Experimental Study on Hardened Properties of Concrete by Partial Replacement of Cement with Rice-Husk-Ash

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Abstract— Making and using of a sustainable concrete has become an important requirement day by day. To reduce the environmental effect, several of supplementary cementing and pozzolanic materials and mineral admixtures and chemical admixtures are introduced and they are partial replacement of cement in the concrete. This paper reports the results of Fresh and Hardened properties of the concrete with partial replacement of Partial replacement of Rice-husk-ash (0%, 5%, 10%, 15%& 20%).The test results indicate that rice-husk-ash is an effective mineral admixture, with 10% as the optimal replacement ratio of cement.

Key words: Cement, Rice-Hush-Ash, Hardened Properties

I. INTRODUCTION

Concrete is the most extensively used construction material in the world, which consumes natural resources like lime, aggregates and water. The worldwide production of cement has greatly increased, due to this production environmental pollution increases with emission of CO_2 gas. To reduce this effect cement was replaced by some supplementary materials like Marble Powder, Rice Husk Ash, Fly ash, Brick Powder and Ground Granulated Blast Furnace Slag (GGBS), etc. In this content Rice Husk Ash is a pozzolanic material used in wide range in replacement of cement. Rice Husk Ash are Pozzolanic materials due to its pozzolanic activity the strength properties and durability properties of concrete increases and reduction in Porosity and Permeability also. Recently many researchers focused on the use of waste materials in concrete as cement replacement. Mehta P.K and D.Pirtz [1] in a concrete mixture, when 30% rice husk ash by weight of the total cementiting material was present, the 7 days on the 28days compressive strength higher than the control concrete.

II. EXPERIMENTAL PROGRAMME

Concrete was made of ordinary Portland cement 53 grade, Fine aggregate, Coarse aggregate, water, Rice husk ash as a mineral admixture and Super plasticizer as chemical admixture.

A. Cement

Cement may be defined as the adhesive substance capable of uniting fragments or masses of solid matter to a lumped whole Lea *et al.* (1970). Various types of cements can be used in the concrete production. It should be fresh, free from foreign matters and of uniform consistency.

B. Fine Aggregate

The most common fine aggregate used in the concrete is river sand. River sand is a vital ingredient in making the two most normally used construction material viz. cement concrete and mortar. The sand should be clean, hard, strong and free from the organic impurities and deleterious substances. It should be capable of producing a sufficiently workable mix with minimum water-cement ratio.

C. Coarse Aggregate

The aggregates are formed due to natural designation of rocks or by artificial crushing of the rock or gravel. Specific gravity and fineness modulus of aggregate is 2.65 and 6.98 respectively.

D. Water

Mixing water should be clean, fresh and potable. Water should be free from impurities like clay, loam, soluble salts which leads to deterioration in properties of concrete. Potable water is fit for mixing and curing of concrete.

S. No	Constituents (Mass %)	R.H.A
1	Silica (Sio_2)	88.90%
2	Alumina (Al_2O_3)	2.50%
3	Ferric Oxide (Fe_2O_3)	2.19%
4	Calcium Oxide (Cao)	0.22%
5	Total Alkalies (Na_2O+K_2O)	0.69%

Table 1: Chemical Properties RHA

S. No	Particular	R.H.A	Cement
1	Color	Light white	Grey
2	Specific gravity	2.25	3.11
3	Fineness	9%	3%
4	Standard consistency	-	31%
5	Initial setting time	-	76min
6	Final setting time	-	345min

Table 2: Physical Properties of Binder Materials

Properties	Results obtained	Range
Specific Gravity	2.67	2.5-3.0
Fineness Modulus Test	2.8	2.6-3.2
Bulking Of sand	4%	-

Table 3: Test Results on Fine Aggregate

Material mixture	Gravel (KG)	Sand (KG)	Cement (KG)	R.H.A	W/C	sp
Reference	1215	744	370	0%	0.39	0.015%
RHA5	1215	744	351.5	5%	0.39	0.015%
RHA10	1215	744	333	10%	0.39	0.015%
RHA15	1215	744	314.5	15%	0.39	0.015%
RHA20	1215	744	296	20%	0.39	0.015%

Table 4: Concrete Mixture Proportions For 1 M^3 of Concrete (M30 Grade)

III. TEST METHODS

The compressive strength, Split tensile strength and Ultrasonic pulse velocity test of various concrete mixtures were determined on 150mm^3 cubes, 150x300mm cylinders.

Fig. 1: UPV Cube Testing

IV. RESULTS AND DISCUSSION

Table-5, Table 6, shows development for RHA10% and reference concrete at different ages up to 90 days. From the results it can be seen that in both cases compressive strength and split tensile strength is increased with age. Table 7 shows the ultrasonic pulse velocity of concrete for RHA15% is >4000 m/sec the quality of concrete is excellent up to 15% of RHA.

S. No	R.H.A (%)	7 Days	28 Days	56 Days	90 Days
1	0	32.4	39.6	42.3	46.3
2	5	29.2	38.4	39.4	40.3
3	10	30.9	41.2	43.3	47.5
4	15	26.7	35.6	35.9	37.1
5	20	25.4	34.1	35.5	36.5

Table 5: Compressive Strength R.H.A Concrete (Mpa)

S. No	R.H.A (%)	7 Days	28 Days	90 Days
0	Ref. Mix	3.24	3.96	4.63
1	5	3.21	4.22	4.47
2	10	3.73	4.94	5.73
3	15	2.67	3.56	3.71
4	20	2.54	3.41	3.65

Table 6: Tensile Strength of RHA (MPa)

S. No	RHA (%)	28 Days
1	REF.MIX	4387
2	5	4217
3	10	4587
4	15	4178
5	20	3854

Table 7: Ultrasonic Pulse Velocity of RHA concrete in m/sec

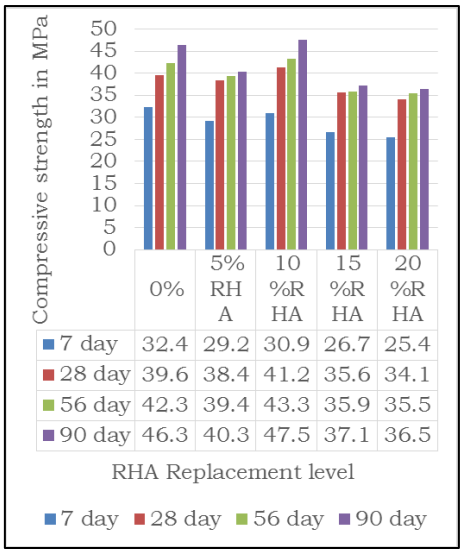

Fig. 2: Compressive strength

This graph shows compressive strength will be maximum at RHA [10%] at 90 days is 47.5N/mm^2 and 28 days strength is 41.20N/mm^2 .In this graph X axis is replacement proportion and Y axis is compressive strength

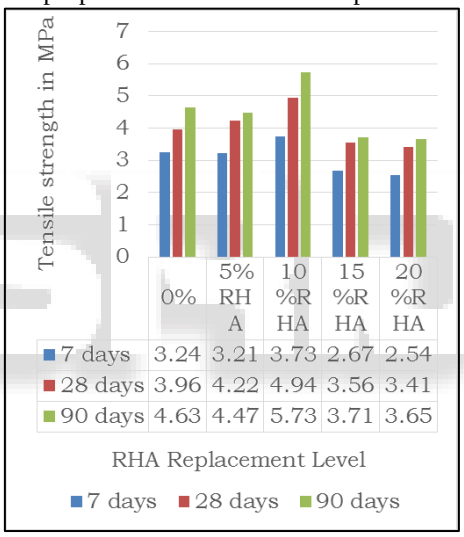

Fig. 3: Split tensile strength

This graph shows Split tensile strength will be maximum at RHA [10%] at 90 days is 5.73N/mm^2 and 28 days strength is 4.94N/mm^2. In this graph X axis is replacement proportion and Y axis is Split tensile strength.

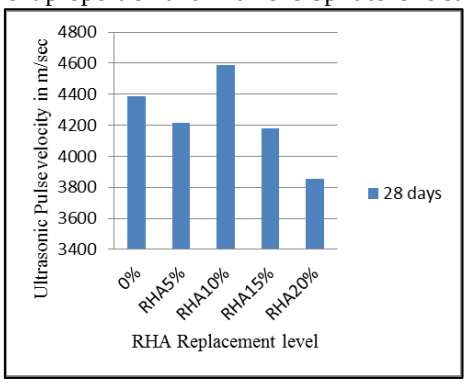

Fig. 4: Ultrasonic pulse velocity

This graph shows ultrasonic pulse velocity is >4000m/sec up to a percentage of RHA15% the quality of concrete is excellent. In this graph X axis is replacement proportion and Y axis is UPV value.

V. CONCLUSION

1) Compressive strength of concrete is increases with the addition of RHA up to 10% of cement after it is decreases.
2) Split tensile strength of concrete is increases with the addition of RHA up to 10% of cement after it is decreases.
3) Ultrasonic pulse velocity of concrete is excellent up to percentage of 15%RHA and then adding of RHA the UPV is Satisfactory.

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