PARTIAL REPLACEMENT OF FINE AGGREGATE BY WASTE FOUNDRY SAND IN M40 GRADE OF CONCRTE

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Abstract:
This study is carried out to examine the productive use of waste foundry sand in M40 grade of concrete. Foundry industries emplace huge quantity of waste sand into landfill causing harmful effect on environment. Using waste foundry sand as building material can reduce risks of environmental problems. In this experimental investigation behaviour of concrete by partially replacing waste foundry sand is studied. In India major problems were faced due to removal of harmful & toxic elements released from the factory outlet got mixed with the foundry sand henceforth the sand is of no practical importance for the environment & thus making it harder to dispose. By using the waste foundry sand in concrete, we tried to enhance the properties for conventional concrete at the same time reduces the environmental pollution.
Fine aggregates were replaced by waste foundry sand by 0%, 10%, 20%, 30%, 40%, at a mix design of 1 part of cement 2.27 parts of coarse aggregate, 1.5 parts of fine aggregate (which is replaceable by foundry sand at 10% intervals) & 0.40 parts of water. There was considerable amount of increment when the dosage of foundry sand was increased by an interval of 10% & mixture containing 30% replacement of waste foundry sand showed the highest compressive strength among all the dosages.
Index Terms— waste foundry sand.

I. INTRODUCTION

In the world of growing technology and mass media, civil engineers face the problem on how to enhance the work culture by using waste by-product in construction and to generate a low cost workable concrete. Real estate is working on a high scale and has come across with the involvement of new construction technologies and ideas which can be helpful for the environment in the future run. Foundry sand is high eminence silica sand that is a result from the production of ferrous & non- ferrous metal casting. The physical & chemical characteristic of foundry sand will depend in great part on type of casting process and industry sector from which it originates & concrete is also a major part of construction industry and required huge quantity of materials for production of concrete. Thus, foundry sand can be used in replacement of river sand up to certain percentage in concrete for strength as well as durability purpose. Foundry sand is also cheaper than river sand and thus economy can be achieved.

II. LITERATURE REVIEW

Mahima Ganesha ,dr. Sreevidya,salim p. M (2016),they performed an experimental work on the topic 'waste foundry sand as replacement for fine aggregate in high strength solid concrete masonry blocks'. From the test results they obtained that incorporation of waste foundry sand increases the strength of blocks and optimum % was found between 20-30%. They also stated that 100% replacement is not advisable as it causes efflorescence due to salt content waste foundry sand.

Mr. I. M.attar,a. K. Gupta,they carried out an experimental investigation on the topic 'application of foundry sand in civil construction'. Initially there was increase in compressive strength as the foundry sand as replaced from 8-13% and a drop takes place up to the 13-20%. There was again increase in strength between 20-40% replacement and slight decreases at 60%. But it gave more splitting tensile strength than the minimum strength given by natural sand.

Eknath.P. salokhe,d.b.desai(2016),they carried out an experimental investigation on the topic 'application of waste foundry sand in manufacture of concrete' in which they used ferrous and nonferrous waste foundry sand. After performing the stated tests, it was found that comp. Strength at 7 days of m20 grade of concrete was maximum for 20% replacement of ferrous wfs than nonferrous wfs and ordinary mix. Comp. Strength at 28 days was maximum for 30% replacement of ferrous wfs than ordinary concrete whereas it was same for 10% replacement of nonferrous wfs. Split tensile strength gave utmost worth with 20% substitute of both types of sand. Inclusion of both ferrous and nonferrous wfs gave dense concrete at 20% addition.

T. C. Nwofor,c. Ukpaka (2016), in 'assessment of concrete produced with foundry waste as partial replacement for river sand' they stated that the maximum compressive strength was achieved at 15% replacement of foundry waste sand.

Dushyant rameshbhai,bhimani,jayeshkumar pitroda, they concluded experimental investigation concerning the water absorption & compression strength of concrete but partially replacing foundry sand. The water absorption decrease up to 50% replacement of fine

aggregate by used foundry sand. Replacement of fine aggregate with used foundry sand provides max compression strength at 50% replacement.

Fig 1. Foundary sand

III. MATERIALS

A. Cement- Ordinary Portland Cement confirming to IS 269:2015, having specific gravity 3.15 and initial and final setting time as 75 minutes & 235 minutes respectively. Standard consistency was 28%.

B. Coarse aggregate- Coarse aggregates of fraction 20mm and 10 mm were used and the properties are as follows:

Table no:1 Properties of coarse aggregates

1.	size of aggregate	20mm	10mm
2.	specific gravity	2.78	2.76
3.	fineness modulus	7.05	6.45
4.	water absorption%	0.98	1.12
5.	impact test%	9.8	10.6
6.	crushing test	13.5	11.5

C. Fine aggregate- Fine aggregates passing from IS sieve :4.75mm is used for project work with specific gravity 2.72, fineness modulus 3.65% and water absorption 2.25%.

Table no:2 Sieve analysis of fine aggregates

Sr. No	Sieve size	Weight retained [in gms]	Cumulative weight retained	% Retained	% Passing
1.	4.75 mm	21.81	0	2.181	97.819
2.	2.36mm	90.72	112.53	11.253	88.747
3.	1.18mm	334.66	447.19	44.719	55.747
4.	600µ	189.62	636.81	63.68	36.32
5.	300µ	180.46	817.27	81.72	18.28
6.	150µ	93.8	911.07	91.107	8.893
7.	75µ	31.09	942.16	94.216	5.784
8.	Pan	16.74	958.9	95.89	4.11

D. Foundry sand- Foundry sand having specific gravity 2.74 were used for the project. Sieve analysis results for foundry sand are:

Table no:3 Sieve analysis of waste foundry sand

Sr. No	Sieve size	Weight retained [in gms]	Cumulative weight retained	% Retained	% Passing
1.	4.75 mm	3.88	0	0.194	99.806
2.	2.36mm	1.95	5.83	0.2915	99.70
3.	1.18mm	8.72	14.55	0.7275	99.27
4.	600µ	16	30.55	1.5275	98.473
5.	300µ	560	590.55	29.52	70.48
6.	150µ	1220	1810.55	90.52	9.48
7.	75µ	146	1956.55	97.82	2.18

8.	Pan	22.6	1979.15	98.95	1.05

E.WATER – Ordinary water was used for mixing of concrete.

F.ADMIXTURE- Rapid hardening admixture was used.

IV.METHODOLOGY

Mix Design

As per IS 10262:2009 mix design is prepared for M40 grade of concrete. Table below shows mix design proportion:

Table no:4 Mix proportion

Water (lit)	Cement (kg)	Fine aggregate (kg)	Coarse aggregate (kg)	
			20mm	10mm
200	486	733	607	497
0.41	1	1.50	2.27	

Mixture was prepared by replacing waste foundry sand as 0%, 10%, 20%, 30%, 40% by weight of fine aggregate and casted in cube specimen of size 150mmX150mmX150mm. Cubes specimens were tested for compressive test at 7 days, 14 days and 28 days after curing.

V.RESULTS AND DISCUSSION

Table no. 5 below shows the average compressive strengths for different % replacement of waste foundry sand at 7, 14 and 28 days. Results shows that there is increase in compressive strength at 20%, 30%, and 40% replacement as compared with 0% replacement. Maximum compressive strength was observed at 30% after further replacement the strength was found reduced.

Table no: 5 Compressive strength results

Sr. No.	% replacement	Compressive strength (N/mm2)		
		7days	14 days	28 days
1.	0	31.64	37.06	43.61
2.	10	30.56	38.05	44.63
3.	20	33.32	44.17	47.25
4.	30	41.71	48.02	54.57
5.	40	34.66	45.00	50.43

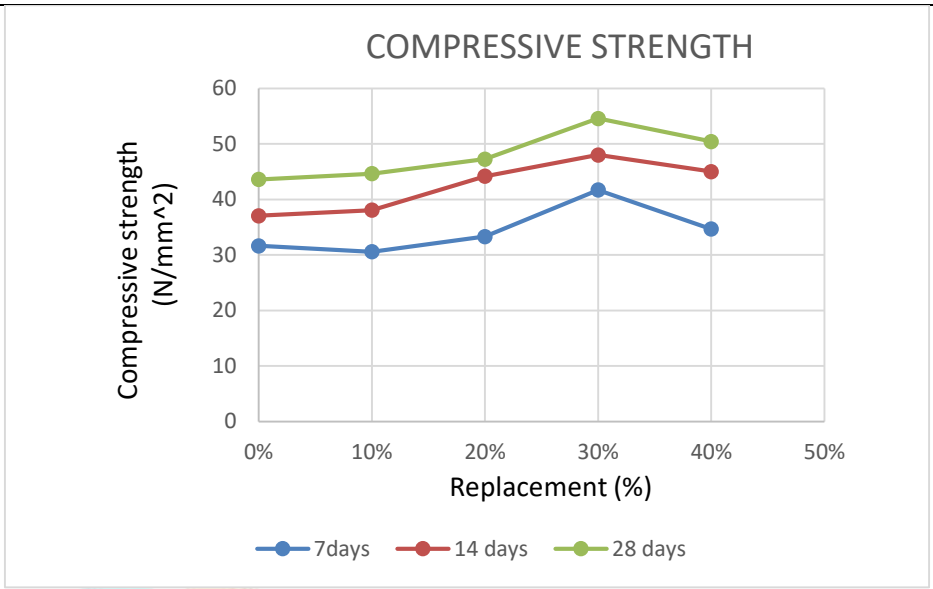

Fig2. Graph compressive strength v/s replacement of fine aggregate with various percentage of foundary sand

VI.CONCLUSION

Compressive strength of concrete increase as percentage of fritter away foundry sand increase up to definite substitution. The compressive strength increased by 23.79% at 30% replacement when compared to ordinary mix without any replacement of foundry sand at 28 days.

Workability of concrete increased slightly in various replacement levels. Waste foundry sand can be effectively use in concrete thus reducing disposal problems.

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