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COMPARISON OF PROPERTIES OF CEMENT INCORPORATED PARTIALLY BY RICE HUSK ASH AND FLY ASH

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Abstract—*An experimental study is performed to investigate the effect of incorporating Fly Ash (FA) and Rice Husk Ash (RHA) in the properties of Ordinary Portland Cement (OPC) pastes. Specimens were prepared by varying the percentage of FA and RHA up-to 10% in the OPC. The properties studied include bulk density, compressive strength, water absorption and apparent porosity. In addition, non-destructive tests such as rebound hammer and ultrasonic pulse velocity tests were performed. The results of FA and RHA incorporated specimens were also compared with the control specimen. Bulk density decreased with increasing FA and RHA content in OPC specimens. However, water absorption is observed to increase with increasing replacement of FA and RHA. Compressive strength decreases with increasing replacement of FA and RHA. The results indicate the suitability of using FA and RHA in making cement concrete without compromising on the properties. Keywords: fly ash, rice husk ash, compressive strength, bulk density, water absorption, apparent porosity, non- destructive tests.*

1. INTRODUCTION

With increase in urbanization and industrialization, there is an impact on all over the world leading to depletion of natural resources and thus invariably causing environmental hazards. With climate change affected weather events becoming prominent day by day, it is of utmost concern to account for sustainability in the development of backbone infrastructure of the country. Cement is one of the most major constituents critical to construction of various infrastructure. However, production of cement has considerable impact to the environment – mainly depletion of natural resources for limestone and also air pollution (carbon dioxide) [1-5]. Therefore, research are trying to find new materials in cement to make it economical and improve quality [6] various filler material having high binding properties are a viable alternative to replace cement partially or wholly for use in the formation of cement paste, mortar or concrete mix. Researcher have studied the replacement of cement by fly ash[13-20] and rice husk ash[1-13] and determined their suitability.

In the present study, rice husk ash and fly ash has been used as a filler material in cement paste upto 10% to study the effect in the properties such as compressive strength, water absorption, including non destructive tests at the age of 28 days was obtained.

2. MATERIALS AND METHODS

2.1 Materials

Ordinary Portland Cement(OPC) of grade 43 was used having a specific gravity of 3.1.Filler materials like Rice husk ash(RHA) was collected from Kolkata, West Bengal which exhibits high pozzolanic characteristics and contributes high strength and impermeability of concrete having a specific gravity of 1.8 and typical low calcium class F fly ash procured from Kolaghat Thermal Power Plant, Kolaghat, West Bengal, India was used for the production of paste having a specific gravity of 2.4 with potable water of pH not less than 6 was used for these study. Mould size of 50mm x 50mm x 50mm was used for casting. The details of specimens casted are given in Table 1.

Table 1: Details of Specimens

Specimen ID	Cement	Fly Ash	Rice Husk Ash	w/c Ratio
CP	100	-	-	0.3
CF1	95	5	-	0.325
CF2	90	10	-	0.335
CR1	95	-	5	0.32
CR2	90	-	10	0.33

2.2 Methods

Cubes were casted as per standard methods at different water cement ratios as provided in Table 1. Cubes were cured for 28 days in water. Tests such as compressive strength [21] ,bulk density, water absorption, apparent porosity,. non destructive tests were also performed on the specimens i.e., ultrasonic pulse velocity test [22] and rebound hammer test [23].

3. RESULTS AND DISCUSSION

3.1 Compressive strength

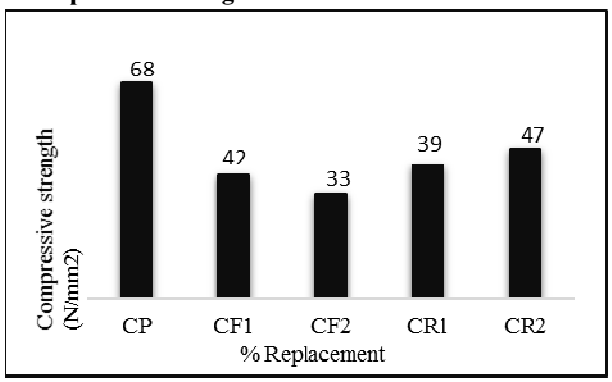

Figure 1: Compressive Strength of the Specimens

The compressive strength of the specimens are presented in Figure 1. The results indicate decrease in strength with increasing fly ash replacement. Similar pattern was observed in specimens replaced rice husk ash though an insignificant increase in recorded for specimen with 10% replacement of RHA. The strength obtained from replacement of cement by RHA and FA is far more than the general requirement of strength for construction purposes, i.e, 15 MPa-30MPa.

3.2 Bulk Density

Figure 2 shows the results of bulk density test on specimens. Specimens replaced with FA and RHA generally decreases in bulk density. This could be due to increasing pores in such specimens. The highest bulk density recorded is 20.89 kN/m^3 for CP and lowest value was for CR2.

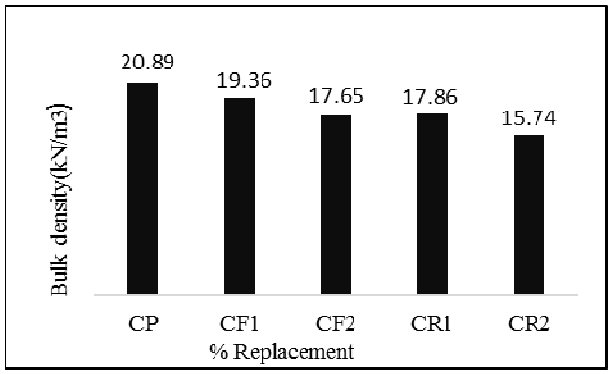

Figure 2: Bulk Density of Specimens

3.3 Water Absorption

Water absorption test was performed on all the specimens after 28 days from casting. Results of water absorption test is shown in Figure 3. CP specimen shows lowest water absorption of 8.04% while CR2 which has 10% replacement by RHA present highest value of 36.58%. This may be due to increased porosity of the specimen.

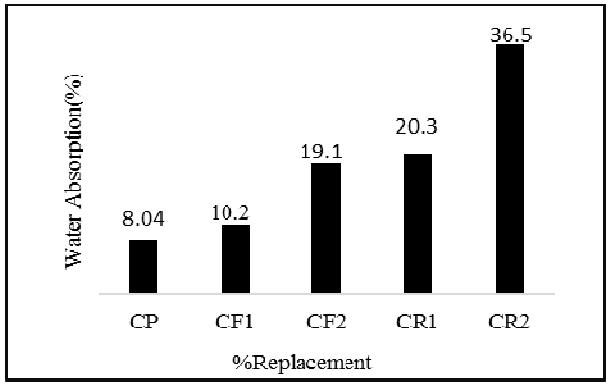

Figure 3: Water Absorption of Specimens

3.4 Apparent Porosity

Specimens were tested for apparent porosity and results are presented in Figure 4. Lower porosity was observed for CP specimen though CF1 (5% FA) also showed comparable apparent porosity. As the replacement of FA and RHA was increased, the apparent porosity was found to increase correspondingly. The maximum value of apparent porosity was obtained for CF2 specimen at 44.4%.

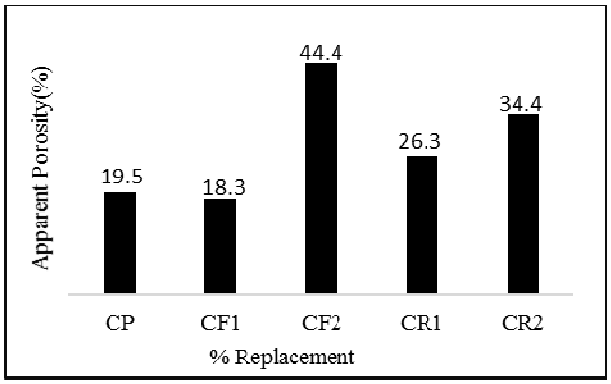

Figure 4: Apparent Porosity of Specimens

3.5 Rebound Strength

Non-destructive test was conducted with Rebound hammer. The rebound values were correlated with compressive strength. The compressive strength obtained from rebound values are given in Figure 5.

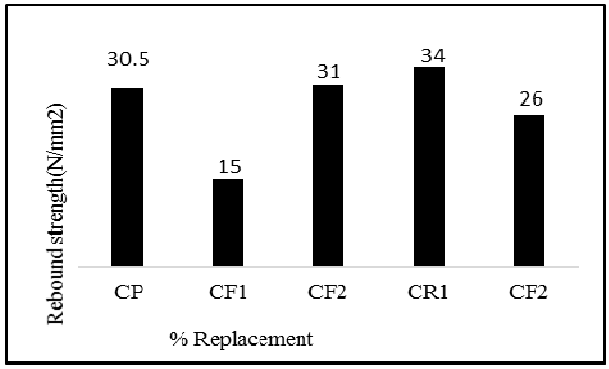

Figure 5: Rebound Strength of Specimens

3.6 Ultrasonic pulse Velocity

Table 2: Pulse velocity for paste quality grading

% Replacement	Pulse Velocity by cross probing (km/s)	Paste quality grading
CP	3.8	Good
CF1	3.4	Medium
CF2	3.7	Good
CR1	3.6	Good
CR2	3.4	Medium

The results of ultrasonic pulse velocity is given in Table

2. From the table, it is observed that the quality increases when cement is replaced by FA than those replaced by RHA. This may be due to increase in voids for RHA replaced specimens. Percentage replacement by FA may be increased.

4. CONCLUSION

From the following results it may be concluded as- reduction in the amount of cement used may reduce in the emission of $C0_2$ resulting an ecofriendly and efficient environment .The compressive strength of cement replaced partially by RHA and FA have more strength than the general requirement of strength for construction h .The quality increases when cement is replaced by FA than those replaced by RHA when tested by ultrasonic pulse velocity. Cement can be replaced suitably up to the range of 10% by FA and RHA .

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