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Studies on Strength and Durability Properties of Rice Husk Ash in Concrete with Partial Replacement of Fine Aggregate

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***Abstract*: In this experimental research can reduces the consumption of river sand the partial replacement of fine aggregate in concrete with rice husk ash from 0%, 5%,10%, 15%, 20% and 25% with 5% interval. Nowadays the mass quantity of Rice Husk Ash are sources in small scale industries with an important effects of surrounding environment and living things like human being , plant and animals. In few decades, scientist and many researchers have evaluated that utilization of pozzolanic materials like fly ash, silica fume, blast furnace , ground nut shell ash , rice husk ash and metakolin etc. this pozzolanic materials are not only improve the different properties of concrete in fresh and hardened strength and also to intent the economy of construction costs.**

***Keywords*: Compressive strength, Rice husk ash, Water absorption**

1. Introduction

Rice husk Ash is a one of the good pozolanic material that can be utilized for universally adopted for the preparation of high strength and high performance concrete structures. The rice husk ash was the main contains the reactive amorphous silica that react with $Ca(OH)_2$ liberated by cement hydrated in concrete mix to produce change calcium silicate gel (CSH) that is mainly important for improve the concrete strength and ecological benefits. The utilization of rice husk ash in concrete as pozzolanic cementitious materials was experimentally analyzed and substitute to traditional concrete. The fine aggregate has been replaced as per the testing procedure in ranging of 0%, 5%, 10%, 15%, 20% and 25% by weight of sand for mix ratios. The cement concrete various mixtures were prepared, tested and compared in terms of compressive strength, split tensile strength and water absorption with the control concrete. The experimental tests were carried out to analyze for the strength and durability characteristics for the test results 7, 14, and 28 days for the curing period.

2. Literature review

Y. Chen,etal (2010) in this study Growing environmental consciousness at all levels of society, the environment pollution and health hazards especially associated with cement concrete, and natural resource depletion and accompanying social problems, sustainable development and sustainable construction have becomes a developing issue throughout the world. Buildings are one of the maximum consumers of natural resources and account for a significant portion of the greenhouse emissions effects [1]. A.N. Givietal (2010) The 10% replacement of cement with ultra-fine RHA gave the highest compressive strength, less water permeability and acceptable workability.

K. ShyamPrakash and Ch. Hanumantha Rao, et. al, test results of conducted, it is concluded that the quarry dust can be used as a partial replacement for fine aggregate. It is obtained that 40% replacement of fine aggregate by quarry dust gives maximum result in strength than normal concrete and then decreases from 50%. The compressive strength is quantified for varying percentage and grades of concrete by replacement of sand with quarry dust. Ravindra Nagar, Vinay Agrawal, Aditya Rana, Anshuman Tiwari, et. al, experimentally evaluated for the feasibility of utilizing granite cutting waste (GCW) as a partial substitute of river sand in high strength concrete based on strength, durability & micro structural attributes at 0.30, 0.35 and 0.40 water cement ratios (w/c) by substituting 0%, 10%, 25%, 40%, 55% and 70% river sand by GCW suggested that 25–40% river sand can be substituted by the GCW with a favorable condition on the obtained the parameters. The maximum amount of GCW to be utilized in concrete depends upon the water-cement ratio of significant concrete.

3. Significance of research

The main goal of present experimental analysis to study the strength and durability properties of cement concrete by partial replacement of fine aggregate with preparation of different percentages of 0%, 5%10%, 15%, 20% and 25% by weight of sand. In this experimental study was carried out on M20 grade of concrete with water cement ratio 0.50.

4. Materials and methodology

A. Cement

In this experimental research obtained by ordinary Portland

cement was utilized all the concrete specimens; the cement was used fresh and without lumps. The experimental testing of cement was done as per Indian standard specification IS 8112-1989. The specific gravity of cement was determined to be 3.12.

B. Water

Potable tap water is used for in this experimental research.

Table 1
Physical properties of cement

S. No.	Description	Results obtained
1	Fineness modulus	3.5%
2	Normal consistency	33%
3	Initial setting time	45minutes
4	Final setting time	480 minutes
5	Soundness	2.5mm
6	Specific Gravity	3.12

Table 2
The physical properties of fine and coarse aggregate

S. No.	Description	Fine aggregate	Coarse aggregate
1	Specific Gravity	2.72	2.68
2	Fineness modulus	6.6	3.10
3	Bulk Density Kg/m^3	1378	1425
4	Impact value	-	22.5%

Table 3
Chemical composition of OPC and rice husk ash

S. No.	Description	OPC	Rice Husk Ash
1	SiO_2	20.45	80.12
2	Al_2O_3	5.02	0.24
3	Fe_2O_3	3.22	0.22
4	CaO	62.63	1.45
5	MgO	4.36	0.48
6	Na2O3	0.10	1.00
7	K_2O	0.61	3.04
8	Loss on Ignition	3.04	2.18

C. Experimental program

The cement concrete cube specimens size of 150mm x 150mm x150mm made up of compressive strength and 150mm diameter and 300mm height for split tensile strength and 100mm dia and 50mm thick for durability studies in the mix ratio 1:1.44:3.19 with water cement ratio 0.50. The following replacement of fine aggregate with and without rice husk ash.

- Cement Concrete with fine aggregate 100% and Rice husk ash 0%.
- Cement Concrete with fine aggregate 95% and Rice husk ash 5%.
- Cement Concrete with fine aggregate 90% and Rice husk ash 10%.
- Cement Concrete with fine aggregate 85% and Rice husk ash 15 %.
- Cement Concrete with fine aggregate 80% and Rice husk ash 20%.
- Cement Concrete with fine aggregate 75% and Rice husk ash 25%.

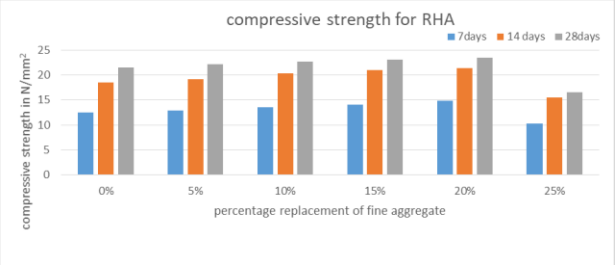

Fig. 1. Compressive strength for RHA concrete

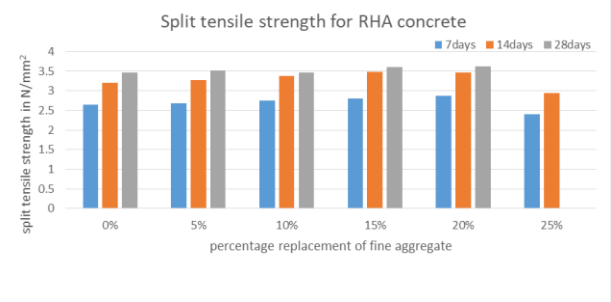

Fig. 2. Split tensile strength of RHA concrete

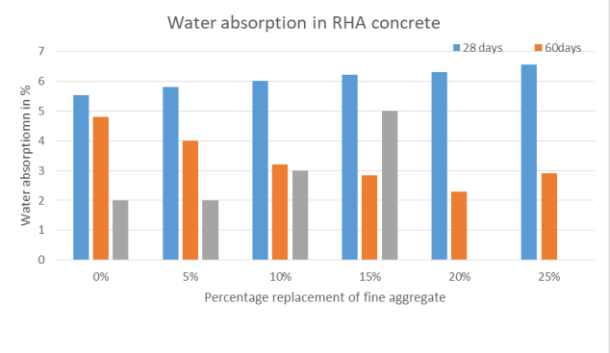

Fig. 3. Water absorption for RHA concrete

5. Results and discussion

The compressive strength and split tensile strength of rice husk ash mixed concrete specimens are given in Table 4 and shown in Fig. 1, 2 and 3. The comparison of the experimental results for 7, 14, and 28days curing period shows that the

Table 4
Strength and durability properties of rice husk ash concrete

S. No.	Replacement of fine aggregate in %	Average compressive strength in N/mm^2			Average split tensile strength in N/mm^2			Average water absorption in %	
		7days	14 days	28days	7days	14days	28days	28 days	60days
1	0%	12.50	18.50	21.50	2.65	3.20	3.47	5.53	4.80
2	5%	12.85	19.20	22.10	2.68	3.28	3.52	5.80	4.00
3	10%	13.50	20.35	22.75	2.75	3.38	3.47	6.00	3.20
4	15%	14.10	21.05	23.10	2.81	3.48	3.60	6.20	2.85
5	20%	14.80	21.35	23.45	2.88	3.460	3.63	6.30	2.30
6	25%	10.30	15.50	16.50	2.40	2.95	3. 04	6.55	2.90

compressive and split tensile strength increases with rice hush ash up to 20 %. Therefore the maximum limit up to 20% of rice husk ash. The water penetration property as pointed out the water absorption of rice husk ash mixed concrete specimens after 28days and 60 days of curing are show in Table 4. It can be seen that 28days curing , the water absorption percentage was increase with rice husk ash upto 25%.This is due to the fact that RHA is finer than OPC and also it is hygroscopic in nature. When the curing time was increased to 60 days the percentage of water absorption values decreased considerably with increase in RHA content up to 20% replacement level.

6. Conclusion

Based on the experimental research the following conclusions are drawn.

The partial replacement of fine aggregate with rice husk ash up to 20% will give the higher strength than compared to conventional concrete. The compressive strength, split tensile strength and water absorption of the concrete specimens increases in the percentage of the rice husk ash which results to increases in strength. .With increase in the percentage of rice husk ash above the limit there will be decrement in the strength of concrete specimens.

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