PARTIAL REPLACEMENT OF CEMENT WITH RICE HUSK ASH

[1]Prof. Amol J. Padwal , [2]Mr. Khandagle Vaibhav G. , [3]Mr. Patil Sachin E. , [4]Mr. Pawar Vaibhavraj S. , [5]Mr. Patil Tushar D.

[1]Professor, [2,3,4,5]Students, Civil Engineering Dept. , Genba Sopanrao Moze College of Engineering, Balewadi, Pune (Maharashtra)

ABSTRACT

Due to pozzolanic reactivity, Rice Husk Ash is used as a supplementary cementing material in concrete. It has economical and technical advantages to be used in concrete. I am going to partially replace cement by the use of RHA by 10% & 15% & 20% by weight of cement in four different experiment to find out the maximum strength and compare it with the strength of normal concrete by using the grade of M30 at the days of 7days,14days&28 days. This research therefore is an investigation of the performance of the concrete made of partially replacing OPC with RHA on the structural integrity and properties of RHA concrete.

I. INTRODUCTION

Traditionally, rice husk has been considered a waste material and has generally been disposed of by dumping or burning, although some has been used as a low-grade fuel. Nevertheless, RHA has been successfully used as a pozzolana in commercial production in a number of countries including India. RHA use in the civil construction field may be a viable solution to its disposal as waste on the environment. Interest in RHA utilization by the construction industry is not new. The process was investigated by Mehta [1977], who observed that it was possible to obtain ashes rich in silica (in crystalline or glassy state) depending on the combustion conditions. In the glassy silica case, highly pozzolanic ashes would be obtained, which would be adequate for partial substitution of Portland cement. Pozzolanic definition by ASTM C618 [1978] is a siliceous or siliceous and aluminous material which, in itself, possesses little or no cementitious value but which will, in finely divided form in the presence of moisture, react chemically with calcium hydroxide at ordinary temperature to form compounds possessing cementitious properties.

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. As per study by Hwang and Wu [1989] RHA produced by burning rice husk between 600 and 700°C temperatures for 2 hours, contains 90-95% SiO_2, 1-3% K_2O and < 5% un burnt carbon. Under controlled burning condition in industrial furnace, conducted by Mehta [1992], RHA contains silica in amorphous and highly cellular form, with 50-1000 m^2/g surface area. So use of RHA with cement improves workability and stability, reduces heat evolution, thermal cracking and plastic shrinkage. This increases strength development, impermeability and durability by strengthening transition zone, modifying the pore-structure, blocking the large voids in the hydrated cement paste through pozzolanic reaction. RHA minimizes alkali-aggregate reaction, reduces expansion, refines pore structure and hinders diffusion of alkali ions to the surface of aggregate by micro porous structure. These properties are difficult to achieve by the use of pure Portland cement alone.

Recent study on the use of RHA as a construction material has been reported by Jayasankar et al. [2010], Nargale et al. [2012] and Sandesh et al. [2012], where the amount of replacement varies from 0 to 20% without varying the grade of ordinary Portland cement (OPC). The strength gained in concrete when OPC was partially replaced by a material processing pozzolanic property also depends upon the grades of OPC [Marthong, 2002]. Different grades of OPC are available depending on the respective country codal classification. Bureau of Indian Standard (BIS) normally classify three grades of OPC namely: 33, 43 and 53, which are commonly used in construction industry. Indian Standard code of practice for plain and reinforced concrete [IS 456, 2000], recommends use of RHA in concrete but does not specify quantities. The possibility of using RHA as part replacement of OPC need to be investigate for confident used of these materials. The review of literature however, could not find any comparative study on the effect of concrete properties when cement of varying grades were partially replace by RHA are addressed together. Thus, in the present work a holistic approach was adopted to investigate the possibility of using RHA as a construction material. The contributions to strength gain, improvement in durability, water absorption and shrinkage are the main parameter of study.

II. MATERIALS AND METHODS

Materials

A. Cement

Ordinary Portland cement (OPC) was used in which the composition and properties is in compliance with the Nigerian standard organization defined standard of cement for concrete production.

B. Fine Aggregate

Fine aggregate was purchased which satisfied the required properties of fine aggregate required for experimental work and the sand conforms to zone III as per the specifications of IS 383: 1970.

C. Coarse Aggregate:

Crushed granite of 20 mm maximum size has been used as coarse aggregate. The sieve analysis of combined aggregates confirms to the specifications of IS 383: 1970 for graded aggregates.

D. Water

Water is an important ingredient of concrete as it actively participates in the chemical reaction with cement. Since it helps to form the strength giving cement gel, the quantity and quality of water is required to be looked in to very carefully. Mixing water should not contain undesirable organic substances or inorganic constituents in excessive proportions.

E. Rice Husk Ash (RHA).

After collection, the Rice Husk is burnt under guided or enclosed place to limit the amount of ash that will be blown off. The ash is ground to the required level of fineness and sieved through 600 μm sieve in order to remove any impurity and larger size particles.

Methods

A. Batching and mixing of materials

Batching of materials was done by weight. The percentage replacements of Ordinary Portland cement (OPC) by Rice Husk Ash (RHA) were 0%, 10%, 15% and 20%. The 0% replacement was to serve as control for other samples.

B. Concrete Mix Design

The concrete used in this research work was made using Binder, Sand and Gravel. The concrete mix proportion was 1:1.5:3 by weight.

C. Casting of samples

Cubic specimens of concrete with size 150 x 150 x 150 mm were cast for determination of all measurements. Six mixes were prepared using different percentages of 0, 10, 15 and 20 RHA. The concrete was mixed, placed and compacted in three layers. The samples were demoulded after 24 hours and kept in a curing tank for 7, 14 and 28 days as required. The Compacting Factor apparatus was also used to determine the compacting factor values of the fresh concrete in accordance with BS 1881: Part 103 (1983).

D. **Testing of samples**

Testing is done as per following IS code. The testing done for compressive strength of cubes were measured 7,14, 28 as per IS : 516 – 1959 ,the testing done for flexural strength of beam were measured 28 days as per IS : 5816 - 1999 and the testing done for split tensile strength of cylinder were measured 28 days as per IS : 516 – 1959.

E. Physical Properties

Table 1: Physical Properties of Rice Husk Ash

Physical state	*Solid-non hazardous*
Appearance	Very fine powder
Color	Grey
Odor	Odorless
Specific gravity	**1.7**

A. Workability

The slump and compacting factors test decreased upon the inclusion of RHA as partial replacement of OPC. Thus, it can be inferred that to attain the required workability, mixes containing RHA will required higher water content than the corresponding conventional mixes. The workability (slump) of concrete for 33, 43 and 53 grades OPC varies from 24, 20 and 15 mm for concrete containing 40% RHA respectively. The higher value of slump is obtained for concrete with cement of 33 grades and least for 53 grades cement. This behaviour was as expected because higher the grade of cement the more fine it is. Finer cement requires more water to wet the surface particles.

D. Compressive Strength

The variation of cubes strength at different ages of 7, 28 days with different grades of OPC and various percentages of RHA contents. The compressive strength of concrete in all grades of OPC at early age is significantly higher than that of concrete produced with RHA. It was also observed that compressive strength continued to increase with age but decreased with RHA contents in all grades of OPC. The strength reduction was found to be lower for higher grade OPC. Comparison on the attaining of strength at 28 days it was observed RHA with 43 and 53 grades OPC attained about 60% of strength as compared to normal concrete, while RHA with 33 grades OPC could attain only 50% of its strength. This comparison shows that RHA 43 and 53 OPC with medium workability concrete compared favorably with OPC concrete in term of early strength development. In long term strength gain , RHA 43 and 53 grades OPC attained about 75% strength as compared to concrete with 0% RHA replacement, while RHA 33 grades OPC the strength gain was about 55% only. The comparison clearly shows that strength of RHA concrete slightly increase with age in all three grades of OPCs. Thus it indicate that replacement by RHA for 43 and 53 ;8grades OPC is seems to be better in term of ultimate strength gain than that of 33 grades OPC. The same behavior was also observed by Marthong [2002] when OPC of various grades were partially replaced by class-F fly ash. However, the optimum strength of RHA concrete was observed to be 10% replacement in all the three grades of OPCs.

E. Shrinkage

The consistency of RHA cementitious paste decreased as compared to OPC cement paste. This shows reduction in water demand and should reduced shrinkage. However, in the present study it has been observed that the shrinkage of specimens with 40% RHA content measured at the age found to be same as that of pure concrete at each proportion. Hence it may be Concluded that influence on RHA is negligible.

F. Water Absorption

The variation in water absorption with RHA contents. The water absorption was calculatedon the basis of initial soaked cube and then oven dried. The test results depict that water absorption up to 20% replacement decreased with the inclusion of RHA in all grades OPC as compared to pure cement and there after start increasing. The water absorption of 53 grade OPC concrete with RHA content is least than the other two and being maximum for 33 grades OPC concrete. This behaviour may be due to the fact that, 53 grade cement is finer and 33 grade OPC being coarser particles. Thus, permeability of paste with coarser cement particle is higher. The water absorption of RHA concrete also varies with age of concrete. The results also depict that water absorption too decreased with age. With age the water absorption decreased because gel gradually fills the original water filled spaces.

G. Durability

The variation in compressive strength with RHA content for 28 days exposed in sulphate solution and tap-water. It is observed that for each grades of cement the strength of ordinary cube and that partially replaced by RHA immersed in sulphate solution have less compressive strength than the corresponding referral cubes immersed in tap-water. Strength decreases as RHA contents increased. The decreased in cube strength exposed in sulphate solution over that exposed in tap-water are about 9% for ordinary cubes and that of 40% RHA content are about 10% for all grades of OPC. Thus, inclusion of RHA as partial replacement of cement seems that it does improve the durability when exposed to sulphate environment. Comparing all the three grades of OPC, the strength loss seem to be betters for 53 grade OPC as compared to the other two grades.

III. CONCLUSION

From the investigations carried out, the following conclusions can be made:

The optimum addition of RHA as partial replacement for cement is in the range 10-20%.

The compacting factor values of the concrete reduced as the percentage of RHA increased.

The Bulk Densities of concrete reduced as the percentage RHA replacement increased.

ISBN: 978-93-86171-12-2

The Compressive Strengths of concrete reduced as the percentage RHA replacement increased.

Using RHA as replacement of OPC in concrete, the emission of greenhouse gases can be reduced up to a greater extent.

OPC replacement by RHA results in reduction of cost of production of concrete in the range of 7 to 10%.

OPC replacement by RHA is environmental friendly due to utilization of waste.

ACKNOWLEDGEMENT

We on the behalf of this acknowledgement wants to thanks those persons and resources due to which we are able to complete the Reasearch Work. First of all we would like to thanks G. S. Moze college of Engineering, Balewadi Pune for their Idea to engage students In such activity due to which We students open up to vast engineering applications. We also would like to express our Gratitude to our respected H. O. D. of Civil Engineering Department Prof. Bharti Gavhane and Faculties for their planning and guidance which proved a milestone in this this work.. We are also grateful to our parents and friends for their help and Encouragement.

REFERENCES

[1.] Satish H Sathawane,Vikrant S. Vairagade & Kavita S. Kene, 2013, "Combine effect of Rice Husk Ash and Fly Ash on concrete by 30% cement replacement."

[2.] P. Padma Rao, A. Pradhan Kumar & B. Bhaskar Singh, 2014,"A study of Rice Husk Ash in concrete."

[3.] Ephraim et. al, (2012): Compressive Strength of Concrete with RHA as partial replacement of ordinary Portland cement. Scholarly Journal of Engineering Research Vol. 1(2) pp32-36.

[4.] Cook, D. J. (1996): "Rice Husk Ash" increment Replacement Materials, Concrete Technology and Design, Vol. 3 Ed. R.N Swamy, Surrey University Press, Uk.

[5.] Ganesan, K, Rajagopal, K. Thangavel, K. Selvaraji, R Sara Swarthi, V. "Rice Husk Ash – As Versatile Supplementary Cementitious Material "India Concrete Institute Journal, March 2004