

Study on Durability Properties of Concrete using Rice Husk Ash and Manufactured-Sand

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Abstract- Concrete is a widely used structural material. if its consumption is done at the same rate, it may get exhausted in the coming future. So we have to find alternatives to replace concrete fine aggregate is one of the essential components of concrete. We can preserve concrete by finding replacement material for cement, sand or gravel which can give same or more strength to concrete. In past, already many replacements were done by many people for cement, sand and gravel to make better concrete. The present proposal involves partial replacement of sand by manufactured sand and cement by rice husk ash to get good strength concrete. 15% of rha is used as partial replacement of cement and m-sand as partially and fully replacement of river sand in concrete with different weight percentages ranging from 0%, 25%, 50%, 75%, and 100% in production of sustainable concrete. The mix design was carried out for m20 grade of concrete.

Keywords: compression strength, water absorption, acid resistance and sorptivity.

I. INTRODUCTION

Concrete is the mostly used construction material due to its structural stability and strength. Materials used for making concrete come from the earth's crust. As per the survey and research it was found to be that there should be a replacement for the concrete materials in the place of cement and the fine aggregate because of the depletion and the cost. While the Natural sand was excavated from the river beds which is found to be low cost. By the degradation of the sand from the river it effects the environment and cause damage to the earth. As the sand in the river bed contains slit, clay, sulphates and also it has the high percentage of the inorganic materials. They affect the strength of the concrete and the inorganic substances are adversely affecting the reinforcement. In order to decrease the effects made by the natural sand and also to reduce the environmental degradation there should be partial replacement for the fine aggregate. As the river sand has the silts, which are not finely graded and inorganic materials which affect the Durability of the concrete the replacement is done with the Manufactured Sand also called as the robotic sand. The Manufactured sand is finely graded and it is the best replacement for filling of voids in the cement aggregate. Rice Husk Ash (RHA) is one of the best replacements for the cement which is partially replacement with 15% of the cement with it. As the material is contains of high amorphous silicon material and it has the pozzolonic effect. In this present project work mainly deals with replacement of fine aggregate 0%, 25%, 50%, 75%, 100% proportion of sand with Manufactured Sand and with the constant proportion of 15% Rice Husk Ash (RHA) is replaced with cement. In the present study is planned to do cubes and cylinders with 15-25%, 15-50%, 15-75%, 15-100% mix proportion for the further study of water absorption, acid resistance, and sorptivity and compression strength of the concrete.

II. EXPERIMENTAL INVESTIGATION

In the present experimental investigation, durability of concrete with partial replacement of cement is partially replaced with 15% of RHA and river sand is replaced with different weight percentages from 25%, 50%, 75% & 100% with Manufactures sand in the production of sustainable concrete has been evaluated by conducting tests like Water absorption, acid resistance, sorptivity and compressive strength test for M20 grade of concrete.

Rice husk ash (RHA):

It was partially replaced with the cement percentage of 15%. Below tests are conducted for rise husk ash as it contains more silicon with was pozzolonic. Physical properties of RHA are tabulated below Table 1.

Table 1: properties of RHA

S.No.	Physical Properties of RHA	Results
1	Normal consistency (%)	30%
2	Fineness	5
3	Initial setting time (hours, min)	30min
4	Final setting time	10 hours

	(hours, min)	
5	Specific gravity of	3.12
6	Soundness	6

Manufactured sand (m-sand):

Manufactured sand is the best one for the replacement for the river sand as it was depletion of good quality from it and causing deficiency of suitable river sand and also for the fast growing of the construction Industry. Another best reason for the usage of the manufactures sand is to reduce the transportation cost compared with far-off the river sand bed. Properties of manufactured sand are tabulated below in table 2.

Table 2: properties for manufactured sand

S.No.	Physical Properties of m-sand	Results
1	Specific gravity	2.62
2	Bulk density with compaction(kg/lit)	1.689
3	Bulk density without compaction (kg/lit)	1.995
4	Water absorption (%)	1.6
5	Bulking of m-sand(%)	12

III MIX DESIGN

A mix M20 grade was designed as per IS 10262 – 2009 as the code results the test samples were used. The design mix proportion is shown below in table 3. percentage of replacement materials are tabulated in below table 4.

Mix proportion of concrete per cubic meter:

Table 3: mix proportion details

Opc 53 grade (kg)	Water (lit)	Sand (kg)	20mm aggregate (kg)	12.5 mm Aggregate (kg)
358.18	197	768.4	452	552.5

Mix proportion of sustainable concrete for different replacements per cubic meter:

Table 4: percentages of replacement materials

S.No.	Mix Proportions	RHA Replacement for Opc (Kg)	M-Sand Replacement For River Sand (Kg)
1	15-25%	53.72	192.0
2	15-50%	53.72	384.2
3	15-75%	53.72	576.2
4	15-100%	53.72	768.4

4 RESULTS AND DISCUSSION:

Compressive Strength Test:

The compressive strength was conducted on cubical specimens after 7, 14 and 28 days curing period. The test results were tabulated in table 5 and plotted in fig 1. The compressive strength(N/mm²)= Failure load/cross sectional area.

Table 5: compressive strength test

S.No.	Mix proportions	7 days test (N/mm ²)	14days test (N/mm ²)	28 days test (N/mm ²)
1	15-25%	16.8	23.33	27.5
2	15-50%	20.5	26.7	30.4
3	15-75%	18.7	24.4	28.84
4	15-100%	19.20	23	26.22

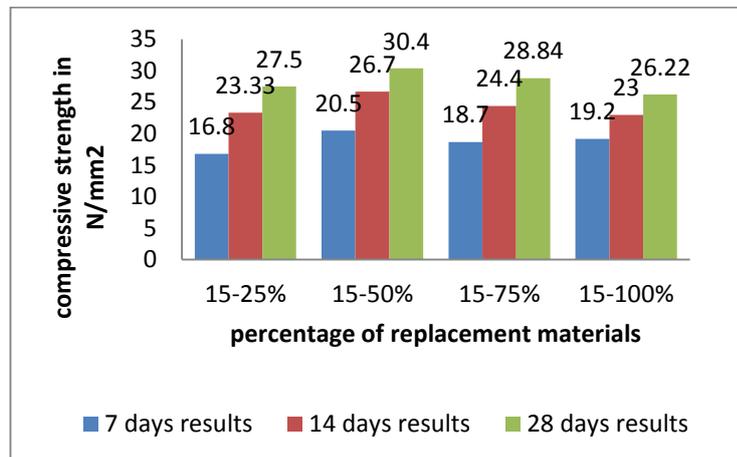


Figure 1: graphical representation of compression strength

It has been observed that, after replacement of cement with 15% of rice husk ash and river sand with manufactured sand in normal concrete there is about 25% increase in compressive strength as compare to normal concrete. Afterwards the compressive strength starts decreasing. Therefore the maximum compressive strength can be obtained by replacing cement with 15% RHA and river sand with 50% M-Sand.

Ultra Pulse Velocity Test-

Ultrasonic pulse velocity test was conducted on concrete cubes at periods of 7, 14 and 28 days. The test results were tabulated in table 6 and plotted. Pulse velocity = (path length/travel time).

Table 6: Test Results for Upv

Sl. No.	Mix Proportions	7 Days Results		14 Days Results		28 Days Results	
		UPV (m/s)	Compressive Strength (N/mm ²)	UPV (m/s)	Compressive Strength (N/mm ²)	UPV (m/s)	Compressive Strength (N/mm ²)
1	15-25%	4121	16.8	4291	23.33	4445	27.5
2	15-50%	3759	20.5	3856	26.7	4011	30.4
3	15-75%	3623	18.7	3667	24.4	3958	28.84
4	15-100%	3417	19.20	3580	23	3807	26.22

Water Absorption Test:

Water absorption test was conducted on cylindrical specimens of size 100 mm x 50 mm after 28 days of curing as per ASTM C 642-97. Three test specimens were cast and tested for each age and each mix. After each curing period, these specimens were oven dried for 24 hours at the temperature of 110°C. results were taken for 28, 56, 90 days

$$\text{Water absorption} = [(W2 - W1) / W1] \times 100$$

Table7: Test results for water absorption

Sl. No.	Mix Proportions	Percentage loss in water absorption		
		24 Days Test Results	56 Days Test Results	90 Days Test Results
1	15-25%	1.99	1.52	0.51
2	15-50%	3.19	2.17	0.67
3	15-75%	3.25	2.45	0.78
4	15-100%	3.01	2.82	1.50

Acid Resistance Test

The Acid Resistance Test was conducted on concrete cylinders size of 100mm x 200 mm. ASTM C 267 was used as the basic standard for this testing procedure. Three test specimens were cast and tested for each age and each mix. After each curing period, The test specimens were immersed in 4% sulphuric acid solution for 28 days. After 28 days, the cylinders were removed from the solution and their saturated dry weight was measured after smooth brushing by a nylon brush. The weight of the specimens was compared with their initial values before testing. Test results for acid resistance test are tabulated below in table 8. graphical representation of acid resistance is showed in figure 2.

$$\text{Percentage of loss in Weight} = [(W_0 - W_1) / W_0] \times 100$$

Table 8: Test results for Acid Resistance

Sl. no.	Mix proportions	24 days test results	56 days test results	90 days test results
1	15-25%	8.57	1.52	0.51
2	15-50%	9.66	2.17	0.67
3	15-75%	10.19	2.45	0.78
4	15-100%	85.25	2.82	1.50

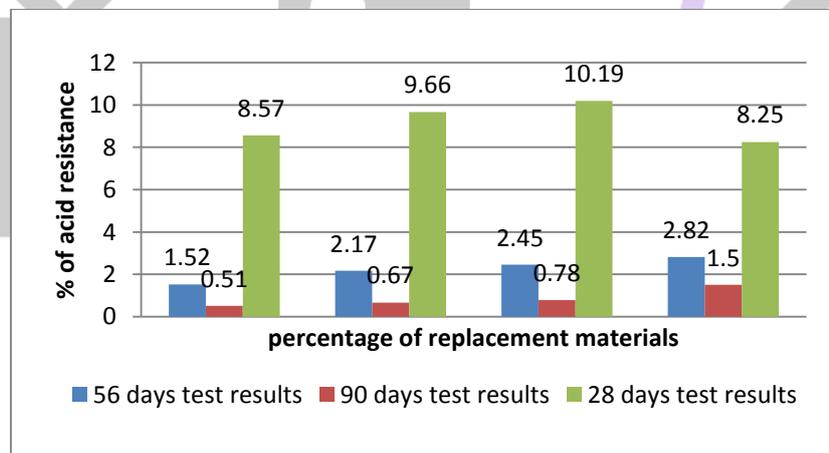


Figure 2: graphical representation of acid resistance

Sorptivity:

Test is conducted for the cylinder of size 10 x 5 mm size of the cylinder cube which is taken from the middle part of the cylinder as it was well finished, compacted firmly and the materials were casted without any voids in. The cylinder specimens were taken with different proportion of the concrete cubes along with the difference in the curing period. Resin is used as the water repellent coater mixed with the hardener. When the structure is constructed under the water this is useful to withstand the structure. Procedure is carried out with the resin paste coating and after the taken for 24 hours to dry the coat. It was secured with the plaster only to be attached to the concrete leaving the bottom surface of the specimen. Take out the pan and fill the water up to the 5mm of the bottom surface of the specimen to be touched. To the support the specimen is placed on the sticks which is helpful to be drained in the water more than 5mm. sorptivity values are tabulated below table 9 and graphical representation in fig 3.

$$I = S/t^{0.5}$$

Table 9: sorptivity test results

S.no.	Mix proportion	W1 dry weight (kg)	W2 wet weight (kg)	Sorptivity value in 10^{-5} (min/min ^{0.5})
1	15-25%	1.10	1.12	1.4
2	15-50%	1.00	1.05	1.89
3	15-75%	1.07	1.08	4.9
4	15-100%	1.15	1.16	6.9

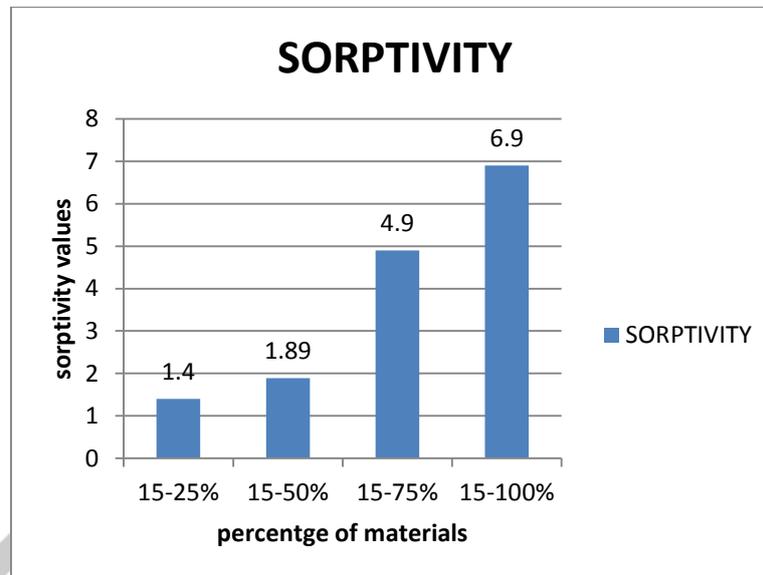


Figure 3: graphical representation of sorptivity

CONCLUSION:

Based on the results of these experimental investigations, the following conclusions can be drawn:

1. Based on the test results if the fineness modulus of sand is increased, strength is increased but after certain limit the strength is decreased due to specific surface area of the fine aggregate.
2. Based on the tests results the maximum compressive strength of 30.4 N/mm² is obtained for 15% RHA and 50% M sand replacement with cement and sand respectively.
3. By Ultra pulse velocity, compression strength is maximum at the replacement of 15% rice husk ash and 25% manufactured sand.
4. Water absorption test conducted on the cylinders results the amount of percentage in water absorption is increased in 15-75% of rha& m-sand. It has lesser absorption in 25% of manufactured sand and 15% of rice husk ash.
5. Acid attacks on the cylinders were conducted and it results with lesser resistance in 75% of manufactured sand replacement and it has good resistance in 25% of manufactured sand.
6. Sorptivity is the test which results in capillarity and it has less capillary rise in 15-25% replacement.

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