USE OF RICE HUSK ASH IN CONCRET

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Abstract- **The optimized RHA, by controlled burn or grinding, has been used as a pozzolanic material in cement and concrete. Using it provides several advantages, such as improved strength and durability properties, and environmental benefits related to the disposal of waste materials and to reduced carbon dioxide emissions. Up to now, little research has been done to investigate the use of RHA as supplementary material in cement and concrete production .The main objective of this work is to study the suitability of the rice husk ash as a pozzolanic material for cement replacement in concrete. However it is expected that the use of rice husk ash in concrete improve the strength properties of concrete. Also it is an attempt made to develop the concrete using rice husk ash as a source material for partial replacement of cement, which satisfies the structural properties of concrete like compressive strength. From the entire experimental work & studies it is concluded that mix M20 with the replacement of 20% is the best combination among all mixes, which gives the maximum compressive strength.**

Index Terms- **Rice Husk Ash in Concrete, Portland Pozzolana Cement, Cubic strength.**

I. INTRODUCTION

Concrete is a composite man-made material mostly used as building binding material in construction era. Now-a-days concrete is used with advanced and improved technologies such as R.C.C. structures or F.R.C. structures to give extra ordinary strength and durability to the structures against sliding, cracking, buckling, overturning etc. Now-a-days in the field of Civil Engineering era a lot of work has been done related to the experimental study of compressive strength of concrete cubes in which only cement, sand, aggregates and water are used in the form of water-cement ratios with different grade of concrete with steel fiber concrete and silica fume and without Admixture. Admixture are the materials other than the three basic ingredients of cement-concrete-cement, aggregate and water added to the concrete mix before or during mixing to improve certain properties like setting time, workability, dispersion etc.

Construction industry is one of the fastest growing sectors in India. Rapid construction activity and growing demand of houses has lead to the short fall of traditional building materials like bricks, cement, sand and wood. Demand of good quality of building materials to replace the traditional materials and the need for cost effective and durable materials for low cost housing has necessitated the researchers to develop variety of new and innovative building materials. Rice milling generates a byproduct known as husk and this husk is converted in to ash is known as rice husk ash. This RHA in turn contains around 85-90% silica. Silica is the basic component of sand which is used with cement for plastering and concreting. Few researchers have been studied the use of rice husk ash. But they didn't use RHA as a partial replacement material or product with cement-sand-aggregate. In this paper a study has been carried out on compressive strength of concrete cubes using Rice husk 5% and 15% as a partial replacement of cement with M-20 grades of concrete.

This paper deals with the effects and impacts of Admixture and Rice-husk on compressive strength of concrete cubes of M-20 grades and also makes a comparative study for compressive strength of cubes with the replacement of 20% is the best combination among all mixes, which gives the maximum compressive strength.

1.1 What is R.H.A

Rice husk can be burnt into ash that fulfills the physical characteristics and chemical composition of mineral admixtures. 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, ash must contain only a small amount of carbon. The optimized RHA, by controlled burn and/or grinding, has been used as a pozzolanic material in cement and concrete. Using it provides several advantages, such as improved strength and durability properties, and environmental benefits related to the disposal of waste materials and to reduced carbon dioxide emissions.*

RHA produced after burning of Rice husks (RH) has high reactivity and pozzolanic property. Chemical compositions of RHA are affected due to burning process and temperature. Silica content in the ash increases with higher the burning temperature. The effect of partial replacement of cement with different percentages of ground RHA on the compressive strength and durability of concrete is examined.

1.2 Properties of R.H.A

Rice Husk Ash is a Pozzolanic material. It is having different physical & chemical properties. The product obtained from R.H.A. is identified by trade name Silpoz which is much finer than cement.

Fig 1: Rice husk ash (R.H.A)

Table 1: Physical Properties of R.H.A

S.No	PARTICULARS	PROPERTIES
1	Colour	Gray
2	Shape texture	Irregular
3	Mineralogy	Non crystalline
4	Particle size	>45 micron
5	Odour	Odourless
6	Specific gravity	2.3

Table 2: Chemical properties of R.H.A

S.No	Particulars	Proportion
1	Silicon dioxide	86.94%
2	Aluminum oxide	0.2%
3	Iron oxide	0.1%
4	Calcium Oxide	03.-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%

1.3 MATERIALS USED

(A) Rice Husk Ash (RHA).

Rice Husk Ash was burnt for approximately 72hours in air in an uncontrolled burning process. The temperature was in the range of 400-600 degree C .The ash collected was sieved through BS standard sieve size 75µm and its colour was grey.

(B) Cement

Ordinary Portland cement (OPC) of 43 grade was used in which the composition and properties is in compliance with the Indian standard organization.

Cement can be defined as the bonding material having cohesive & adhesive properties which makes it capable to unite the different construction materials and form the compacted assembly. Ordinary/Normal Portland cement is one of the most widely used type of Portland Cement. The name Portland cement was given by Joseph Aspdin in 1824 due to its similarity in color and its quality when it hardens like Portland stone. Portland stone is white grey limestone in island of Portland, Dorset.

B (i) The chief chemical components of ordinary Portland cement are:

1. *Calcium*
2. *Silica*
3. *Alumina*
4. *Iron*

Calcium is usually derived from limestone, marl or chalk while silica, alumina and iron come from the sands, clays & iron ores. Other raw materials may include shale, shells and industrial by products.

B (ii) BASIC COMPOSITION

Contents	***%***
i. *CaO*	*60-67*
ii. *SiO2*	*17-25*
iii. *Al2O*	*3 3-8*
iv. *Fe2O*	*3 0.5-6.0*
v. *MgO*	*0.5-4.0*
vi. *Alkalis*	*0.3-1.2*

vii. *SO 3 2.0-3.5*

The chief compound which usually form in process of mixing:

1. *Triclcium silicate (3CaO.SiO2)*
2. *Dicalcium silicate (2CaO.SiO2)*
3. *Tricalcium aluminates (3CaO.Al2O3)*
4. *Tetracalcium aluminoferrite (4CaO.Al2O3.Fe2O3)*

B(iii) CHARATERSTICS OF OPC 43 GRADE

1. *Durable*
2. *Corrosion resistance*
3. *Low heat of hydration*
4. *Volume stability*
5. *Gigantic compressive strength*

B (v) USE OF OPC 43 GRADE

The most common use for Portland cement is in the production of concrete. Concrete is composite material Consisting of aggregate (gravel and Sand), Cement and water. As a construction material, concrete can be cast in almost any shape desired, and once hardened, can become a structural (load bearing) element. Concrete can be used in the construction of structural elements like panels, beams, road furniture, or may make cast-in situ concrete for building superstructures like roads and dams. These may be supplied with concrete mixed on site, or may be provided with "ready-mixed" concrete made at permanent mixing sites. Portland cement is also used in mortars(with sand and water only) for plasters and screeds, and in grouts (cement/water mixes squeezed into gaps to consolidate foundations, road-beds, etc.). When water is mixed with Portland cement, the product sets in a few hours and hardens over a period of weeks. These processes can vary widely depending upon the mix used and the conditions of curing of the product, but a typical concrete sets in about 6 hours and develops a compressive strength of 8 MPa in 24 hours. The strength rises to 15 MPa at 3 days, 23 MPa at 1 week, 35 MPa at 4 weeks and 41 MPa at 3 months. In principle, the strength continues to rise slowly as long as water is available for continued hydration, but concrete is usually allowed to dry out after a few weeks and this causes strength growth to stop.

(C) AGGREGATES

The inert mineral materials such as sand, gravel, etc used for manufacture of concretes are known as aggregates. Requirements Of Good Aggregates

1. *It should be sufficiently strong.*
2. *It should be hard*
3. *It should be durable*
4. *It should have rough surface.*
5. *It should be in spherical or cubical in shape.*

D (i) Classification of Aggregate

1. *Coarse Aggregates*
2. *Fine Aggregates*

Coarse aggregates –

The aggregate which pass through 75mm IS sieve and retain on 4.75mm IS sieve are known as coarse aggregates.

Fine aggregates –

The aggregate which pass through 4.75 mm IS sieve and retain on 75 micron IS sieve are known as fine aggregates.

*****The research work is restricted to sand collected from the river. The sand was collected to ensure that there was no allowance for deleterious materials contained in the sand and the size of 5mm. In this research, granite of 20mm maximum size was used.

(E) Water

Water plays an important role in concrete production (mix) in that it starts the reaction between the Cement, pozzolan and the aggregates. It helps in the hydration of the mix. In this Research, the water used was distilled water.

II. METHODOLOGY

Out of many test applied to the concrete, Compressive strength of concrete is the utmost important which gives an idea about all the characteristics of concrete. By this single test one judge that whether Concreting has been done properly or not. According to I.S. 456-2000 compressive strength of different grades of concrete is tabulated below in Table 1. Similarly, according to I.S. 456-2000 types of mixes are: (1) Nominal Mix (2) Standard Mix and (3) Designed Mix. Out of these, Standard Mix Design Method has been adopted here in this experimental study. In this paper only M-20 grade of Concrete Mix design has been prepared by weight that the ingredients cement, sand and aggregates with required water. Mixing was done by in a laboratory batch mixer. The specimens were cast in steel mould and compacted on a table vibrator. The specimens of 150 mm × 150 mm × 150 mm size of cube were cast for the determination of compressive strength. Curing of the specimens was started as soon as the top surface of the concrete in the mould was hard enough. Spreading wet gunny bags over the mould for 24 hours after the casting was carried out for the initial curing. The specimens were later placed immediately in water tank for further curing.

Table 1 Compressive strength of different grades of concrete at 7 and 28 days

Grade of Concrete	Minimum compressive strength N/mm^2 at 7 days	Specified characteristic compressive strength (N/mm^2) at 28 days
M15	10	15
M20	13.5	20
M25	17	25
M30	20	30
M35	23.5	35
M40	27	40
M45	30	45

First of all six concrete cubes were cast and prepared without RHA with required quantity with respect to volume of cement used in standard mix design of M-20 grade concrete.

Similarly, six cubes were molded with required quantity of Rice husk ash in partial replacement of cement six cubes of M-20 Mix with 20% of RHA has been used in partial replacement of cement ingredient for preparation of six cubes. These specimens were tested by compression testing machine after 7 days and 28 days curing.

This is a generalized methodology adopted one by one to determine the compressive strength of M-20 mix with use of Admixture and Rice husk ash respectively.

III. EXPERIMENTAL ANALYSIS

An experimental study has been carried out in laboratory to find the compressive strength of M-20 mix concrete cubes at 7 and 28 days by using Admixture and Rice husk respectively.

3.1 Procedure for making cubes without RHA.

1 *To perform experimental study in laboratory six concrete cubes without RHA has been prepared in specimen of size: 15cm×15cm×15cm for M-20 grade respectively.*

2 *Since for one cubic meter concrete mix 350kg cement is M-20 grade ratio 1:1.5:3 (cement: sand: Aggregates) with required quantity of water with respect to 0.4 water-cement ratio. These cubes were placed in to water tank for curing of 7 and 28 days.*

3 *Compressive strength of concrete cubes was determined in compressive testing machine.*

4 *Results from the experimental work have been plotted in MS-Excel sheet after calculations.*

3.2 Procedure for making cubes with Rice Husk Ash (RHA)

(1) *To prepare next six cubes with 20% rice husk as partial replacement of cement, M-20 mix according to 1:1.5:3 ratios was designed. Ordinary Portland cement of 43 grades and Crushed lime stone*

coarse aggregate were used for the present experimental investigation. The rice husk ash used in cement concrete in experiment was prepared by burning the husk in open air at temp of about 1000^{o}C. When it was done in a closed chimney it did not remove its carbon content and produced a black powder, which could be hazardous for concrete when mixed.

(2) *This concrete is poured in the moulds and tempered properly. After 24 hours these moulds are removed and test specimens are put in water for curing.*

(3) *These cubes were tested in compression testing machine after 7 days and 28 days curing.*

(4) *Results from the experimental work have been plotted in MS-Excel sheet after calculations.*

IV. RESULTS & DISCUSSIONS

After conducting of experimental study on compressive testing machine to find out the compressive strength of concrete cubes without RHA and with Rice Husk ASH at 7 and 28 days following results is concluded here-

4.1 Compressive Strength of Concrete Cubes without RHA.

Because standard ratio (1:1.5:3) for making 12 cubes hence material ratio is increased in the form of standard ratio as (12.36kg: 30.12kg: 45.48kg.) i.e. cement, sand and aggregates. Water was taken 0.47 for one cube as 0.4 of water-cement ratio.

Results of Compressive strength of cubes without RHA are listed below in Table 1. Results obtained from experimental analysis shows that by using in concrete mix design compressive strength of concrete cubes increases at 7 and 28 days respectively as compared to with RHA shown in Table 1.

4.2 Compressive Strength of Concrete Cubes with Rice Husk Ash for M-20 grade (1:1.5:3)

Because standard ratio for M-20 mix (1:1.5:3) for making 12 cubes at 7 and 28 days respectively with 20% RHA as a partial replacement of cement so material ratio was increased in the form of standard ratio.

First of all for making of 12 cubes, ratio of cement: sand: aggregates were taken as (9.347kg: 30.12kg: 45.48kg). Since in this ratio, with 20% RHA ratio of quantity of RHA was taken as 3.012 kg. Quantity of water was added as 0.4 of water-cement ratio.

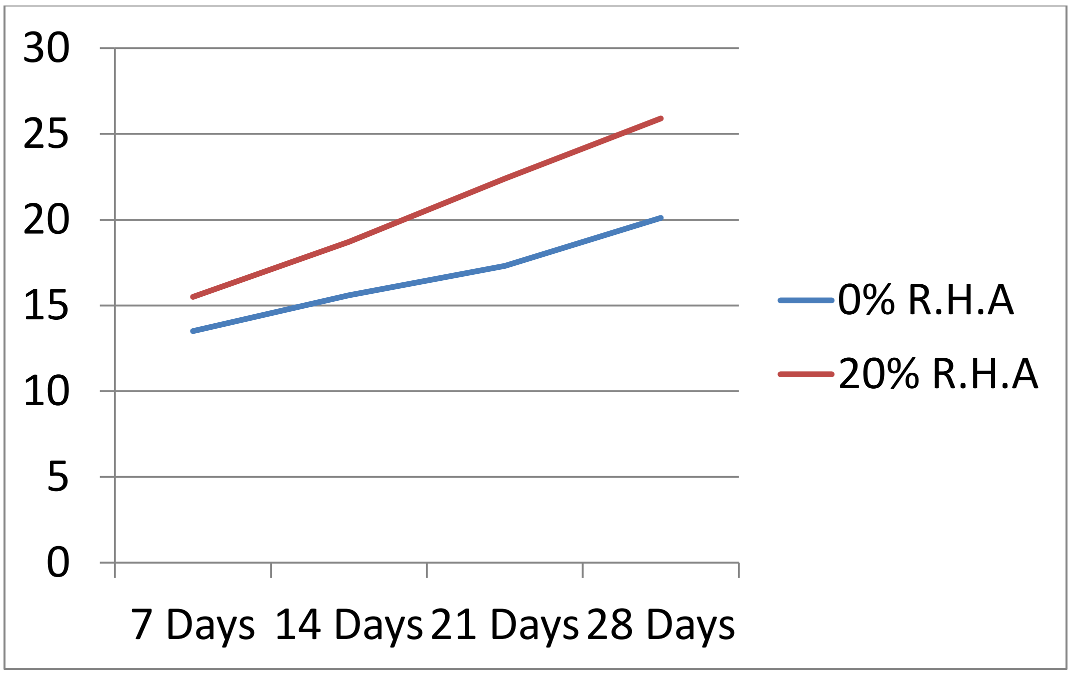
Results were obtained for compressive strength of concrete cubes at 7 and 28 days without RHA and 20% RHA respectively are presented in Table 1.

Compressive Strength

Table 1. Compressive M-20 grade concrete strength at different curing days

	M-20 Grade Concrete Compressive Strength (n/mm2)	
DAYS	(0% R.H.A)	(20% R.H.A)
7	13.5	15.5
14	15.6	18.7
21	17.3	22.4
28	20.1	25.9

FIG: 1 Graph Shows Variation in Compression Strength



V. CONCLUSION

Based on the limited study carried out on the strength behavior of Rice Husk ash, the following conclusions are drawn

- *At all the cement replacement levels of Rice husk ash; there is gradual increase in compressive strength from 3 days to 7 days. However there is significant increase in compressive strength from 7 days to 28 days followed by gradual increase from 28 days.*
- *By using this Rice husk ash in concrete as replacement the emission of greenhouse gases can be decreased to a greater extent. As a result there is greater possibility to gain more number of carbon credits.4.*
- *The technical and economic advantages of incorporating Rice Husk Ash in concrete should be exploited by the construction and rice industries, more so for the rice growing nations of Asia.*
- *RHA based sand cement block can*

significantly reduce room temperature. Hence air conditioner operation is reduce resulting in electric energy saving.

- *Moreover with the use of rice husk ash, the weight of concrete reduces , thus making the concrete lighter which can be used as light weight construction material.*

- *The pozzolonic activity of rice husk ash is not only effective in enhance the concrete strength, but also in improving the impermeability characteristics of concrete*

- *As the Rice Husk Ash is waste material, it reduces the cost of construction.*

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