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Stabilization of Black Cotton Soil using Human Hair Fiber and Chicken Fur

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Abstract - *Strengthening of Black cotton soil (BCS) is very necessary and much important process during any construction practices, since BC soil is well known for its dramatic nature according to the seasonal variation's and causes vast problems in construction practices, Thus in the present work Chicken Fur (CF) and Human Hair Fibers (HHF) is used as strengthening material for BC soil, since CF and HHF are waste materials and non-bio degradable and abundantly available material, Economical when compared to other stabilizing materials. Initially the Index and Engineering properties of BCS is determined by varying percentage of HHF 0.5%, 1%,1.5% and 2% by weight of soil mass from which 1% replacement of HHF obtained as optimum value, For CF 1.5%, 3% and 4.5% by weight of soil mass from which 3% replacement of CF obtained as optimum value which gives MDD and less OMC thus by keeping 1% replacement of HHF as constant with 1 to 5% variation of CF , Then combination of 1% HHF+4% CF gives better results in OMC,MDD, UCS, DST values. Thus by using HHF and CF the strength properties of soil can be greatly increased up to certain extent.*

***Key Words*: BC Soil, Human Hair Fibre, Chicken Fur, OMC, MDD, UCS**

1. INTRODUCTION

Foundation is the main factor in any construction activities and it should be potent enough to clench the loads (i.e. superstructure loads etc.,) coming on it. So, for the potent foundation, the soil which is present beneath the foundation must be potent. Have dealings with, Black Cotton Soil (BCS) is a predicament soil with dramatic nature because of its physical properties i.e. it undergo changes in its behavior (volume changes) during every seasonal variations of moisture content. Due to this nature it is also referred as expansive soil. These soils undergo enormous swelling and shrinkage due to the existence of clay mineral montmorillonite. So, any structures constructed on these soils are more susceptible to destruction. Thus, these soils need to be strengthened before start of any construction works. Stabilization means increasing the properties of soil by compaction or using external agents like admixtures or additives to the soil. Different additives are used for stabilization purpose, the additives should be easily available, eco-friendly and cost effective.

Here 2 additives were used as stabilizing materials which are waste products and easily available. The additives which are used here are, Human Hair Fiber (HHF) and Chicken Fur (CF).

Accession of solid waste requires a wide area for its disposal. HHF a non-degradable matter, considered as valueless solid waste are dumped to landfills thus creating an environment problem so its use in soil improvement can minimize the problem. Also HHF available in abundance at a very low cost.

CF is excogitated as an unwanted product from the poultry farms. Large amount of waste fur produced and disposed every year by the poultry processing plants and butchers shop results in awful solid waste unease. The productive usage of CF in any field is lower and they become muck, to outplay this complication which is used for energize the soft soils which are frail in nature.

2. LITERATURE REVIEW

1. Anjanadevi K.A. et. al., (2019): In this work jute and HHF are used as a stabilizing material of clayey soil. They conducted tests to determine the MDD, OMC Values along with UCS and CBR. From the results they get, they concluded that with the increase in HHF up to 1% and 0.5% Jute the compressive strength of clayey soil increases and so decreases. CBR increased by inclusion of 1.5% of jute and HHF.

2. K. Shankar Narayanan et. al., (2017): In this work HHF used as a natural reinforcing agent to strengthening of soft clayey soil. They conducted tests to determine the MDD, OMC Values along with UCS, CBR value, they concluded that increase in up to 1.2% the compressive strength of the soft soil increases and so decreases.

3. MATERIALS AND METHODOLOGY

The soil which is to be strengthened is collected from the site where box culvert excavation in progress near the Sri Sadguru school, Bhalki, Bidar District, Karnataka state, India. The soil is cumulated from the deepness of 2m to 3m from the surface level.

Table 2.1 Properties of BC Soil

Table 3.1.1 Properties of BCS

Sl No	Properties	BCS
1	Specific gravity	2.69
2	Liquid limit (%)	61.41
3	Plastic limit (%)	30.60
4	Plasticity index (%)	30.81
5	Natural moisture content (%)	14.25
6	I S Soil Classification	CH
7	MDD (g/cc)	1.59
8	OMC (%)	22.27
9	Free swell index (%)	40
10	Wet Sieve Analysis (%)	76 (clay + silt)
11	Color	Dark Black
12	Category	Clay of High Plasticity
13	Unconfined Compressive Strength (kPa)	139.15
14	Direct Shear	C=9.79 kPa and Φ=64.44
15	California Bearing Ratio (CBR)	2.5mm=1.64 5.0mm=1.34

3.1 Human Hair Fiber (HHF): HHF are collected from the hair cutting shops, Saloons in Bhalki. It is a non–biodegradable substance, while it is directly disposed into land, soil get polluted and creating environmental issues. The HHF is a excellent stabilizing material to use as a soil stabilizer. In this project we used it as potent reinforced material to enhance the compressive strength and shear strength of BCS.

3.2 Chicken Fur (CF): CF is collected from the poultry farms and waste dumping yards in outskirts of Bhalki. Then it washed in water to remove other wastes attached to them, after CF dried completely it is shredded using mechanical mixers.

3.3 METHODOLOGY

The tests which were conducted here are,

1. Compaction Test

2. Unconfined Compressive Strength Test (UCS)

Firstly, the above tests are conducted for normal soil (BC) without additives and the results are taken. Then tests to be carried out UCS and DST are conducted for the BCS with the addition of HHF optimum Percentage value got in the test which is carried out with BCS+HHF and the varying percentage of CF 1%, 2%,3%,4%, 5%. The results of these tests are taken and compared with results for BCS+HHF and BCS+CF.

4. RESULTS AND DISCUSSIONS

4.1 OMC and MDD

OMC and MDD are main parameters of Compaction; here we conducted Standard Proctor Test for determination of OMC and MDD

1) Table 3.1: OMC and MDD Values of Soil replaced with various percentages of HHF and CF

Sl.no	Description	MDD g/cc	OMC, (%)
1	BCS	1.59	20.16
2	BCS+ 0.5% HHF	1.58	26.32
3	**BCS+ 1%HHF**	**1.72**	**22.19**
4	BCS+ 1.5%HHF	1.54	28.85
5	BCS+2% HHF	1.52	27.54
5	Soil + 1.5% C F	1.42	23.38
6	**Soil + 3% C F**	**1.75**	**25.35**
7	Soil + 4.5% C F	1.49	25.18

The results for the **replacement of 1% HHF with the soil** we get the value of **MDD as 1.72g/cc and the OMC as 22.19%.** Here, **MDD value increases when compared it with that of Soil (1.59) and OMC value decreases when compared it with the Soil (20.16).**For the **replacement of 3.5% CF with the soil** we get the result that the **MDD value is 1.75g/cc and OMC value is 25.35**%. Here, the MDD value of SOIL + 3% CF is more than that of both Soil and Soil + HHF and also the OMC value is more than that of both soil and Soil + HHF.From the overall results we concluded that the MDD value increases after the addition of admixtures thus, they are suitable for stabilization

4.2 Unconfined Compressive Strength (UCS):

Table 3.2: Compressive Strength Values of Soil replaced with various percentages of HHF and CF and their combinations

Sl.no	Description	Compressive Strength (kPa)
1	BCS	139.15
2	BCS + 0.5%HHF	392.16
3	**BCS + 1% HHF**	**1046.46**
4	BCS + 1.5% HHF	719.79
5	BCS + 1.5% CF	1214.04
6	**BCS + 3% CF**	**1333.21**
7	BCS + 4.5% CF	1303.21
8	BCS + 1% HHF +1% CF	3206.56
9	BCS + 1% HHF +2% CF	6820.07
10	BCS + 1% HHF +3% CF	8781.27
11	**BCS + 1% HHF +4% CF**	**9240.19**
12	BCS + 1% HHF +5% CF	6682.78

The above **Table3.2and the Fig 3.2** shows the overall results of UCS tests conducted for Soil, Soil replaced with HHF by the weight of soil mass, Soil replaced with CF by the weight of soil mass and the Soil replaced with Optimum percentage of HHF with various percentages of CF by the weight of soil mass. The results which we obtained are, for the **replacement of 1% HHF with the soil** we get the value of compressive strength as **1046.46kpa** and it is the maximum value among the replacement of various percentage of HHF with Soil and it is more than that of **compressive strength of Soil (139.15kpa).**

For the **replacement of 3% CF with the soil** we get the result that the UCS value is **1333.21kpa** and it is maximum value of UCS among the replacement of various percentage of CF and its UCS value is more than that of Soil. For the **replacement of 1% HHF (Optimum Percentage obtained from the test) + 4% CF with the soil** we get the value of UCS as **9240.l9kpa** and it is a maximum value among the replacement of 1% HHF + percentage variation of CF + Soil and it is more than that of Soil. From the overall results, the UCS value obtained for the **SOIL + 1% HHF + 4% CF** is Maximum. Thus, this percentage replacement is better for Stabilization purpose.

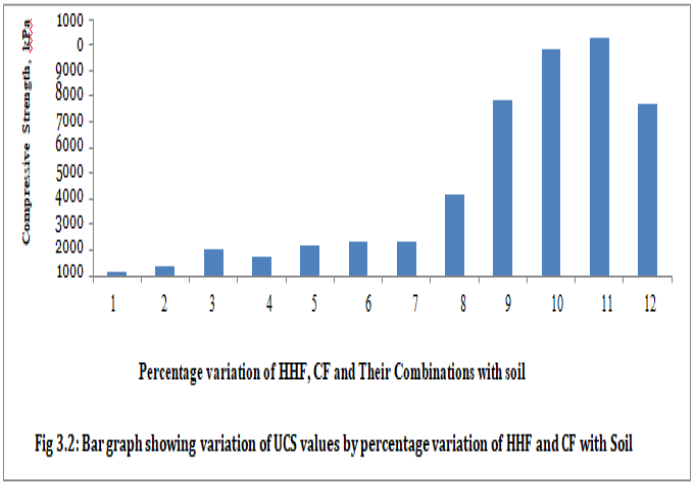

Fig 3.2: Bar graph showing variation of UCS values by percentage variation of HHF and CF with Soil

5. CONCLUSIONS

The Experimental study will be done on the soil by replacing it with admixtures by weight of soil mass to stabilize the soil i.e. to increase the strength of the soil with less cost, without effecting an environment and in an effective way by using admixtures like HHF and CF which are the waste product of poultry farming, we utilizing here those waste products as stabilizing material and the results we obtained shows that they serve as a better stabilizing material for BC Soil by increasing the strength of a soil

The **MDD value increased by 7.55% and also the OMC value decreased by 10.06%** when compared with the original Soil sample and the **Soil replaced with 1% HHF** by the Weight of soil mass. The **MDD value increased by 9.14% and also the OMC value increased by 25.74%** when compared with the Original Soil sample and **the Soil replaced with 3% CF** by the weight of soil mass.

The Compressive strength value **increased by 652.03%** when compared with the original Soil sample and **the Soil replaced with 1% HHF** by the weight of soil mass. **The Compressive strength** value **increased by 858.39%** when compared with the original Soil sample and the **Soil replaced with 3% CF** by the weight of soil mass and also **the UCS value increased by 27.43% when compared it with Soil The Compressive strength** value **increased by 6543.84%** when compared with the original Soil sample and the Soil replaced with 1% HHF and 4% of CF

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BIOGRAPHIES

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