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RICE HUSK ASH CONCRETE- COMPRESSIVE STRENGTH AND RCPT TEST

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Abstract: *In the ancient period, construction work was mostly carried out with help of mudstone from industry. Rice husk ash is the by –product of burned rice husk at higher temperature from paper plant. Considerable efforts are being taken worldwide to utilise natural waste and bye –product as supplementary cementing materials to improve the properties of cement concrete. Rice husk ash (RHA) and Fly ash (FA) is such materials. RHA is bye-product of paddy industry. Rice husk ash is a highly reactive pozzolanic material produced by controlled burning of rice husk.*

The project presents the experimental investigation conducted on Rice Husk Ash (RHA) concrete to evaluate the compressive strength and to study RCPT test. In the preparation of rice husk concrete, cement was replaced at various percentage levels such as 5%, 10%, 15% and 20%. The strength of the concrete increased with the levels of percentage of replacement of 5% & 10% at which the increase in strength was 10% & 27% at 28 days compared to normal concrete. From the test results of RCPT, it is found that as the cement replacement by rice husk ash level increases, the charge passed decreases.

Keyword's: *Rice Husk Ash Concrete,experimental investigation, Compressive strength, Rapid Chloride Permeability Test (RCPT).*

1. INTRODUCTION

Day by day the natural resources are depleting every year. Hence it is creating an ecological

strain on earth. On the other hand, human activities on earth produce solid wastes such as industrial wastes, agricultural wastes and wastes from rural and urban societies in considerable quantities of over 2500 million tons per year. Rice husk is an agricultural residue which accounts for 20% of the 649.7 million tons of rice produced annually worldwide. The produced partially burnt husk from the milling plants when used as a fuel also contributes to pollution and efforts are being made to overcome this environmental issue by utilizing this material as a supplementary cementing material. The chemical composition of rice husk is found to vary from one sample to another due to the differences in the type of paddy, crop year, climate and geographical conditions. Among the solid wastes, the most prominent materials are fly ash, blast furnace slag, rice husk (converted into ash), silica fume and materials from construction demolition. Substantial energy and cost savings can result when industrial by-products are used as a partial replacement for the energy intensive Portland cement. The use of by products is an environmental–friendly method of disposal of large quantities of materials that would otherwise pollute land, water and air. By reducing the use of Portland cement, CO2 emission may be controlled. Concrete as is well known is a heterogeneous mix of cement, water and aggregates. The utilization of RHA as a pozzolanic material in cement and concrete provides several advantages, such as improved strength and durability properties, reduced materials cost due to cement savings, and environmental benefits related to the disposal of waste materials. In the present investigation, Portland cement was replaced by Rice Husk Ash at various percentages and its effect on the compressive Strength and its RCPT test was studied. RHA has not been utilized in the construction industry yet, the reason for that may be due to the lack of understanding of the RHA blended concrete characteristics.

2. EXPERIMENTAL PROGRAM

2.1 **Cement:** The cement used was Birla Cement Ordinary Portland cement (43 grade cement) .The cement was procured from local markets and in one lot to maintain uniformity throughout the investigation. The different properties of cement are: specific gravity-3.15, normal consistency-27.5%, fineness-3%, initial setting time- 40minutes, and final setting time- 290 minutes.

2.2 **Fine Aggregates:** The available sand confirming to IS 383:1970 is used as fine aggregate in the present investigation. The specific gravity was 2.86 in accordance with IS 2386-1963.

2.3 **Coarse Aggregate**: The coarse aggregate used is locally available. The maximum nominal size of aggregate is 20 mm. Aggregate are the major ingredient of concrete. They contribute about 70-75 % of the total volume, provide a rigid skeleton structure for concrete & act as economical space fillers .The specific gravity was 2.80.

2.4 **Water:** Ordinary tap water was used for mixing and curing operations.

2.5 **Rice Husk Ash:** Rice Husk Ash was obtained from Hi-Tech agro industries, Pune in Maharashtra State, India. The physical and chemical properties of rice husk ash is as follows.

Sr. No	Parameters	Values
1	Fineness passing 45 micron	93%
2	Specific gravity	2.08
3	Specific surface m^2/ kg	27389
4	Silicon dioxide (SiO_2)	86.20%
5	Ferric oxide (Fe_2O_3)	0.17%
6	Calcium oxide (CaO)	0.53%
7	Magnesium oxide (MgO)	0.33%
8	Carbon (C)	5.87%
9	Loss on ignition	5.32%
10	Pozzolanic activity	81%
11	Particle size (µm)	6

Table 1- Physical and Chemical Properties of Rice Husk Ash

3. MIX PROPORTION

By taking several trial mixest he mixture proportions for the controlled concrete of M30 grades were arrived. As M30 grade is medium strength concrete and is used in column design hence was selected. Table 2. Gives the mix proportion for M30 grade concrete with various percentage replacement of RHA.

Mix Designation	BC	BR1	BR2	BR3
Rice husk ash as CRM (%)	0	5	10	15
w/b ratio	0.45	0.45	0.45	0.45
Cement (kg/m^3)	420	399	378	357
Rice husk ash (kg/m^3)	0	21	42	63
Sand (kg/m^3)	621	582	542	503
Coarse aggregate (kg/m^3)	1108	1108.	1108	1108
Water (lit/m^3)	180.60	180.60	180.60	180.60
SP (%)	0.4	0.4	0.8	1.4

Table 2. Mix Proportion for M30 Grade Concrete Mixtures

Note: BC - Control Concrete BR1 - 5% Rice husk ash

BR2 - 10 % Rice husk ash BR3-15% CRM - Cement Replacement Material
SP-Superplasticizer

4. TEST CONDUCTED

A. Compressive Strength:

The cube specimen was placed in the machine of 2000kN capacity. The load was applied at a rate of approximately 140 kg/sq.cm/min until the resistance of the specimen to the increasing load can be sustained. Results are presented in Table 3

Sr.no	w/c ratio	Mix ID	RHA Content (%)	Compressive Strength (N/mm^2)
1	0.45	AC	0	30.21
2	0.45	AR1	5	32.91
3	0.45	AR2	10	38.01
4	0.45	AR3	15	24.20

Table 3. Effect of Rice Husk Ash on Compressive Strength of M30 Grade Concrete for 28 days.

B. Rapid Chloride Permeability Test:

Reinforced concrete structures are exposed to harsh environments yet are often expected to last with little or no repair or maintenance for long periods of time. To do this, a durable structure needs to be produced. RCPT is based on the principle that negatively charged chloride ions are attracted to a positive electrode and consists of measuring the total charge passed through a sample over the six hours test duration when a direct current potential difference of 60V is applied across the end of the samples. The ability of chloride ions to penetrate the concrete must then be known for design as well as quality control purposes. Test results for the resistance to penetration of chloride ions into concrete of 28 days after casting, measured in terms of the electric charges passed through the specimens in Coulombs for M30 grade concrete.

By using the result current and time, chloride permeability is calculated in terms of total charge passed in Coulombs at the end of 6 hours by using the formula given in Eq.

$$Q = 900 \times 2 \times (Io+I30+I60+\cdots\cdots+I330+I360)$$

Where,

Q: Charge passed (Coulombs)

Io: Initial current

I30: Current at the 30 minutes

Fig.1. Samples for RCPT

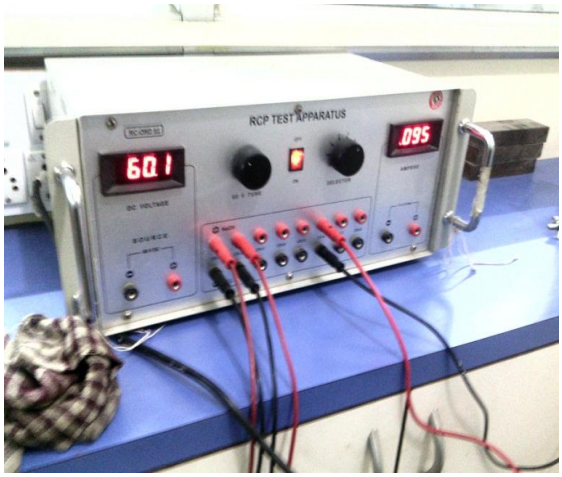

Fig.2. RCPT Test Apparatus

Charge Passed (coulombs)	Chloride Ion Penetrability
> 4,000	High
2,000-4,000	Moderate
1,000-2,000	Low
100-1,000	Very Low
< 100	Negligible

Table 4. RCPT Ratings

Sr.no	Mix ID	RHA Content (%)	Total Charge Passed Coulombs @ 28 days
1	CC	0	2154
2	CR1	5	1932
3	CR2	10	1822
4	CR3	15	1633
5	CR4	20	1520

Table 5. Result for Rapid Chloride Permeability Test

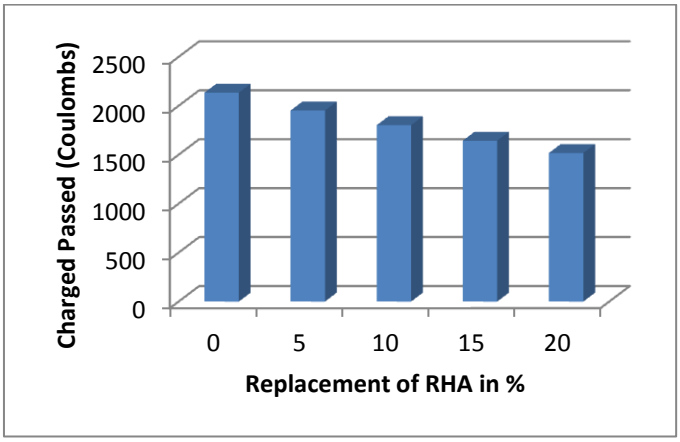

Fig.3. Rapid Chloride Ion Permeability For 28 Days

5. CONCLUSION

From the result it is observed that the chloride ion penetration decreases as the replacement of Rice Husk Ash increases in the concrete. The incorporation of RHA in concrete results in a finer pore structure. For achieving the higher compressive strength, the optimum level of replacement of Rice Husk Ash is 10%. Moreover, the incorporation of RHA in concrete

materials resolves the current problems associated with RHA disposal. To improve the workability of RHA concrete it is necessary to add the superplasticizer as it absorbs more water.

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REFERENCES

[1] Alireza Naji Givi, Suraya Abdul Rashid & Farah Nora A. Aziz , "Assessment of the effects of rice husk ash particle size on strength, water permeability and workability of binary blended concrete" Institute of Advanced Technology, University Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia, April 27,2010,pp 2145-2150.

[2] Andres Salas, Silvio Delvasto & David Lange, "Comparison of two processes for treating rice husk ash for use in high performance concrete" Escuela de Ingeniería de Materiales, Grupo de Investigación de MaterialesCompuestos, Universidad del Valle, Colombia, May 20, 2009, pp 773-778.

[3] C.Marthong,"Effect of Rice Husk Ash (RHA) as Partial Replacement of Cement on Concrete Properties",Lecturer" Civil Engineering Department, Shillong Polytechnic, Shillong, Meghalaya, India, 793008, Aug. 6,2012, Vol.1, pp-111-118

[4] Carlos A. R. da Silva, Jorge L. Akasaki, Michele Beniti Barbosa, "Possibility of adding the rice husk ash to the concrete", Civil Engineering Department, FEIS/UNESP, Brazil, February 2011, pp 550-559

[5] Gemma Rodriguez de Sensale, "Effect of rice-husk ash on durability of cementitious materials",Instituto de la Construcción – Instituto de Ensayo de Materiales, Universidad de la Republica, Hugo Prato 2314, CP 11200 Montevideo, Uruguay, July 15,2010, pp-718-725.

[6] Ghassan Abood Habeeb & Hilmi Bin Mahmud, "Study on properties of rice husk ash and its use as cement replacement material", Department of Engineering and Material Research, University of Malaya, Kuala Lumpur, Malaysia, March 21, 2010, pp 185-190.

[7] Godwin A. Akeke, Maurice E. Ephraim, Akobo, I.Z.S and Joseph O. Ukpata, "Structural properties of rice husk ash concrete", Department of Civil Engineering, Cross River University of Technology, Calabar, Nigeria. International Journal of Engineering and Applied Sciences, Vol.3, May 2013, pp 203-209.

[8] Mauro M. Tashima, S.D.Nagrale, Dr.Hemant Hajare, Pankaj R. Modak,"Utilisation of rice husk ash", International Journal of Engineering Research and Applications, Vol. 2, August 2012, pp.001-005

[9] Shetty M. S.,"Concrete Technology", S. Chand & Co. Ltd., New Delhi, 4th edition, pp 218-322

[10] Maurice E. Ephraim, Godwin A. Akeke and Joseph O. Ukpata,"Compressive strength of concrete with rice husk ash as partial replacement of ordinary Portland Cement", Scholarly Journal of Engineering Research, Vol. 1, May 2012, pp.32-36