An Experimental Investigation on Behavior of Concrete on Partial Replacement of Cement by Rice Husk Ash

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Abstract

The objective of this experimental work is to assessment the performance of concrete when the cement is partial replacement with Rice Husk Ash (RHA) in concrete using OPC (43grade).Experimental work done for reducing the cost of concrete and check workability, durability and strength of concrete. Some effort has been done for Enhancing the performance of concrete for the past few year suggest that replace of cement with mineral and chemical admixture can improve the workability, durability and strength of concrete. Rice Husk Ash is a waste material that can be utilized to make low cost concrete and it has the pozzolanic properties. In this experimental work Rice Husk Ash (RHA) is used as partial replacement with cement which is 5%, 10%, 15%,20%, and 25% by total weight of cement. A total eighteen mix were prepared for M35, M40, and M45 grades of concrete. This Study carry out the performance of concrete in terms of slump, compressive strength for 3days, 7 days, 14 days and 28 days, Total number of specimens for cubes 54 which were casted for testing to study effects of RHA on concrete. These specimens of concretewere deep in water for curing at atmospheric temperature in normal condition. On the basis of result that RHA concrete almost same as ordinary concrete and it was also found low cost then ordinary concrete so its use should be prompted for low cost infrastructure and better performance.

Keywords*:-Concrete, Rice Husk Ash, Compressive Strength, Workability, Slump*

1. Introduction

Concrete is a mix of Natural sand, Cement and Aggregate with water. It is very useful due to as it can be mould any shape during the constructions. Researcher and investigators are trying to increase their range further with the help of supplementary cementations materials SCM and innovative chemical reagents.

RHA produced after burning of Rice husks (RH) has high reactivity and pozzolanic property. Chemical compositions of RHA are affected due to burning process and temperature. Silica content in the ash increases with higher the burning temperature. The effect of partial replacement of cement with different percentages of ground RHA on the compressive strength and durability of concrete is examined.

Table-1 Properties of Rice Husk Ash

Properties	Range
	Rice Husk Ash
Appearance	Gray Black
Moisture	0.63
Bulk density(gm/cc)	0.60
Specific gravity	1.94
Silica(SiO2)	82.36
Al2O3	1.10
Fe2O3	0.75
Carbon	0.67
CaO	0.60
MgO	0.87
K2O	1.88
Na2O3	0.14

2. Experimental Program

2.1 Proportion of Rice Husk Ash with concrete Mix

In this mix cement was replace with Rice Husk ash few percentage of cement which is from 0% to 25% at interval of 5% for both concrete mixes of M35, M40 and M45.

Table-2 Replacement of Rice Husk Ash into OPC for M35

S.N.	Mix Type	Cement (Kg)	RHA (Kg)	Coarse Aggregate (Kg)		Fine Aggregate (Kg)	Water (Kg)	Admixture (Kg)
				20mm	10mm			
1	OPC+RHA (100+0)	405	0	625	417	806	167	3.5
2	OPC+RHA(95+5)	384.75	20.25	625	417	806	167	3.5
3	OPC+RHA(90+10)	364.5	40.5	625	417	806	167	3.5
4	OPC+RHA (85+15)	344.25	60.75	625	417	806	167	3.5
5	OPC+RHA(80+20)	324	81	625	417	806	167	3.5
6	OPC+RHA(75+25)	303.75	101.25	625	417	806	167	3.5

Table-3 Replacement of Rice Husk Ash into OPC for M40								
S.N.	Mix Type	Cement (Kg)	RHA (Kg)	Coarse Aggregate(Kg)		Fine Aggregate (Kg)	Water (Kg)	Admixture (Kg)
				20mm	10mm			
1	OPC+RHA (100+0)	451	0	611	408	788	166	4.5
2	OPC+RHA (95+5)	428.45	22.55	611	408	788	166	4.5
3	OPC+RHA (90+10)	405.9	45.1	611	408	788	166	4.5
4	OPC+RHA (85+15)	383.35	67.65	611	408	788	166	4.5
5	OPC+RHA (80+20)	360.8	90.2	611	408	788	166	4.5
6	OPC+RHA (75+25)	338.25	112.75	611	408	788	166	4.5

Table-4 Replacement of Rice Husk Ash into OPC for M45

S.N.	Mix Type	Cement (Kg)	RHA (Kg)	Coarse Aggregate(Kg)		Fine Aggregate (Kg)	Water (Kg)	Admixture (Kg)
				20mm	10mm			
1	OPC+RHA (100+0)	493	0	601	401	781	168	5
2	OPC+RHA (95+5)	468.35	24.65	601	401	781	168	5
3	OPC+RHA (90+10)	443.7	49.3	601	401	781	168	5
4	OPC+RHA (85+15)	419.05	73.95	601	401	781	168	5
5	OPC+RHA (80+20)	394.4	98.6	601	401	781	168	5
6	OPC+RHA (75+25)	369.75	123.25	601	401	781	168	5

3. Results And Analysis

3.1 Slump

According to IS1191: 1959, slump testing process was conducted and process is given below: In this test, the mould was placed on a horizontal, rigid, smooth and non-absorbent surface, with carefully placed metal plate, the mould is being trusted, while it is being filled.

Table-5 Comparative Analysis of Slump in M35,M40 & M45

% of RHA	Slump for M35	Slump for M40	Slump for M45
0	120	110	100
5	114	103	96
10	110	98	91
15	107	90	87
20	102	87	80
25	92	83	75

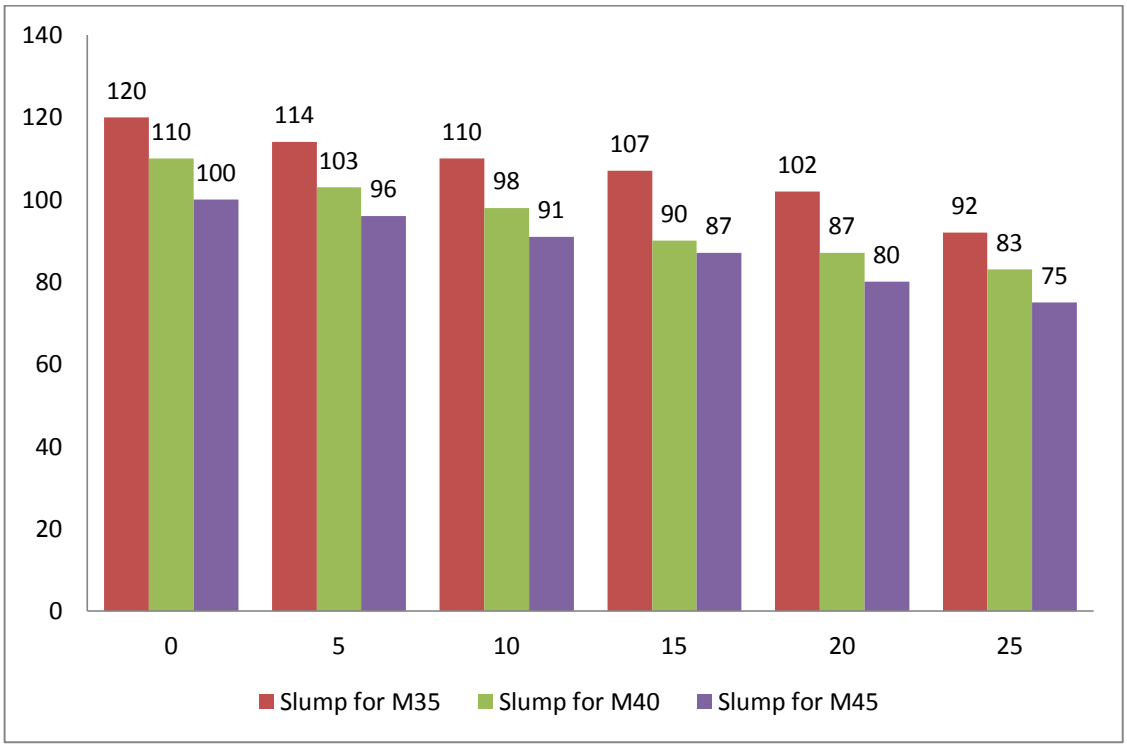

Figure-1 Comparison of slump in M35,M40 & M45 Mix

3.2 Compressive Strength

The compressive strength of Rice Husk Ash mixes was measured with cube specimen of size 150mm(length) x 150mm(width) x 150mm(depth).The specimens were tested after curing for 7 days and 28 days fully immersed in water tank as per IS 516:1959 for method of tests for strength of concrete.

Table- 6Compressive Strength of M35 concrete at various days When Cement is Replaced by Rice Husk Ash

S.N.	Rice Husk Ash	Compressive Strength			
		3 day (N/mm^2)	7 day (N/mm^2)	28 day (N/mm^2)	56 day (N/mm^2)
1	0%	15.69	25.94	38.75	51.63
2	5%	14.49	24.27	43.65	53.36
3	10%	15.63	31.57	44.89	60.46
4	15%	14.63	21.95	43.82	56.89
5	20%	10.66	14.27	23.42	56.85
6	25%	9.53	12.54	22.43	48.96

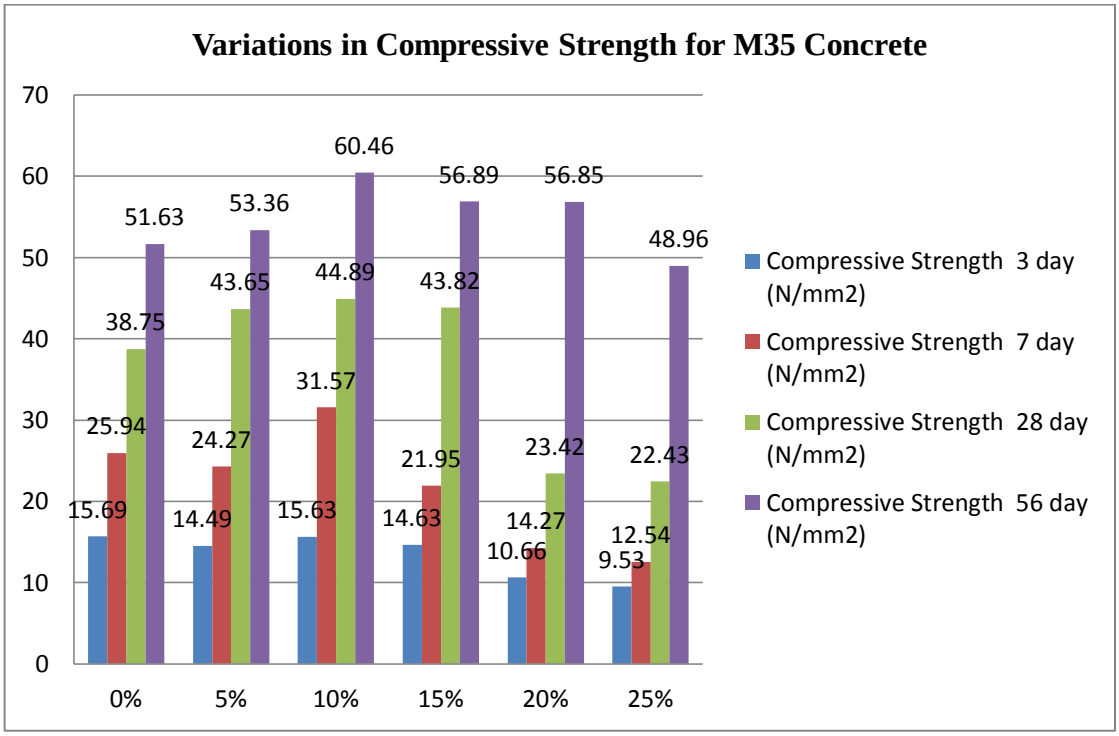

Figure-2 Compressive Strength of M35 concrete at various days When Cement is replaced by Rice Husk Ash

Table -7 Compressive Strength of M40 concrete at various days When Cement is Replaced by Rice Husk Ash

S.N.	Rice Husk Ash	Compressive Strength			
		3 day (N/mm^2)	7 day (N/mm^2)	28 day (N/mm^2)	56 day (N/mm^2)
1	0%	0%	19.65	29.63	44.25
2	5%	5%	18.45	27.96	51.63
3	10%	10%	22.23	35.26	52.29
4	15%	15%	20.98	25.64	48.78
5	20%	20%	14.63	17.96	29.25
6	25%	25%	11.23	16.23	27

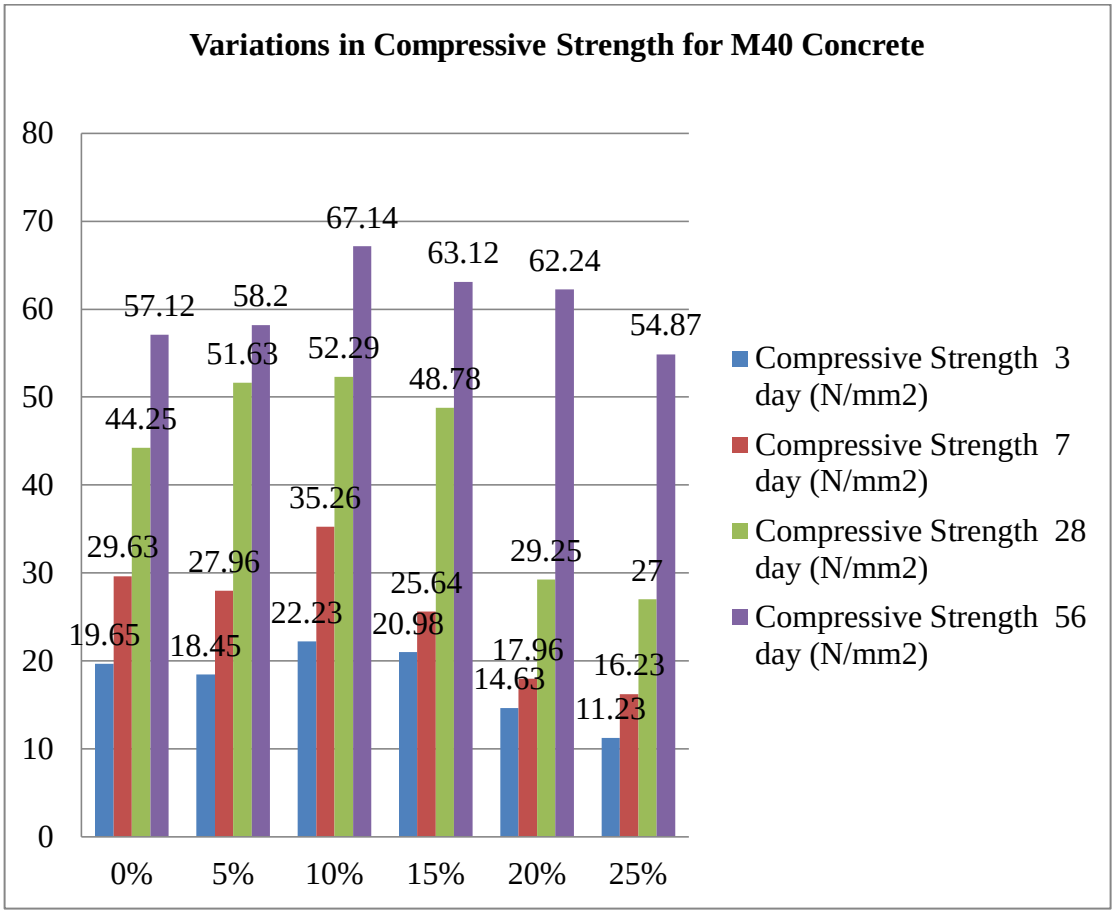

Figure-3 Compressive Strength of M40 concrete at various days When Cement is Replaced by Rice Husk Ash

Table-8 Compressive Strength of M45 concrete at various days When Cement is Replaced by Rice Husk Ash

S.N.	Rice Husk Ash	Compressive Strength			
		3 day (N/mm^2)	7 day (N/mm^2)	28 day (N/mm^2)	56 day (N/mm^2)
1	0%	24.28	27.93	48.85	60.24
2	5%	23.08	26.73	56.23	61.87
3	10%	30.94	34.59	56.89	71.65
4	15%	25.61	29.26	53.38	67.24
5	20%	15.17	18.82	33.85	62.75
6	25%	13.25	16.9	31.6	59.25

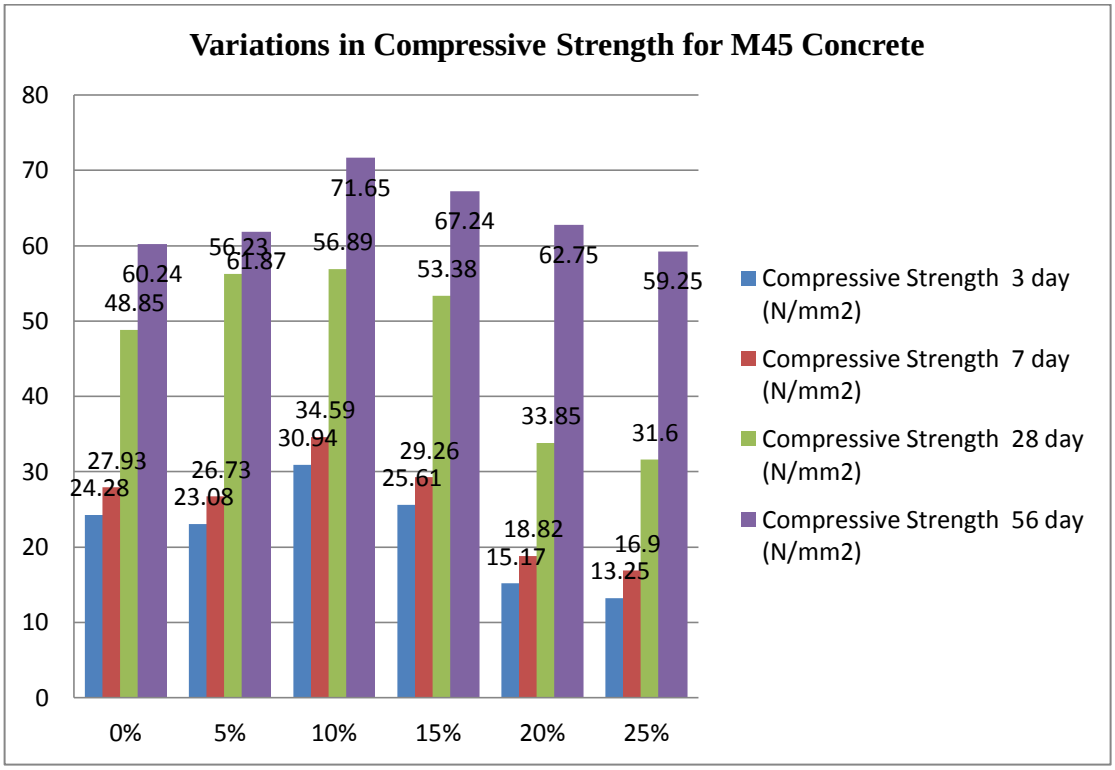

Figure- 4 Compressive Strength of M45 concrete at various days When Cement is Replaced by Rice Husk Ash

4. Conclusion

1. When the partial replacementof cement by Rice Husk Ash from 5% to 25% at a interval of 5% , the slump of the concrete mix was decreased up to 25 % replacement for mixes M35, M40 & M45due to High water demand.
2. Low slump have been found as 100 mm for M45, 110 mm for M40 and 120 mm for M35 on replacement of cement by RHA.
3. WhenRice Husk ash was replacing (0% to 10% with increment of 5%) to OPC, Compressive strength of concrete wasincreasedin mixes M35, M40 & M45.
4. But after replacing Rice husk Ash (15% to 25% with increment of 5%) Compressive strength slightly decreased.
5. Maximum compressive strength was found in M35- 44.98 N/mm^2), M40- 52.29, N/mm^2& M45- 56.89 N/mm^2 at 28 days when Rice Husk Ash is Replaced 10% with the OPC.

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