

Experimental Investigation on Strength Characteristics of Concrete Incorporating Mineral and Chemical Admixture and Bamboo Fibres as Partial Replacement of Coarse Aggregate

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Abstract— The main objective of this experimental project is to investigate and find out the strength characteristics of concrete after the replacement of cement with fly ash along with rice husk ash which are the mineral admixture and bamboo fibre as a replacement of coarse aggregate. In addition to this master rheobuild 918 which is the chemical admixture used as a super plasticizer. This paper has been made an attempt to study the influence of fly ash and rice husk ash each on replacement ratios of 0%, 5%, 10%, 15%.The coarse aggregate is made with 0%, 1%, 2%, 3% of bamboo fibres. The tests considered for our study are compressive strength test, split tensile strength test, flexural strength test and these test results are compared with strength results of conventional concrete.

Key words: Fly Ash, Rice Husk Ash, Master Rheobuild 918, Bamboo Fibre, Compressive Strength, Split Tensile Strength, Flexural Strength

I. INTRODUCTION

Cement manufacturing leads to the destruction of natural resources there by emitting CO₂ in the atmosphere. Fly ash is the waste material from the pulverized coal manufacturing unit, which possess pozzolanic property. While using OPC the chance for the formation of voids in the concrete is high as it lacks pozzolanic property. This drawback can be rectified by the addition of fly ash.

Rice husk ash is one of the agro based wastes. It is produced during the dehusking operation of paddy rice. Since they are bulky, the husks create enormous disposal problem for centralized rice mills. Rice husk converted ash is fought to have desirable properties to be used as replacement to cement. It imparts high strength and high impermeability to the concrete. It contains more than 90% of SiO₂.

Bamboo is rich in fibre and it is a natural product, cheaply available and mainly strong enough in tension and compression. Concrete having brittle property with less value of tensile strength and strain capacities hence is preferred with fibres to overcome this problem.

Master rheobuild 918 is composed of synthetic polymers specially designed to impart rheoplastic qualities to concrete. It is a ready to use liquid which is dispensed in to the concrete together with the mixing water.

II. METHODOLOGY

- 1) Studying literature related to admixtures and fibres used in concrete.
- 2) Selection of materials depending on its quality (cement, fine aggregate, coarse aggregate, water and some other required materials).

- 3) Calculating the ratio of mix proportions by mix design for M40 grade of concrete.
- 4) Casting concrete specimen such as cube, cylinder and prism.
- 5) Water curing is done for 7 days, 14 days, 28 days,
- 6) Various strength tests are conducted on various concrete specimen for 7 days, 14 days and 28 days.

A. Materials Used

- 1) Ordinary Portland Cement 53 grade confirming to IS 456 2000.
- 2) Fly ash
- 3) Rice husk ash
- 4) Graded fine aggregate
- 5) Graded coarse aggregate
- 6) Bamboo fibre
- 7) Master rheobuild 918
- 8) Water

1) Ordinary Portland Cement

OPC is the basic Portland cement and is best suited for use in general concrete construction for its binding property. OPC is divided into 3 grades of 33, 43 and 53. In our experimental work we are using 53 grade of cement.

Compound	Formula	Mass %
Calcium oxide	CaO	61-61%
Silicon dioxide	SiO ₂	19-23%
Aluminium oxide	Al ₂ O ₃	2.5-6%
Iron Oxide	Fe ₂ O ₃	0-6%
Sulphate	SO ₃	1.5-4.5%

Table 1: Chemical composition of cement

2) Fly ash

Fly ash is one of the productions of coal combustion composed of fine particles that is determined out of the boilers with flue gases.

Compound	Percentage(%)
SiO ₂	50
Al ₂ O ₃	32.85
Fe ₂ O ₃	4.21
MgO	1.58
CaO	4.91
Na ₂ O	1.42
K ₂ O	1.35
Loss of ignition	3.2

Table 2: Chemical composition of fly ash

3) Rice Husk Ash

Rice husk ash is an agricultural waste product and how to dispose of it is a problem to waste managers. Rice husk contains silica in hydrated amorphous form and cellulose which yields carbon when then thermally decomposed.

4) Graded Fine Aggregate

The aggregate having size less than 4.75mm is termed as fine aggregate. Locally available sand conforming to zone IV was used in the experimental work. Specific gravity determined by pycnometer method found to be 2.55.

5) Graded Coarse Aggregate

The aggregate having size more than 4.75 mm is termed as coarse aggregate. Locally available crushed coarse aggregate of size 20 mm was used in our experiment. Specific gravity of coarse aggregate was 2.64.

6) Bamboo Fibre

Bamboo fibres with size of varying length from 2 to 4 cm and breadth from 1 to 2 cm and thickness of 1cm is also used as a partial replacement of coarse aggregate.

7) Water

Portable water free from impurities and salt for casting and curing the concrete blocks as per IS 456 2000.

8) Master rheobuild 918

Master rheobuild 918 is a retarding super plasticizer with relative density 1.18. The plasticizing effect and water reduction are higher if the admixture is added to the damp concrete after mixing of water has been done.

III. RESULTS AND DISCUSSION

The average compressive strength test, split tensile strength test, flexural strength test readings after 7 day,14 day and 28 day are listed below:

% of materials added	Compressive strength (N/mm ²)		
	7 days	14 days	28 days
Conventional concrete	27.76	38.4	49.05
5% FA,5% RHA,0.2% MR 918,1% Bamboo fibre	29.44	40.25	50.85
10% F.,10% RHA,0.4% MR 918,2% Bamboo fibre	31.32	42	52.65
15% FA,15% RHA,0.6% MR 918,3% Bamboo fibre	30.4	41.7	51.32

Table 3: Effect of mineral and chemical admixture and bamboo fibre on Compressive strength of concrete

Fly Ash-FA
Rice Husk Ash-RHA
Master Rheobuild 918-MR 918



Fig. 1: Compressive strength of concrete

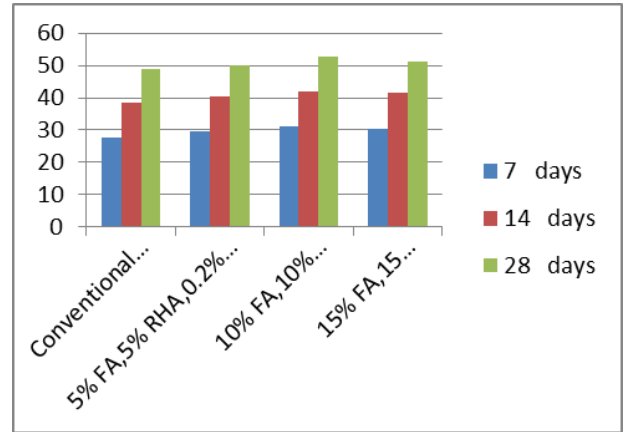


Chart 1: Compressive strength of concrete

% of materials added	Split tensile strength(N/mm ²)		
	7 days	14 days	28 days
Conventional concrete	3.05	4.22	5.39
5% FA,5% RHA,0.2% MR 918,1% Bamboo fibre	3.23	4.42	5.5
10% FA,10% RHA,0.4% MR 918,2% Bamboo fibre	3.44	4.62	5.79
15% FA,15% RHA,0.6% MR 918,3% Bamboo fibre	3.34	4.58	5.64

Table 4: Effect of mineral and chemical admixture and bamboo fibre on split tensile strength of concrete



Fig. 2: split tensile strength of concrete

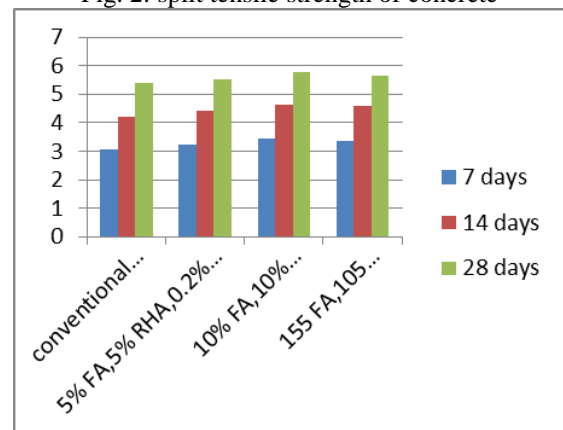


Chart 2: split tensile strength of concrete

% of materials added	Flexural tensile strength(N/mm ²)		
	7 days	14 days	28 days
Conventional concrete	4.164	5.76	7.35
5% FA,5% RHA,0.2% MR 918,1% Bamboo fibre	4.416	6.03	7.62
10% FA,10% RHA,0.4% MR 918,2% Bamboo fibre	4.698	6.30	7.89
15% FA,15% RHA,0.6% MR 918,3% Bamboo fibre	4.56	6.25	7.69

Table 5: Effect of mineral and chemical admixture and bamboo fibre on flexural strength of concrete



Fig. 3: flexural strength of concrete

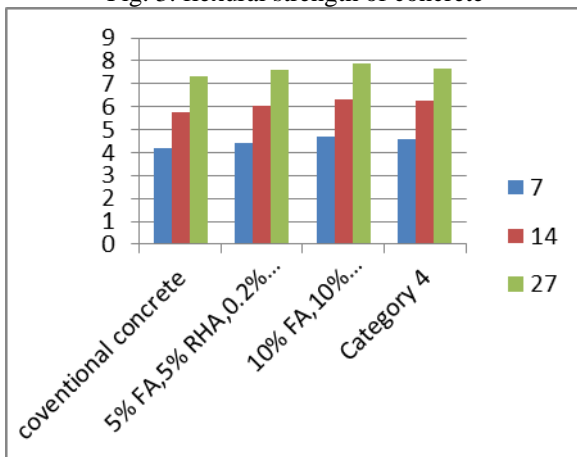


Chart -3: flexural strength of concrete

IV. CONCLUSIONS

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

- 1) Upon the addition of mineral, chemical admixture and bamboo fibre the strength of the fibre has increased considerably.
- 2) The optimum value of mineral admixture addition is found to be 10%, chemical admixture addition is 0.4% and bamboo fibre addition is found to be 2%.
- 3) The compressive strength, split tensile strength and flexural strength has fallen upon the addition of 10% of mineral admixtures, 0.4% chemical admixture and 2% bamboo fibre.

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