Assessment of Concrete Strength using Partial Replacement of Cement for Rise Husk Ash

Anil Kumar Suman, Anil Kumar Saxena, T. R. Arora

Abstract:- Concrete is being widely used for the construction of most of the buildings , bridges, etc throughout the world. Hence it is the backbone to the infra structure development of a nation. India is taking major initiatives to improve and develop its infrastructure by constructing express highways, power projects and industrial structures. A huge quantity of concrete is required to meet out this infrastructure development. Rice husk ash (RHA) is the byproduct of burned rice husk at higher temperature. Considerable efforts are being taken worldwide to utilize natural waste and by product as supplementary cementing materials to improve the properties of cement concrete. RHA is a product of paddy industry. Rice husk ash is a highly reactive pozzolonic material produced by controlled burning of rice husk. Hence currently the entire construction industry is in search of a suitable and effective waste product that would minimize the use of cement and reduce the construction cost. Few of such products have already been identified like Rice Husk Ash. Fly Ash (FA), and Silica Fumes etc. Rice husk ash globally approximately 600 million tons of rice paddy is produced every year. On an average 20% of the rice paddy is husk giving an annual total production of 120 million tones. From rice husk the concept of generating energy has great potential. Rice husks are one of the largest readily available but most underutilized bio mass resources being an ideal fuel for electricity generation. In recent years special attention has been devoted to industrial sectors.

Keywords: RHA, Fly Ash, Rice Husk Ash, pozzolonic, Silica Fumes.

I. INTRODUCTION

RHA has two roles in concrete manufacture as a substitute for cement, reducing the cost and weight of concrete in the production of low cost building blocks. The work presented in this paper reports an investigation on the behavior of concrete produced from blending cement with RHA. In this work the compressive strength of concrete after 7, 14, 28 days is measured. Rice husk ash used is obtained from Kamal Solvent ltd located in Rajnandgaon (Chhattisgarh). RHA, produced after burning of Rice husk (RH) has high reactivity and pozzolonic property. Indian Standard code of practice for plain and reinforced concrete, IS 456-2000, recommends use of RHA in concrete but does not specify quantities Chemical compositions of RHA are affected due to burning process and temperature. Silica content in the ash increases with higher the burning temperature.

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RHA is a great environmental threat causing damage to the land and the surrounding area in which it is dumped .Various ways being thought of for disposing it by making commercial use of this RHA. In the present investigation ordinary Portland cement is replaced by rice husk ash (RHA) at various percentages to study compressive and flexural strength. It is an agro based waste material which is produced in about 100 millions of tons. It is obtained by the combustion of rice husk. This RHA is a great environment threat causing damage to the land and the surrounding area in which is dumped. Lots of ways are being thought of for disposing it by making commercial use of this RHA.

II. REVIEW OF LITERATURE

Houson D F (1972) has investigated that the RHA produced by Burning rice husk between 600 to 700 c temperatures for two hours contains 90% to 95% of SiO_2 and 1% to 3% K_2O. Ramezonian et al (2009) investigated that burning rice husk at temperature below 700^0C produces rice husk ash with high pozzolonic activity. Ismail and walludin (1996) had worked on effect of RHA on high strength 0f concrete .Test result indicated that strength of concrete decreases when cement was partially replaced by RHA above 20%Al Khalaf and yasif (1984) have investigated that the effect of rice husk and pozzolonic behaviour of rice husk ash.They investigated that up to 15% replacement of cement with RHA can be made with no change in compressive strength as compared to controlled mix. Rodary guiz desensele(2002) reported that mortars and concrete containing RHA have compressive strength values inferier or superior to that of OPC concrete. In addition ,in most of the cases mortar and concrete containing RHA improves durability of concrete at various ages. Mehta and pitt (1976) have led to the conclusion that rice husk is properly burnt and ground down to a certain fineness ,can yield a reactive ash which is suitable for partially replacing cement in making concrete.This is because as high as 85% to 95% of the ash by wt is silica (SiO_2) and most of which is reactive depending on the burning process amongst other factors. Mehta (1977) compared the durability of OPC concrete to RHA concrete. Two cylinders ,one of OPC concrete and the other of RHA concrete,were submersed continuously in a 5% HCL solution for a period of 63 days. He found that OPC concrete registered 35% wt loss during the test period and RHA concrete showed only 8% wt loss.

2.1:Properties of Rice husk ash: (Source: From Kamal Solvent, Rajnandgaon)

Physical Properties:

Physical state	Solid-non hazardous
Appearance	Very fine powder
Particle size	25 microns- mean
Color	Grey
Odor	Odorless
Specific gravity	2.11

Chemical Properties:

1- Normal consistency = 16.71 %
2- Initial and final setting time- = 195 minutes and 265 minutes
3- Compressive strength = 11.6 N/mm^2
4- Specific gravity = 2.11

III. EXPERIMENTAL WORKS ON CONCRETE

Tests on Concrete

An M20 mix is designed as per guide lines in IS -10262, 2009 based on the preliminary studies conducted in the constituent material. Test on concrete is obtained as follows –

1- Slump Test
2- Compressive Strength Test
3- Flexural Test

Methods of Testing:

Testing is done as per following IS Code; the testing is done for Compressive strength of cubes as per IS 516-1959 .The testing done for Flexural strength of beam as per IS 516-1959.

3.1: Slump Test:

It is used to determine the workability of fresh concrete. The apparatus used for slump test are: slump cone and tamping rod.

3.2: Compressive Strength Test:

By this single test one judge that whether Concreting has been done properly or not. For most of the works cubical moulds of size 150 mm x 150 mm x 150 mm are commonly used. Concrete is poured in the mould and tempered properly so as not to have any void. After 24 hours these moulds are removed and test specimens are put in water for curing.. These specimens are tested by compression testing machine after 7 days curing or 28 days curing. Load should be applied gradually at the rate of 140 kg/cm^2 per minute till the Specimens fails. Load at the failure divided by area of specimen gives the compressive strength of concrete. The test specimens are stored in moist air for 24hours and after this period the specimens are marked and removed from the moulds and kept submerged in clear fresh water until taken out prior to test

3.3: Flexural Strength Test:

Test specimens shall be prepared by moulding concrete to a beam section, curing and storing in accordance with standard procedure. The section of the beam shall be square of 100 mm. The overall length of the specimen shall be 500 mm. Size (100x100x500) mm the specimen stored in water shall be tested immediately on removal from water. The test specimen shall be placed in the machine correctly cantered with the longitudinal axis of the specimen at right angles to the rollers. For specimens, the mould filling direction shall be normal to the direction of loading.

The Flexural Strength is given by:

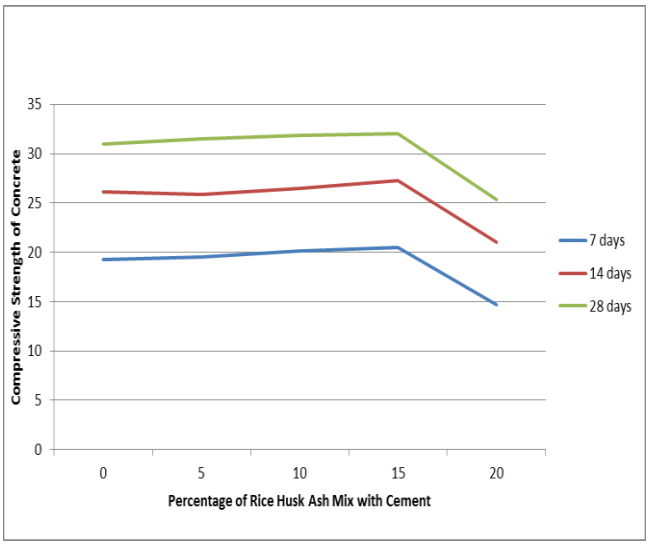
$F_b = pl/bd^2$ Where, b = width of specimen, d = failure point depth, l = supported length

Test results:

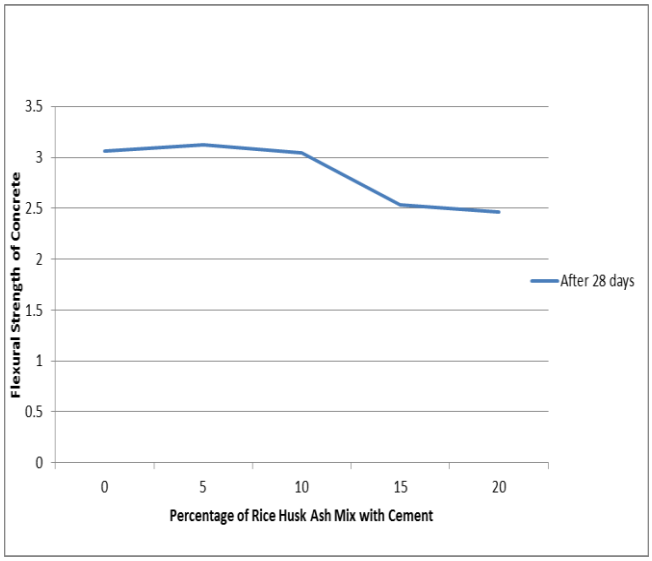
TABLE-1:

Cement OPC	% of RHA	Compressive Strength Strength in N/mm^2			Flexural strength (N/mm^2)
		7 days	14 days	28 days	28 days
Normal concrete	0 %	19.08	26.13	31.04	3.06
95 %	5 %	19.54	25.84	31.52	3.12
90 %	10 %	20.12	26.46	31.89	3.04
85 %	15 %	20.51	27.25	32.06	2.53
80 %	20 %	14.69	21.02	25.33	2.46

Cement + Rice Husk Ash:



Graph-1 Compressive Strength of Concrete with Rice Husk Ash in 7 days, 14 days and 28 days



Graph-2: Flexural Strength of Concrete with Rice Husk Ash after 28 days

IV. CONCLUSION

The following facts are established about RHA concrete from the experiments and results of findings:

1-RHA will bring several improvements to concrete characteristics besides reducing environmental polluter factors.

2-The compressive strength and workability test suggests that RHA can be substituted for OPC cement up to 30% in the production of concrete.

3-The flexural strength studies indicate that there is a marginal improvement with 5% to 15% RHA.

4-Rice husk concrete posses a number of good qualities that make a durable and good structural concrete for both short term and long term considerations.

5-It is good for structural concrete at 15% replacement level.

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