Use of Rice Husk Ash in Concrete

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Abstract: This paper summarizes the research work on the properties of Rice Husk Ash (RHA) when used as partial replacement for Ordinary Portland Cement (OPC) in concrete. OPC was replaced with RHA by weight at 5%, 10% and 15%. 0% replacement served as the control. Compressive Strength test was carried out on hardened 150mm concrete cubes after at1, 3, 7, 28, 45 & 56 days curing in water. The results revealed that the Compacting factor decreased as the percentage replacement of OPC with RHA increased. The compressive strength of the hardened concrete also decreased with increasing OPC replacement with RHA. It is recommended that further studies be carried out to gather more facts about the suitability of partial replacement of OPC with RHA in concrete.

Key words: Rice Husk Ash, Cement, Concrete, Compressive strength.

INTRODUCTION

The need to reduce the high cost of Ordinary Portland Cement in concrete has intensified research into the use of some locally available materials that could be used as partial replacement for Ordinary Portland Cement (OPC) in Civil Engineering and Building Works.

Extensive research has established, beyond a shadow of doubt that the most direct, technically sound and economically attractive solution to the problems of reinforced concrete durability lies in the incorporation of finely divided siliceous materials in concrete.

Rice husk is an agricultural waste product which is produced in about millions of tons. Approximately, for 100 Kg of rice, 20 Kg of rice husk are obtained. Rice husks contain organic substances and 20% of inorganic material**.**

Physical characteristics and chemical composition of mineral admixtures can be fulfilled by burning Rice husk into ash. Pozzolanic activity of rice husk ash (RHA) depends on (i) silica content, (ii) silica crystallization phase, and (iii) size and surface area of ash particles. In addition, only a small amount of carbon must be present in ash. Combustion of rice husk at controlled temperature produces RHA that has amorphous silica content and large surface area.

Rice Husk Ash (RHA) has been reported to be a good pozzolan by numerous researchers. During mass concrete, as compared to OPC concrete, RHA is very effective in reducing the temperature of mass concrete.

This research work summarizes the use of Rice Husk Ash as partial replacement for Ordinary Portland Cement in concrete. Compressive strength of the concrete at different level of replacement of RHA with OPC is determined.

MATERIALS AND METHODS

Materials

1. Cement- Ambuja OPC 53 grade of cement was used.
2. Flyash- Ashtech (India) Class F Flyash was used.
3. RHA- RHA was obtained from Orissa, India.
4. Coarse Aggregate- Coarse Aggregates of size 10mm & 20mm were used for this research work. It was sourced from a quarry in Turbe in Mumbai, India.
5. Fine Aggregate- Fine Aggregates used for this research work was crushed sand (VSI). It was sourced from a quarry in Turbe in Mumbai, India.
6. Water- Water was obtained from a boring. The water was clean and free from any visible impurities. It conformed to IS 456-2000 requirements.
7. Admixture- A highly effective superplasticizer Sikament5204NS was being used.
8. Fibre- Poly Propylene fibre manufactured by NINA Company was used.

Mix Design

In this Experimental Work Department of Environment (DOE) Method of Mix Design was used for manufacturing concrete of grade M40. DOE method is standard British method of concrete mix design.

In this method, three replacements of Cement i.e., 5%, 10%, and 15% of PFA with Rice husk ash (RHA) are done, whereas the total binder content remains the same. The mix proportions considered for each replacement by replacement method with RHA are presented in tables.

M40	OPC+PFA 1CUM(KG)	1 CUM WITH RHA (kg)	0.05 CUM (kg)
Cement	400	393.5	19.675
Flyash	130	130	6.5
RHA	0	6.5	0.325
C/Sand	644	644	32.2
C.A 1	440	440	22
C.A 2	640	640	32
Water	182.4	182.4	9.12
Admixture	5.3	5.3	0.265

Table 1: 5% Replacement of OPC with RHA.

M40	OPC+PFA 1CUM(KG)	1 CUM WITH RHA (kg)	0.05 CUM (kg)
Cement	400	387	19.35
Flyash	130	130	6.5
RHA	0	13	0.650
C/Sand	644	644	32.2
C.A 1	440	440	22
C.A 2	640	640	32
Water	182.4	182.4	9.12
Admixture	5.3	5.3	0.265

Table 2: 10% Replacement of OPC with RHA.

M40	OPC+PFA 1CUM(KG)	1 CUM WITH RHA (kg)	0.05 CUM (kg)
Cement	400	380.5	19.025
Flyash	130	130	6.5
RHA	0	19.5	0.975
C/Sand	644	644	32.2
C.A 1	440	440	22
C.A 2	640	640	32
Water	182.4	182.4	9.12
Admixture	5.3	5.3	0.265

Table 3: 15% Replacement of OPC with RHA.

Casting of Samples

Cubic specimens of concrete with size 150 x 150 x 150 mm were cast for determination of all measurements.

Testing of samples

To study the strength development of Rice husk ash (RHA) concrete in comparison to Control concrete, compressive strength tests were conducted at the ages of 1, 3, 7, 28, 45 and 56 days. The tests results are reported in table for control concrete. Table 4 gives the test results of Control concrete and Strength achieved by M40 grade control concrete at different ages as a ration of strength at 28 days.

No of Days	Compressive Strength (MPA)	% Gain At 28 Days (MPA)
1	8	0.178
3	19	0.422
7	30	0.667
28	45	1
45	52	1.156
56	55	1.222

Table 4: Comp.Strength & ratio of 28 days of Control Concrete.

RESULTS AND DISCUSSIONS

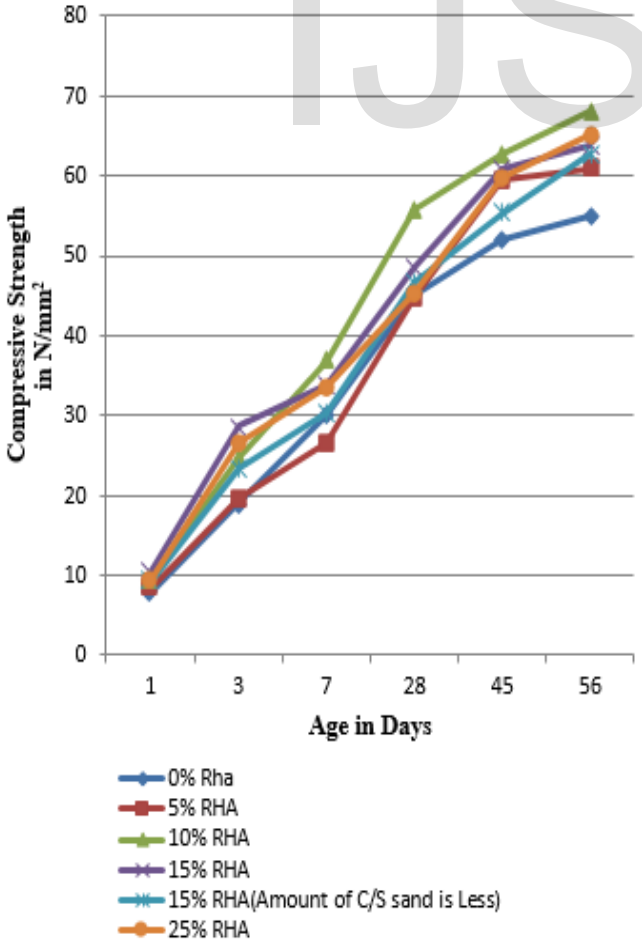

Fig 1: Effect of age on compressive strength of concrete w.r.t different %of replacement of rice husk ash by the weight of Cement

Variation of compressive strength with age is depicted separately for each replacement level of RHA considered namely 5%, 10%, and 15%. Along with the variations shown for each replacement, for comparison a similar variation is also shown for control concrete i.e., for 0%replacement. In each of these variations, it can be clearly seen that, as the age advances, the compressive strength also increases.

Percentage Replacement (%)	Variation (%)
5	+9.375
10	+27.5
15	+32.5

Table 5: Variation in Compressive Strength of Concrete at 1Day W.R.T % Replacement of RHA with OPC.

Percentage Replacement (%)	Variation (%)
5	+1.789
10	+29.895
15	+22.526

Table 6: Variation in Compressive Strength of Concrete at 3Days W.R.T % Replacement of RHA with OPC.

Percentage Replacement (%)	Variation (%)
5	-11.1
10	+22.967
15	+12.6

Table 7: Variation in Compressive Strength of Concrete at 7Days W.R.T % Replacement of RHA with OPC.

Percentage Replacement (%)	Variation (%)
5	-0.422
10	+23.956
15	+8.044

Table 8: Variation in Compressive Strength of Concrete at 28Days W.R.T % Replacement of RHA with OPC.

Percentage Replacement (%)	Variation (%)
5	+14.577
10	+20.519
15	+16.923

Table 9: Variation in Compressive Strength of Concrete at 45Days W.R.T % Replacement of RHA with OPC.

Percentage Replacement (%)	Variation (%)
5	+10.727
10	+23.818
15	+16

Table 10: Variation in Compressive Strength of Concrete at 56Days W.R.T % Replacement of RHA with OPC.

Compressive Strength test was carried out on hardened 150mm concrete cubes after at1, 3, 7, 28, 45 & 56 days curing in water.

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CONCLUSION

At all the cement replacement levels of Rice husk ash, the rate of development of compressive strength up to 28 days is slower as compared with that of concrete in which RHA content is zero, while the rate of development of strength gradually increases after 28 days up to 56 days in case of RHA mixed concrete.

The compressive strength of concrete having 10% replacement was found to be more than the other levels of replacements. (i.e. 0%, 5%, & 15%).

The study shows that the compressive strength of concrete is optimal by replacing OPC by 10% of PFA with RHA keeping total binder content same.

For the desired workability and strength, the water content required in case of RHA mixed concrete was more than in normal concrete. This is because RHA is finer than cement & the fact is that RHA particles being finer it has more surface area and hence water required is comparatively more.

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