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Modification of Geotechnical Properties of Red soil by the Application of Wood Ash and GGBS

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Abstract - Red soil sample was collected from Bidadi, Karnataka.It was collected at a depth of 1m below the ground surface and the obtained sample was disturbed soil sample. And the following laboratory tests were conducted- grain size analysis, compaction and shear strength characteristics test. Wood ash poured to the soil sample at the following percentages(10%,20%,30%) and GGBS was added to the soil sample at the following percentages(5%,10%,15%) and it was found that geotechnical properties improved(shear strength characteristics increased, LL decreased). The optimum dosage was found to be 20% of wood ash and 10% of GGBS.

***Key Words*: GGBS, Wood ash, Geotechnical properties, Stabilization of Red soil, Bidadi, Karnataka, India.**

1. INTRODUCTION

Soil stabilization is the method of soils to increase their geotechnical properties. It can be done by increasing their shear strength characteristics and thus improving the load bearing capacity of a subgrade to support foundations as well as well as pavements. Generally the materials like GGBS, fly ash, coconut fibre and glass powder are used for the stabilization purpose.

Red soils in India are found in Karnataka, Southern Maharashtra, Andhra Pradesh, Chota Nagpur, Chatthisgarh and in large tracts of western Tamilnadu.

In the study we have used Wood ash and GGBS.Wood ash is the burnt waste material obtained from trees. And GGBS(Ground Granulated Blast furnace Slag) from the RMC plant near Bidadi, Karnataka.

1.1 Literature Review

Ch.Ravi Tej et.al(2017): Conducted a study on Stabilization of Red soil by GGBS and Jute fibre in the percentage of 0 to 25 by dry weight of soil and found that MDD increased and OMC decreased with GGBS content at 25%.

Ashish Kumar Pataaki et.al(2014): They investigation showed that the MDD increases and OMC decreases with increase in GGBS content and at 25% they got maximum value of dry density.

M.Sai Nandan et.al(2020): They have studied the Stabilization of Red soil by using Coconut coir fibre and Rice husk ash. They conducted this study in various percentages of rice husk ash and coconut coir fibre(5 to 25). And the optimum value of the assessment found at the proportion of 15%,the value of Uncompressed strength is 142kn/m2.

1.2 Objectives

The aim of this study is to improve the geotechnical properties of red soil.

2. Materials and Methodology

2.1 Materials

Red Soil: The red soil sample was collected from Bidadi, Karnataka and it was collected at a depth of 1m below the ground surface. The soil sample that was collected from site was disturbed soil sample. The soil sample was collected in a polythene bag and taken to laboratory for further testings.

Fig – 1 : Red Soil

Wood Ash: Wood ash is the burnt waste material which is obtained from trees. It was collected from surroundings of JVIT campus, Bidadi.

Fig – 2 : Wood ash

GGBS: Ground Granulated Blast furnace Slag was collected from RMC plant near Bidadi.

Fig – 3: GGBS

2.2 Methodology

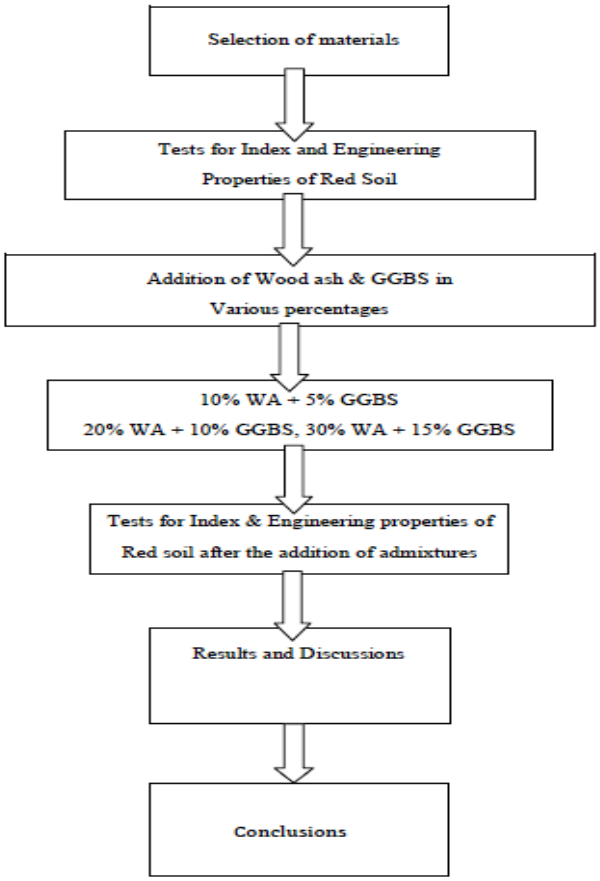

Fig – 4: Methodology

3. Results and Discussions

3.1 Sieve Analysis

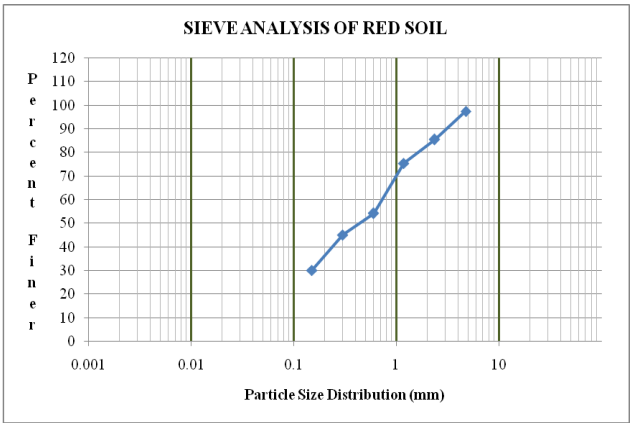

Chart – 1 : Sieve Analysis of Red soil

3.2 Liquid Limit Test

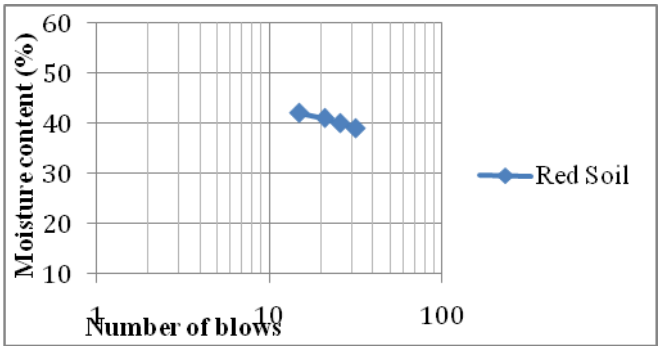

Chart – 2: Flow curve of Red soil

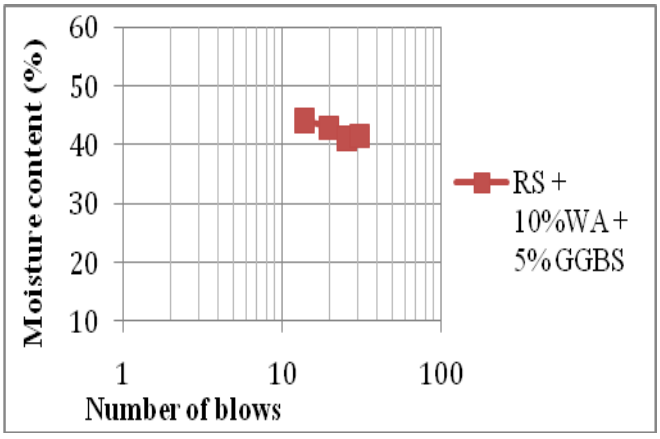

Chart – 3: Flow curve of RS+10%WA+5%GGBS

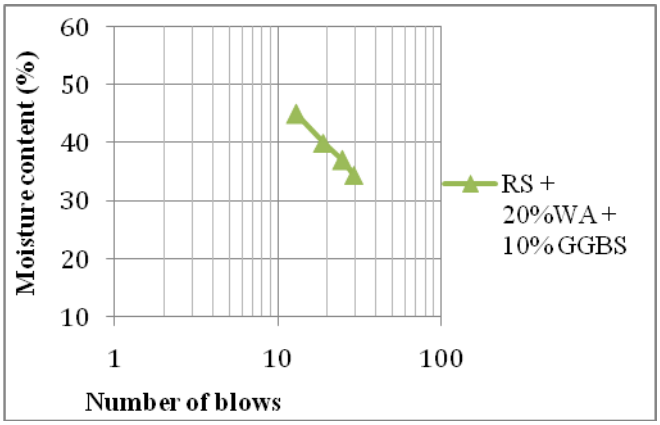

Chart – 4: Flow curve of RS+20%WA+10%GGBS

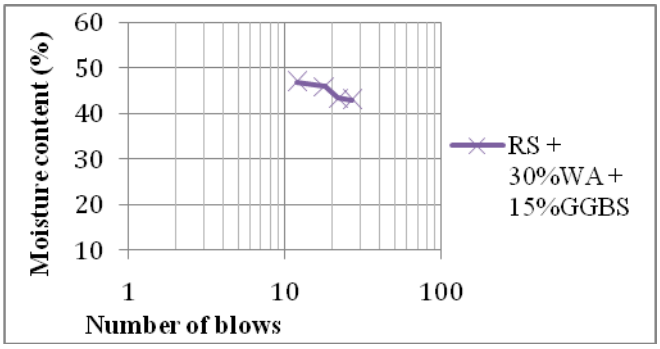

Chart – 5: Flow curve of RS+30%WA+15%GGBS

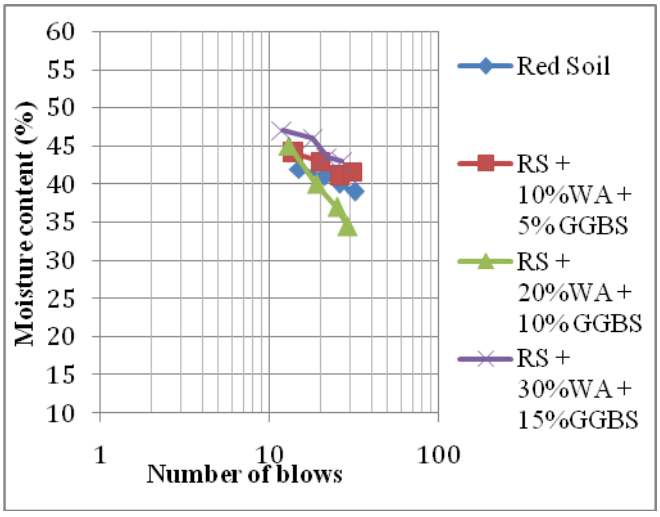

Chart – 6: Combined graph of Flow curve

3.3 Compaction Test

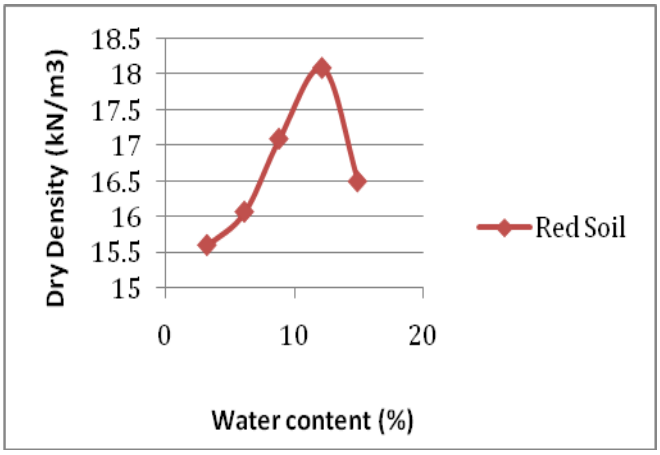

Chart – 7: Compaction curve of Red soil

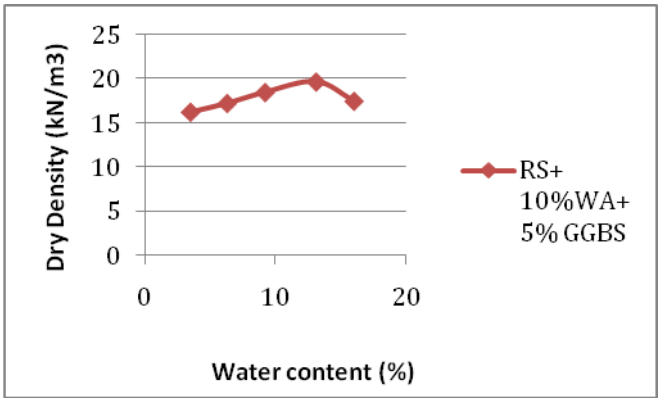

Chart – 8: Compaction curve of RS+10%WA+5%GGBS

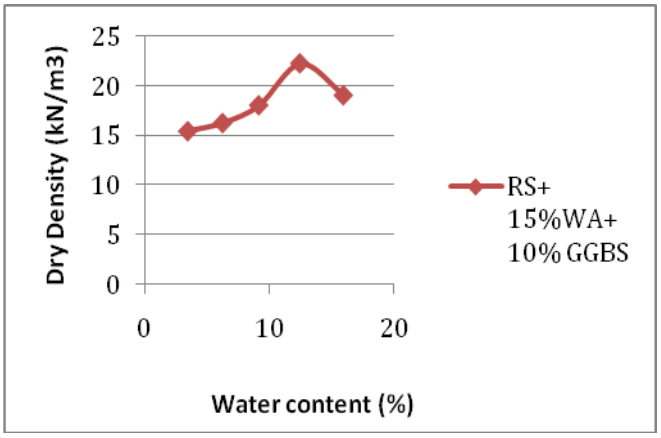

Chart – 9: Compaction curve of RS+20%WA+10%GGBS

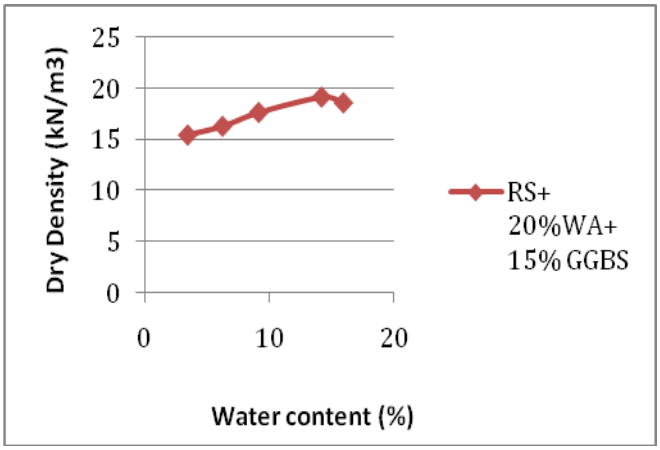

Chart – 10: Compaction curve of RS+30%WA+15%GGBS

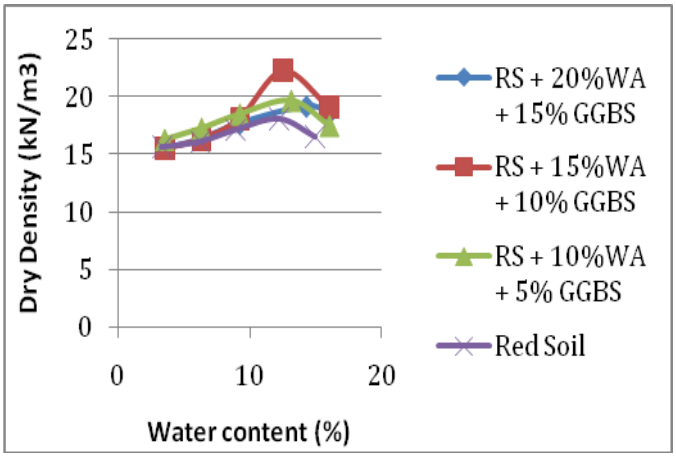

Chart – 11: Combined graph of Compaction curve

3.4 UCS TEST

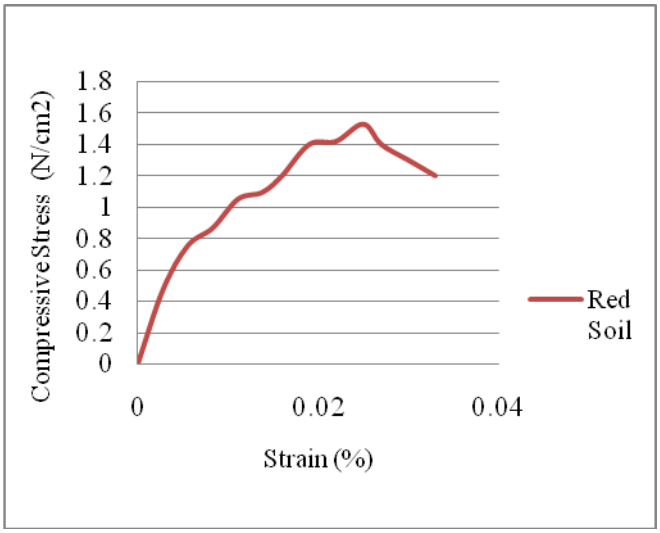

Chart – 12: Compressive Stress-Strain graph of Red soil

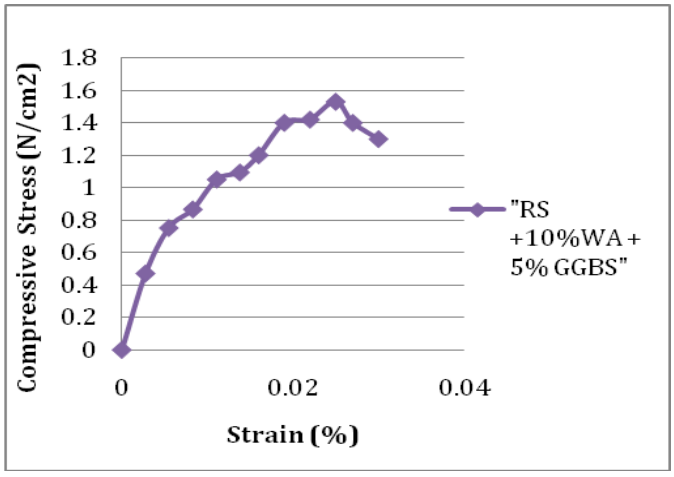

Chart – 13: Compressive Stress-Strain graph of RS+10%WA+5%GGBS

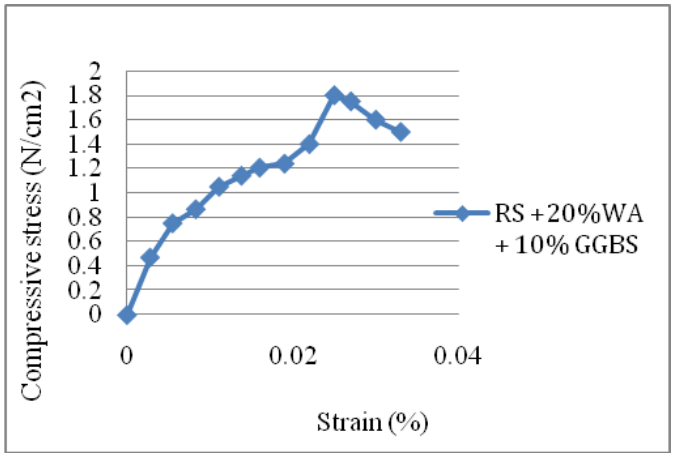

Chart – 14: Compressive Stress-Strain graph of RS+20%WA+10%GGBS

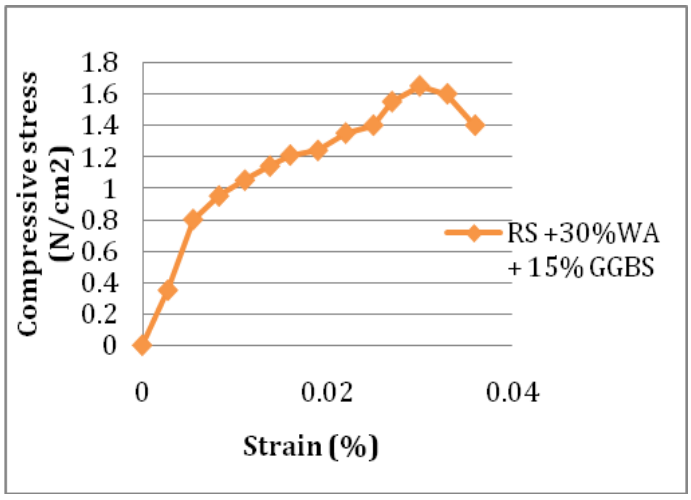

Chart – 15: Compressive Stress-Strain graph of RS+30%WA+15%GGBS

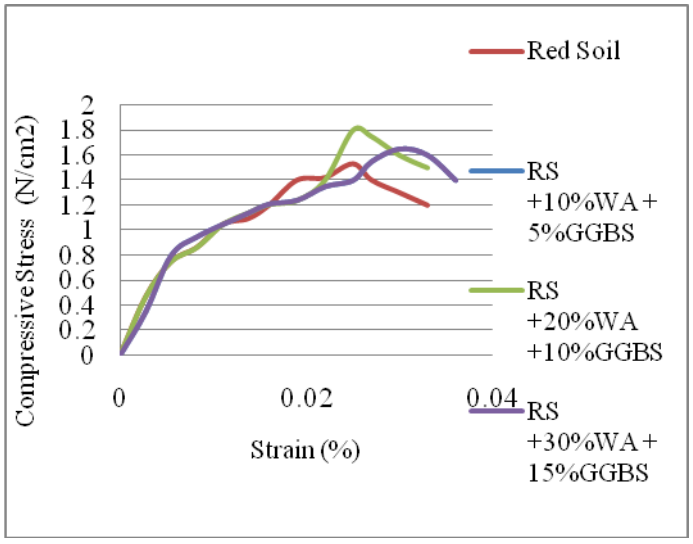

Chart – 16: Combined Compressive Stress-Strain graph

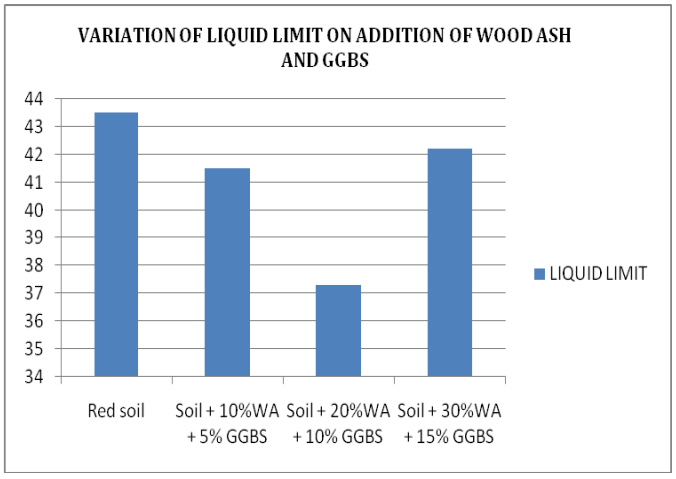

Chart – 17: Variation of LL on addition of wood ash and GGBS

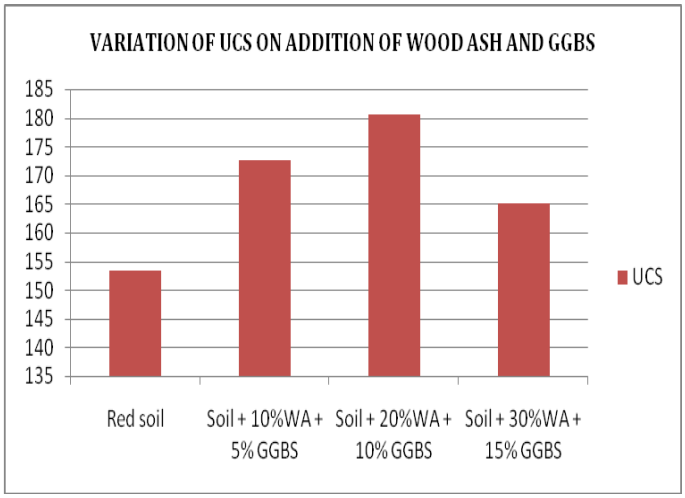

Chart – 18: Variation of UCS on addition of wood ash and GGBS

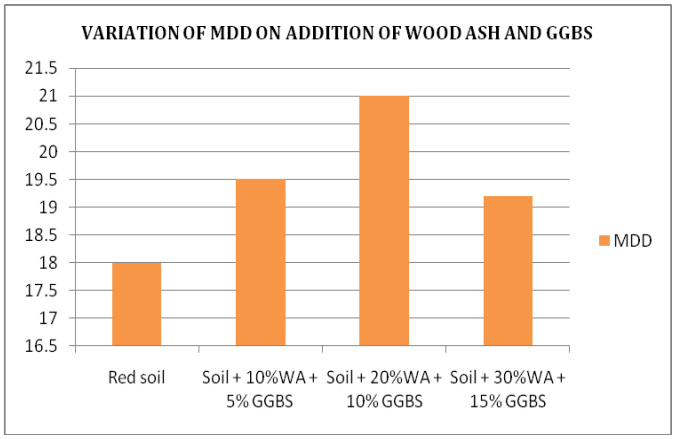

Chart – 19: Variation of MDD on addition of wood ash and GGBS

Table 1: Overall Test Results

Description	Red soil	RS + 10% WA + 5% GGBS	RS + 20% WA + 10% GGBS	RS + 30% WA + 15% GGBS
Specific Gravity	2.67	-	-	-
Liquid Limit (%)	43.50	41.50	37.30	42.20
Plastic Limit (%)	21.50	20.75	19.84	20.98
Plasticity Index (%)	22.00	20.75	17.46	21.22
OMC(%)	13.50	13.00	12.50	14.25
MDD (kN/m^3)	18.0	19.5	21.0	19.2
UCS (kN/m^2)	153.3	172.7	180.6	165.0
Cohesion, C (kN/m^2)	30	32.5	36.0	33.5
Angle of Internal friction (°)	18.00	17.00	15.20	18.00

From the above test results, we observe that liquid limit and OMC values decreased with the increase in % of admixtures upto a certain extent and again increased. UCS values increased with the increase in % of admixtures upto a certain extent and again decreased. MDD values increased upto RS+20%WA+10%GGBS. Hence the optimum dosage recommended is 20% wood ash and 10% GGBS.

4. CONCLUSIONS

Several experiments were performed after the detailed study and the following conclusions were made-

1. Addition of 20% of WA and 10% of GGBS resulted in increased soil shear strength.
2. Upon the addition of 20% of WA and 10% of GGBS to the red soil, LL values decreased from 43.50 to 37.30%.
3. Upon the addition of 20% of WA and 10% of GGBS to the red soil, OMC values decreased from 13.50 to 12.50%. On further addition of admixtures, its values increased.
4. Upon the addition of 20% of WA and 10% of GGBS to the red soil, MDD values increased from18 to 21kN/m^3. On further addition of admixtures, its values decreased.
5. Upon the addition of 20% of WA and 10% of GGBS to the red soil, UCS values increased from 153.3 to 180.6kN/m^2. On further addition of admixtures, its values decreased.
6. So the final conclusion is that the optimum dosage to be added to red soil to improve its geotechnical properties is 20% wood ash and 10% GGBS.

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