Influence of used Foundry Sand and Ceramic Waste in Concrete

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***Abstract*— -The main objective of this research is to investigate the performance of concrete contained used foundry sand and ceramic waste as a replacement for fine aggregate and coarse aggregate respectively. Mix was prepared in replacement with used foundry sand and ceramic waste for all possible combinations of 10%, 20% and 30% of fine aggregate and coarse aggregate. The investigation indicates that replacement of fine and coarse aggregate with used foundry sand and ceramic waste at different ranges in concrete production, results in higher compressive strength and flexural strength as of concrete specimens without foundry sand and ceramic waste.**

Keywords—: Foundry Sand, Ceramic Waste, Compressive Strength, Flexural Strength

I. INTRODUCTION

Concrete is a widely used vital material in the construction world. Nowadays, the good quality materials face a great demand. Especially the natural river sand is in greater need. The production of coarse aggregate face a serious crisis. These resources are also exhausting very rapidly. The cost of construction is also at its peak. So there is a need to find alternatives to these materials. As natural ri9ver sand is a nonrenewable resource, it is partially replaced by foundry sand which is a waste product from machine industries.

Coarse aggregate is replaced by ceramic wastes which contribute the highest percentage of waste about 54%. India stands third in the ceramic tile production accounting for 691 million square meter tiles production which is 6.2% of world production. Most of the bulk ceramic wastes are generated during destroying constructions. About 30% of daily production of ceramic materials in India change into wastage and this amount reaches to millions ton per year. The advancement of concrete technology can reduce the consumption of natural resources and energy sources and lessen the burden of pollutants on environment. The use of the replacement materials offer cost reduction, energy savings, arguably superior products, and fewer hazards in the environment.

The properties of these materials make them a good and suitable choice to be used in concrete. The use of foundry sand and waste ceramic tiles in concrete effects the properties of fresh and hardened concrete and make it economical and solves disposal problems. The foundry sand and ceramic waste are replaced for (10%, 20%,30%) the weight of fine and coarse aggregate. A total of 10 concrete mix proportions are made with and without foundry sand and ceramic waste. Compressive strength and flexural strength of concrete were carried out at the age of 7 and 28 days.

II. EXPERIMENTAL PROGRAMME

A. Materials

Ordinary Portland (43 grade) cement was used. It was tested as per the Indian Standard Specifications IS:8112-1989 [7]. Its properties are shown in Table 1. Ceramic waste and foundry sand was obtained from local Industries. Fine aggregate was natural sand having a 4.75 mm nominal size. The coarse aggregate used in this investigation was 20 mm nominal size. Both aggregates were tested according to BIS:383-1970[8]. Their physical properties are given in Table 2.

TABLE.1. PROPERTIES OF CEMENT

Physical properties	Test Results	BIS.8112-1989 Obtained Specifications
Normal consistency(%)	34	-
Initial setting time(min)	48	>30
Final setting time(min)	240	<600
Fineness %(residue retained on 90 micron sieve)	2.2	<10
Specific gravity	3.15	-

TABLE.2 PROPERTIES OF AGGREGATE

Physical properties	Coarse aggregate	Fine aggregate	Ceramic waste	Foundry sand
Maximum size (mm)	20	4.75	12.5	4.75
Specific gravity	2.74	2.54	2.5	2.43
Total water absorption(%)	1.85	4.5	0.18	1.2
Fineness modulus	4.74	3.34	2.59	3.36

B. Mixture proportions

Control mixture (0%) was proportioned to have 28-day compressive strength of 25MPa according to BIS: 10262-2009[9]. The ratio of concrete mix proportion was 1:1.62:2.5; 1part cement, 1.62 part fine aggregates and 2.5 part coarse aggregates. Nine additional concrete mixtures were proportioned where fine and coarse aggregate was replaced with 10%, 20% and 30% used foundry sand and ceramic waste by mass respectively. All mixtures had constant water-to-cement ratio of 0.45. The slump of all mixtures was 80 + 5 mm. Details of mixtures and values of slump determined as per BIS: 1199-1959[10]

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 7 Issue 05, May-2018

C. *Specimen preparation and casting*

150 mm concrete cubes were cast for compressive strength and 500x100x100 mm beams for flexural strength. All the specimens were prepared in accordance with BIS: 1199-1959 [10]. Soon after casting, test specimens were covered with plastic sheets, and left in the casting room for 24 h at a temperature of about 26 ± 1^0C. They were demoulded after 24 h, and were put into a water-curing room until the time of testing.

D. *Hardened concrete properties*

150mmm cubes were tested for compressive strength, 150x 300 mm cylinders for splitting- tensile strength and 500x100x100 mm beams for flexural strength. Tests were performed at the ages of 7 and 28 days in accordance with the provisions of Indian Standard specifications BIS: 516-1959[11]

III. RESULTS AND DISCUSSION

A. *Compressive Strength*

The test results are also presented in Table 3. By increasing the used foundry sand the compressive strength values of concrete tends to increase at each curing age. Furthermore, the mean strength of concrete mixes with 30% used foundry sand and 20% ceramic waste was higher than the reference concretes. However, there is a slight decrease in compressive strength value of concrete mix when 30% ceramic waste is used as compared with that of 20%.

Fig. 1. Determination of compressive strength of cube

TABLE 3 COMPRESSIVE STRENGTH TEST RESULTST

S.no.	Replacement	Compressive strength N/mm^2	
		7 days	28 days
1	Control concrete	22.67	31.27
2	UFS 10% CW 10%	21.50	27.03
3	UFS 10% CW 20%	15.25	28.12
4	UFS 10% CW 30%	16.78	24.85
5	UFS 20% CW 10%	21.79	33.57
6	UFS 20% CW 20%	15.67	23.76
7	UFS 20% CW 30%	26.37	29.21
8	UFS 30% CW 10%	24.85	29.43
9	UFS 30% CW 20%	24.63	39.24
10	UFS 30% CW 30%	15.47	20.92

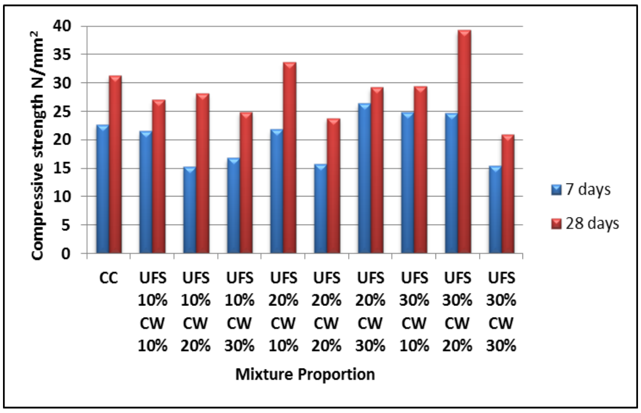

Fig.2. Compressive Strength in relation to curing age

B. *Flexural strength*

The flexural strength calculations are done as per IS: 516-1959. The results of the flexural strength tests for the ceramic waste and used foundry sand mixed concrete are shown in Table 4. The results show that the concrete mix containing 30% used foundry sand and 30% ceramic waste attains the highest flexural strength.

Fig.3. Determination of Flexural Strength of Prism

Table.4 Flexural strength test result

S.no.	Replacement	Flexural Strength N/mm^2 (28 days)
1	Control concrete	3.386
2	UFS 10% CW 10%	2.501
3	UFS 10% CW 20%	1.752
4	UFS 10% CW 30%	1.625
5	UFS 20% CW 10%	1.625
6	UFS 20% CW 20%	1.812
7	UFS 20% CW 30%	1.750
8	UFS 30% CW 10%	1.256
9	UFS 30% CW 20%	1.650
10	UFS 30% CW 30%	2.761

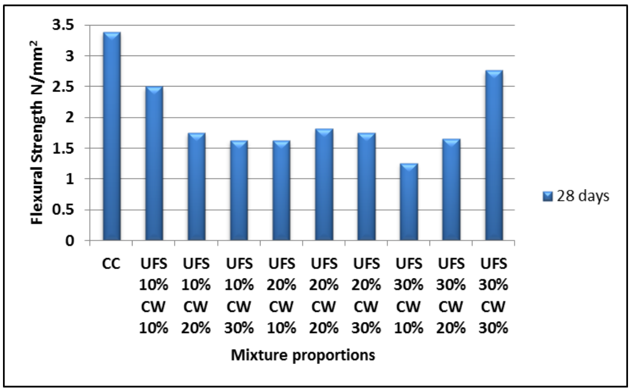

Fig.4. Flexural Strength in relation to curing age

IV.CONCLUSION

- From the test results obtained it is evident that concrete mix incorporated with 30% used foundry sand and 20% ceramic waste attains the highest compressive strength which is higher than the control mix.
- In case of flexural strength concrete mix incorporated with 30% of used foundry sand and 30% of ceramic waste attains the highest flexural strength value and is less than the flexural strength of control mix.
- Result of this investigation that marble dust and ceramic waste could be conveniently used in making good quality concrete and construction materials.

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