

Assessment of Strength Characteristics in Mortar Incorporating Foundry Sand for Fine Aggregates

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ABSTRACT: The Sand is a prime material used for preparation of mortar which plays a major role in mix design. Many researches are finding different materials to replace sand and one of the major materials is foundry sand. The demand for sand is the major problem for conventional construction recently. We need a best alternate construction material to fulfill the sand demand. In this paper presents the results of an experimental investigation carried out to evaluate the properties of mortar mix in which fine aggregate (sand) was partially replaced with foundry sand using mortar 1:2 ratio. The Fine aggregate was replaced with five different percentages (0%, 10%, 20%, 30%, 40% and 50%) of foundry sand by weight. The Compressive strength was determined at 7 and 28days. The Water absorption and Sorptivity were determined at 28days. The test results indicate significant improvement in the strength properties of mortar by the inclusion of foundry sand as 10% replacement of fine aggregate and it can be effectively used in pointing work and damp proof course construction.

KEYWORDS: Compressive strength, Foundry sand, Mortar, Sorptivity, Water absorption

I. INTRODUCTION

Industry estimates are that approximately 100 million tons of sand is used in casting annually. In India, approximately 6 to 10 million tons of waste foundry sand is produced yearly. However, the foundry sand is durable, Hard and highly resistant to biological, chemical, and physical degradation forces. The metal casting industries are dumping the sand in any nearby Pit or unoccupied places, near their unit although notified areas have been marked for discarding. This leads to serious environmental and dust pollution and occupation of a vast area of land. The advancement of construction technology can reduce the consumption of natural resources. They have forced to focus on recovery, reuse of natural resources and find other alternatives. The use of the replacement materials offer cost reduction, energy savings, possibly better products, and fewer hazards in the environment. The construction industry can be the end user of all foundry sand and in this way can contribute to solve this environmental problem. The nature of construction industry, especially the mortar industry, is such that foundry sand can be used safely with no need for staged change in production and application process. On one hand, the cost of deposition of foundry sand in landfill will be saved and on the other raw materials and natural resources will be replaced, thus saving energy and defending the environment. The worldwide consumption of sand as fine aggregate in mortar production is very high, and several developing countries have encountered some strain in the source of natural sand in order to meet the increasing needs of infrastructural development in recent years. A situation that is responsible for increase in the price of sand, and the cost of mortar. The cost of the mortar is decreased while using the foundry sand as a replacement material for fine aggregate.

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II. MATERIALS AND RESULTS

Foundry Sand

Most metal casting sand (FS) is high quality silica sand with uniform physical characteristics. It is a by product of the ferrous and nonferrous metal casting industry. Specific gravity of foundry sand is 2.46 and fineness of modulus is 4.37.

Cement

The OPC 53 grade conforming to IS: 8112-1982 is being used. Normal consistency of cement is 31%, initial setting time 30 minutes, final setting time is 600 minutes and specific gravity is 3.16.

Fine Aggregate

River sand is used. It is conformed as per the IS code 383:1970, specific gravity of sand is 2.6 and fineness of modulus is 5.07.

Water

Portable water is used.

III. EXPERIMENTAL METHODOLOGY

The utilization of foundry sand use as a replacement of cement material beings with the mortar testing. The mould size of 70.6mm X 70.6mm X 70.6 mm is casted as per the mortar mix with a proportion of shown in below table no. 1 The CM 1:2 was casted and compressive strength was carried out at 7 and 28 days.

Table 1 Mix proportion for CM 1:2

<i>% of foundry sand Replacement</i>	<i>Cement in kg/m³</i>	<i>Foundry sand in kg/m³</i>	<i>Fine aggregate in kg/m³</i>	<i>Water in mili liters</i>
0	768	0	1536	384
10	768	153.6	1382.4	384
20	768	307.2	1228.8	384
30	768	460.8	1075.2	384
40	768	614.4	921.6	384
50	768	768	768	384

IV. COMPRESSIVE STRENGTH

The performance on compressive testing machine in mortar cube is place as shown figure no. 1 and continuous loading is applied on it, after shown first crack in mortar cube is 70.6mm x 70.6mm x 70.6mm its reading which is in kN is noted down,



Fig. 1 Compression test on mortar cubes

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Table -2: Compressive strength results on mortar cubes

Mix ID	Compressive strength for mortar cubes N/mm^2	
	7 days	28 days
CC (0%)	16.86	33.06
R1 (10%)	19.17	39.34
R2 (20%)	15.20	28.43
Mix ID	Compressive strength for mortar cubes in N/mm^2	
	7 days	28 days
R3 (30%)	12.56	20.49
R4 (40%)	15.20	27.77
R5 (50%)	12.56	21.82

For mortar 3 cubes were casted for each batch of CC, R1, R2, R3, R4 and R5. As shown in figure no.2 up to 10% replacement it achieves the desired strength of mortar. After that the compressive strength continuous decreased with replacement of foundry sand.

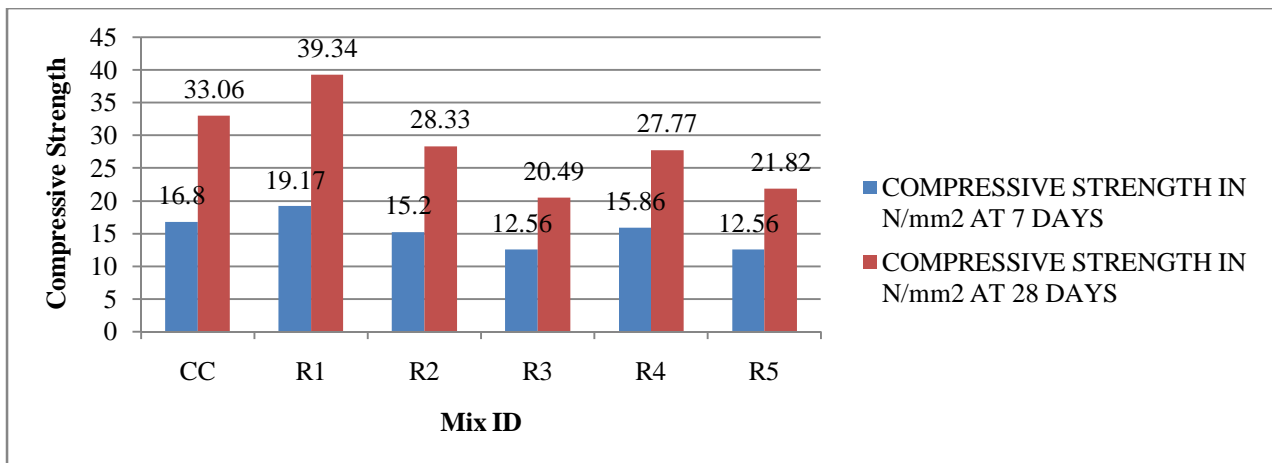


Fig. 2 Compressive strength test results on mortar cubes

V. WATER ABSORPTION

The specimen is dried in a ventilated oven at a temperature of 105°C to 115°C till it attained substantially constant mass. The specimen is cooled to room temperature and its mass (W1) is noted. The completely dried specimen is immersed in clean water at a temperature of 27°C for 24 hours. The specimen is removed and wiped out of any traces of water with a damp cloth and weighed (W2) within three minutes is noted.

Table 3: Water absorption test results on mortar cubes

Mix ID	Water absorption in %
CC (0%)	2.44
R1 (10%)	2.13
R2 (20%)	2.74
R3 (30%)	3.36
R4 (40%)	3.95
R5 (50%)	2.6

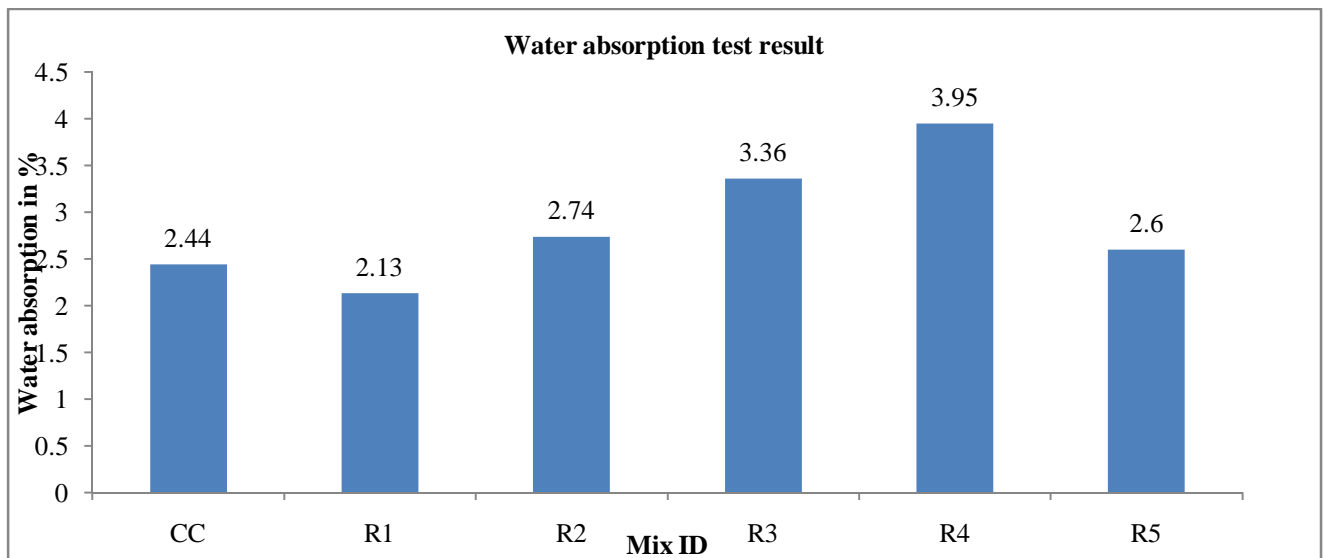


Fig. 3 Water absorption test results on mortar cubes

For mortar 3 cubes were casted for each batch of CC, R1, R2, R3, R4 and R5. As shown in figure no.3 at 10% replacement it achieves the low water absorption of mortar with compared to 0% of replacement of mortar. After that the water absorption continuous increased with replacement of foundry sand.

VI. SORPTIVITY

The sorptivity values of mortar cubes for various mix proportions are given in Table 4. When groundnut husk ash is used as a replacement material for natural river sand, sorptivity coefficient increases as shown in Fig 4.

Table 4: Sorptivity test results on mortar cubes

Mix id	Sorptivity in mm/min^2
CC (0%)	0.21
R1 (10%)	0.13
R2 (20%)	0.19
R3 (30%)	0.27
R4 (40%)	0.36
R5 (50%)	0.17

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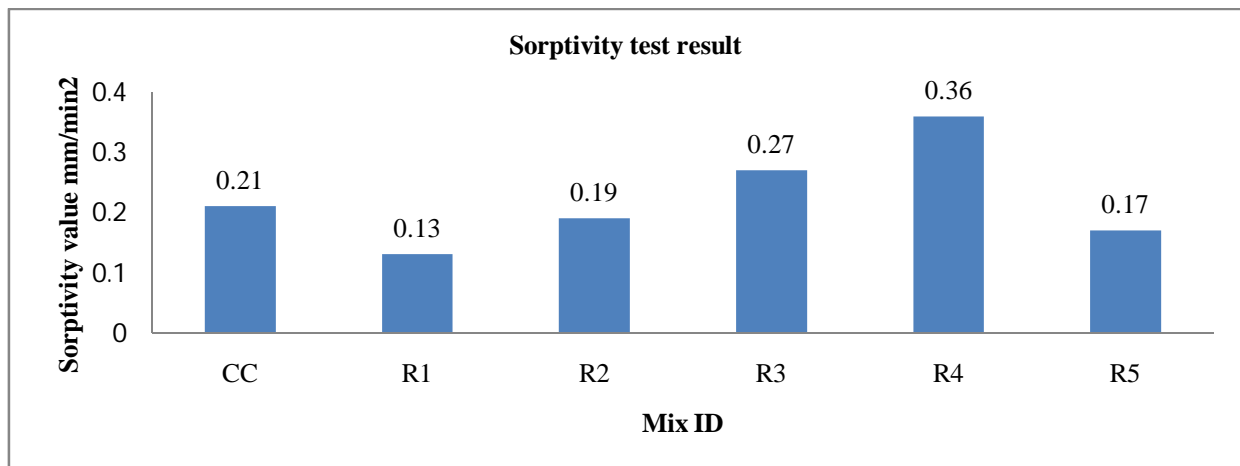


Fig. 4 Sorptivity test results on mortar cubes

For mortar 3 cubes were casted for each batch of CC, R1, R2, R3, R4 and R5. As shown in figure no.4 up to 20% replacement it achieves the low sorptivity of mortar with compared to 0% of replacement of mortar.. After that the sorptivity continuous increased with replacement of foundry sand.

VII.CONCLUSION

In this project to utilize the foundry sand as a replacement of cement in construction industry. The percentage replacement of foundry sand varied from 0% to 50% in cement mortar (C.M 1:2). different tests were performed and results were examined. The Graphs were obtained for various proportions of foundry sand. The influence of foundry sand by replacing cement in mortar was examined and the following conclusions were derived.

- From compressive strength test result, the mortar cube strength is optimum in 10% replacement mutually. Thus we have to utilize foundry sand 10% by replacing cement in cement mortar.
- From water absorptions & sorptivity test result, the mortar cube strength is optimum in 10% replacement mutually. Thus we have to utilize foundry sand 10% by replacing cement in cement mortar.

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