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EXPERIMENTAL STUDY ON RICE HUSK ASH AS PARTIAL REPLACEMENT OF CEMENT IN CONCRETE

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Abstract - *Now a days, increasing demand for cement and concrete is met by the partial cement replacement. Partial replacement for the energy intensive Portland cement by industrial by-products can result in Substantial energy and cost savings. Among the different existing residues and by products, the possibility of using rice husk ash in the production of structural concrete is advantageous. Both the technical advantages offered by structural concrete containing rice husk ash and the social benefits related to the decrease in number of problems of ash disposal in the environment have simulated the development of research into the potentialities of this material. Thus the concrete industry offers an ideal method to integrate and utilize a number of waste materials, which are socially acceptable, easily available, and economically within the buying powers of an ordinary man. Presence of such materials in cement concrete not only reduces the carbon dioxide emission, but also imparts significant improvement in workability and durability. The objective of the investigation is to evaluate commercially available RHA as supplementary cementations material for cement. The main aim of this work is to determine the optimum percentage (0, 5, 10, 15 & 20%) of RHA as a partial replacement of cement for testing the compressive strength of M30 grade of concrete.*

Key Words: ***Rice husk ash, workability, cement, optimum percentage, compressive strength***

1. INTRODUCTION

The effect of using RHA as a partial replacement for cement has been investigated in this research. Compressive strength of OPC/RHA sand Crete blocks increases with age of curing and decreases as the RHA content increases (Abdullahi et al (2006) [1]). Concrete incorporating RHA had higher compressive strength and modulus of elasticity at various ages compared with that of the control concrete (Ramezanianpour,A.A. Mahdikhani (2009) [2]). Increasing RHA fineness enhanced the strength of blended concrete compared to coarser RHA (AdylovG.T.Kulgania (2005)[3]). There was a significant improvement in Compressive strength of the Concrete with rice husk ash content of 10% at different ages i.e. 7 days and 28 days (Abhilash,C.K.Singh (2011)[4]). At all the bond substitution levels of Rice husk fiery debris; there is slow increment in compressive quality from 3 days to 7 days. However there is huge expansion in compressive quality from 7 days to 28 days took after by slow increment from 28 days(Ankit Kumar(2016)[5]).

1.1 Scope of work

The main and foremost objective of the present investigation is to evaluate the threshold limit of replacement of cement. This investigation targets to determine the optimum percentage (0, 5, 10, 15 and 20%) of RHA as a partial replacement of cement for M30 grade of concrete.

2. MATERIALS

Concrete mixtures to be examined were made in the laboratory using the following materials: cement, coarse aggregate, fine aggregate, Rice husk ash and water.

2.1 Cement

The Ordinary Portland Cement of 43 Grade conforming to IS 8112 – 1989 was used in this study. The specific gravity of OPC was 3.27.

2.2 Fine Aggregate

Locally available sand conforming to grading zone I of IS 383 –1970.Specific gravity of sand was 2.53.

2.3 Coarse Aggregate

Crushed granite stones of size passing through 20mm sieve and retained on 4.75 mm sieve as per IS: 383-1970 was used for experimental purpose.

2.4 Water

Casting and curing of specimens were done with the potable water that was available in the college Premises.

2.5 Rice husk ash

The concrete material, cement is partially replaced with more natural, local and affordable material like RHA will take care of waste management. RHA from the parboiling plants is posing serious environmental threat and ways are being thought of to dispose them.

Rice Husk was burnt for approximately 60 hours in air under uncontrolled burning process. The temperature at the range of 400-600°C. The ash collected was porous as fine aggregate. Ash are grinding and sieved through IS sieve size 75µm.

3. MIX DESIGN

The mix was designed for M30 grade as per IS: 10262-2009 at ratio of 1:1.3:2.32.The identification of mix proportions and quantity of materials taken for one metre cube of concrete mixes are given in table 1 .Concrete mixes were prepared with cement replacement levels of 0, 5, 10, 15 &20% by rice husk ash.

Table 1- Mix proportion for M30 grade mixture

MIX DESIGNATION	R0	R1	R2	R3	R4
Rice husk ash present (%)	0	5	10	15	20
w/c ratio	0.45	0.40	0.40	0.40	0.40
Cement(kg/m^3)	426	445	421.2	398	374
Rice Husk ash (Kg/m^3)	0	23.4	46.8	70.2	94
Fine aggregate(kg/m^3)	640	621.15	615.5	608.8	601.33
Coarse aggregate(kg/m^3)	1118.7	1085.7	1075.8	1064.25	1051.05

Note: R0-0% Rice husk ash, R1-5% rice husk ash, R2-10% rice husk ash, R3- 15% rice husk ash, R4-20% rice husk ash.

4. TEST RESULTS AND DISCUSSIONS

4.1 Preparation of test specimen

The ingredients for various mixes were weighed and mixes prepared. Precautions were taken to ensure uniform mixing of ingredients. The specimen were cast in steel mould and compacted on a table vibrator. The specimens of 150x150x150 mm size of cube were cast for test.

4.2 Slump cone test

This test is used extensively at work sites all over the world. Slump test for workability of concrete is easy to carry out, it does not measure the workability of concrete directly. This method is quite useful in detecting variations in water content and uniformity of a given proportions.

FIG-1 SLUMP CONE

4.2 Weighing

The quantities of cement, each size of aggregate, and water for each batch shall be determined by weight, to an accuracy of 0.1 percent of the total weight of the batch.

4.3 Mixing of Concrete

The concrete shall be mixed by hand or preferably in a laboratory batch mixer, in such a manner as to avoid loss of water or other materials. Each batch of concrete shall be of such a size as to leave about 10 percent excess after moulding the desired number of test specimens.

4.4 Placing of mix in moulds

After mixing the proportions, the concrete is placed in to the moulds (cubes), which are already oiled .The concrete placed is then compacted by placing the cubes in vibrating machine.

FIG-2 CONCRETE IN MOULDS

4.5 Curing

After 24 hours the specimens were removed from the moulds and immediately placed in clean fresh water, kept there until taken out just prior to testing.

FIG-3 CURING OF SPECIMENS

4.6 Compressive Strength

The type and size of the specimens could affect considerably on compressive strength test results. Cube specimens of dimensions 150 mm × 150mm × 150 mm experienced water curing and then placed in compression testing machine to calculate the compressive strength at 7, 14 days of curing. Replacement of cement by rice husk ash showed in M30 grade concrete. Compressive strength improvement up to the replacement of 5% in all ages. Concrete mixes at 5% rice husk ash level showed 3 to 10% increase in compressive strength. Rice husk ash levels of 15 to 20% showed reduction in compressive strength in all ages as showed in the table 2 and table 3.

FIG-4 COMPRESSION TESTING MACHINE

TABLE 2. Average compressive strength(Mpa) at 7days

MIX SPECIMEN	RHA REPLACEMENT	NO OF SPECIMEN	ULTIMATE STRESS (N/mm^2)	AVERAGE COMPRESSIVE STRENGTH(MPa)
R0	0% RHA	3	14.92 16.57 21.43	17.64
R1	5% RHA	3	23.28 23.61 25.22	24.03
R2	10% RHA	3	18.96 21.21	20.5

			21.30	
R3	15% RHA	3	19.07 19.62 18.94	19.21
R4	20% RHA	3	8.52 9.62 7.88	8.67

Replacement of cement by rice husk ash showed in M30 grade concrete. Compressive strength improvement up to the replacement of 5% in all ages. Concrete mixes at 5% rice husk ash level showed 3 to 10% increase in compressive strength as shown in chart 1 and chart-2.

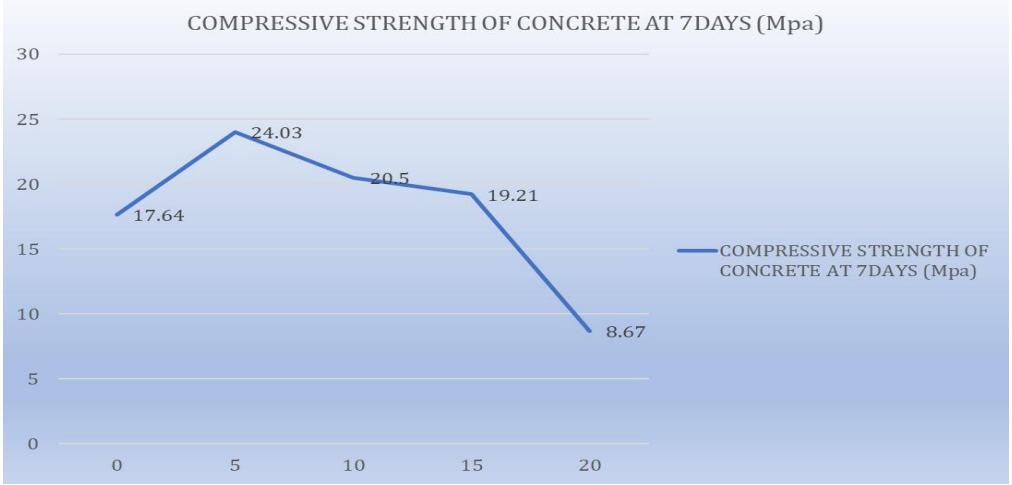

Chart -1: Compressive strength of concrete at 7days (Mpa)

TABLE 3. Average compressive strength(Mpa) at 14days

MIX SPECIMEN	RHA REPLACEMENT	NO OF SPECIMEN	ULTIMATE STRESS (N/mm²)	AVERAGE COMPRESSIVE STRENGTH(MPa)
R0	0% RHA	3	29.88 36.30 28.62	31.6
R1	5% RHA	3	29.50 32.25 30.38	30.71
R2	10% RHA	3	19.00 17.28	19.47

			22.15	
R3	15% RHA	3	19.92 17.55 19.20	18.88
R4	20% RHA	3	12.3 15.00 13.35	13.5

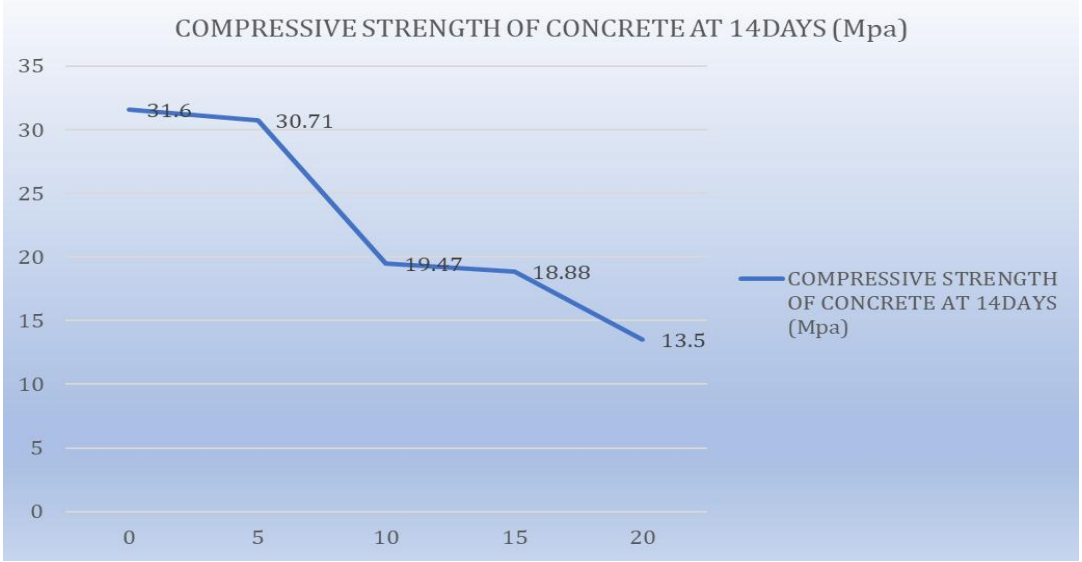

Chart -2 Compressive strength of concrete at14days (Mpa)

5. CONCLUSION

Over the past years, performance-based investigations on concretes by different additives entered extensive areas of test methods. It is generally thought that utility of additives to cement can serve to create mechanical and pro- mechanical aspects of that can be a source of economical and biological benefits, higher levels of slump flow, cohesion of fresh mixture, and strength during hardened state. These aspects leads to more potential opportunities can be understood in its entirely and exploited to improve concrete properties. Here, 5 mix plans varies in RHA proportions by about 0–20% this investigation aimed to present an analysis based on benefits resulting from different contents of RHA.

From the study conducted, the following results obtained:

- Prevention from environmental interferences and reduction of pollutants are issues attributed to cementitious replacements leads to more comprehensive framework to environmental- based issues.
- Replacement of cement by rice husk ash showed in M30 grade concrete. Compressive strength improvement up to the replacement of 5% in all ages. Concrete mixes at 5% rice husk ash level showed 3 to 10% increase in compressive strength. Rice husk ash levels of 15 to 20% showed reduction in compressive strength in 7days and 14days.

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