Rice Husk Ash Alternate Construction Material Used in Cement Mortar

Abhishek Sen
M. Tech Student
Department of Civil Engineering (Structural Engineering)
Madan Mohan Malviya University of Technology, Gorakhpur

Abstract— Due to pozzolanic reactivity, Rice Husk Ash is used as a supplementary cementing material in mortar and concrete. It has economical and technical advantages to be used in mortar and concrete. I am going to replace cement by the RHA by 5%, 10%, 15% & 20% by weight of cement in different experiments to find out the maximum strength and compare it to the normal mortar at 7,14 and 28 days. Therefore this research is an investigation of the performance of the mortar made of partially replacing the OPC with RHA on the structural integrity and properties of RHA mortar

Key words: OPC, Mortar, Rice Husk Ash, OMC, MDD and structural integrity

I. INTRODUCTION

Rice Husk is generated from the rice processing industries as a major agricultural by product in developing countries. About 500 million tons of paddies is produced in the world annually after incineration only about 20% of the Rice husk is transformed in Rice HUSK Ash. Still now there is no useful application of RHA and is usually dumped into the water streams or as landfills causing environmental air pollution, water pollution, and soil pollution. RHA consist of non-crystalline silicon dioxide with high specific surface area and high pozzolanic reactivity, thus due to growing environmental concern and the need to conserve energy and resources, utilization of industrial and biogenic waste material has become an integral part of mortar construction. RHA is active pozzolana. Pozzolanas improve strength because they are smaller than the cement particles, and can pack in between the cement particles and provides a finer pore structure. RHA has two roles in mortar and concrete manufacturing as a substitute for Portland cement, reducing cost of mortar and concrete in production of low cost building blocks and as an admixture in the production of high strength mortar.

II. MATERIALS

A. *Rice Husk Ash (RHA):*

Rice husk ash used in this experiment was obtained from J.K. Enterprises, Gorakhpur, Uttar Pradesh. Specification, Physical and Chemical Properties as given by the supplier are given below in the table:

Physical State	Solid Non-Hazardous
Appearance	Very Fine Powder
Color	Grey
Odor	Odorless
Specific Gravity	1.7

Table 1: Physical Properties Of RHA

SiO_2	93.80%
Al_2O_3	0.74%
Fe_2O_3	0.30%
TiO_3	0.10%
CaO	0.89%
MgO	0.32%
Na_2O	0.28%
K_2O	0.12%

Table 2: Chemical Properties of RHA

B. *Cement:*

Cement used in the experiment work is Ordinary Portland Cement conforming to IS:8112:1989. The properties of OPC are shown in table as given by manufacturer-

Characteristics	IS:8112:1989	OPC
Fineness	Min225	
Setting Time Initial (minutes) Final (minutes)	 Min 30 Max 600	 80 300
Soundness Lechateliers Methods(mm) Autoclave Expansion%	Max 10 Max 0.8	5 4
Compressive Strength 3 Days(MPa) 7 Days(MPa) 28 Days(MPa)	 Min 23 Min 33 Min 43	 25 34 45

Table 3: Physical properties of OPC

C. *Fine Aggregate:*

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

- Specific Gravity = 2.3
- Fineness Modulus = 2.71

D. *Water:*

Water is an important ingredient of mortar 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 carefully. Mixing water should not contain undesirable organic substances or inorganic constituents in excessive proportion. In this project clean potable water is used.

E. *Mix Proportion Of Mortar:*

The OPC was replaced by different amount of RHA (0%, 5%, 10%, 15% and 20%) in dry condition. Sample prepared with only OPC called the controlled samples. The mix designations are in the table. Cement mortar used in proportion of (1:3) (cement: sand) and water cement (w/c) ratio =0.56

Mix Designation	OPC%	RHA% (By Weight)
M_0	100	0
M_5	95	5
M_{10}	90	10

M_{15}	85	15
M_{20}	80	20
M_{25}	75	25
M_{30}	70	30

The Mortar was mixed in laboratory at room temperature. After casting all cubes are kept for 24 hours and after that demolded and placed in a water bath at the same temperature until the time of testing.

III. Testing Procedures

A. Compressive Strength Test:

Compressive strength of cement mortar were conducted on (70.7mm) cubes according to B.S. 1881-Part 4-1989, by using 100KN capacity testing machine. The compressive strength of the mortar was tested at the age of 7, 14 and 28 days.

B. Porosity:

Cubes are used for mortar porosity test. This test was conducted at 7, 14 and 28 days of water curing. These cubes were dried in an oven at $(105\pm5)^0$C for 72 hours. Then the cubes are immersed in water for 24 hours, moreover we need a third weight for cubes which represents the submerged weight. The porosity can be determined from the following equation:

Porosity % = $\frac{Wsat-Wdry}{Wsat-Wsub} x100\%$

Where

W_{dry}: the average weight of three dry cubes (g)

W_{sat}: The average weight of three saturated Cubes (g)

W_{sub}: The average weight of three submerged cubes (g)

IV. Result And Discussion

A. Compressive Strength:

Compressive strength of mortar specimens are shown in table and fig. Comparison of data for curing time of 7 and 14 days shows that the compressive strength of OPC mortar is higher than the others but at later age 28 days, the samples having 5%, 10%, 15% RHA shows better result than the OPC only. The increase in strength may be due to partially to the pozzolanic reaction and the presence of reactive silica in RHA as reported by many researchers [Ganesan 2007 and Al-Khalaf 1984].

Mix Designation	Compressive Strength, (MPa)		
	7 Days	14 Days	28 Days
M_0	4.8	8.5	12
M_5	4.92	6.39	8.82
M_{10}	5.11	7.21	10.5
M_{15}	5.62	9.2	11.2
M_{20}	4.88	6.28	9.3
M_{25}	4.68	5.90	8.2

Table 4: Compressive Strength of Cement Mortar

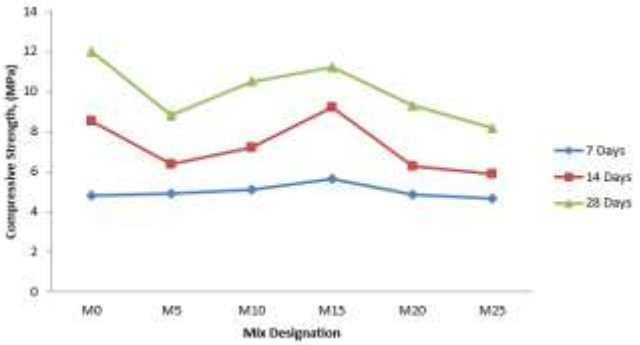

Fig. 1: Compressive Strength Graph

B. Porosity:

The results of the porosity of cement mortar at different days are shown in table. It can be seen that the porosity of mortar containing 5%, 10% and 15% of RHA is lower than the controlled specimens at all ages. At 20% cement replacement level by RHA, the porosity of mortars increased with that of the controlled one in all ages. The porosity of cement mortar reduced with an increase of age. This is due to the increase of hydration of cementitious materials.

Mix Designation	Porosity %		
	7 Days	14 Days	28 Days
M_0	19.0	18.1	15.9
M_5	18.7	17.5	15.7
M_{10}	18.4	17.3	15.6
M_{15}	18.8	17.1	15.4
M_{20}	19.3	17.6	16.0
M_{25}	19.9	18.3	16.8

Table 5: Porosity of Cement Mortar

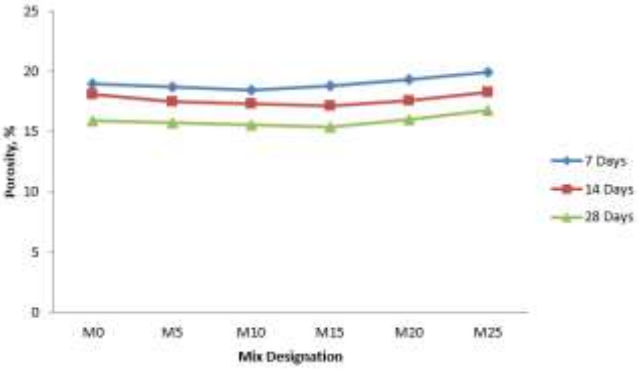

Fig. 2: Porosity Graph

References

[1] Suraya Abdul Rashid," Contribution of rice husk ash to the properties of mortar concrete: a review", journal of American Science 2010; 6(3):157-165; ISSN: 1545-1003.

