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"PARTIAL REPLACEMENT OF CEMENT BY WOOD-ASH"

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ABSTRACT -*In this study, Wood Ash (WA) prepared from the uncontrolled burning of the saw dust is evaluated for its suitability as partial cement replacement in conventional concrete. The physical, chemical characteristics of wood ash is presented and analyzed. The strength parameters (compressive strength, split tensile strength and flexural strength) of concrete with wood ash cement are evaluated and studied. Water-to-binder ratio is (0.5) and five different replacement percentages of WA (5%, 10%, 15%, 20% and 25%. The results shows that the compressive strength, split tensile strength and flexural strength is increased up to 15% of replacement and then start decreasing at 20% and 25% of replacement of cement by wood ash. Chemical analysis of wood ash shows that it contains silica and thus can be used as cement replacing material. Through the analysis of results obtained in this study, it was concluded that wood ash could be blended with cement with positive effects on strength of concrete.*

(***Key words***: *wood ash, compressive strength, flexural strength, split tensile strength, replacement.)*

I. INTRODUCTION

Concrete is a composite material composed of fine and coarse aggregate bonded together with fluid cement (cement paste) that hardens over time. Most concretes used are lime-based concretes such as Portland cement concrete or concretes made with other hydraulic cements, such as calcium aluminates cements.

When aggregate is mixed together with dry Portland cement and water, the mixture forms fluid slurry that is easily poured and molded into shape. The cement reacts chemically with the water and other ingredients to form a hard matrix that binds the materials together into a durable stone-like material that has many uses. Often, additives are included in the mixture to improve the physical properties of the wet mix or the finished material.

The need of replacement of cement by wood ash is wood ash is generated as residual/waste from combustion done in boilers at pulp and paper mills, steam power plants, and other thermal power generating facilities. Since wood is a renewable resource for energy and an environmentally friendly material, there is an increased requirement of using waste wood for the purpose of energy production thus leading to formation of more wood ash waste. Hence, incorporating the usage of wood ash as replacement for cement in blended cement is beneficial for the environmental point of view as well as producing low cost construction entity thus leading to a sustainable relationship

II. ANALYSIS OF WOOD ASH

2.1. To Determine Constituent Of Wood Ash:-

2.1.1. Silica:-

Take 1gm of sample to a china dish, moisture with 10ml of distilled water to prevent lump prevention and add 5 to 10 ml of HCL. Evaporate the solution just to dryness in the oven. Treat it with 5 to 10 of HCL and equal quantity of water. Cover the dish and digest for another 10min.Take the weight of plain filter paper.(W1)Dilute the solution with an equal volume of hot water and immediately filter through Whatman No.40 ash less filter paper. Take the filter paper to the oven up to dryness and take weight of filter paper.(W2)Evaporate the filtrate once again to dryness and heat it in an oven at 105˚C-110˚C for 1 hour. Treat the residue with 10-15ml of 1:1 HCL. Heat the solution in an oven and dilute with an equal volume of hot water. Filter into another Whatman No.40 filter paper. Take the weight of another filter paper. (W2)% Silica= (W2-W1 / Weight of sample) x 100

2.1.2. Combined Ferrous Oxide and Aluminium Oxide:-

Dilute the above solution to about 200ml in a beaker. Add 2gm of ammonium chloride and 3-4 drops of methyl red indicator and heat to boiling. Add ammonia drop wise until the color of the solution is distinctly yellow. Keep it for 10minutes.Filter the solution with Whatman paper No.40.Take the filtrate to determine calcium oxide. The residue in paper washes with ammonium nitrate solution 2%.Burn it for 800˚C in furnace, then cool it. Weight the combined ferrous oxide and aluminum oxide.

2.1.3. Ferrous Oxide:-
Take 1gm of sample, add 10ml of distilled water and while vigorously shaking the mixture and add 5ml of HCL.Heat the solution if necessary while stirring with glass rod until the cement is completely digested. Make up the volume for 100ml, keep it for settle down. Take 20ml solution in conical flask; add 5ml buffer and 1ml salicylic acid. Titrate it with 0.01 EDTA solutions, until the red solution becomes blue. % weight (Fe2o3) = (volume of EDTA x contain of EDTA x100x100) / (1gm x 20 ml x 1000 x 2) Al2O3%=Al2o3+Fe2o3-Fe2o3

2.1.4. Calcium Oxide:-
Take the filtrate of ferrous oxide and ammonium oxide; evaporate it to 100ml in a beaker. Add 40ml, 4% ammonium oxalate gradually, until the solution becomes yellow. Keep it for 10minutes, filter it. Filtrate solution is taken for magnesium oxide Burn the residue filter paper at 550℃ for 50 minutes, cool in a crucible. Weight the filter paper.CAO %=(Wt. of CAO / Wt. of sample) x 100

2.1.5. Magnesium Oxide:-
Take the above 50ml filtrate in conical flask, add EBT and buffer solution until it becomes red. Titrate it with EDTA 0.01m until it becomes blue.MGO% = (Volume of EDTA x Contain of EDTA x 40.32 x 200 x 100) / (1gm x 50 x 1000)

"***Table 1. Comparison Between Chemical Composition Of Wood Ash, Fly Ash, Ordinary Portland Cement".***

Particulates (%)	Wood Ash	Fly Ash F	Fly Ash C	Ordinary Portland Cement
Silica	38.9	55	40	21.25
Aluminum Oxide	3.727	26	17	5.04
Ferrous Oxide	14.373	7	6	3.24
Calcium Oxide	16.4	9	24	63.61
Magnesium Oxide	4.83	2	5	3.26

III. OBJECTIVE

In the recent years, there has been increasing demand for renewable energy resources. Among these resources, biomass (forestry and agricultural wastes) is a promising source of renewable energy. The usage of wastes generated from the biomass industries (sawdust, woodchips, wood bark, saw mill scraps and hard chips) as fuel offer a way for their safe and efficient disposal. The thermal combustion greatly reduces the mass and the volume of the waste thus providing an environmentally safe and economically efficient way to manage the solid waste. The most prevailing method for disposal of the ash is land filling. Wood ash consists of particulate matter which may cause respiratory diseases and groundwater contamination. A sustainable ash management which integrates the ash within the natural cycle needs to be employed in the coming year. The objective of this project is to find the compressive strength, split tensile strength and workability of concrete with wood ash cement. The water-to-binder ratio will be taken as 0.5.

The objective can be listed point wise as under-
1) To study the effect of wood ash on fresh and harden properties of concrete.
2) To study the effects of wood ash in cement concrete mix.
3) To study the effect of wood ash on compressive strength..
4) To study the effect the quality of material on strength of concrete mix.

IV. AIM:

To study the incorporation of wood ash in combination with ordinary Portland cement while using it for various structural works. A critical review study compressive strength, split tensile strength, flexural strength, setting time and slump tests of wood ash added to OPC will produce significant results to emphasize the detailed study process. Uncontrolled burning of wood ash to form wood ash is used as a partial replacement of cement, thereby changing its physical and chemical properties. These properties are found somewhat similar to fly ash. The concrete mixes are replaced with the amorphous wood ash as an admixture of cement having grain size less than 90 microns in proportions of 5%, 10%, 15%, 20%, 25% by weight of cement

V. TESTING

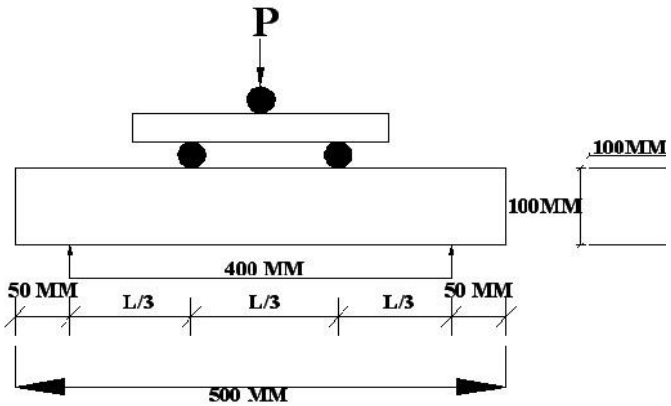
5.1. COMPRESSIVE STRENGTH OF CONCRETE

For cube test two types of specimens either cubes of 15cm X 15cm X 15cm or 10cm X 10cm x 10cm depending upon the size of aggregate are used. For most of the works cubical moulds of size 15cm x 15cm x 15cm are used by us. This concrete is poured in the mould and tampered properly so as not to have any voids. After 24 hours these moulds are removed and test specimens are put in water for curing. The top surface of these specimens should be made even and smooth. This is done by putting cement paste and spreading smoothly on whole area of specimen. These specimens are tested by compression testing machine after 7 days, 14 days,28 days curing.

"Figure 1. Compression Testing Machine".

5.2. FLEXURAL TEST

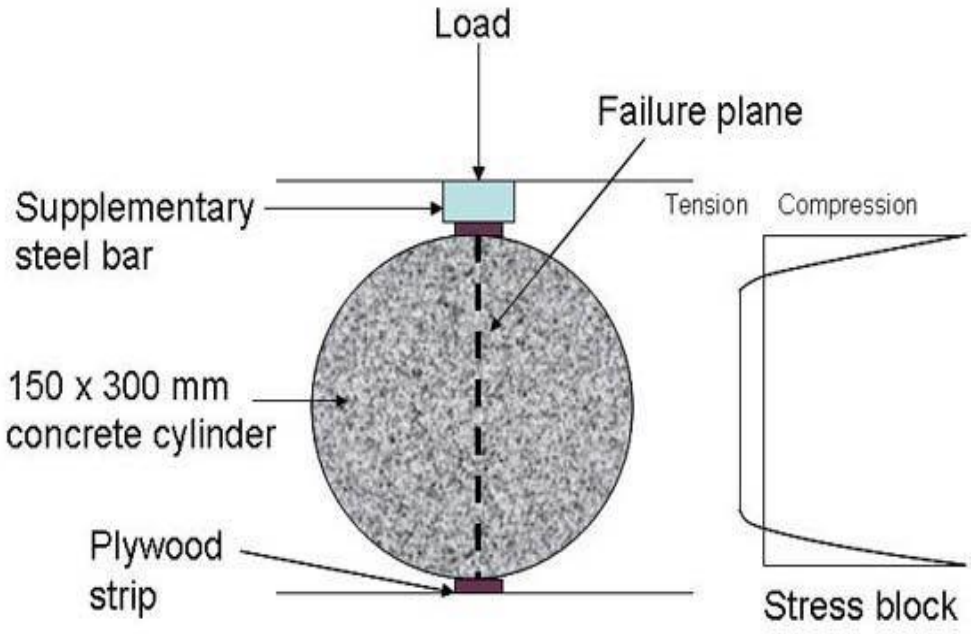
Flexural strength, also known as modulus of rupture, or bend strength, or transverse rupture strength is a material property, defined as the stress in a material just before it yields in a flexure test. The transverse bending test is most frequently employed, in which a specimen is having either a circular or rectangular cross-section. The flexural strength represents the highest stress experienced within the material at its moment of yield. It is measured in terms of stress. These specimens are tested by universal testing machine after 7 days, 14 days, and 28 days curing.



"Figure 2. Load Application on Beam".

5.3. SPLIT TESILE TEST

The tensile strength of concrete is one of the basic and important properties. Splitting tensile strength test on concrete cylinder is a method to determine the tensile strength of concrete. The concrete is very weak in tension due to its brittle nature and is not expected to resist the direct tension. The concrete develops cracks when subjected to tensile forces. Thus, it is necessary to determine the tensile strength of concrete to determine the load at which the concrete members may crack. Cylinders were casted with diameter being 15cm and height being 30 cm for water–binder ratio and for each replacement percentage. Specimens when received dry shall be kept in water for 24 h before they are taken for testing. Surface water and grit shall be wiped off the specimens and any projecting fins removed from the surfaces which are to be in contact with the packing strips. Central lines shall be drawn on the two opposite faces of the cube using any suitable procedure and device that will ensure that they are in the same axial plane.



"Figure 3. Load Application on Cylinder".

VI. EARLIER RESEARCH

6.1. Evaluation of Wood Ash as Partially Replacement to Cement (Etaveni Madhavi[1], K .Naveen, D .Naresh[2], Ch. Chandrasekhar[3])

The objective of this research work is to reduce the cost of the construction. Nowadays the industrial wastes are rapidly increasing and to utilize such materials and to reduce such type of waste in environment. The cement is replaced by the wood ash. Wood ash limited to the grain size of less than 90 micrometer is added to cement by weight percentage of 0%, 5%, 10%, 15%, 20%, 25% and 30% by the method of replacement by weight. The samples were hydrated at different time intervals ranging from one hour to 4 weeks. From this research the results are much better as compared to ordinary Portland cement. The paper aims to the study of compressive strength of a normal concrete using wood ash at a partial proportion. Also aim to reduce the cost of the construction. The wood ash exhibits an appreciable amount of pozzolonic properties. The water requirement increases with the increase with WA addition. In between 10%- 20% wood ash sample shows higher degree of hydration and compressive strength than conventional concrete. The optimum replacement percentage of wood ash is therefore in between 10%- 20% for construction industry.

6.2. Durability Studies On Concrete With Wood Ash Additive (C Sashidhar[1], H Sudarsana Rao[2])

Concrete is an artificial material in which the aggregates both fine and coarse are bonded together by the cement when mixed with water. The concrete has become so popular and indispensable because of its inherent in concrete brought a revolution in applications of concrete. With the advancement of technology and increased field of applications of concrete and mortars, the strength workability, durability and other characters of the ordinary concrete need modifications to make it more suitable for a by situations. Added to this is the necessity to combat the increasing cost and scarcity of cement. Under these circumstances the use of admixtures is found to be an important alternative solution. Hence an attempt has been made in the present investigation to study wood waste ash addition (0 – 30%) in concrete. Wood ash concrete is tested for compressive strength, acid attack with concentrated acids like H2SO4 and HCL and water absorption. The result states that,

1. The 28 day cube compressive strength of WAC mixes decreases with increasing wood waste ash content from 0 to 30%. The compressive strength after 30, 60, and 90 days of acid immersion of concrete decreases with increasing percentage of wood ash content
2. Maximum loss of compressive strength occurred with H2SO4 acid immersion. Hence H2SO4 acid attack is most severe on WAC.
3. Percentage decrease in compressive strength increases with the age of acid immersion.
4. Maximum Percentage decrease in compressive strength is noticed at 90 day age of acid immersion.
5. For 10% wood waste ash based concrete, the weight loss due to acid attack is minimum 6.H2SO4 has maximum deteriorating effect than other acids used in present investigation.
6. The percentage of water absorption of wood ash concrete (WAC) specimens increased with increase in wood waste ash content from 0 to 30%.

7. RESULTS AND DISCUSSION

About 36 Cubes, 36 beams and 36 cylinders were casted with M20 grade of concrete. The 0%,5%,10%,15%,20%,25% of cement was replaced by wood ash . Compressive strength, flexural strength and split tensile strength of cube ,beam, cylinder respectively at 7,14,28 days were tested and noted below and also there comparison are noted in tables.

7.1. Compressive Strength Of Cube

Compressive strength of cube for all ratio replacement of cement by WA						
Days	Compressive Strength					
	0%	5%	10%	15%	20%	25%
7	25	21.34	20	21.8	17.44	15.89
14	27.03	24.02	23.54	23.69	19.62	16.56
28	30.24	25.60	24.41	26.16	22.67	16.13

"Table 2. Compressive Strength Of Cube For All Ratio Replacement Of Cement By WA".

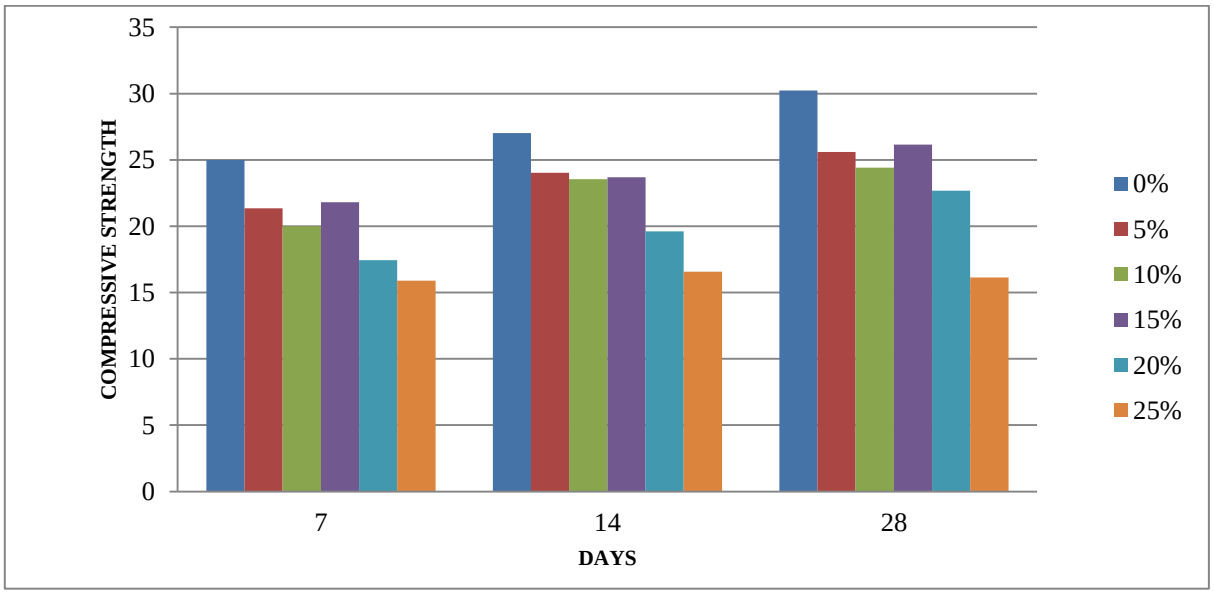
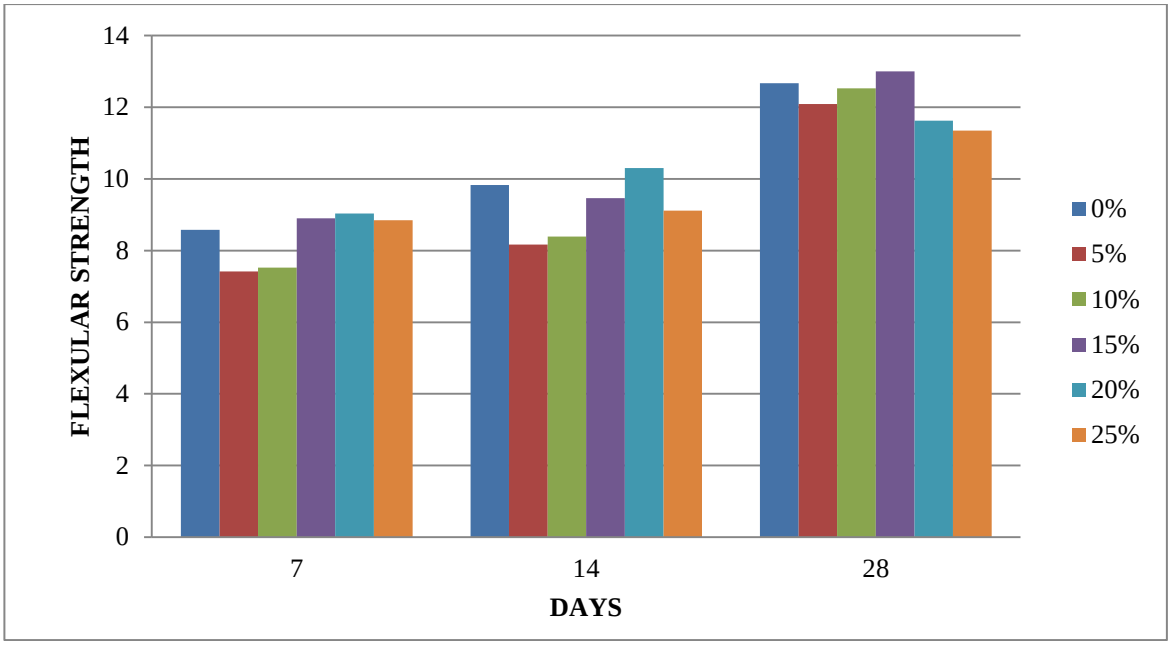


Figure 4. Compressive Strength Of Cube For All Ratio Replacement Of Cement By WA

7.2. Flexural Strength Of Beams

Flexural strength of beam for all ratios replacement of cement by WA						
Days	Flexural Strength					
	0%	5%	10%	15%	20%	25%
7	8.58	7.42	7.52	8.9	9.03	8.85
14	9.83	8.17	8.39	9.46	10.3	9.11
28	12.67	12.09	12.53	13	11.62	11.35

"Table 3. Flexural strength of beam for all ratios replacement of cement by WA".

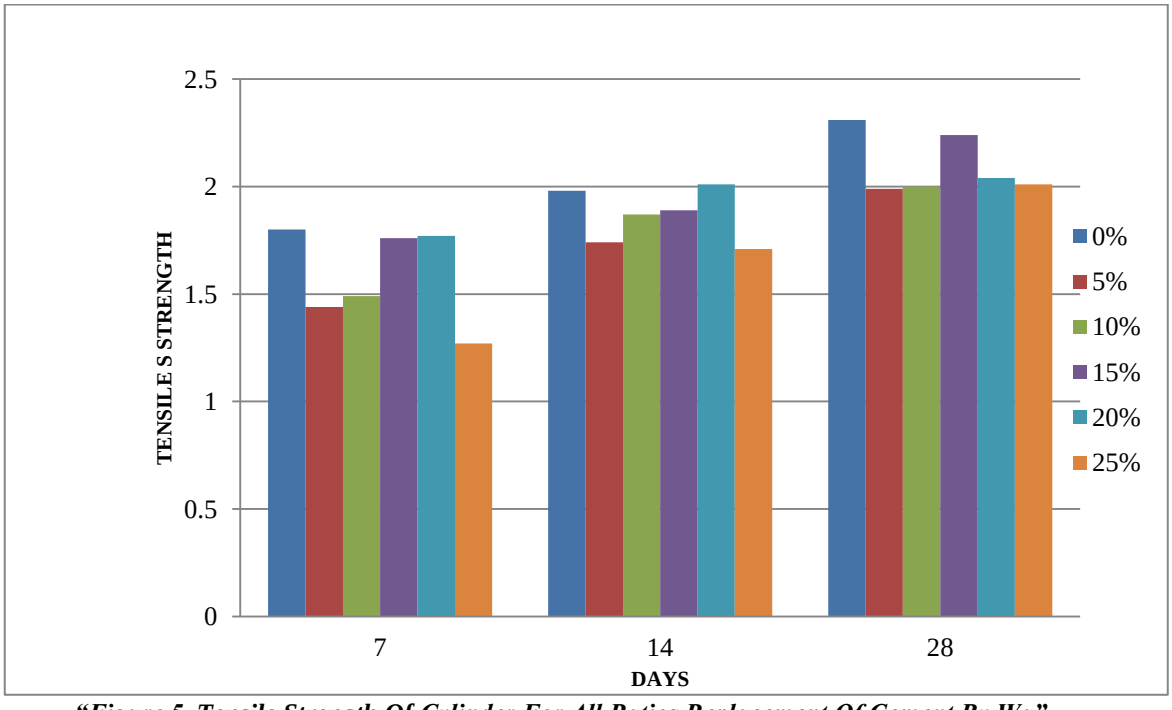


"Figure 5. Flexural Strength Of Beam For All Ratios Replacement Of Cement By WA".

7.3. Tensile Strength Of Cylinders:

Tensile strength of cylinder for all ratios replacement of cement by WA						
Days	Tensile Strength					
	0%	5%	10%	15%	20%	25%
7	1.8	1.44	1.49	1.76	1.77	1.27
14	1.98	1.74	1.87	1.89	2.01	1.71
28	2.31	1.99	2	1.89	2.01	2.01

"Table 4. Tensile strength of cylinder for all ratios replacement of cement by WA".



"Figure 5. Tensile Strength Of Cylinder For All Ratios Replacement Of Cement By Wa".

VIII. CONCLUSION

- Wood ash chemical characteristics differ with species of wood but chiefly contain silica.
- Incorporation of wood ash as partial replacement of cement adversely decreases the slump of concrete. Due to decrease in slump it indicates increase in water absorption.
- There was marginal decrease in strength with increasing wood ash percentage in concrete
- Wood ash at replacement percentage up to 15% of the weight of binder can be successfully used as additive in place of cement.
- Compressive strength of wood ash concrete is found to be optimum at 15%(26.16 N/MM^2)
- Tensile strength of wood ash concrete is found to be optimum at 15%(1.89 N/mm^2)
- Flexural strength is also found to be optimum at percentage of 15%(13 N/mm^2)

IX. FUTURE SCOPE

- Quantity and quality of wood ash may vary with many factors such as combustion temperature, species of wood and combustion technology used. Hence proper analysis of wood ash is important before its application in concrete.
- Effect on different curing periods on concrete.
- It can be also be tested for water permeability test, water absorption test, modulus of rupture, modulus of elasticity, resistance to abrasion.
- Effect on the strength of concrete by using wood ash of different trees such as babul, orange etc for the design mix concrete.
- The logistics of implementing the use of wood ash concrete in developing country construction should also be investigated to ensure that this low cost construction material is helping the people who need it most.

REFERENCES

[1] Evaluation of wood ash as partially Replacement to cement by Etaveni Madhavi[1],k.Naveen[2], D.Naresh[3], Ch.Chandrasekhar[4]

[2] durability studies on concrete with wood ash additive C.sashidhar[1], H sudarshan Rao[2]

