Impact of Ricehusk Ash as Mineral Admixture In concrete

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Abstract—This study investigates the mechanical behaviors of the concrete when rice husk ash (RHA) is added as the mineral admixture.In the majority of rice producing countries, much of the husk produced from the processing of rice is either burnt or dumped as waste.Rice husks are one of the largest readily available but most under-utilized biomass resources, being an ideal fuel for electricity generation. Due to pozzolonic reactivity, Rice Husk Ash is used as a supplementary cementing material in concrete. This project therefore presents the behavior of concrete made from Ordinary Portland Cement with Rice-Husk Ash (RHA) made from a rice paddy replacement up to the age of 28 days. Six different replacement percentages of cement by RHA, (i.e. 0%, 10%, 15%, 20%, 25% and 30%) were used for the concrete specimens. The results are compared with those of concrete without RHA (i.e. 0% RHA and 100% OPC).RHA thus proves to be an effective pozzoloniccementitious material and provides optimum results at 15% replacement with cement. RHA therefore provides a positive effect on the mechanical strength of concrete mix, up to 15 % Rice Husk Ash replacement up to the age of about 28 days and reduction in utilization of cement, and expenditures.

Keywords—rice husk ash,pozzolonic material and mechanical strength.

I. INTRODUCTION

Supplementary cementitious materials is considered to be effective in meeting most of the requirements of durable concrete and recently blended cements are widely used in many parts of the world.

In the consideration of the fact "wealth to waste", Rice is considered as major food grain for the people of the southern and some of the northern states in India, and also at least 15 other countries in the world. Production of rice paddy is generally made from the production of two byproducts, rice husk and rice bran. Husk, also known as hulls, consists of the outer shell covering the rice kernel. In use, the term rice husk refers to the byproduct produced in the milling of paddy and forms 16-25% by weight of the paddy that is processed. Much of the husk produced from the processing of rice is either burnt for heat or dumped as a waste in much countries.Burning result to the production of the rice husk ash (RHA). Rice husk is extremely available in East and South-East Asia because of the huge rice production in this area. The rich land and tropical climate make for suitability to cultivate rice and is taken advantage by these Asian countries. The husk of the rice is removed initially in the farming process before it is sold and consumed. There are many mineral admixtures that are used in way throughout the world but rice husk ash stands out as an eco- friendly, sustainable and durable option for concrete.

This paper attempts to bring out the effectiveness of rice husk ash. There are many mineral admixtures that are used in way throughout the world but rice husk ash stands out as an eco-friendly, sustainable and durable option for concrete. This paper attempts to bring out the effectiveness of rice husk ash.during burning silica must be kept at the non-crystalline form in order to produce an ash with high pozzalonicactivity.the high pozzalonic activity is necessary if we indend to use it as a substute or as an admixture in concrete.it is founded that the ideal temperature for producing such results is between 600^0 C to 700^0 C

The following properties of concrete are considerably altered when blended with RHA:

1. Reduced heat of hydration – leading to minimal crack formation in higher grades of concrete.
2. Reduced permeability at higher dosages.
3. Increased chloride and sulphate resistance/mild acids.

It has been found to be an effective process to burn this rice husk in kilns to make various outcomes. The rice husk ash is then used as a substitute or admixture in cementfor various strength gaining aspect. Therefore the entire rice product is used in an efficient manner and environmentally friendly approach can be achieved. In this article we will be exploring the various processes and the advantages of using the burnt ash in cement to provide effective and facilitated structural development primarily in the East and South-East Asian regions.

II. MATERIALS AND EXPERIMENTAL PROGRAM

A. Material Properties

Cement

Ordinary Portland cement of 53 grade locally available is used in this investigation. The cement is tested for various properties as per the code IS: 4031-1988 and it is found to be conforming to various specification of IS: 12269-1987 having specific gravity of 3.15

Fine Aggregate

The sand used for this experimental program was locally available and conformed to grading Zone II as per IS: 383-1970. The sand was first sieved through 4.75mm sieve and having specific gravity of 2.67.

Coarse Aggregate

Coarse aggregates which were locally available having the size of 20mm were used in the experimental work. Testing of coarse aggregate was done as per IS: 383-1970. The specific gravity of coarse aggregate is 2.87.

Rice husk Ash

The manufacture and batching of Rice Husk Ash involves bulk handling of a light raw material and proper and a controlled burning methodology has to be adopted. Grinding of the ash is done after necessary cooling and can be done to any desired fineness. The burnt ash must pass through a BS sieve of 75 micron. It contains lime, silica, alumina and iron oxide.

The ash being collected is in ungrounded stage and is grounded by mechanical means using ball mill. The process resulted in the fine ash texture. The whitish color of the ash represents the low carbon content.

Fig. 2. 1. RHA before grinding *Fig. 2. 2. RHA after grinding*

Water

Water is a main ingredient of concrete, as it actively participates in the chemical reactions with cement to form the hydration product such as C-S-H gel. A higher water cement ratio will results in decreases of strength, durability etc. Addition of excess water ends in formation of undesirable voids in hardened cement paste of concrete. The pH value of water lies between 6 & 8 and it should be free from organic matter, acids and other suspended solids. Locally available water conforming to standard specified in IS: 456-2000 is used.

B. Experimental Program

The compressive strength, Split tensile strength and flexural strength for M_{25} grade of concrete were investigated. The cube of 150x150x150mm, cylinder of 150mm dia& 300mm height and prism of 100x100x500mm were used. The test should be carried out as per codal provision IS: 516-1959.

Compressive strength test

Compressive strength test was carried out on the specimens after 7 and 28 days of curing by compression testing machine. The test should be carried out as per codal provision IS: 516-1959. Totally 30 cubes were casted. The compressive strength is calculated as,

$$F_{ck}=P/A$$

Where,

F_{ck}= Compressive strength (N/mm^2)
P = Ultimate load (N)
A = Loaded area (mm^2)

Split tensile strength test

The test is carried out by placing cylindrical specimens horizontally between the loading surfaces of a compressive testing machine and the load is applied until failure of cylindrical specimen. The test should be carried out as per codal provision IS: 516-1959. Totally 30 cylinders were casted. The split tensile strength is calculated by

$$F=2P/\pi DL \ N/mm^2$$

Where,

P= applied load
D= dia of cylinder
L= Length of cylinder

Flexural strength test

The test should be carried out as per the code IS: 516-1959. Flexural strength is calculated by,

$$\text{Flexural strength}= PL/bd^2$$

Where,

P=applied load
b= breadth of prism
d=depth of prism
l= c/c distance between the supports

C. Mix Proportion and Mix Details

The Mix proportion for the ordinary grade concrete and standard concrete is designed using IS: 10262-2009. Material required for 1 cubic meter of concrete in ordinary grade concrete M_{25} is

Table 2.1. Mix Proportion

w/c	Cement	Fine aggregate	Coarse aggregate
0.47	1	1.69	2.93

III. RESULTS AND DISCUSSION

A. Compressive strength test result

Compressive strength test results after 7 and 28 days are given in table. The result shows that the strength gets increases at 15% replacement of cement by RHA.

Table 3.1.Compressive strength test

S. No	Percentage (RHA)	Average Compressive Strength (N/mm^2)	
		7 days	28 days
1	0	20.40	28.67
2	10	18.93	26.52
3	**15**	**23.19**	**30.07**
4	20	20.11	21.60
5	**25**	16.50	21.06
6	**30**	16.28	18.51

The results showed that at early ages the strength was comparable, while at the age of 28 days, 15%RHA concrete exhibited higher strength than the normal concrete. This is illustrated in fig.

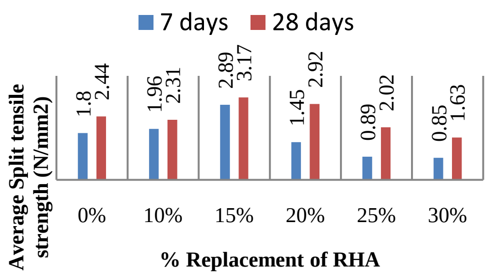

Fig. 3.1. Average compressive strength for M_{25} grade of concrete

B. Split Tensile Strength Test result

Split tensile strength test results after 7 and 28 days are given in table.

Table 3.2. Split tensile strength test

S. No	Percentage (RHA)	Average Spilt tensile strength (N/mm^2)	
		7 days	28 days
1	0	1.80	2.44
2	10	1.96	2.31
3	**15**	**2.89**	**3.17**
4	20	1.45	2.92
5	25	0.89	2.02
6	30	0.85	1.63

The flexural strength properties of RHA concrete was investigated in the laboratory, the results of this investigation are presented in table 3.2. There is improved strength at 7 days test by replacement of RHA. But after 28 days 10% replacement of RHA gives a minimum increased strength moreover equal to the normal concrete. This is illustrated in fig.2.

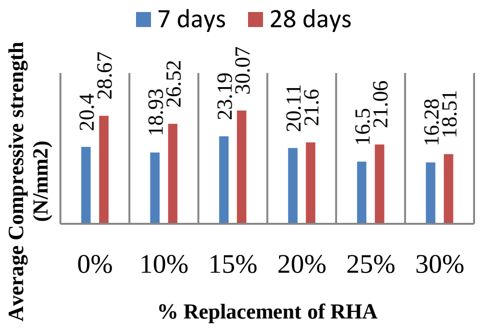

Fig. 3.2. Average split tensile strength for M_{25} grade of concrete

C. Flexural Strength Test

The average flexural strength test result for 7 days and 28 days testing are given in table.

Table 3.3. Flexural strength test

S. No	Percentage (RHA)	Average Flexural strength (N/mm^2)	
		7 days	28 days
1	0	4.27	4.99
2	**10**	**4.07**	**5.50**
3	15	2.47	3.90
4	20	2.49	3.48
5	25	2.31	3.08
6	30	1.59	2.23

The replacement of ordinary Portland cement by RHA up to 10% the strength get increases after that the strength reduces, due to decreases of C_3S.

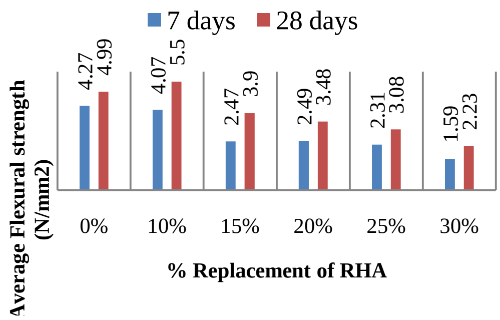

Fig. 3.3. Average flexural strength for M_{25} grade of concrete

IV. CONCLUSIONS

During this experimental study of Rice Husk ash concrete, indicated that a combination of OPC and RHA can be effectively used to optimize the behavior of concrete. A description is given of an optimum combination of cement and RHA in concrete. On the basis of the investigations conducted,

Addition of RHA in concrete proves to give the desired strength in concrete.

- The compressive strength by using 15% of RHA gives 12% and 5% increased strength at 7 and 28 days respectively when compared to conventional concrete.
- The replacement of 15% of RHA gives increased tensile strength of 37% and 23% at 7 and 28 days respectively when compared to conventional concrete.
- There is reduction of 2% flexural strength at 7 days and 9% increased flexural strength at 28 days at 10% replacement of RHA compared to the conventional concrete.
- RHA thus proves to be an effective pozzoloniccementitious material and provides optimum results at 15% replacement with cement.
- From the entire experimental work & studies it is concluded that OPC+15% RHA is the best combination among all mixes, which gives max, tensile & compression strength over normal concrete.
- From this experimental study it is inferred that the incorporation of RHA in concretes results in improved compressive strength and spilt tensile strength.
- As the Rice Husk Ash is waste material, it reduces the cost of construction.

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