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Experimental Performance of Fiber Reinforced Concrete using Rice Husk Ash as a Partial Replacement of Cement

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***Abstract* : A series of tests were conducted to study the effect of 5%, 10%, 15%, 20% and 25% replacement of cement by waste Rice Husk Ash on compressive strength, split tensile strength and flexural strength. Another aim of my study is that addition of Polyester in concrete which will increase the structural integrity. A series of tests were conducted to study the effect of 0.5%, 1.0%, 1.5%, 2.0% addition of polyester along with the above mentioned each percentage replacement of cement with Rice Husk Ash. Results showed that replacement of both the materials gave the desired strength. The ultimate compression strength and split tensile strength was obtained at 15% replacement of Rice Husk Ash with 1.5% of PEF. The ultimate flexural strength was obtained for the above mentioned replacement. The various comparisons of test results were illustrated graphically.**

I. INTRODUCTION

A. Fiber Reinforced Concrete

Plain concrete possesses a very low tensile strength, limited ductility and little resistance to cracking. Internal micro cracks are inherently present in the concrete and its poor tensile strength is due to the propagation of such micro cracks, eventually leading to brittle fracture of the concrete. In the past, attempts have been made to impart improvement in tensile properties of concrete members by way of using conventional reinforced steel bars and also by applying restraining techniques. It has been recognized that the addition of small, closely spaced and uniformly dispersed fibers to concrete would at as crack arrester and would substantially improve its static and dynamic properties. This type of concrete is known as Fiber Reinforced Concrete.

B. Rice Husk Ash

RHA is an agricultural waste which is produced in millions of tons. Waste managers have found it difficult over the years to dispose this agro-waste. RHA is obtained by the combustion of rice husk and has been found to be super pozzolanic. RHA is a highly reactive pozzolanic material suitable for use in lime pozzolan mixes and for Portland cement replacement. RHA is very reach in silicon dioxide which makes it very reactive with lime due to its non-crystalline silica content and its specific surface. This material is actually a super-pozzolan since it is rich in Silica and has about 85% to 90% Silica content.

II. MATERIALS USED

The Rice Husk was obtained and burnt. The ash is grinded to a required level of fineness and sieved through 90µm sieve in order to remove the impurity and large size particles. Size of thecoarse aggregate used in the study was 20 mm. The fine aggregate was collected from Cauvery River, India which is used for thisand the impurities was removed. Cement used was OPC grade 53. The specific gravity of fine
aggregate, coarse aggregate, RHA and cement is found to be 2.60, 2.68,2.33 and 3.15. Portable tap water which is available in college campus was used. For improving the mechanical and durability properties of concrete 12 mm triangular shaped polyester fiber were added in proportion of cementing material by mass. Polyester fiber in normal concrete in terms of improvement in compressive and flexural strength, impact and abrasion resistance and resistance to alkaline condition.

III. MIX DESIGN

The concrete used in this research work is made of cement, fine aggregate and coarse aggregate. The mix proportion followed in this research is 1:1:2 by weight.

IV. CASTING AND TESTING

Six mixes were prepared for each percentage of 0, 5, 10, 15, 20 and 25 RHA. The concrete was mixed, placed and compacted in three layers and it is demolded after 24 hours and kept in a curing tank for 7 and 28 days. The testing was carried out by the universal testing machine to find the compressive strength, split tensile strength and flexural strength of the sample.

V. MIX PROPORTION

Percentage of fine aggregate and coarse aggregate is 100% for all mix proportion.
RH1, RH2, RH3 and RH4 - 95% of cement content + 5 % of RHA content + 0.5 %, 1%, 1.5% and 2%of polyester fiber respectively.
RH5, RH6, RH7 and RH8 - 90% of cement content + 10 % of RHA content +0.5 %, 1%, 1.5% and 2%of polyester fiber respectively.

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RH9, RH10, RH11 and RH12 - 85% of cement content + 15 % of RHA content+ 0.5 %, 1%, 1.5% and 2% of polyester fiber respectively.
RH13, RH14, RH15 and RH16 - 80% of cement content + 20 % of RHA content +0.5 %, 1%, 1.5% and 2% of polyester fiber respectively.
RH17, RH18,RH19 and RH20 - 75% of cement content+, 25 % of RHA content + 0.5 %, 1%, 1.5% and 2% of polyester fiber respectively.

VI. RESULTS AND DISCUSSIONS

A. Compressive Strength

TABLE.1 Result for compression test

Specimen	Avg. compressive strength at 7 days (N/mm^2)	Avg. compressive strength at 28 days(N/mm^2)
C.C	21.1	26.2
RH1	18.96	27.24
RH2	19.52	28.18
RH3	20.65	30.66
RH4	16.68	21.56
RH5	19.55	28.15
RH6	22.38	31.62
RH7	22.73	32.85
RH8	17.10	23.90
RH9	20.44	29.23
RH10	22.76	32.20
RH11	23.09	33.42
RH12	18.39	24.65
RH13	19.85	27.84
RH14	20.93	31.04
RH15	21.26	31.87
RH16	17.25	22.45
RH17	18.56	27.16
RH18	19.38	27.96
RH19	20.41	30.29
RH20	16.37	21.11

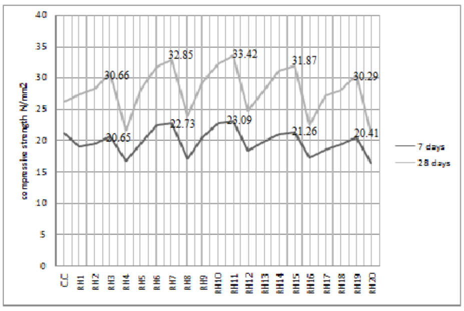

Fig.1. Comparative analysis chart for 7 days and 28 days

B. Split Tensile Strength

TABLE.2 Result for Split Tensile Strength

Specimen	Avg. Split tensile strength at 7 days in N\mm^2	Avg. Split tensile strength at 28 days in N\mm^2
CC	1.62	2.39
RH1	1.66	2.45
RH2	1.72	2.49
RH3	1.78	2.52
RH4	1.62	2.34
RH5	1.70	2.49
RH6	1.75	2.56
RH7	1.81	2.89
RH8	1.60	2.35
RH9	1.72	2.52
RH10	1.78	2.62
RH11	1.85	2.92
RH12	1.59	2.36
RH13	1.67	2.48
RH14	1.74	2.56
RH15	1.83	2.85
RH16	1.53	2.30
RH17	1.63	2.45
RH18	1.70	2.53
RH19	1.79	2.81
RH20	1.49	2.27

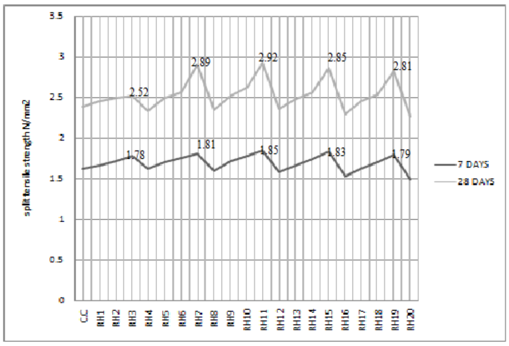

Fig.2 Comparative analysis chart for 7 days and 28 days

C. Flextural Strength

The flextural test is carried out on 28 days cured moulds. The size of beam specimen is 1200mm X 160mm X 230mm. The beam are tested using universal testing machine. Demountable dialgauges are fixed at L/2 and L/3 distances of the beam .The point loads are allowed to apply on the same point of L/2 and L/3 distances of the beam

- R= PL/BD2 (N/mm2)

TABLE.3 Flextural Strength on Beams

Specimen	Initial crack (KN)	Fletural strength (MPa)
C.C	11.5	1.63
RH11	17.5	2.44

1) *DUCTILITY*

TABLE.4 Ductility Index

Specimen	First crack at mid span deflection δy (mm)	Ultimate mid deflection δu (mm)	Ductility index D.I = δu/δy
C.C	0.38	3.01	7.92
RH11	0.57	3.45	6.05

2) *STIFFFNESS*

TABLE.5 Stiffness at first crack load

Specimen	First crack load (KN)	First crack mid span deflection (mm)	Stiffness KN/mm
C.C	11.5	0.38	30.26
RH11	17.5	0.57	30.70

TABLE.6 Stiffness at ultimate crack load

Specimen	Ultimate load (KN)	Ultimate load mid span deflection (mm)	Stiffness KN/mm
C.C	53.26	3.01	17.69
RH11	59.12	3.45	17.67

7. CONCLUSION

The formation of micro-cracks in concrete gets reduced by using polyester fibers. The results show that the composites with polyester fiber are reliable materials to be used in practice for the production of structural elements to be used in civil construction.

The ultimate strength of concrete reaches the satisfactory value at a replacement level of 15 % of RHA and 1.5 % addition of polyester fiber compared to conventional concrete and other replacements.

Conventional concrete shows at 28 days compressive strength as 26.2 N/mm2, split tensile strength as 2.39 N/mm2 and flexural strength as 1.63 N/mm2.

Replacement of RHA in cement by 15% with addition of 1.5% of polyester fiber (RH11) at 28 days increases the compressive strength by 33.42 N/mm2, tensile strength by 2.92 N/mm2 and flextural strength by 2.44 N/mm2 respectively

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