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Effect of Rice Husk Ash and M-Sand on Concrete

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***Abstract*: In today's world, the construction activities has been increasing day to day life. Concrete plays an important role in construction industry. The consumption of concrete is high, the materials cement, sand and gravels exhausted in future. So we have to find the replacement materials to overcome the scarcity and enhance the properties of concrete. The various industrial materials like Rice Husk Ash, fly ash, silica fume etc having similar properties. Manufactured sand is the best replacement material to natural sand. In this present study, to investigate experimentally the effect of manufactured sand and Rice husk ash on concrete. Constant 10% of rice husk ash is used for the replacement of cement and manufactured sand with different proportions25%, 50%, 75%, 100% are used as replacement material for fine aggregate. Compressive strength, split tensile strength, flexural strength, bond strength, acid resistance, water absorption tests were conducted and compared the test results with the control mix. Design mix M20 grade of concrete is used in this study. Rice husk ash and manufactured sand is easily available and low cost.**

***Keywords*: Rice husk ash, Manufactured sand, Concrete, cement, sand, compressive strength, split tensile strength, flexural strength, bond strength, acid resistance, water absorption.**

1. Introduction

Concrete is most extensively used construction material. The constituent's materials of the concrete are binding material, fine aggregate, coarse aggregate and water. Cement and natural sand are the main components in making of concrete. Rapidly increasing the constructional activities leads to exhausted in future. Production of cement involves the large amount emissions of carbon dioxide gas in the atmosphere. This is the reason for the greenhouse effect and global warming. So we have found the replacement materials for the cement. The various industrial waste like RHA, silica fume, fly ash etc., are the replacement materials to enhance the properties of concrete. RHA is replacing the cement with rice husk ash because rice husk ash contains about 85% to 95% amorphous silica. And also it is highly reactive and low cost. Fine aggregate is quarrying in the river beds and it results scarcity in future. As the exhaustion of the great quality natural sand from the river bed which has adversely affect the earth crust and as it was only source of fine aggregate used in the construction. Manufactured sand is used in concrete to increase its strength as well as durability.

2. Materials

OPC cement of grade 53 is used in this study. Specific gravity of cement is 3.15 and normal consistency is 32%. Fine aggregates used are river sand of zone II which have specific gravity of 2.61, water absorption is 1.2% and bulking of sand is 14%. Crushed aggregate are used as coarse aggregate which are angular in shape and have specific gravity of 2.68, water absorption is 0.63% and crushing value is 19.5%. Specific gravity of M Sand is 2.64 and water absorption is 1.6%. Potable water is used in this study.

A. Experimental program

1. Design mix of M20 grade of concrete using as per IS 10262:2009.
2. The volume of the aggregate proportions is taken by trail mix depending on the Zone II.
3. Preparation of different concrete mix with the constant percentage of RHA as 10% and varying the percentages of manufactured sand is used.
4. Varying percentages of manufactured sand are10-25%, 10-50%, 10-75% and 10-100%.
5. For compressive strength test of the concrete cubes specimens of 150 × 150 × 150 mm size and cylinder specimens of 150 × 300 mm size is used for split tensile strength test and flexural strength of the concrete beam size 500 × 100 × 100 mm is used for the test. And for bond strength the test specimen of size 150 mm x 150 mm x 150 mm with an embedded single reinforcing bar of 10 mm diameter. The tests are performed for different curing periods of 7, 14 and 28 days.
6. For acid resistance test for the cube specimens of 150 × 150 × 150 mm size is used and water absorption test for the cube specimens of 150 × 150 × 150 mm size is used and carried out the tests for 28, 56 and 90 days.
7. Comparing the study of compressive strength, split tensile strength, flexural strength, bond strength, acid resistance, water absorption of concrete mix with the control mix.

3. Results and discussions

In this study, test of compressive strength, split tensile

strength, flexural strength, bond strength, acid resistance, water absorption tests are conducted. The test results are given in following tables where RHA stands for Rice Husk Ash and M sand stands for manufactured sand.

Table 1
Compressive strength results

S. No.	M20 MIX RHA & M-SAND	7 Days Compressive Strength (N/mm^2)	14 Days Compressive Strength (N/mm^2)	28 Days Compressive Strength (N/mm^2)
1	0-0	19.14	22.74	27.33
2	10-25	18.17	21.57	26.81
3	10-50	19.53	23.56	27.21
4	10-75	20.63	24.67	28.93
5	10-100	21.18	25.82	29.23

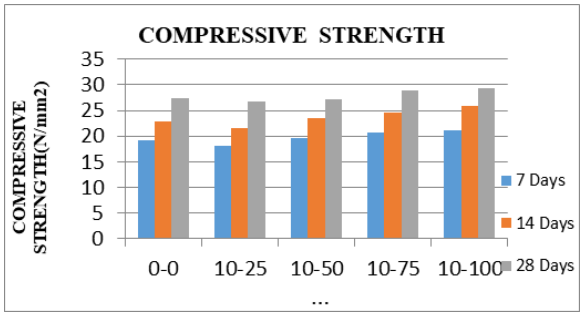

Fig. 1. Compressive strength test results for different days

Table 2
Flexural strength results

S. No.	M20 MIX RHA & M-SAND	7 Days Flexural Strength (N/mm^2)	14 Days Flexural Strength (N/mm^2)	28 Days Flexural Strength (N/mm^2)
1	0-0	2.42	2.97	3.49
2	10-25	2.39	2.87	3.38
3	10-50	2.43	2.99	3.51
4	10-75	2.57	3.09	3.53
5	10-100	2.69	3.19	3.57

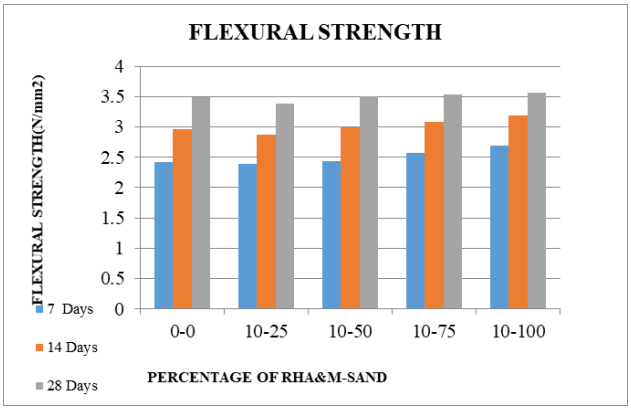

Fig. 2. Flexural strength test results in days

Table 3
Split tensile strength results

S. No.	M20 MIX RHA & M-SAND	7 Days Split tensile Strength (N/mm^2)	14 Days Split tensile Strength (N/mm^2)	28 Days Split tensile Strength (N/mm^2)
1	0-0	2.42	2.97	3.49
2	10-25	2.39	2.87	3.38
3	10-50	2.43	2.99	3.51
4	10-75	2.57	3.09	3.53
5	10-100	2.69	3.19	3.57

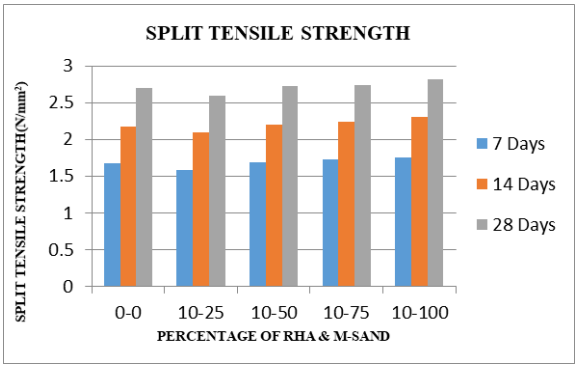

Fig. 3. Split tensile strength test results for different days

Table 4
Bond strength results

S. No.	M20 Mix RHA &M-Sand (%)	7 Days Bond Strength (N/mm^2)	14 Days Bond Strength (N/mm^2)	28 Days Bond Strength (N/mm^2)
1	0-0	1.68	2.00	2.20
2	10-25	1.53	1.84	1.92
3	10-50	1.57	1.89	1.98
4	10-75	1.66	1.92	2.34
5	10-100	1.72	2.23	2.48

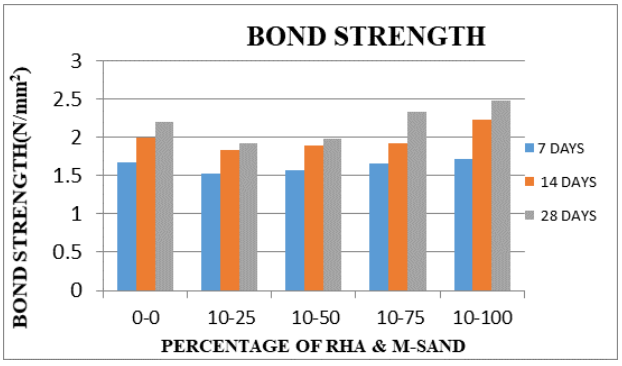

Fig. 4. Bond strength test results for different days

Table 5
Water Absorption test results

S. No.	Mix Proportions (%)	Percentage loss in water absorption (%)		
		28 Days Test Results	56 Days Test Results	90 Days Test Results
1	0-0	1.25	1.00	0.40
2	10-25	1.52	1.20	0.51
3	10-50	3.20	2.17	0.67
4	10-75	3.30	2.45	0.78
5	10-100	3.70	2.82	1.50

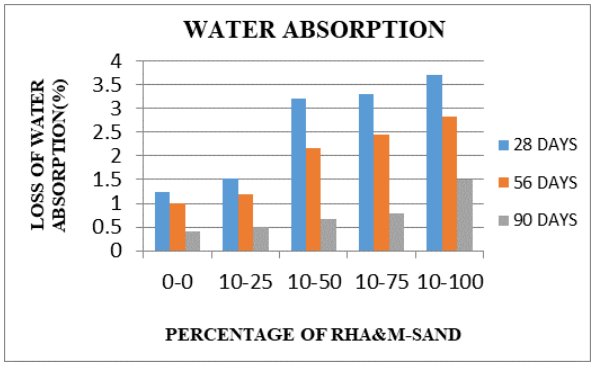

Fig. 5. Water absorption test results for different days

Table 6
Acid Resistance test results

S. No.	Mix Proportions (%)	Acid Resistance (%)		
		28 Days Test Results	56 Days Test Results	90 Days Test Results
1	0-0	7.75	0.77	0.54
2	10-25	7.21	0.31	0.12
3	10-50	8.24	1.23	0.71
4	10-75	8.63	1.58	0.94
5	10-100	8.91	1.71	1.21

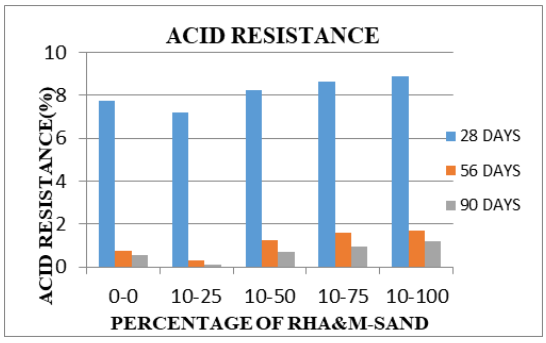

Fig. 6. Acid Resistance test results for different days

4. Conclusions

1. The mechanical and durability behavior of the hardened concrete specimens with constant replacement of cement with RHA (10%) and M-sand partially replacing with fine aggregates in different percentages (25%,50%,75%,100%).
2. The mechanical strength of concrete increased with the replacement of M-sand of 50% and above with constant replacement of 10% RHA.
3. The Compressive strength is 29.3N/mm^2 for 10% of RHA and 100% of M sand (mix-4) is higher when compared to control mix.
4. The Flexural strength is 3.54N/mm^2 for 10% of RHA and 100% of M sand (mix-4) is higher when compared to control mix.
5. The Split tensile strength is 2.74N/mm^2 for 10% of RHA and 100% of M sand (mix-4) is higher when compared to control mix.
6. The Bond strength is 2.48N/mm^2 for 10% of RHA and 100% of M sand (mix-4) is higher when compared to control mix.
7. There is a decrease in water absorption for 100%M sand when compare to control mix.
8. For acid resistance there is a decrease in weight loss for final mix when compare to control mix.
9. The replacement of fine aggregate to M sand and cement with RHA shows good strength to the concrete and it is economical.

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