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Effect of rice husk ash on partial replacement of cement in concrete

Ronak Devasia
ronakdevasia2011@gmail.com
Gharda Institute of Technology, Ratnagiri, Maharashtra

Aniket Auti
aniketauti11@gmail.com
Gharda Institute of Technology, Ratnagiri, Maharashtra

Prasad Shirgaonkar
prasadshirgavkar@gmail.com
Gharda Institute of Technology, Ratnagiri, Maharashtra

Ashutosh Surve
surveashu20@gmail.com
Gharda Institute of Technology, Ratnagiri, Maharashtra

Dr. Amardeep Bhosale
adbhosale@git-india.edu.in
Gharda Institute of Technology, Ratnagiri, Maharashtra

ABSTRACT

Cement is the most expensive constituents of the concrete. Over 5% global CO2 emission is attributed by cement production. In this work alternative source for cement as rice husk ash is used. A comparative study is carried on properties of concrete when cement is partially replaced with rice husk ash. Percentage replacement of cement with RHA is varied as from 10%, 15% and 20% with silica fumes kept as constant at 10%. Silica fumes are very reactive pozzolan and are considered having higher durability and strength inhibiting properties which may contribute in attaining the required characteristic properties of concrete. The compressive strength is found at 7 and 28 days. The strength is then compared to standard concrete and the optimum percentage of replacement of RHA is found out.

Keywords— *Rice Husk Ash, Compressive test, Partial replacement*

1. INTRODUCTION

Concrete is the key material used in various types of construction, from the flooring of a house to a multi-storied high-rise structure. Concrete is one of the versatile heterogeneous materials. It is mainly a mix of cement, sand and aggregates, Aggregates being both coarse and fine types of aggregate. Cement used in the concrete mix acts as a binder between the constituent materials. Many researchers have done work to increase strength and to improve durability of concrete by replacing the cement content or by finding an alternative for sand or by replacing the type of aggregate to be used in concrete mix.Out of the various materials used in the production of concrete, cement plays a major role due its size and adhesive property. Fly ash, Rice husk ash, Silica fume etc. is some of the pozzolanic materials which can be used in concrete as partial replacement of cement. Even though it's a conventional method it is so far one of the inexpensive methods used for mass concrete production.

Addition of RHA not only reduces the amount of cement that goes in a concrete but also reduces the temperature of mass concrete. Also, the main goal is to achieve maximum compressive strength by replacing maximum proportion of RHA as possible. Silica fumes are used as the filler material because of its chemical and physical properties which is a very reactive pozzolan. Concrete containing silica fume can have very high strength and can be very durable.

2. EXPERIMENTAL STUDY

2.1 Material Used

(a) Cement: ACC OPC grade 53 was used.
(b) Rice Husk Ash: The RHA was obtained from a nearest 'Rice Mill' from Khed, India.
(c) Fine Aggregates: The aggregates which passes through sieve size (4.75mm) is known as fine aggregates. We have used sand as well as crushed sand as fine aggregates.
(d) Coarse Aggregates: 10mm and 20mm aggregate was used in this study in a proportion of 60% course aggregate retaining on 10mm sieve and 40% course aggregate retaining on 20mm sieve respectively.
(e) Silica fumes: A by-product termed micro silica or silica fumes were obtained from an industry in Thane, India.
(f) Water: The water used in Research work was of boring well. There were no visible impurities in the water and was confirmed with IS 456-2000.
(g) Admixture: A super plasticizer named SNF 340 was used in the mix.

2.2 Mix Design

The mix proportion was carried out based on the guidelines by IS.12062.2009. The Mix design was carried out for M20 grade of concrete with RHA as a partial replacement of cement with replacements of 0%, 10%, 15%, and 20% keeping a constant fraction of 10% of silica fumes by cement. The quantities calculated here are for 1cu. m of concrete.

Table 1: 0% replacement of OPC with RHA

MATERIAL	0% replacement (KG)
Cement	315
RHA	-
Silica Fumes	-
C/Sand	850.5
C.A.1	756
C.A.2	504
Water	126
Admixture	-

Table 2: 10% replacement of OPC with RHA

MATERIAL	10% replacement (KG)
Cement	252
RHA	31.5
Silica Fumes	31.5
C/Sand	850.5
C.A.1	756
C.A.2	504
Water	126
Admixture	1.20%

Table 3: 15% replacement of OPC with RHA

MATERIAL	15% replacement (KG)
Cement	236.25
RHA	47.25
Silica Fumes	31.5
C/Sand	850.5
C.A.1	756
C.A.2	504
Water	126
Admixture	1.20%

Table 4: 20% replacement of OPC with RHA

MATERIAL	20% replacement (KG)
Cement	220.5
RHA	63
Silica Fumes	31.5
C/Sand	850.5
C.A.1	756
C.A.2	504
Water	126
Admixture	1.20%

By IS.10262.2009 the maximum water for 20mm aggregate is 186kg; with the help of super plasticizer we have reduced the w/c ratio thereby reducing the water by 32.25%.

3. PREPARATION OF TEST SPECIMENS

(a) Mixing: The mixing of all the constituent materials are done in accordance with the partial replacements of the tests carried out.

(b) Casting: Properly mixed concrete is poured immediately in the moulds of size 150mm x 150mm x 150mm. The concrete is poured in three layers and tamping is carried out for each layer by giving more than 25 blows, so as to get a fully compacted concrete specimen. The upper surface is then fined well.

(c) Curing: After a period of 24 hours the moulds are de-moulded and were immersed in a water tank for curing. The curing was done for a period of 7 days and 28 days respectively.

4. RESULTS AND DISCUSSIONS

Compressive strength at 7 days and 28 days of curing are presented in Table 5 and figure 1 and figure 2.

Table 5: Compressive test results for 7 days and 28 days of curing

MIX	7 days(MPA)	28 days(MPA)
M	13.8	24.44
T1	8.7	12.41
T2	9.63	13.12
T3	12.21	19.53
M1	9.63	19.23
M2	11.11	21.07
M3	13.33	23.75

M: Standard mix without any replacement and admixture so as to compare the results of trial mixes.

T1: Average of all Trial Mix with 10% replacement of cement with RHA and extra 10% of silica fumes as filler without any admixtures.

T2: Average of all trial mix with 15% replacement of cement with RHA and extra 10% of silica fumes as filler without any admixtures.

T3: Average of all trial mix with 20% replacement of cement with RHA and extra 10% of silica fumes as filler without any admixtures.

M1: Final mix with 10% replacement of cement with RHA and extra 10% of silica fumes as filler with admixture solution.

M2: Final mix with 15% replacement of cement with RHA and extra 10% of silica fumes as filler with admixture solution.

M3: Final mix with 20% replacement of cement with RHA and extra 10% of silica fumes as filler with admixture solution.

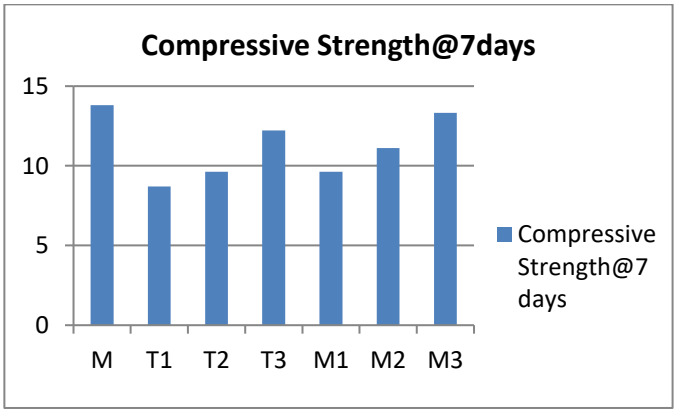

Fig. 1: Compressive strength of mix at 28 days in MPA

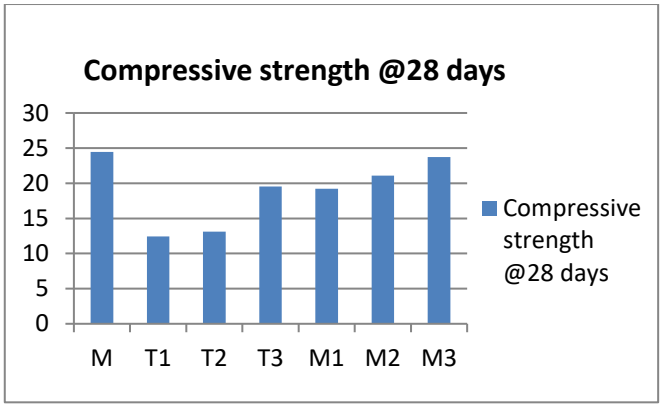

Fig. 2: Compressive strength of mix at 28 days in MPA

5. CONCLUSION

The following conclusions are observed of all the trials carried out with RHA in this study:

- Compressive strength of M20 concrete with replacement of 20% RHA is found maximum.
- Comparing the results of compressive strengths for 7 days and 28 days it is found that, RHA concrete based mix concrete achieves its strength much slower as compared to the standard mix concrete.
- Dry ash absorbs more water while wet ash absorbs less water keeping the water cement ratio intact which in turn also increases the workability of the concrete since ash is finer than cement and also more surface area.
- Addition of silica fumes and admixture to the modified concrete mix helped in improving its properties, in particular its compressive strength, bond strength and abrasion resistance.

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