



EXPERIMENTAL INVESTIGATION ON THE MECHANICAL PROPERTIES OF CONCRETE BY PARTIAL REPLACEMENT OF CEMENT WITH MARBLE POWDER & 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 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 marble powder (0%, 5%, 10%, 15% & 20%). Partial replacement of Rice-husk-ash (0%, 5%, 10%, 15% & 20%) separately and blended both marble powder and rice-husk-ash combines partial replacement (0%, 5%+5%, 10%+10%, 15%+15% & 20%+20%). The test results indicate that marble powder & rice-husk-ash is an effective mineral admixture, with 10% and combine of both (5%+5%) as the optimal replacement ratio of cement.

Keywords: *Marble Powder, Rice-Husk-Ash, Mechanical Properties & Regression Model*

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 CO₂ 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 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 cementing material was present, the 7 days on the 28 days compressive strength higher than the control concrete.



II. EXPERIMENTAL PROGRAMME

Materials

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.

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.

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.

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.

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

Table-1 Chemical Properties Of Binder Materials

S.NO	CONSTITUENTS (MASS %)	R.H.A	M.P
1	Silica (Sio ₂)	88.90%	11.38%
2	Alumina (Al ₂ O ₃)	2.50%	0. 23%
3	Ferric Oxide (Fe ₂ O ₃)	2.19%	0. 09%
4	Calcium Oxide (Cao)	0.22%	45.18%
5	Total Alkalies (Na ₂ O+K ₂ O)	0.69%	-

Table-2 Physical 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-3 Test Results On Fine Aggregate (Is 383-1970)

Properties	Results obtained	Range
Specific Gravity	2.61	2.5-3.0
Fineness Modulus Test	2.74	2.6-3.2
Bulking Of sand	4%	-

Table-4 Concrete Mixture Proportions For 1 M³ Of Concrete(M40 Grade)

Material mixture	Gravel(KG)	sand(KG)	cement(KG)	R.H.A	M.P	W/C	sp
Reference	1148	692	400	-	-	0.38	0.015%
MP5	1148	692	380	0%	5%	0.38	0.015%
MP10	1148	692	360	0%	10%	0.38	0.015%
MP15	1148	692	340	0%	15%	0.38	0.015%
MP20	1148	692	320	0%	20%	0.38	0.015%
RHA5	1148	692	380	5%	0%	0.38	0.015%
RHA10	1148	692	360	10%	0%	0.38	0.015%
RHA15	1148	692	340	15%	0%	0.38	0.015%
RHA20	1148	692	320	20%	0%	0.38	0.015%

**Test Methods**

The compressive strength, tensile strength and flexural strengths of various concrete mixtures were determined on 150mm³ cubes, 150x300mm cylinders and 100x100x500mm beams respectively.

III. 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 Tensile strength. Table-11, 12 shows development for MP15 and RHA15 reference concrete at different ages of flexural strength.

Table-5 Compressive Strength (N/Mm²) Of M.P Concrete

s.no	M.P (%)	7 DAYS	28DAYS	56DAYS	90DAYS
1	0(REF.MIX)	42.45	49.36	52.23	56.27
2	5	40.23	50.16	51.12	54.16
3	10	41.62	52.15	53.4	58
4	15	39.14	47.17	50.19	52.6
5	20	35.6	44.17	45.17	50.16

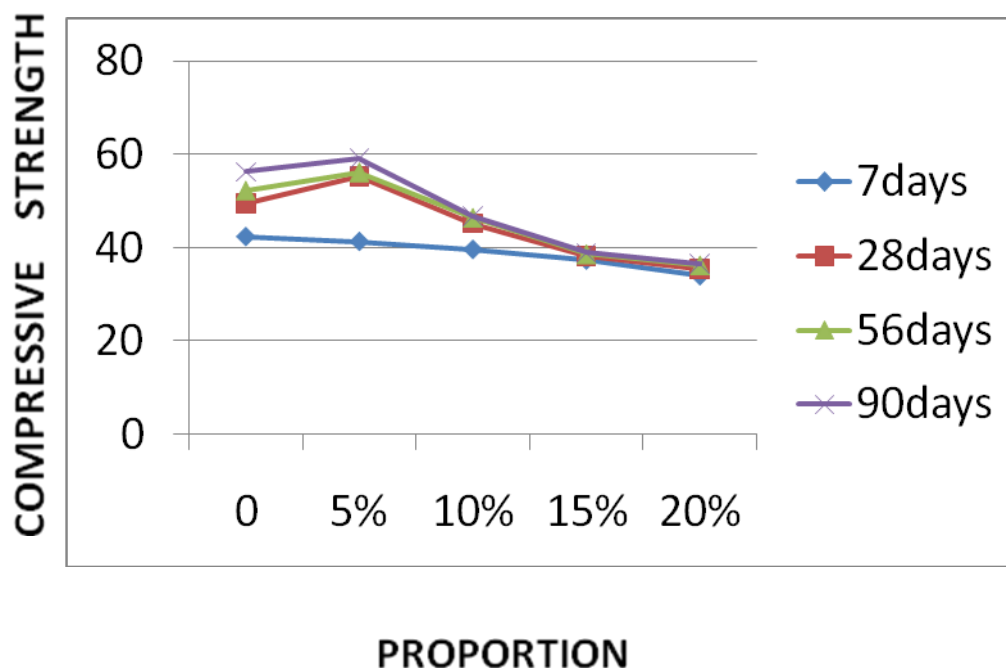
Table-6 Compressive Strength R.H.A Concrete (Mpa)

s.no	R.H.A (%)	7 DAYS	28DAYS	56DAYS	90DAYS
1	0(REF.MIX)	42.45	49.36	52.23	56.27
2	5	39.24	48.65	49.42	50.25
3	10	40.49	51.24	53.43	57
4	15	36.71	45.46	45.91	47.12
5	20	35.41	44.12	45.41	46.54

Table-7 Compressive Strength Of M.P And Rha Concrete(Mpa)

s.no	M.P+R.H.A (%)	7 DAYS	28DAYS	56DAYS	90DAYS
1	0(REF.MIX)	42.45	49.36	52.23	56.27
2	5+5	41.42	55.24	56.12	59.15
3	10+10	39.68	45.14	46.38	46.7
4	15+15	37.4	38.2	38.6	39
5	20+20	34	35.4	36.2	36.6

Graph for table-7



This graph shows compressive strength will be maximum at MP+RHA [5%+5%] at 90 days is 59.15 N/mm² and 28 days strength is 55.24 N/mm². In this graph X axis is replacement proportion and Y axis is compressive strength.

Table-8 Tensile Strength Of Rha (Mpa)

S.no	R.H.A (%)	7 DAYS	28DAYS
0	REF.MIX	3.10	3.69
1	5	2.90	3.81
2	10	2.92	3.83
3	15	2.99	3.94
4	20	2.42	3.63

Table-9 Tensile Strength Of Mp(Mpa)

S.no	M.P(%)	7 DAYS	28DAYS
0	REF.MIX	3.100	3.690
1	5	2.96	3.84
2	10	2.99	3.96
3	15	3.12	3.99
4	20	2.72	3.65

Table-10 Tensile Strength Of Mp And Rha(Mpa)

s.no	M.P+R.H.A(%)	7 DAYS	28DAYS
0	REF.MIX	3.100	3.690
1	5+5	3.01	4.1
2	10+10	2.97	3.76
3	15+15	2.95	3.71
4	20+20	2.82	3.54

Graph for table-10

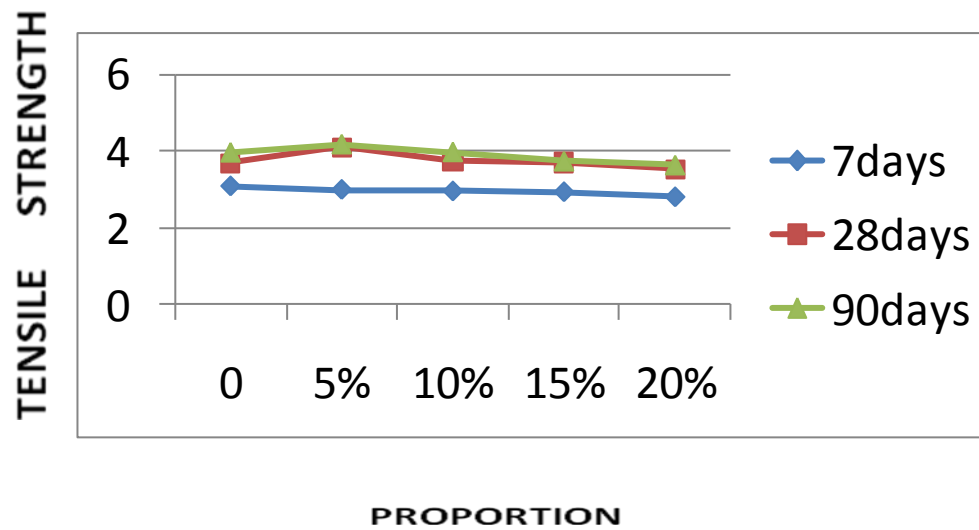


Table-11 Flexural Strength Of Mp(Mpa)

s.no	M.P (%)	7 DAYS	28DAYS
0	REF.MIX	4.91	5.1
1	5	5.7	6.1
2	10	5.91	8.25
3	15	5.93	8.35
4	20	3.89	4.12

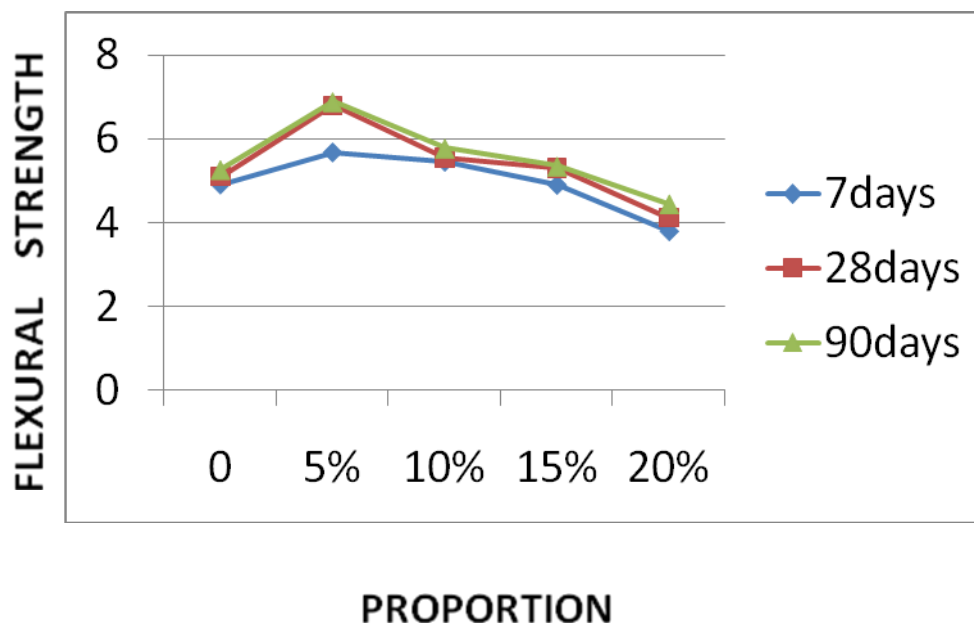
Table-12 Flexural Strength Of Rha(Mpa)

s.no	R.H.A(%)	7 DAYS	28DAYS
0	REF.MIX	4.91	5.1
1	5	5.73	5.8
2	10	5.78	6.4
3	15	5.79	6.49
4	20	4.72	4.89

Table-13 Flexural Strength Of Mp And Rha(Mpa)

s.no	M.P+R.H.A(%)	7 DAYS	28DAYS
0	REF.MIX	4.91	5.1
1	5+5	5.67	6.8
2	10+10	5.45	5.56
3	15+15	4.9	5.3
4	20+20	3.8	4.12

Graph for table-13



IV. CONCLUSION

- 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.
- The optimum combined replacement level of RHA and MP is found to be (5%+5%).



- The optimum replacement level of RHA and M.P for for flexure and Tensile strength is 15%

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