STUDY ON PARTIAL REPLACEMENT OF CEMENT WITH SAWDUST ASH IN CONCRETE

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ABSTRACT:

Cement industry is one of the major environmental pollution source as it consumes a lot of energy in the production .It releases CO2 which leads to global warming and other pollutions so to minimize the pollution to some extent new method was proposed i.e., replacement of cement with wood byproducts like dust ash. To replace this cement with saw dust ash various tests are performed on the quality and various strengths like compression strength, flexural strength, split tensile strength of the replaced product. The cement is replaced with sawdust ash of about 0%, 5%, 10% and 15%.After the replacement the test results were compared conventional concrete. The sawdust ash concrete was found to be economical, ecofriendly material than Portland cement concrete in the proportion of cement replaced.

Keywords: *Sawdust ash, Workability, Compressive strength, Split tensile strength & Flexural Strength*

1.0 INTRODUCTION

Concrete is one of the most widely used construction material in the world. It is composed of coarse aggregate, fine aggregate, cement and water. It has been in use for over a century in all construction works .A new material in the field of concrete technology has been developed during the recent past with the ongoing demand of industries to meet the functional, strength, economical and durability requirements. In India, the wood production is 50million m3 of logs in 2015. In the wood production industry about 15-20% waste is generated from total production although the reutilization of wood waste has been practiced. Construction industry can be the user of all wood waste and this way can contribute to solve the environmental pollution.

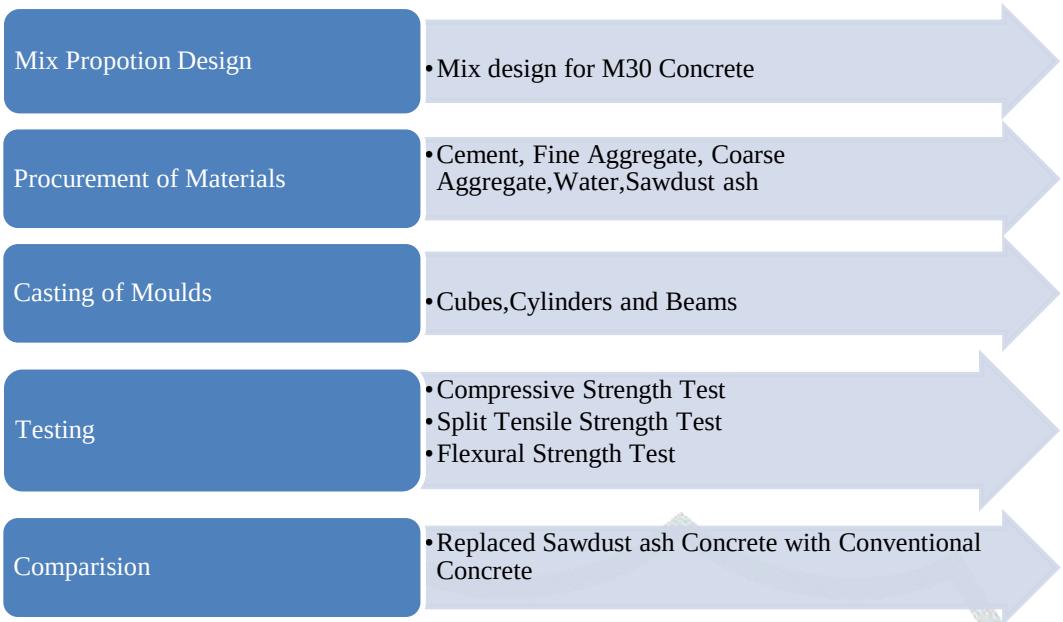
2.0 LITERATURE REVIEW

Ratod Vinod Kumar1 , M. Shiva Rama Krishna2 . (2013) presented a journal on ," A Case Study on Partial Replacement of Cement by Saw Dust Ash in Concrete Studied about this research proposal looked into the viability of the use of saw dust ash as a partial cement replacement material and compared the fresh and hardened concrete properties of the saw dust ash concrete and Portland cement concrete. They replaced with different percentages saw dust ash such as 0%, 6%, 12%,18%) by weight of cement. They concluded compressive strength, splitting tensile strength and the flexural strength of the SDAC also decreased with more replacement of the cement.

Mohammad Iqbal Malik (2009) presented a journal on," use of saw dust ash as partial replacement of cement in concrete They studied about the use of saw dust ash as partial replacement of cement in concrete. They replaced materials is saw dust ash (5%, 10%, 15%, 20%).They test on conducted tested for compressive strength, durability (water absorption) and density at 28 days. They conclude that partial replacement of cement up to 10% by weight for particle size of range 90micron

C.Marthong(2016) presented paper on the possibility of using sawdust ash (SDA) as a construction material was experimentally investigated .Saw dust was burnt and the ash sieved using 90 micron sieve. A comparative study on effects of concrete properties when OPC of varying grades was partially replaced by SDA is discussed on this paper. Percentage replacement of OPC with SDA 0%, 10%,20%,30%,40% respectively. The compressive strength, water absorption, shrinkage and durability of concrete were mainly studied .Test results shows that inclusion of SDA cause little expansion due to low calcium content.

3.0 METHODLOGY



4.0 THEORITICAL FORMULATION

The materials were used for the preparation of Sawdust ash Concrete

1. **Cement:**

   Cement may be prescribed as material with adhesive and cohesive properties which make it capable of bonding material fragments in to compact whole. The most commonly used cement in construction today is Portland cement and hence ordinary Portland cement of 53 grade has been selected for this experimental investigation. It should be dry, powdery and free from lumps. The cement according to the Indian specification must satisfy the IS: 8122-1989(reaffirmed 1999)

2. **Fine Aggregate**

   Fine Aggregate is an essential material of concrete .Those fractions from 4.75 to 150 microns are termed as fine aggregate .The main Purpose of the fine Aggregate is to fill the voids in the coarse aggregate and it acts an workability agent. For this study, the river sand of Zone II is considered

3. **Coarse Aggregate**

   The fractions from 20mm to 4.75mm are used as coarse aggregate. Angular granite material of 20mm nominal size from the local source available was used. The coarse aggregate chosen for concrete was typically angular in shape, well graded and smaller than maximum size suited for conventional concrete. The physical Properties of coarse aggregate were investigated in accordance with IS 383-1963

4. **Water**

   Water is an important ingredient of concrete as it actually participates in the chemical reaction with cement. Since, it gives the strength to cement concrete, the quantity and quality of water are required to be looked in to very carefully. Water should be selected according to IS 456-2000

5. **Sawdust Ash**

   It is a by-product of cutting, grinding, drilling, sanding, or otherwise pulverizing wood with a saw or other tool. It is composed of fine particles of wood. The saw dust obtained for this study was collected from nearby sawmill. Samples were carefully collected to avoid mixing with sand by collecting the newly produced ones with shovel and packing into bags. The saw dust collected was sundried for 10 days to aid the burning process. The saw dust samples collected were burnt into ashes by open. Following cooling, the ash was grounded. Sawdust ash obtained is sieved through IS sieve of 90 micron and the retained material obtained is used for experimentation purposes

5.0 EXPERMENTAL INVESTIGATION

5.1 MIX PROPOTION

Table5.1 Mix Proportion of M30 grade Concrete

Grade	M30
Proportion	1:1.78:3.17
W/C Ratio	0.45
Cement	380
Fine Aggregate	680.13
Coarse Aggregate	1207.55
Water	171

5.2 RESULTS AND DISCUSSION

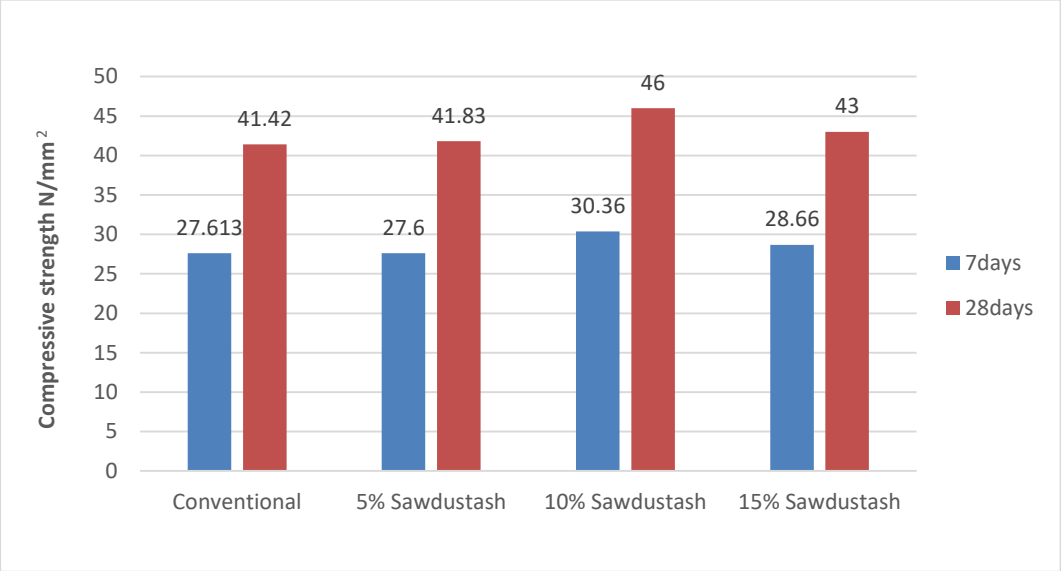
5.2.1 Workability

Workability of Normal Concrete and concrete mixed with sawdust ash for various percentages are measured before casting the samples. Slump cone test is performed to know the workability of concrete. The workability is increased by addition of sawdust ash.

5.2.2 Compressive Strength of concrete

The cube size of 150mm x 150mm x150mm is used in this experimental study to identify the compressive strength of concrete. For each type of mix three cubes were casted for 7days and 28days .Twenty four cubes are casted for 4 different mixes and placed in curing tank up to testing date .Test results shows that the compressive strength of the material is increased by the addition of sawdust ash

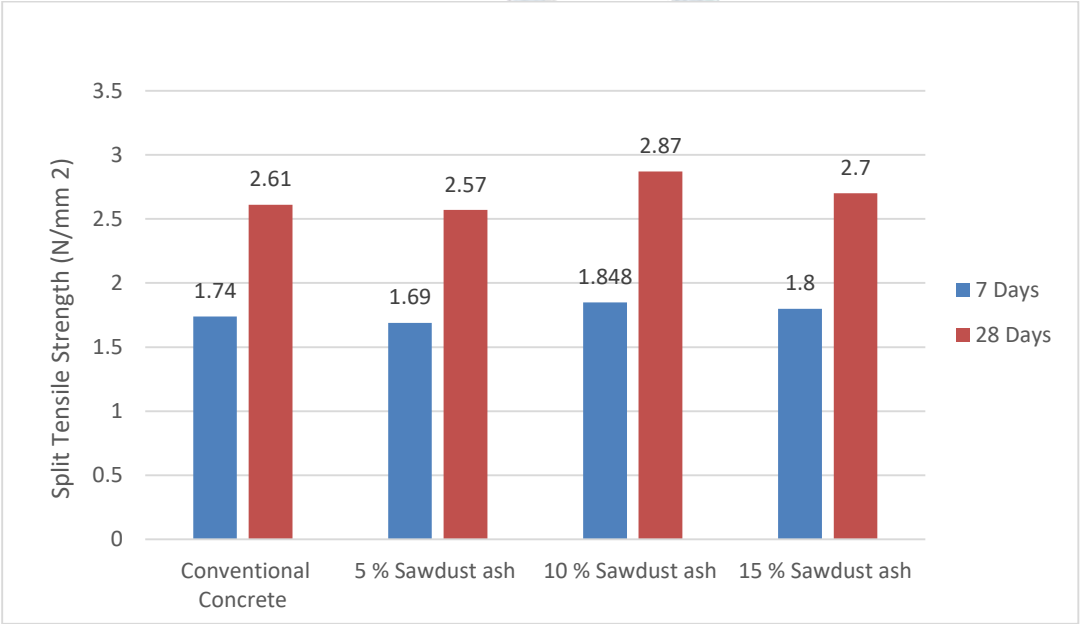
Days	**Compressive strength (N/mm 2)**			
	M30 Conventional Concrete	**5 % saw dust ash replacement**	**10 % saw dust ash replacement**	**15 % saw dust ash replacement**
7 Days	27.613	27.6	30.36	28.66
28 days	41.42	41.83	46	43



5.2.3 Split Tensile strength of concrete

Tensile strength of concrete was determined by using UTM.The split tensile strength of concrete was tested using 100mm x 300mm cylinder specimens are carried out by placing a specimen between the loading surfaces of UTM and the load was applied until the failure of the specimen .The average value of specimens for each mix at the age of 7days.28 days are shown in below figure. The increase in the tensile strength of various concrete mixtures over conventional concrete is also tabulated in figure

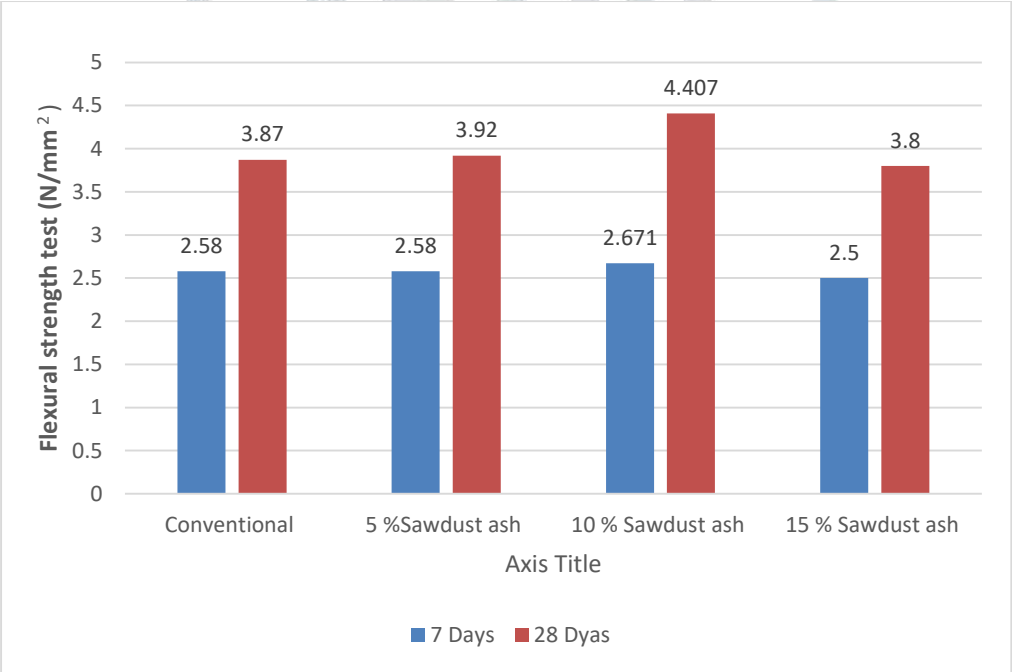
Days	Split Tensile Strength (N/mm 2)			
	M30 Conventional Concrete	**5 % saw dust ash replacement**	**10 % saw dust ash replacement**	**15 % saw dust ash replacement**
7 Days	1.74	1.69	1.848	1.8
28 days	2.61	2.57	2.87	2.70



5.2.4 Flexural Strength of concrete

The unreinforced beam of 100 x 100mm x 500mm is used. Because of the concrete brittleness, the failure occur suddenly and single crack will be obtained at the time of failure of a beam .This test is conducted under Universal Testing Machine. The average load carrying capacities of unreinforced sawdust ash concrete with conventional is little bit high at different mix.

Days	Flexural strength test (N/mm^2)			
	M30 Conventional Concrete	**5 % saw dust ash replacement**	**10 % saw dust ash replacement**	**15 % saw dust ash replacement**
7 Days	2.58	2.58	2.671	2.50
28 days	3.87	3.92	4.407	3.8



CONCLUSIONS:

Based on the analysis of experimental results and discussion there upon the following conclusions can be drawn:

- The utilization of saw dust ash in concrete was found to be economical and free of cost
- It was recognized that the workability of concrete was decreased by the addition of the alternative materials which has increased the demand of water while mixing concrete when compared to conventional concrete.
- The maximum compressive strength attained was 46 N/mm2 after the curing period of 28 days when cement is replaced with 10% and this it is noticed to be 11.05% more than the strength obtained for conventional concrete at same the age.
- From the results obtained through split tensile test at the age of 28 days, it is recognized that the specimens casted with the mix M3 which is replacing 10% of cement have shown highest strength of 2.87 N/mm2 and the strength achieved is 9.96% additional to the strength of conventional mix concrete.

- From the results obtained through flexural strength test at the age of 28 days, it is recognized that the specimens casted with the mix M3 which is replacing 10% of cement have shown highest strength of 4.04 N/mm2 and the strength achieved is4.39% additional to the strength of conventional mix concrete.
- The use of sawdust ash in concrete conserves resources, notably cement, and thereby ensures the long-term sustainability of the concrete construction sector.

References

1 V. Ramachandran, R. Feldman, Concrete Admixtures Handbook, Concr. Sci. (1996) 1–66.

2 V. Mahesh, Hemalatha Chemalapati, A. Vani, Sreenivasulu Dandagala, Evaluation of admixture effect on strength and durability properties of concrete - a critical review, Int. J. Eng. Technol. [Online], 7.2.1 (2018) 28–31.

3 Mark Bediako, Eric OpokuAmankwah, Analysis of Chemical Composition of Portland Cement in Ghana: A Key to Understand the Behavior of Cement, Adv. Mater. Sci. Eng. 2015.

4 S. Chowdhury, A. Maniar, O.M. Suganya, Strength development in concrete with wood ash blended cement and use of soft computing models to predict strength parameters, J. Adv. Res. 6 (2015) 907–913.

5 Lawrence J. Drew, William H. Langer, Janet S. Sachs, Environmentalism and Natural Aggregate Mining, Nat. Resources Res. 11 (2002)19–28.

6 G. Elangovan, V.M. Rajanandhini, Experimental Study and Sem Analysis On Mortar Cube with Wood Ash for Partial Replacement of Cement, Int. J. Eng. Technol. Manag. Res., 5 (3) (March, 2018), ISSN: 2454-1907.