Comparative Study Of High Strength In Husk Ash Concrete With Quarry Dust As A Partial Replacement For Sand

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Abstract- *Rice Husk is a by-product from rice milling industries which is burnt to generate power required for different activities in the factory. The burning of rice husk leave ash as a waste, which has a pozzolanic property that could potentially be used as a cement replacement material.*
India being one of the largest producers of rice in the world produces nearly 240 million tons per year and therefore large a quantity of rice husk is available. Rice Husk ash has recently been tested in some parts of the world for its use as partial cement replacement material. The husk ash was found to improve some properties of the paste, mortar and concrete including compressive strength and water tightness in certain replacement percentages and fineness. The higher silica content in the husk ash was suggested to be the main cause for these improvements. Although the silica content may vary from ash to ash, depending on burning conditions and other properties of raw materials including the soil on which rice is grown, it has been reported that the silicate un-dergoes a pozzolanic reaction.

Keywords- Ash, Quarry dust, sand Rcce husk

I. INTRODUCTION

The natural river sand is the cheapest resource of sand. However the excessive mining of river bed to meet the increasing demand for sand in construction industry has led to the ecological imbalance in the state. Now the sand available in the riverbed is very coarse and contains very high percentage of silt and clay. The silt and the clay present in the sand reduces the strength of the concrete and holds dampness. The natural river sand is the product of sedimentation. Mica, coal, fossils and other organic impurities present in the river sand above certain percentage makes the sand useless for concrete work.

Acute shortage and high price for river sand has led to the adulteration of sand with salty sea sand which has raised serious concern in the construction industry.

Necessity

Change in living standard of people, environmental concerns and economy has made to search for substitutes for basic constituents of concrete. Along with durability and serviceability of the structures, person also wants aesthetic view and fast erection of the structure. To cater to these requirements- new technologies, new construction practices and new concrete making materials are being used. In today's world, various kinds of civil engineering structures are coming into picture, placing greater demand on material performance, the need for more fundamental information on the behavior of concrete under different types of loads is of prime importance.

Aim and Scope

1. To investigate the behavior of modified rice husk ash concrete (MRHAC)composite with various volume fractions of RHA.
2. To investigate the strength properties of MRHAC composite with various volume fractions of RHA.
3. To investigate other properties such as workability, density and elastic constants.
4. To compare the properties of these special concretes with that of normal concrete.
5. To determine the properties of hardened concrete, such as compressive strength, split tensile strength, flexural strength and pull out strength.

Experimental Analysis

The tests on hardened concrete are carried out according to relevant standards wherever applicable. Results of various strengths are computed according to the strength of material theory. Various tables presented in this chapter shows the results obtained from the test on wet and hardened concrete Results of hardened QDC and MRHAC are discussed in comparison with those of normal concrete.

Workability and density

Workability of concrete with and without RHA is determined with the help of slump cone test. The density is obtained by measuring the weight and volume of cube moulds respectively. Results of these properties are shown in Table 4.1.

Table Physical properties of concrete

Sr. No.	Mix designation	% of QD	% of RHA	Wet Density in kg/m^3	Dry Density in kg/m^3 at 7days	Dry Density in kg/m^3 at 28 days	Workability in mm
1	M0	0	0	2642.41	2522.45	2512.30	93
2	M1	5	0	2658.63	2566.86	2528.70	90
3	M2	10	0	2675.71	2572.73	2542.85	85
4	M3	15	0	2699.15	2575.12	2553.30	72
5	M4	20	0	2712.78	2588.77	2572.42	65
6	M5	10	5	2668.43	2549.47	2536.74	87
7	M6	10	10	2661.33	2538.24	2533.95	79
8	M7	10	15	2657.45	2531.45	2521.41	78
9	M8	10	20	2612.20	2524.86	2505.00	69

Table 4.2 Slump loss

Sr. No	QD Volume fraction V_s (%)	RHA Volume fraction V_b (%)	Slump (mm)	Slump Loss using as per eq. 1
1.	0	0	95	0.00
2.	5	0	89	6.31
3.	10	0	85	10.52
4.	15	0	72	24.21
5.	20	0	68	28.42
6.	10	5	83	12.63
7.	10	10	79	16.84
8.	10	15	76	20.00
9.	10	20	70	26.32

From the values of slump loss it can be seen that as QD and RHA content increases the workability decreases and slump loss increases. The graph is plotted for slump loss versus QD content and RHA content respectively as shown in fig 4.1 and fig 4.2

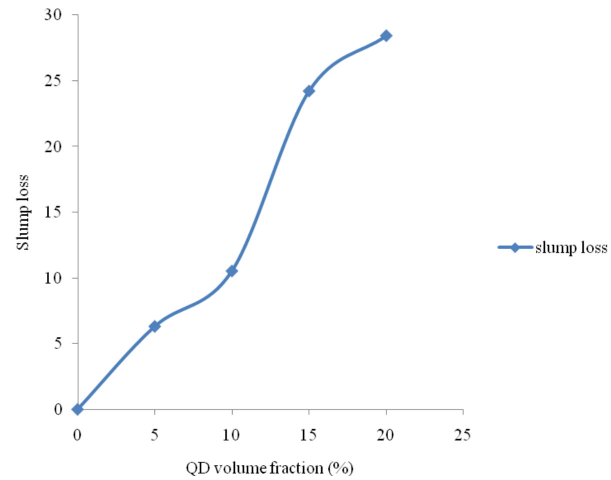

Fig. Variation of slump losswith respective to MS

Fig. Variation of slump losswith respective to RHA

Workability is measured in terms of slump. Results from Table 4.2, indicate that for same mix proportion but increase in QD and RHA content workability is reduced.

Slump loss

Slump loss has a great effect on the concrete workability and it can be considered as an influencing parameter.

Compressive strength test

The results of compressive strength are obtained using Eq.2 and presented in Table 4.3 and Table 4.4.

Table Compressive strength of QDC

Sr. No.	QD (%)	Compressive Strength in N/mm² from Eq. 2		% Variation in Compressive Strength Over Control Concrete		% increase in 28 Days compressive Strength Over
		7 Days	28 Days	7 Days	28 Days	7 Days
1	0	27.5	53.15	0.0	0.0	93.27
2	5	33.99	56.25	23.6	5.8	65.49
3	10	37.48	59.40	36.3	11.8	58.48
4	15	30.11	50.93	9.5	-4.2	69.15
5	20	22.74	41.49	-17.3	-21.9	82.45

From the above table, the optimum percentage of QD in QDC is found out to be 10%. In the remaining experimental investigation, the QDC content is kept constant, *i.e.*10%.

Table Compressive strength of MRHAC

Sr. No	Rice Husk ash(%)	% Variation in compressive strength	
		7 days(N/mm²)	28 days(N/mm²)
1	0	37.48	58.25
2	5	37.78	60.15
3	10	40.89	60.35
4	15	35.40	48.50
5	20	28.00	40.55

Results of compressive strength are shown in Table 4.3 and 4.4 with the addition of QD,compressive strength of concrete is increased. Initially the value of compressive strength increases at 5% and further at 10% and then decreases for 15% and 20%. The compressive strength is found to be maximum at 10% QD. Hence, the optimum value of QD, replacing fine aggregate is 10%. Keeping 10% QD constant for further mixes, cement is replaced by RHA varying from 5% upto 20% at an interval of 5%. It is observed that the compressive strength in MRHAC is greater than the control concrete at 7 days test and also the compressive strength is seen to be increased at 28 days. It is observed that the compressive strength is maximum at 10% RHA in MRHAC. Hence the RHA is suitable for improving the compressive strength of structural concrete.

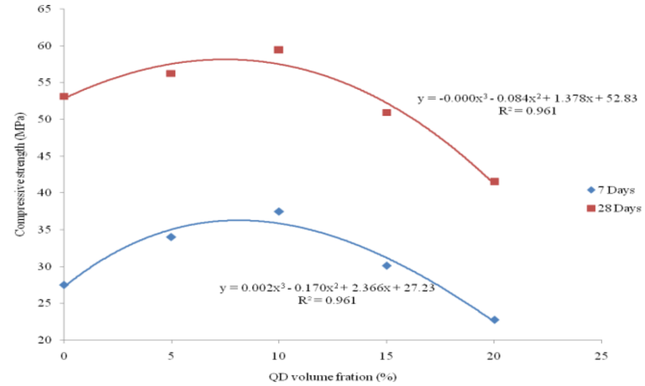

Fig Variation of compressive strength of cube at the age of 7 days and 28 days respectively with respect to percentage QD volume fraction in QDC

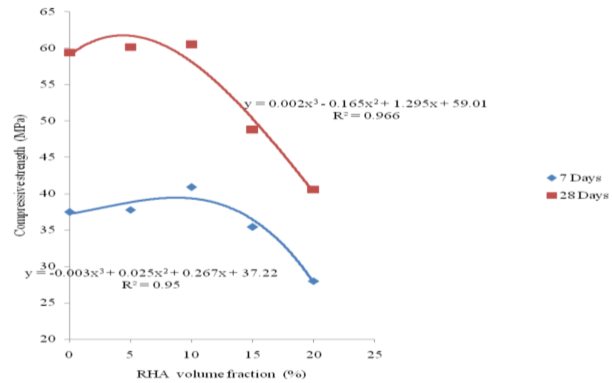

Fig of compressive strength of cube at the age of 7 days and 28 days respectively with respect to percentage RHA volume fraction in MRHAC

Flexural strength test

Flexural strength is obtained for various RHA volume fractions in MRHAC and results are presented in Table 4.5. The variation of flexural strength with respect to RHA volume fraction is shown in fig 4.5

Table Flexural strength of beam

Sr. No.	Mix designation	% of RHA	Flexural strength in N/mm² From Eq.7		% Variation in flexural strength over control concrete		% of increase in 28 days strength over
			7 days	28 days	7 days	28 days	7 days
1	M2	0	6.00	11.32	0.0	0.00	88.60
2	M5	5	8.90	12.19	48.3	7.70	36.99
3	M6	10	10.18	14.49	70.5	36.96	51.55
4	M7	15	7.95	10.30	32.5	-9.05	29.51
5	M8	20	6.35	08.64	5.9	-23.67	36.00

From above Table 4.5, it is observed that there is marginal difference in 28 days flexural strength over 7 days. On addition of RHA in QDC there is an increase in flexural strength initially and then decreases.From the Table 4.5, it can be observed that the flexural strength is maximum at 10% RHA.

The 7 and 28 days variation of flexural strength with respect to RHA content is presented in Fig. 4.5.

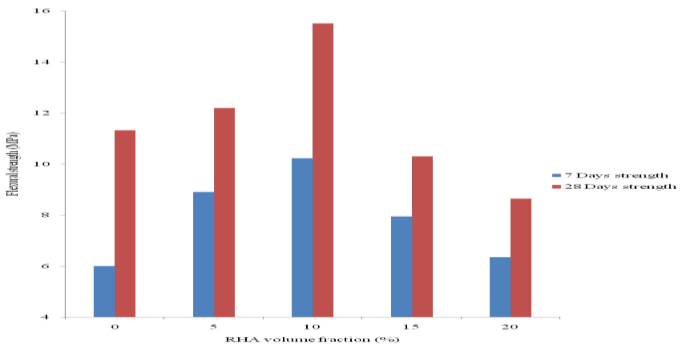

Fig . Variation of flexural strength of beam at the age of 7 days and 28 days respectively with respect to percentage RHA volume fraction

Setting time of cement	
a) Initial setting time	135 minute
b) Final setting time	288 minute
Sound test of cement (with le-Chatelier'smould)	1.5 mm
Compressive strength of cement	

II. CONCLUSIONS

The following conclusions are drawn from the test result and discussion of this investigation.

1. The maximum compressive strength, flexural strength, split tensile and bond strengths achieved are 60.35, 14.49, 3.00and 10.85 MPa at 10% of RHA volume fractions respectively.
2. Elastic constants of QDC and MRHAC are obtained by various methods. Empirical expressions for modulus of elasticity i.e. static and dynamic have been developed in terms of QD and RHA volume fraction and cube compressive strength of QD and MRHAC. Predicted values of modulus of elasticity are excellent agreement with those of expression derived from the graph plotted.
3. In general, the significant improvement in various strengths is observed with the inclusion of QD and RHA in the plain concrete. However, maximum gain in strength of concrete is found to depend upon the amount of RHA content. The optimum RHA content is 10% to impart maximum gain in strength.
4. Satisfactory workability was maintained with addition of super plasticizer of given dosage.
5. It is observed that the equivalent compressive strength of MRHAC decreases as % of RHA increases after 10% of RHA addition.
6. Flexural strength of MRHAC is increased with increasing percentage of RHA
7. The split tensile strength at 7 days and 28 days of curing observed to be increasing marginally.
8. The bond strength is increased with increase in RHA content.

III. SCOPE FOR FUTURE WORK

The present work has good scope for future research. Some of the research areas are as follows:

1. Study of the behavior of MRHAC at elevated temperatures.
2. Study of MRHAC in high-strength, high-performance concrete.
3. Study of impact resistance, abrasion resistance and permeability of MRHAC.
4. Study of behavior of MRHAC after incorporation of fibers.

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