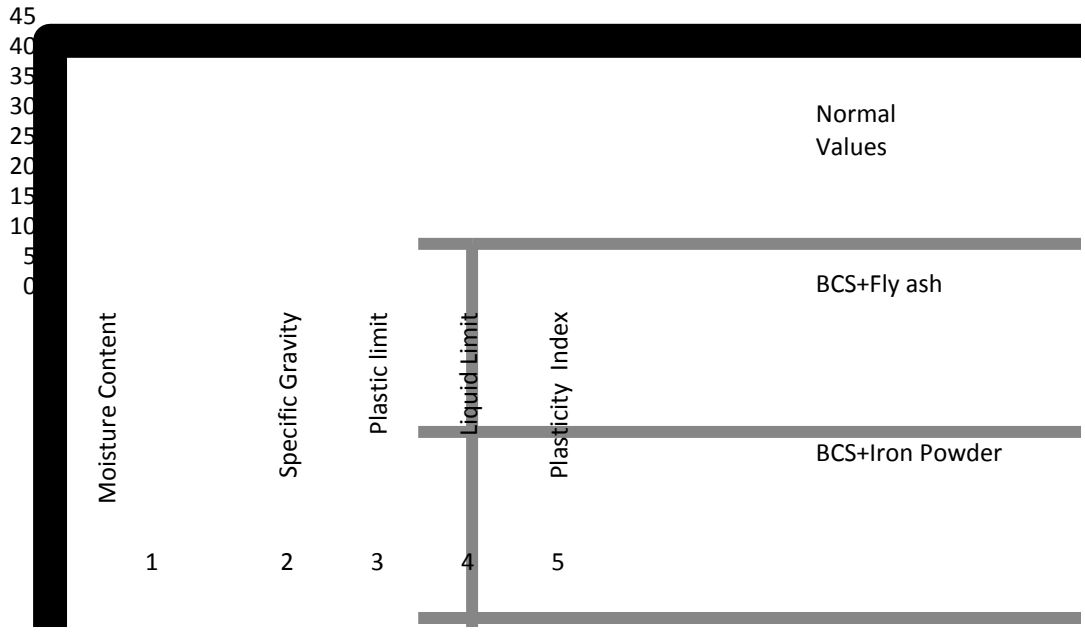

Figure 1 Graph showing the comparative result of soil samples

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