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Experimental Study on Stabilization of Black Cotton Soil by Using Fly Ash and Coconut Coir Fiber

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ABSTRACT: As the Black cotton soil possess undesirable engineering properties like Excessive Variation in volume with change in water content. There is considerable shrinkage on drying result in formation of extensive cracks. Black cotton soil experiences high swelling on being soaked, low compressive strength at higher water content etc. The objectives of the present studies focus on to analyze property of soil such as Atterberg's limit, Compaction curve (O.M.C and M.D.D), shrinkage limit, California Bearing ratio, swelling pressure, permeability, direct shear test, effect of Fly ash, Cocunut coir fiber with various percentages along with Black cotton soil, combination on the above proportions of ingredients, use of waste products instead of conventional materials like cement, lime, etc. & how to increase cost benefit ratio. To achieve this goal experimental study on 50 trial samples test were carried in two phase such as in first phase, the physical properties of soil such as hygroscopic moisture content grain size distribution, Specific gravity, Atterberg's limits, Direct shear test, Swelling pressure, MDD-OMC, CBR, Permeability test values are determined. In second phase, various test investigation performed on black cotton soil using different percentages of Fly ash (FA) at (10%, 20%, 30%, 40%, 50%), and coconut coir fiber (CCF) at (0.25%, 0.5%, 0.75%, 1%, 1.25%).

KEYWORDS: Black cotton soil, California Bearing Ratio, Coconut coir fiber, Fly ash, Soil Stabilization, Swelling pressure.

I. INTRODUCTION

Every structure must rest upon soil and the soil at that particular site should be satisfactory for the intended use. But unfortunately nowadays finding such satisfactory soils is of rare occurrence. Generally the soils, which are unsatisfactory, and are not suitable for the intended uses are mostly expansive clayey soils. Expansive soils are swelling soils and are most problematic because of their drastic changes in volume with addition or removal of water. Hence stabilization of these soils is very essential. It is highly difficult to work on such soils. Since construction on these soils cannot be avoided, we have to identify and modify them to be suitable for our construction works.

Soil stabilization finds many purposes. The first and most obvious one is strength Improvement. Soil stabilization helps increase the strength of the existing soil to improve its capacity for load bearing. Dust control and soil water proofing are two other reasons why soil stabilization is done. With dust control, the dust that is generated by the consistent use of equipment and machinery can be eliminated, especially in dry and arid weather. The third purpose of soil stabilization, soil waterproofing, preserves the natural strength of a soil by obstructing the entry of surface water.

The most practically frequented need for the stabilization is that in case of pavements constructed on expansive soils it causes early failures and leads to the formation of ruts, potholes, waves, and corrugations etc. during monsoons, which are most undesirable resulting in high maintenance cost. These soils show uneven behaviour and the structures constructed on these soils leads to differential settlement, also it is difficult to design a structure for a particular

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Vol. 6, Issue 4, April 2017

intensity as the bearing capacity of the soil varies along with the water content of the soil. It causes wide cracks and leads to the separation of elements from the structure and collapse. Therefore there is a need of treating the soils to improve its properties before it is used for intended purpose.

II. OBJECTIVE OF THE WORK

To upgrade expansive soil as a construction material using coconut coir fiber and fly ash which are waste materials, the materials will increase the physical as well as chemical properties of the soil. Some expecting properties to be improved CBR value, liquidity index, plasticity index etc. The objective of this study was to evaluate the effect of fly ash and coconut coir fiber to improve the performance of black cotton soil. The black cotton soil as treated with fly ash (10%, 20% ,30%, 40%, 50% ,60%, 70%, 80%)and coconut coir fiber (0.25%, 0.5%. 0.75%, 1%, 1.25%, 1.5%, 1.75% ,2%). In second phase various test investigation performed on black cotton soil using different percentages of fly ash and coconut coir fiber.

III. MATERIALS AND METHODOLOGY

Following are the materials which are used in the present study:

Properties of Black cotton soil

S.NO	PROPERTIES	TEST RESULTS	IS CODES
1	Colour	Black	-
2	Specific gravity	2.5	IS:2720(part 3)-1964
3	IS classification soil	CI	IS:2720(part 4)-1965
4	MDD(g/cc)	1.2	IS:2720(part 8)-1980
5	OMC %	18	IS:2720(part 8)-1980
6	CBR %	1.48	IS:2720(Part 16)
7	Liquid limit %	57	IS:2720(part 5)-1985
8	Plastic limit %	36	IS:2720(part 5)-1965
9	Direct shear test	19	-
10	Swelling pressure test	35	IS:2720(part 11)-1997

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Vol. 6, Issue 4, April 2017

Properties of Fly ash

S.NO	PROPERTIES	TEST RESULTS	IS CODES
1	Colour	Grey	-
2	Specific gravity	2	IS:2720(part 3)-1964
3	IS classification of fly ash	SP	IS:2720(part 4)-1965
4	MDD (g/cc)	1.4	IS:2720(part 7)-1980
5	OMC %	20	IS:2720(part 7)-1980
6	CBR %	3.48	IS:2720(part 16)

IV. RESULTS AND DISCUSSION

The clay soil is mixed with different proportions of fly ash and coconut coir fiber and the mixed soils were tested. The soils were designated as Clayey Soil (CS), Fly Ash (FA), Coconut Coir Fiber (CCF), Fly ash 10% + coir fiber 0.25%, 0.5%, 0.75%, 1%, 1.25% (FC1). Fly ash 20% + Coconut coir fiber 0.25%, 0.5%, 0.75%, 1%, 1.25% (FC2). Fly ash 30% + coconut coir fiber 0.25%, 0.5%, 0.75%, 1%, 1.25% (FC3). Fly ash 40% + coconut coir fiber 0.25%, 0.5%, 0.75%, 1%, 1.25% (FC4). Fly ash 50% + coconut coir fiber 0.25%, 0.5%, 0.75%, 1%, 1.25% (FC5). The above soils are subjected to a series of tests to know their physical properties and CBR values of soil samples. The results are discussed below.

CBR TEST IN DIFFERENT PROPORTIONS FLYASH- 10%

S.NO	PERCENTAGE OF FLY ASH	PERCENTAGE OF COIR FIBER	CBR VALUE
1	10	0.25	4.12
2	10	0.5	4.68
3	10	0.75	4.92
4	10	1	4.76
5	10	1.25	4.65

Percentage fly ash will be constant, we increase coconut coir fiber, and it increase the CBR values. Water content based on the standard proctor compaction test. Based on this test water content will be taken in California Bearing Ratio test. And again increase fly ash percentage up to 50%. If in case soil strength will be decrease we increase percentage of fly ash.

International Journal of Innovative Research in Science, Engineering and Technology

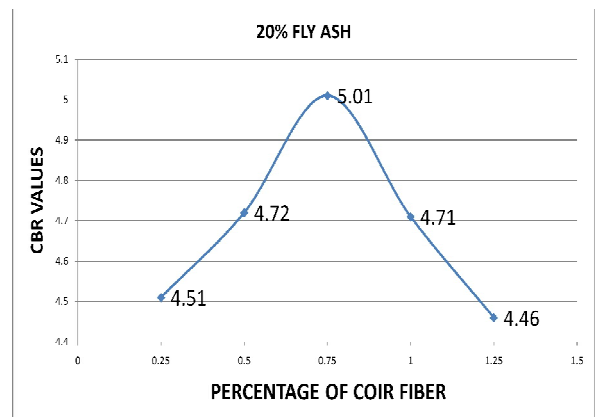
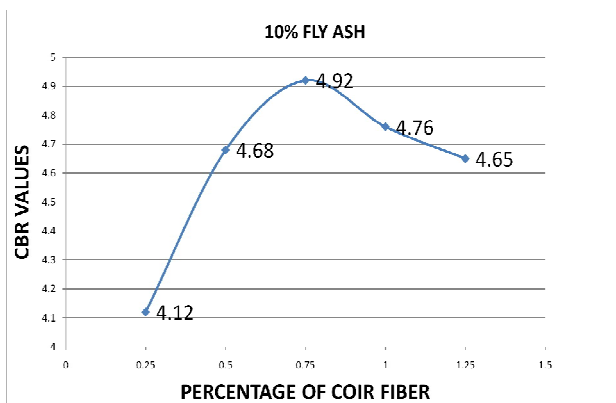
(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

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17

18

FLY ASH 20%:

S.NO	PERCENTAGE OF FLY ASH	PERCENTAGE OF COIR FIBER	CBR VALUE
1	20	0.25	4.51
2	20	0.5	4.72
3	20	0.75	5.01
4	20	1	4.71
5	20	1.25	4.46

The graph and values will be changed we increase the both percentage and coconut coir fiber.. With in present experimental study following discussions are drawn. On carried out experimental study on 30 trial samples we observe following things which are enlightened. On studying graph shows this curve shows great variation and required certain control condition to carry out test. We obtain all the values greater than the plain soil. It means that due to adulteration of this foreign material (FA, CCF) soil quality improves to great extent.

In these test individual behaviour of FA, CCF with soil has also carried out which shows that for adding 10%, 20%, 30%, 40%, 50% fly ash. Similarly on adding 0.25%, 0.5%, 0.75%, 1%, 1.25%. coconut coir fiber. We obtained highest CBR value 5.12 at 0.75%. after that curve will should successive depletion. Hence we determined from experimental results for combinations of made for to set range for combination for this 30 trail samples are made.

V. CONCLUSIONS

On the basis of present experimental study following conclusions are drawn

- Addition of Fly ash, Coconut coir fiber(CCF) in Black cotton soil improves the Engineering properties of soil.
- With the increase in percentage of fly ash, and coconut coir fiber, Liquid limit decreases because the percentage finer of fly ash and coconut coir fiber is more. Both additives have more absorption of water hence Liquid limit decreases.

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Vol. 6, Issue 4, April 2017

- Plasticity index decreases with increase in percentage of fly ash and rice husk ash because the Liquid limit of the soil is decreasing.
Plasticity index= Liquid limit- Plasticity index
- Optimum moisture content decrease with increase in percentage of both fly ash and coconut coir fiber. California bearing ratio values increases with increase in percentage of both fly ash and coconut coir fiber thus indicating the increase in strength.
- Free swell index values are observed to get reduced with the increase in percentage of Fly ash and coconut coir fiber. Increases soil permeability which is good for drainage purpose.

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