

Response of GGBS Treated Clay Soil Reinforced with Human Hair

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Abstract : An expansive soil is a weak soil because it has high swelling and shrinkage in wet and dry condition. Many techniques are available for increasing the strength of the soil and to make better foundation for structures. This paper deals with stabilization of clay soil treated with constant percentage of GGBS and by the aspect ratio (L/D) different percentage of Natural fibers like human hair are added separately. The soil properties with the above combinations are evaluated by using laboratory experiment. The optimum UCC value is obtained by 25% of GGBS 2% of human hair. Combination of GGBS & human hair treated soil can increase the index properties and compressive strength of the soil.

Key Words : Expansive Clay, GGBS, Natural fibers, Index properties, UCC strength.

1.0 Introduction

The clay soil is the expansive and poor soil to make foundation at smaller depth. If the ground surface is not good in deep foundation like pile foundation, wells and caissons are required to get good construction¹. Sometimes the strength of the soil is very poor at greater depth. In such case stabilization of soil and reinforcement techniques are very important. The purpose of stabilization of soil is used to increase the strength properties and reduce the settlement. The main use of stabilization is to improve the soil properties for the construction of high rise buildings in expansive soil.

Fibers and different materials are used to increase the strength parameter of the soil. The synthetic materials like geotextile, geo-membranes and geo grids have successfully been used^{2,3}. Here the strength of the soil will be achieved by adding of the constant percentage of GGBS with various percentage of Human Hair.

2.0 Materials used

2.1 Soil

The soil is taken from Kollapatti, Salem. The properties of clay soil determined in laboratory are liquid limit, plastic limit, shrinkage limit.

Table: 1 Properties of clay soil:

S.No	Contents	Percentage	Nature
1	Liquid limit	70.5	-
2	Plastic limit	40.15	-
3	Shrinkage limit	23.68	Very high
4	Plastic index	38.60	Very high
5	Shrinkage index	55.07	Very high

2.2 GGBS (Ground Granulated

Blast Furnace Slag):

Ground Granulated Blast furnace Slag is a by-product from the blast furnaces used to make iron. It is mainly obtained by the correct mixture of iron ore, coke and limestone at a temperature of about 1500°C. It is then quenched in water or steam to produce a glassy granular product then it is dried into a fine powder⁴.

Stabilization of the existing soil will normally be a much more sustainable solution than importing aggregate. Use of GGBS offers significant advantages of soil stabilization in inhibiting the deleterious swelling that can occur with clay contains sulphates⁵.

Table: 2 Properties of GGBS:

SL.NO	PROPERTIES	RESULT
Physical properties		
1	Appearance	Off- white
2	Specific gravity	2.9
3	Bulk density(Kg/m ³)	1200
4	Fineness(m ² /kg)	350
Chemical properties		
1	SiO ₂	35.0
2	Al ₂ O ₃	12.0
3	Fe ₂ O ₃	0.2
4	CaO	40.0
5	MgO	10.0

2.3 Human Hair

Human Hair is the natural type of fiber which will decomposes slowly over years. It is available in all parts of the world with cheap cost^{6,7}.

Table: 3 Properties of Human hair

S.NO	Properties	Remarks
1	Cross section	Circular
2	Diameter	4-6 μ m
3	Length	6mm
4	Elongation	1.5 times its dry weight
5	Tensile strength	Equal to copper wire of similar diameter
6	Outer coating	Cuticle
7	Protein present	Keratin

3.0 Experimental Test and Result

3.1 Sample Preparation:

To find the soil properties 100g of natural clay soil is sieved in 425 μ m sieve plate. The various percentage of GGBS ranges from 5%, 10%, 15%, 20%, 25% is added to the clay soil and the test is carried out. Based on the test result the fibers are added with the highest percentage of GGBS (15%, 20%, 25%). Then the addition of hair fiber is added in the range of 0.5%, 1%, 1.5%, 2.0% with the GGBS treated clay soil.

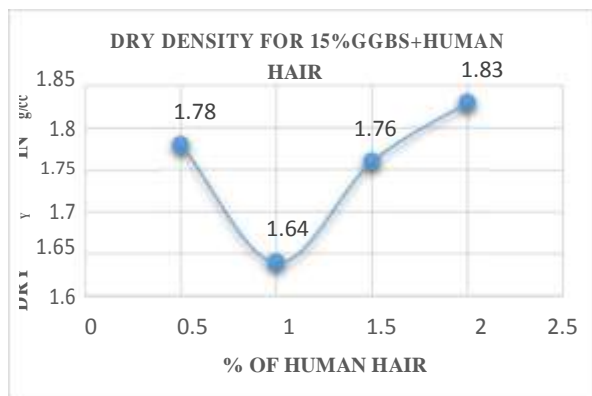
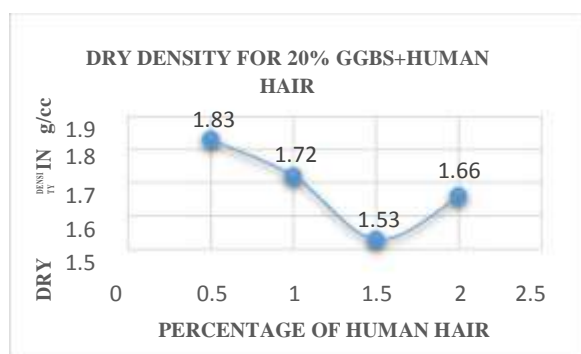
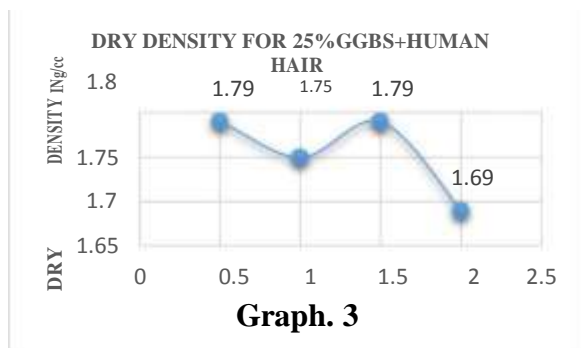
**Figure.1****Figure. 2****Figure. 4****Figure. 5****Figure. 3**

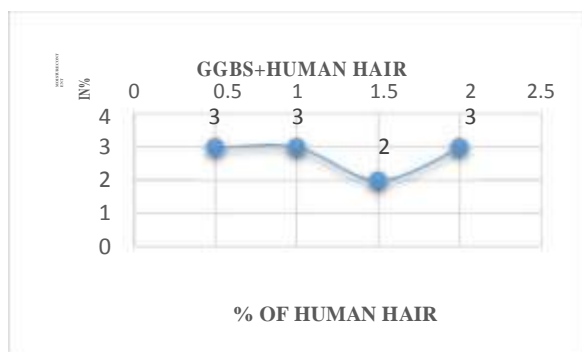
3.2 Laboratory Tests

The physical properties of prepared samples are carried out by liquid limit, plastic limit and shrinkage limit. The MDD and OMC are obtained by standard proctor compaction test.

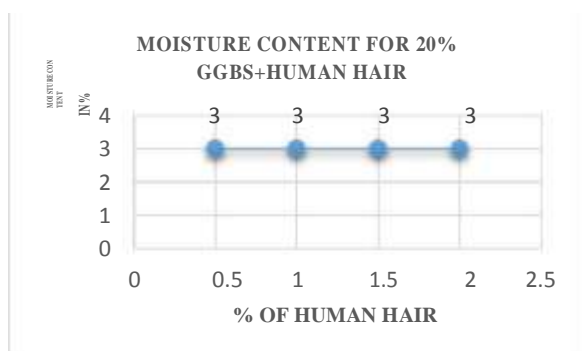
Based on the values obtained from the test the engineering property of the prepared samples are carried out by UCC (Unconfined Compressive strength).

**Figure. 6**

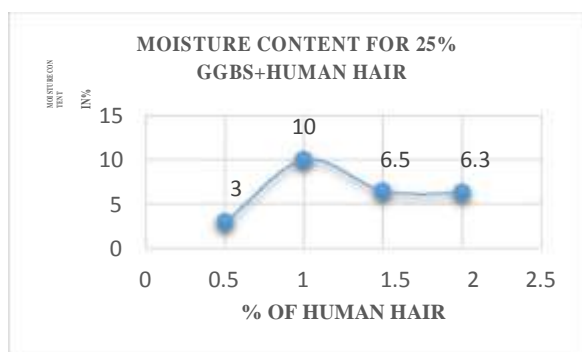
**Graph. 1****Graph. 2****Graph. 3**



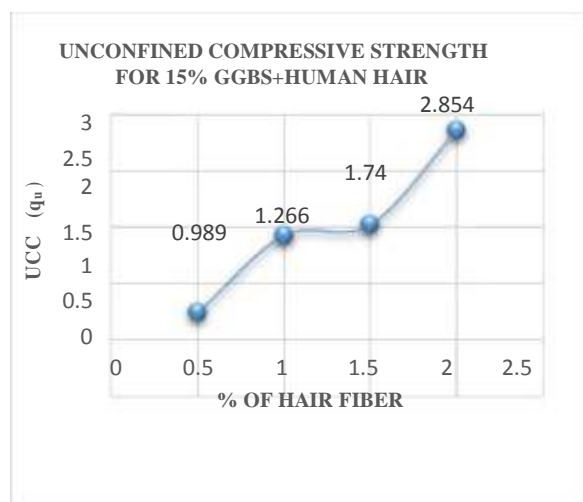
Graph. 4



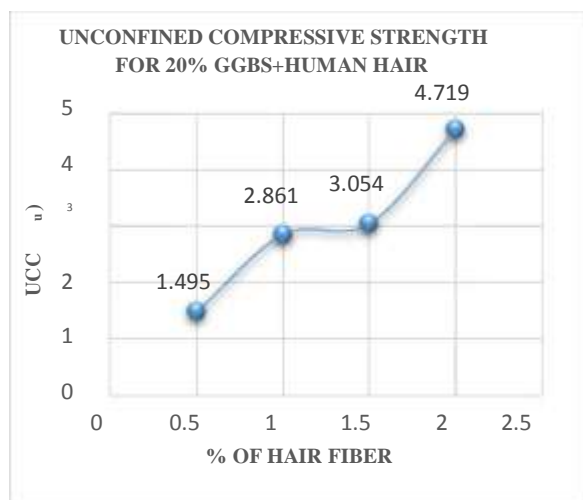
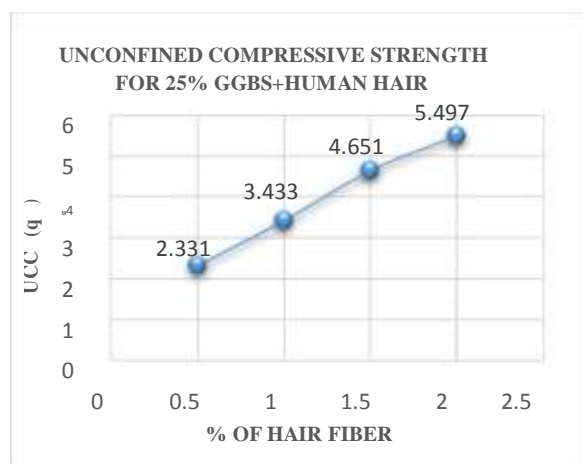
Graph. 5



Graph. 6



Graph. 7

**Graph. 8****Graph. 9**

4.0 Conclusion

The effect of reinforcement of clay soil by the use of GGBS and human hair has been analyzed in this paper. The results shows the maximum dry density and compressive strength is obtained by clay soil with 25% of GGBS and 2% of hair.

5.0 References

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