STRENGTH IMPROVEMENT OF CLAYEY SOIL WITH GLASS FIBRE AND WHEAT HUSK ASH

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Abstract - *The motivation behind this research was to learn more regarding the properties of soilstrengthened with Wheat Husk Ash and Glass fiber, which are industrial waste products and Agricultural products, respectively. The use of these waste materials reduces pollution and human reliance on natural resources, resulting in a more sustainable construction approach. The consequences of Wheat Husk Ash and Glass fiber on soil strength prospects for clayey soilare investigated in this study. The Wheat Husk Ash was blended in various amounts with the soil at the rate 10%, 20%, 30%, and 40%. After that Glass fiber was mixed with soil and ash at various rates in this study, including 0.5 %, 1 %, 1.5 %, and 2 %. The investigation of an influence of Wheat Husk Ash and Glass fiber on Atterberg limits, C.B.R., U.C.S., O.M.C., and M.D.D. was done. Adding Wheat Husk Ash and Glass fiber improved the U.C.S. and C.B.R. As per experimental results, the ideal value of C.B.R. and U.C.S. was at 30 % Wheat Husk Ash, 69.5 % soil and 0.5 % Glass fiber. So, after this research work, we find out that the stabilizationcan be done to some extent*

Key Words: **Soil, Wheat husk ash, Glass fiber, OMC, MDD etc**

1.INTRODUCTION

Reinforcements are effective and reliable in improving the strength of weak soil(Sujatha et al., 2018) particularly when the extent of area to be treated is small. Discrete fibre reinforcement also supports in modifying the permeability and compressibility of the soil. Fibre reinforced soil finds several applications in retaining structures (Ates,2016) pavements (Rafalko et al., 2006), slopes (Ates, 2016), clay liners, covers and barriers (Ple & Le, 2012; Zornberg et al., 2003). Reinforcing soil with fibres help in improving the stability of slopes and bearing capacity of weak soils, reduction of lateral deformations and settlements, etc. (Hejazi et al., 2012). Reinforcements are broadly classified as inextensible (metal bars and strips with high modulus) and extensible inclusions like natural or fibres like coir, sisal, flax, jute, palm, polypropylene, plastic, glass, etc. (Ates, 2016). The extensible fibres are distributed randomly in the soil matrix (Wang et al., 2017). The E glass fibre selected for the study has nearly 40% recycled glass. This study investigates the suitability of (E) glass fibre as discrete random reinforcements in soil, its influence on the strength of the soil and suitability for use as subgrade for pavements. Also, the effect of the fibre content on the index properties of the soil like LL, PL, plasticity index, compaction characteristics are also studied

1.1 Wheat husk Ash

Wheat husk ash is a agricultural waste which obtained from burning wheat straw. When crops of wheat is cut then husk is remain in the ground itself, this husk is a complete waste. But now days by burning these husk its ash can replace by cement. Much literature is not available on wheat straw ash but it completely shows that it posses' pozzolanic properties.

1.2 Glass Fibre

E-glass fibre Electronic grade glass fibres are recycled glass fibre that are obtained from the glass of television, computer, laptops, etc. E glass fibres are composed of 40% recycled glasses, 54% of silicon oxide ($SiO2$), 15% of aluminium oxide ($Al2O3$), 12% of calcium oxide (CaO). The length and diameter of the fibres are 12 and 19 mm respectively. E glass fibres have a density of 2.54 g/cm3.

2. Maximum dry density and Optimum Moisture Content

Standard proctor test was used to find O.M.C and M.D.D of soil mixed with wheat husk ash and glass fibre.

Table -1: Table representing the MDD and OMC value of various mixes together

Soil:WHA:GP	MDD (KN/m³)	OMC
100:0:0	19.2	13
90:10:0	18.5	13.5
80:20:0	18.8	14
70:30:0	19.1	14.8
60:40:0	18.6	15.4
69.50:30:0.5	19.2	15.6
69:30:0.50	18.7	16
68.50:30:1.5	18.5	16.3
68:30:2	17.4	16.7

The MDD of stabilized soil decreases with increase in WHA. The MDD and OMC for clay soil are 19.2 kn/m³ and 13% respectively. The MDD and OMC for the optimum mix are 19.2 kn/m³ and 15.6%, respectively. The optimum mix is determined from the consistency's limit tests. The OMC increases from 13% to 15.6% and the MDD after varying different values reaches to original value of from 19.2 to kn/m³ from virgin soil to stabilized clay soil. The increase in OMC (from 13% to 15.6%) is observed at 69.50: 30: 0.5 (Clay: WHA: GF).

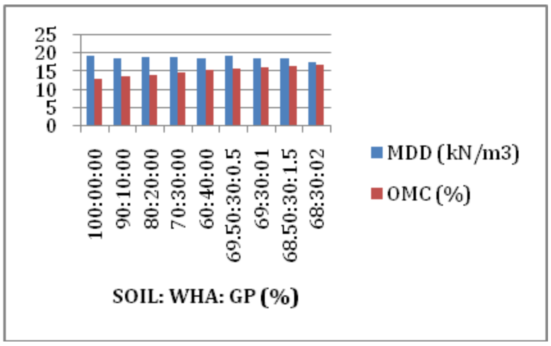

Chart -1: Graph of MDD and OMC

Unconfined Compressive Strength

The unconfined compressive strength is the parameter which shows the ability to bear the compressive load by the soil. In this test various samples has been done and kept for 3 days, 7 days and 28 days for curing for testing. The motive of keep it under curing to make the pozzolanic action to take place

Table -2: Table representing the UCS values of various mixes together

Soil:WHA:GP	UCS (kPa)	UCS (kPa)	UCS (kPa)	UCS (kPa)
	0 day	7 days	14 days	28 days
69.50:30:0.5	107	111	114	120
69:30:1.0	135	138	142	151
68.50:30:1.5	178	183	190	197
68.50:30:2.0	149	153	158	165

The increase in the strength after curing period is varying from 107 kN/mm² to 197 kN/mm². The results also shows that with an increase in the curing period the strain value also goes on increasing but at greater strength, which shows that sample at 28 days resist much amount of load and save our structure from sudden collapse

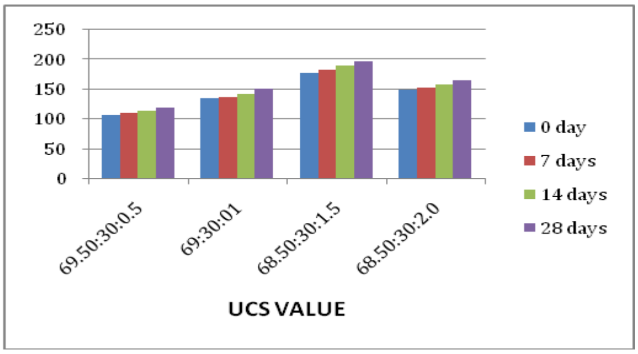

Chart-2: Graph of UCS values

California Bearing Ratio

The California bearing ratio represents the bearing capacity of the soil at how much load how much penetration happens in the soil surface. The load and area of the surface leads to calculate the stress value. With the penetration we get the deformed values, with the help of which we achieve to the strain value. With the value of stress and strain we achieve to the value of modulus of elasticity. The modulus of elasticity shows the ductility of the soil which indicates earlier the soil is going to be failing under the load with the help of which we can prevent our structure to get fail.

Table -3: Table representing the CBR values of various mixes together.

Mix Type	CBR Unsoaked (%)	CBR Soaked (%)
100:0:0	10.55	10.22
90:10:0	14.32	12.65
80:20:0	16.78	15.48
70:30:0	18.98	17.85
60:40:0	22.59	21.11
69.50:30:0.5	28.76	22.57
69:30:1.0	28.65	22.15
68.50:30:1.5	27.50	21.70
68:30:2.0	26.56	20.75

The increment in the CBR value is shown in the optimum mix (69.50: 30: 0.5) sample under dry condition is from 10.55% to 28.76%.

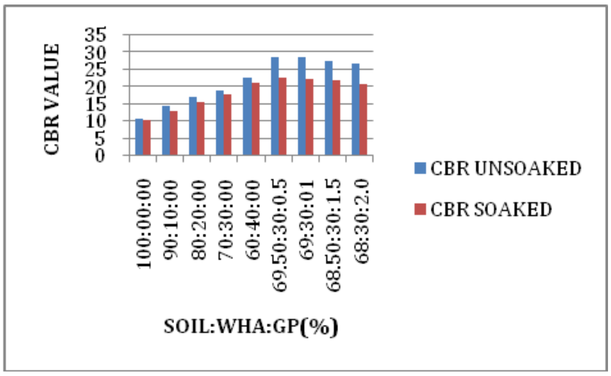

Chart-3: Graph of CBR values

3. CONCLUSIONS

- When percentage WHA increases in soil there is increase in O.M.C. and decrease in M.D.D for some values.
- With the increase in quantity of GP fiber the value of O.M.C. increases and M.D.D. Decreases and then reached the initial value.
- The optimum value of WHA ash to be used for further work was 30%.
- The best ratio obtained was 69.50% soil: 30% WHA: 0.50% GP fiber.
- Soaked CBR value increases from 10.22% for virgin soil to 22.57% for the best ratio of the mix.
- Unconfined compressive strength of soil- WHA mixtures increase with increase in GP fiber up to 1.50 % by weight.

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