Experimental Study on the Mechanical Properties of Concrete by Partial Replacement of Cement with Rice-husk-ash & Marble Powder for M30 Grade of Concrete

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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 the mechanical properties of the concrete with partial replacement of Partial replacement of Rice-husk-ash (0%, 5%, 10%, 15%& 20%, 25%) and marble powder (0%, 5%, 10%, 15%) separately and blended both rice-husk-ash and marble powder combines partial replacement (0%, 5%+5%, 10%+10%, 15%+15% & 20%+20%). The test results indicate that rice-husk-ash & marble powder is an effective mineral admixture, with 10% and combine of both (5%+5%) as the optimal replacement ratio of cement.

Key words: Marble Powder, Rice-hush-ash, Mechanical 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), Silica Fume & Metakaolin etc. In this content Marble Powder and Rice Husk Ash are pozzolanic materials used in wide range in replacement of cement. Marble Powder and 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.Ali Ergun [1] as conducted investigation on marble powder cement upto 15% of powder showed higher compressive strength than the control Portland cement. Mehta P.K and D.Pirtz [2] 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 and Marble powder as mineral admixtures 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	M.P
1	Silica (Sio2)	88.90%	11.38%
2	Alumina (Al2O3)	2.50%	0. 23%
3	Ferric Oxide (Fe2O3)	2.19%	0. 09%
4	Calcium Oxide (Cao)	0.22%	45.18%
5	Total Alkalies (Na2O+K2O)	0.69%	-

Table 1: Chemical Properties of Binder Materials

S.No	Particular	R.H.A	M.P	Cement
1	Color	Light White	White	Grey
2	Specific Gravity	2.25	2. 6	3.11
3	Fineness	9%	4%	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	M.P	W/C	sp
Reference	1215	744	370	-	-	0.39	0.015%
MP5	1215	744	351.5	0%	5%	0.39	0.015%
MP10	1215	744	333	0%	10%	0.39	0.015%
MP15	1215	744	314.5	0%	15%	0.39	0.015%
MP20	1215	744	296	0%	20%	0.39	0.015%
RHA5	1215	744	351.5	5%	0%	0.39	0.015%
RHA10	1215	744	333	10%	0%	0.39	0.015%
RHA15	1215	744	314.5	15%	0%	0.39	0.015%
RHA20	1215	744	296	20%	0%	0.39	0.015%

Table 4: Concrete Mixture Proportions For 1 M3 Of Concrete (M30 Grade)

III. TEST METHODS

The compressive strength, tensile strength and flexural strengths of various concrete mixtures were determined on 150mm^3 cubes, 150x300mm cylinders and 100x100x500mm beams respectively.

IV. RESULTS AND DISCUSSION

Table-5,6 shows development for MP10, RHA10 and reference concrete at different ages upto 90 days. From the results it can be seen that in both cases compressive strength increased with age. Table-8, 9 shows development for MP15 and RHA15 reference concrete at different ages of Tenslie strength. Table-11, 12 shows development for MP15 and RHA15 reference concrete at different ages of flexural strength.

s.no	M.P (%)	7 DAYS	28 DAYS	56 DAYS	90 DAYS
1	0	32.45	39.36	42.23	46.37
2	5	30.23	40.16	41.12	44.16
3	10	31.62	42.15	43.4	48
4	15	29.14	37.17	40.19	42.6
5	20	25.6	34.17	35.17	40.16

Table 5: Compressive Strength (N/Mm^2) Of M.P Concrete

s.no	R.H.A (%)	7 DAYS	28 DAYS	56 DAYS	90 DAYS
1	0	32.45	39.36	42.23	46.27
2	5	29.24	38.65	39.42	40.25
3	10	30.49	41.24	43.43	47
4	15	26.71	35.46	35.91	37.12
5	20	25.41	34.12	35.41	36.54

Table 6: Compressive Strength R.H.A Concrete (Mpa)

s.no	M.P+R.H.A (%)	7 DAYS	28DAYS	56DAYS	90DAYS
1	0	32.45	39.36	42.23	46.27
2	5+5	31.42	45.24	46.12	49.15
3	10+10	29.6	35.14	36.38	36.7
4	15+15	27.4	28.2	28.6	29
5	20+20	24	25.4	26.2	26.6

Table 7: Compressive Strength of M.P and Rha Concrete (Mpa)

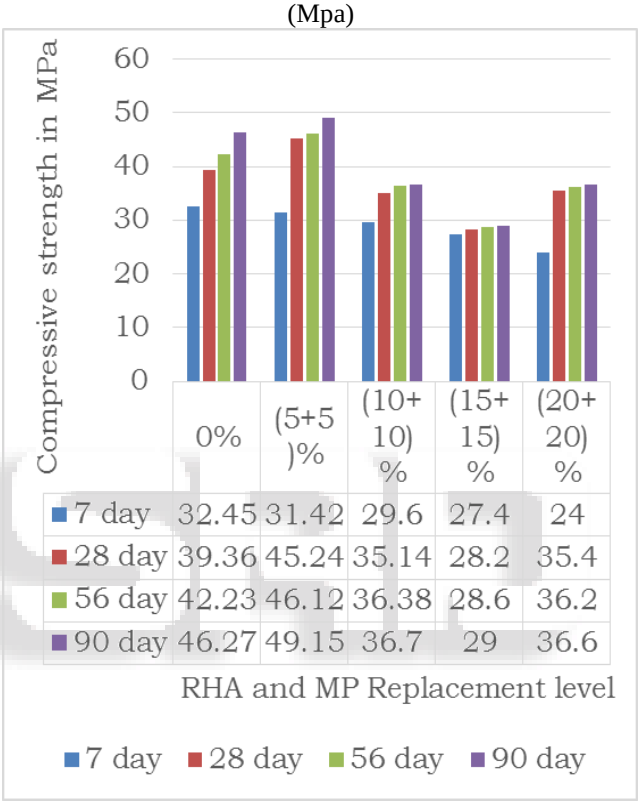


Fig. 1: Graph for Table 7

This graph shows compressive strength will be maximum at MP+RHA [5%+5%] at 90 days is 59.15 N/mm^2 and 28 days strength is 55.24 N/mm^2 .In this graph X axis is replacement proportion and Y axis is compressive strength

S.no	R.H.A (%)	7 DAYS	28DAYS	90 DAYS
0	REF.MIX	2.33	2.77	2.98
1	5	2.17	2.85	2.86
2	10	2.19	2.87	2.88
3	15	2.24	2.95	3.11
4	20	1.81	2.73	2.77

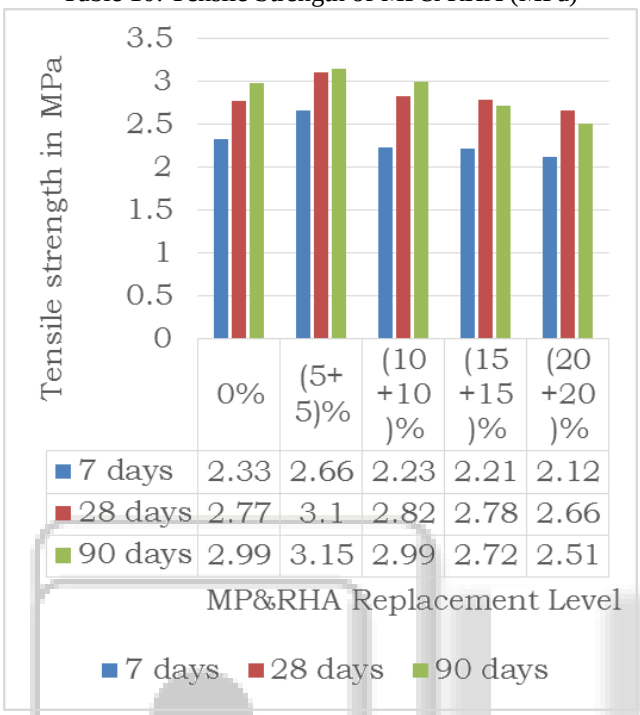
Table 8: Tensile Strength of RHA (MPa)

S.no	M.P(%)	7 DAYS	28DAYS	90 DAYS
0	REF.MIX	2.33	2.77	2.99
1	5	2.22	2.88	2.93
2	10	2.24	2.97	3.01
3	15	2.34	2.99	3.17
4	20	2.04	2.74	2.77

Table 9: Tensile Strength of MP (MPa)

s.no	M.P+R.H.A(%)	7 DAYS	28DAYS	90 DAYS
0	REF.MIX	2.33	2.77	2.985
1	5+5	2.66	3.1	3.15
2	10+10	2.23	2.82	2.99
3	15+15	2.21	2.78	2.72
4	20+20	2.12	2.66	2.51

Table 10: Tensile Strength of MP& RHA (MPa)



Graph for Table-10

s.no	M.P (%)	7 DAYS	28DAYS	90 DAYS
0	REF.MIX	3.68	3.83	3.95
1	5	4.27	4.58	4.73
2	10	4.43	6.19	6.3
3	15	4.44	6.26	6.39
4	20	2.92	3.09	3.83

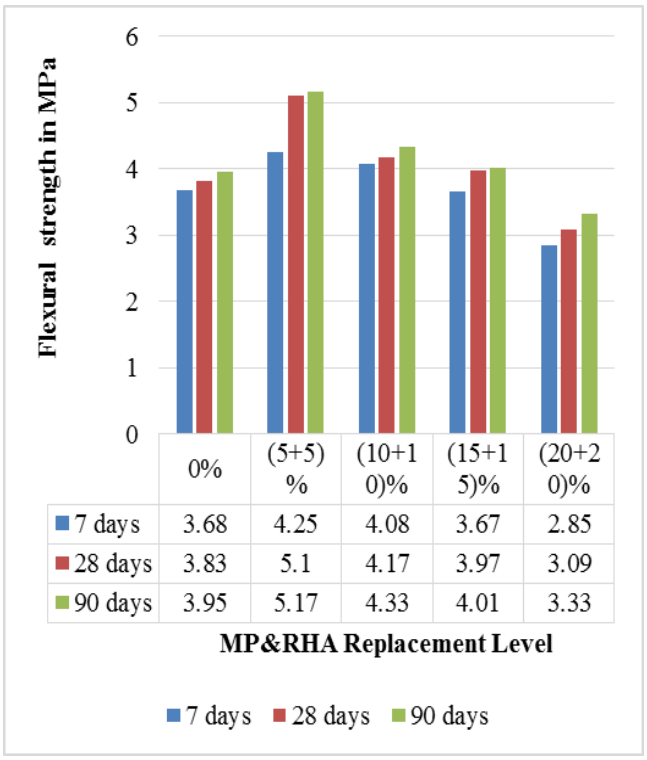
Table 11: Flexural Strength of MP (MPa)

s.no	R.H.A (%)	7 DAYS	28DAYS	90 DAYS
0	REF.MIX	3.68	3.83	3.95
1	5	4.29	4.35	4.37
2	10	4.33	4.8	4.92
3	15	4.34	4.87	5.17
4	20	3.54	3.67	3.71

Table 12: Flexural Strength of RHA (MPa)

s.no	M.P+R.H.A(%)	7 DAYS	28DAYS	90 DAYS
0	REF.MIX	3.68	3.83	3.95
1	5+5	4.25	5.1	5.17
2	10+10	4.08	4.17	4.33
3	15+15	3.67	3.97	4.01
4	20+20	2.85	3.09	3.33

Table 13: Flexural Strength of MP & RHA (MPa)



Graph for Table 13

V. Conclusion

1) The addition of R.H.A and M.P has a significant effect on the compressive strength, Tensile and Flexure strength of concrete. Compressive strength of concrete increases with the addition of RHA and M.P up to 10% of cement after which it decreases.
2) The optimum combined replacement level of RHA and MP is found to be (5%+5%).
3) The optimum replacement level of RHA and M.P for flexure and Tensile strength is (5%+5%)

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