Influence of Rice Husk Ash on the Properties of Concrete

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ABSTRACT:

This paper summaries ongoing researches about the effect on the properties of concrete (compressive strength, flexural strength initial and final setting time, workability and durability) on the partial replacement of rice husk ash with cement by 0%,10%,20% and 30% of weight to make the concrete environment friendly and less costly. The optimum replacement (with improved properties of concrete) is concluded.

KEY WORDS:

Rice husk ash (RHA), compressive strength, Ordinary Portland Cement (OPC)

I. INTRODUCTION:

Concrete is the world's most used material. It ranked second in its usage. The composition of the concrete (cement, sand and aggregates) comes from earth's crust. Cement its one of the composition librates green house gas CO_2 in its production in huge quantity which is not considerable from environment point of view and also the cost of cement is increasing day by day. Various research work is going on to replace the cement partially by agricultural, industrial wastes such as fly ash, rice husk and blast furnace slag which are cheaply and easily available so that properties of concrete is least affected. Rice husk is an agricultural waste which accounts for 20%-30% of the rice produced annually all over the world [1]. Rice husk has been proven as good pozzolonic material by the various researchers. A pozzolona is a siliceous/ aluminous material which itself has little or no cementitious value and reacts with calcium hydroxide liberated during the hydration of Portland cement (on addition of water) to produce stable, insoluble cementitious compound which imparts strength and impermeability to the mixture [2].RHA used as a replacement of silica fume (cement) or as an admixture in manufacturing of cheap concrete [3].

II. PROPERTIES OF RHA:

Physical Properties of R.H.A

Sr. No.	Particulars	Properties
1	Colour	Grey
2	Shape Texture	Irregular
3	Mineralogy	Non Crystalline
4	Particle Size	< 45 micron
5	Odour	Odourless
6	gravity	2.3
7	Appearance	Very fine

Table 1: Physical Properties of R.H.A [4]

Chemical Properties of R.H.A

Sr. No	Particulars	RHA
1	Silicon dioxide	86.94%
2	Aluminum oxide	0.2%
3	Iron oxide	0.1%
4	Calcium Oxide	0.3-2.2%
5	Magnesium Oxide	0.2-0.6%
6	Sodium Oxide	0.1-0.8%
7	Potassium Oxide	2.15-2.30%
8	Ignition Loss	3.15-4.4%

Table 2: Chemical Properties of R.H.A [4]

III. STATUS OF ONGOING RESEARCHES:

In **1984** it was investigated that up to 40% replacement of cement with RHA results in no significant change in the compressive strength if the rice husk is burnt under optimum temperature condition [5]. In **1996** the rise husk ash (RHA) passing 200 and 325 micron sieves with 10- 30 % replacement of cement indicated that strength of high strength concrete decreased on the replacement of cement by RHA for maintaining same value of workability and optimum replacement of 10 – 20 % was reported [6].In **2004** it was reported that RHA with particle size finer than OPC improves the properties of concrete i.e. addition of RHA causes an increase in the compressive strength [7]. In **2009** it was

studied that the best compressive strength was obtained with the replacement of 10% and it decreased significantly as the content of RHA increased. The initial and final setting times increases with increase in rice husk ash content. The chemical analysis done on rice husk ash revealed that high amount of silica in RHA imparts workability to the concrete [8].

Cement (%)	RHA (%)	Initial Setting Time (Mins)	Final Setting Time (Mins)
100	0	122	183
90	10	136	227
80	20	154	255
70	30	165	275
60	40	213	350
50	50	281	402

Fig.1: Initial and final setting time with R.H.A [8]

In **2012** it was found out that for a replacement of cement up to 20% the compressive strength results in 70-80% of normal concrete. The study shows that the early strength of rice husk ash concrete was found to be less and the strength increased with age. Due to the lower density of RHA concrete the self weight of structure gets reduced which results in overall savings and thus results in reduction of cost [9].In **2013** cement mortars by using rice husk ash (RHA) retained on 45 micron IS sieve with 0-30% replacement was studied and concluded that if approximately 10% of cement is replaced by equal amount of RHA, there is not any significant depreciation in the compressive strength [10].

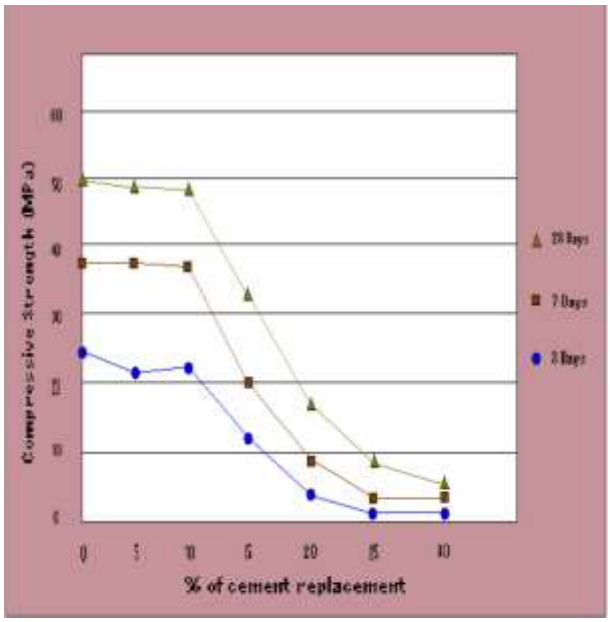

Fig.2: Effect of RHA content on Compressive Strength of Concrete at different curing age [10].

In **2013** it was studied that 25% replacement of cement with RHA gives the same value of compressive strength or workability as for normal concrete. There is little improvement in the Flexural strength with 10 to 25% RHA replacement. Tensile Strength remains unaffected due to the addition of RHA [11]. In **2014** the properties of Concrete was studied with 45 micron rice husk, M30 (1:1.25:2.73) and water-cement content 0.45 with replacement of 0%, 10%, 20% and 30% and concluded that concrete becomes cohesive and more plastic and thus permits easier placing and finishing of concrete and the bulk density of RHA concrete is reduced, early strength gain is slightly increasing with addition of 10%, 20% & 30% RHA in normal concrete at 7 days. But in 28 days tests results it is found that with addition of 20% RHA for M30 grade of concrete, the strength is almost same to normal concrete [4].In **2014** rice husk sieved

through 600 µm sieve and concrete mix proportion 1:2:4 by weight with replacements of 0%, 5%, 10%, 15%, 20% and 25% was studied and concluded that concrete becomes less workable (stiff) as the RHA percentage increases .The Compressive Strengths and Bulk Densities of concrete reduced as the percentage RHA replacement increased. The optimum addition of RHA as partial replacement for cement is in the range 0-20% [12].

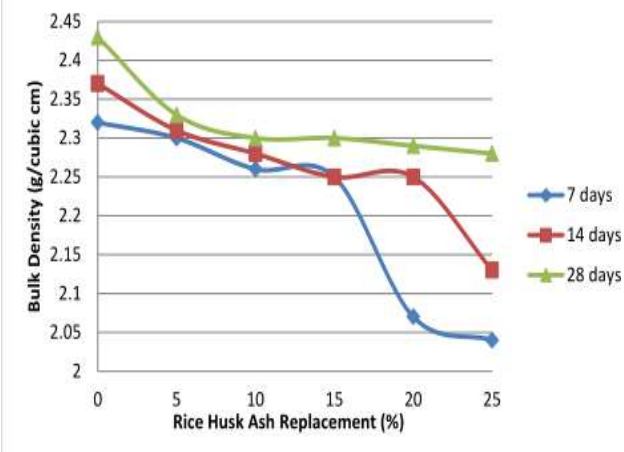

Fig.3: Effect of RHA content on Bulk Density of Concrete at different curing age [12].

In **2014** it was noticed that there is gradual increase in compressive strength from 3 days to 7 days and significant increase from 7 days to 28 days followed by gradual increase from 28 days to 56 days at all the replacement levels. The flexural strength of Rice husk ash concrete is found to be decrease gradually till 7.5% replacement during initial ages and there is a significant decrease in the flexural strength of Rice Husk ash concrete as the age advances. RHA is proved to be good replacement of green house emission products [13].

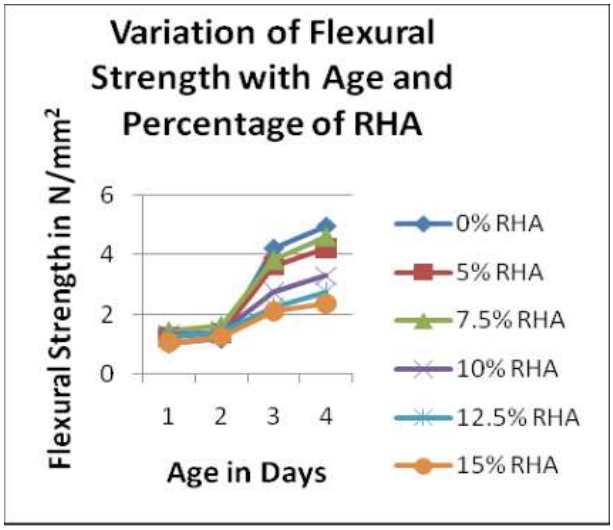

Fig.4: Variation of Flexural with age and percentage of RHA [13]

IV. CONCLUSION

RHA concrete possess a number of good qualities that make a structurally and environmentally good. It helps in reduction of green house gases as well as cost of concrete. After reading a number of research papers I hereby concluded that **5-20%** replacement of cement with RHA helps the concrete in possessing desirable workability, durability, compressive strength, flexural strength and initial and final setting time.

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