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Experimental Study on Effect of Wood Ash on Strength of Concrete

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Abstract - *The present work deals with the results of experimental investigations on effect of Wood Ash on setting time and compressive strength of cement and concrete. Effect of Wood Ash on compressive strength of cement and concrete by using varying percentage of Wood Ash 0%, 10%, 20%, 30% and 40 % by weight of cement. In this paper Wood Ash as partial replacement of cement in concrete was used and its effect on properties of concrete were studied. Cubes of size 70.6 mm X 70.6 mm X 70.6 mm were used for compressive strength test of cement and cubes of size 150 mm X 150 mm X 150 mm for compressive strength test of concrete. All the specimens were water cured and testing is done for 7 days and 28 days. Results were observed and comparison of results of compressive strength of cement and concrete with wood ash with that of normal cement and concrete showed the significant improvements in the results of compressive strength. Optimum percentage of replacement of different agro waste is determined*.

Key Words: **Wood Ash (WA), Concrete, Cement, Compressive strength, Slump value.**

1. INTRODUCTION

Cement concrete is an important construction material. Its importance is increasing every day. Aggregates occupy about 75% space within a given mass of concrete and the rest of 25% is filled by water, cement and air voids. Plain cement concrete possesses a high compressive strength and is not subjected to corrosive or other weathering effects. It has a unit weight of 24 KN/m^3.It is suitable for foundations and floors of buildings but PCC has poor tensile strength and is liable to crack when subjected to tension. Therefore, it cannot be used in structures where tension is likely to develop. Steel, being stronger in tension, is used along with plain cement concrete which results in the formation of a composite material called reinforced cement concrete (RCC). Steel reinforcement is provided in the structure where tensile stresses are likely to develop.RCC has a dual advantage of high compressive and tensile strength. The popularity of the concrete is due to the fact that from the common ingredients, it is possible to tailor the properties of concrete to meet the demands of any particular situation.
Recently, the inclusion of different types of by-products in cement-based materials becomes more and more a common practice; however, most of these investigations have mainly focused on the use of supplementary cementitious materials, mineral admixtures or recycled aggregates in concrete. It is expected that various other types of solid and industrial recycled waste by-products can also be used in concrete materials for different purposes.
In the present study cement was partially replaced by wood ash as 5%, 10%, 15% and 20% by weight. Concrete specimens were tested for slump test, compressive strength, durability (water absorption) and light weight nature for different saw dust percentages. The results obtained were compared with results of normal M-25 concrete mix and it was found that maximum increase in compressive strength occurred for the concrete mix containing 5% saw dust by weight of cement. Slump test was carried out on the fresh concrete and compressive strength test on hardened concrete. The concrete cubes were tested at the ages of 7 day and 28 days. The results showed that WA is a good pozzolana with combined SiO_2, Al_2O_3 and Fe_2O_3 of 62.14%.The slump decreased as the WA content increased. The compressive strength decreased with increasing SDA replacement. The compressive strength of concrete with WA was lower at early stages but improves significantly after 28 days. It was concluded 20 % WA substitution is adequate to enjoy maximum benefit of strength.

2. MATERIALS USED

2.1 Cement

The most common cement used is ordinary Portland cement. Out of the total production, ordinary Portland cement accounts for about 80-90 percent. Khyber ordinary Portland cement of 43 grade confining to IS 8112 was used throughout the work. The fine aggregate used in this investigation is clean river sand, whose maximum size is 4.75 mm, conforming to grading zone II. Machine crushed stone angular in shape were used as coarse aggregate. Two sizes of coarse aggregate are used; one 10 mm and other 20mm.

2.2 Water

Portable water free from any harmful ingredients like oils, alkalis, sugars, salts and organic materials has been used for mixing and curing of the concrete specimens.

2.3 Wood Ash

Wood ash is obtained from the combustion of wood. It can be related to fly ash since fly ash is obtained from coal, which is a fossilized wood. Rice husk ash is also of plant origin. This implies that wood ash could be used as a pozzolana in

concrete. The wood ash used in this work was powdery, amorphous solid, sourced locally, from a bakery in Kulgam.

Table -1: Composition of Wood Ash

COMPONENT	MASS%
SiO_2	31.8
Al_2O_3	28
Fe_2O_3	2.34
CaO	10.53
NaO	6.5
K_2O	10.38
MgO	9.32
P_2O_5	1.17
Loss of ignition	27

3. MIX DESIGN

The concrete mix design has been made using the guidelines as per IS: 10262 – 2009 to produce M25 grade of workable concrete.

3.1 Compressive Strength Test

Compressive Strength is the most important property of hardened concrete. Compressive Strength Test is performed to determine the Compressive Strength of concrete.

For cube compression testing of concrete, 150mm cubes were used. All the cubes were tested in saturated condition, after wiping out the surface moisture. The tests were carried out after the specimen has been centered in the testing machine. Loading was continued till the specimen fails and reading note down from the automatic universal testing machine. The ultimate load divided by the cross sectional area of the specimen is equal to the ultimate cube compressive strength.

$$f_c = P/A$$

Where,
f_c = compressive strength in MPa
P= load in Newton
A= area of the specimen in mm

4. RESULTS AND DISCUSSION

The cube compressive strength results at the age of 7 and 28 days and at the admixtures percentages such as 0%, 10%, 20%, 30%and 40% of cement are presented in Table 2 and Table 3. It was noticed from the results that there is steep increase in compressive strength with addition of wood ash in both concrete and cement cube specimens upto 20%. Beyond 20% replacement there is decrease in strength. This may be due to taking less cement content. Based on this statement it can be concluded that 20% replacement is optimum. The results are shown in Figure 1 and Figure 2.

Table -2: Results of WA concrete

Rice Husk Ash %	w/c ratio	Slump (mm)	Avg. Compressive Strength @7 days(N/mm²)	Avg. Compressive Strength @28 days(N/mm²)
0	0.44	40	21.40	28.46
10	0.44	45	23.56	27.57
20	0.44	50	25.30	32.34
30	0.44	50	22.21	30.22
40	0.44	45	21.54	27.00

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Table -3: Results of WA cement

Rice Husk Ash %	Initial setting time(min)	Avg. Compressive Strength @7 days(N/mm²)	Avg. Compressive Strength @28 days(N/mm²)
0	40	32.66	40.02
10	35	34.32	43.50
20	32	37.43	46.52
30	70	31.26	43.42
40	80	28.23	42.29

5. CONCLUSION

Based on experimental investigations on the compressive strength of sustainable concrete, it was noticed that:

1. The water requirement increases as wood ash content increases.

2. The setting times of wood ash / OPC paste increases as the ash content increases; the 10% and 20% wood ash paste satisfy the recommended standard for ordinary Portland cement paste. 30% and 40% wood ash paste gave higher values of setting times which do not satisfy the standard.

3. The compressive strength of the concrete and cement specimens with 20% wood ash content increased appreciably at 28 days. The optimum replacement level was therefore 20%.

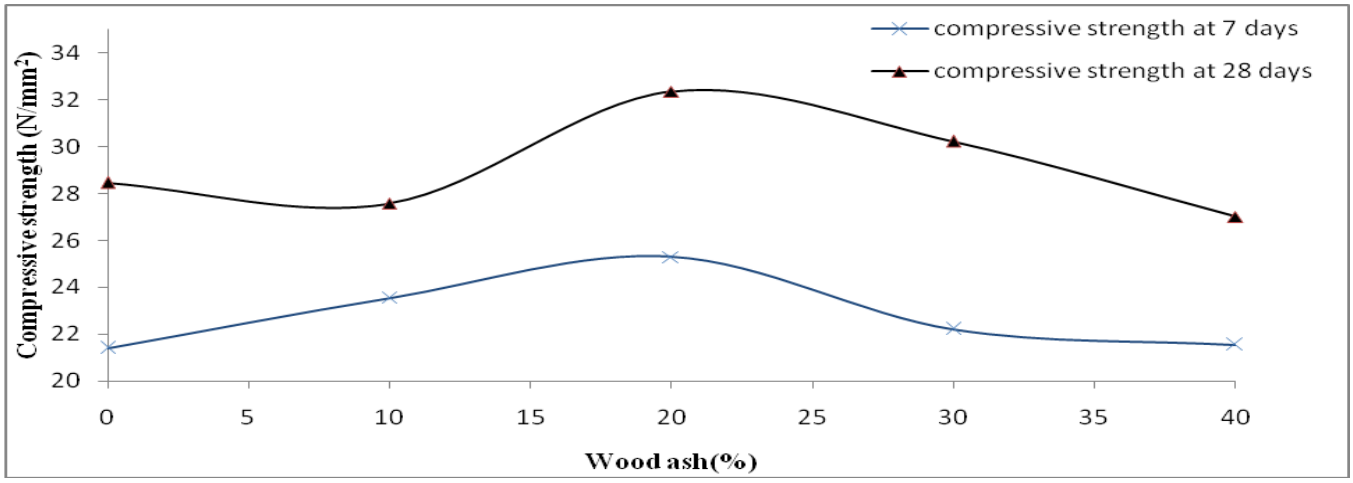

Fig -1: Compressive Strength of Concrete Cubes at 7 days and 28 Days

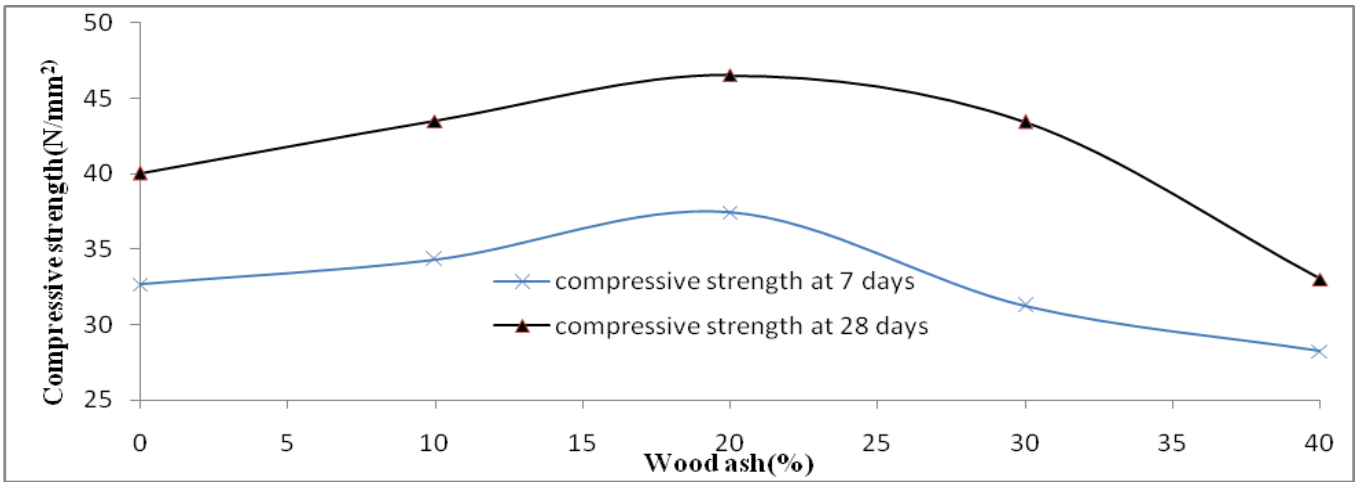

Fig -2: Compressive Strength of Cement Cubes at 7 days and 28 Days

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