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Effective Utilization of Copper Slag and Foundry Sand in Concrete

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Abstract

Today in this fast growing world where the industries are growing at faster rate especially metallic industries where copper slag and Foundry sand are the waste product having high strength. The availability of copper slag and Foundry sand is large and causes lots of disposal problems. Even the use of river sand is banned in many of areas across India because of river depletion, so copper slag and foundry sand may be an effective option as a partial replacement of fine aggregate in concrete. Based upon historical development on the individual material either copper slag or foundry sand is found as replacement of fine aggregate. The best result obtained for compressive strength of concrete are for 30-40% replacement of fine aggregate. This state of art represents effective utilization of copper slag and foundry sand for partial replacement of fine aggregate. Various properties of the fine aggregate, copper slag and foundry sand are studied by performing various tests. Concrete specimens are cast and tested for 3,7 and 28 days for compressive strength for normal concrete and partial replacement by copper slag and foundry sand of fine aggregate in concrete and change in compressive strength is estimated and analyzed.

Keyword*: Fine Aggregate, Copper Slag, Foundry Sand, Compressive Strength.*

1. Introduction

Now-a-days as natural resources are depleting worldwide while at the same time the generated wastes from the industry are increasing substantially. The sustainable development for construction involves the use of nonconventional and innovative materials, and recycling of waste materials in order to compensate the lack of natural resources and to find alternative ways for conserving the environment. Concrete composite construction material made primarily with aggregate, cement, and water. There are many formulations of concrete, which provide varied properties, and concrete is the most-used man-made product in the world.

Copper slag is an abrasive blasting grit made of granulated slag from metal smelting processes (also called iron silicate).Copper Slag blasting grit is manufactured of the granulated slag of copper refineries, and used for blast-cleaning of metal surface. Foundry sand i.e silica sand are produced from rocks that formed under a variety of geologic conditions.

The main purpose of using copper slag and foundry sand as are byproduct of industries. To produce every ton of refined copper, approximately 2.2–3.0 tons copper slag is generated as a by-product material. The waste foundry sand is usually disposed off by the factories in the nearby barren lands or river banks, which causes degradation of the land.

The specific objectives for this study were to compare the following performance characteristics of mixing the concrete in the laboratory by replacing copper slag and foundry sand as fine aggregate with proportions (by weight) added to concrete mixtures were as follows: 0% (for the control mix), 5%, 10%,15% and 20%with that of concrete. Concrete mixtures were evaluated for workability and compressive strength along with other essential characteristics.

2. Experimental program

The details of various material used in the Experimental investigation are

1) Cement - Opc Grade 53 cement having specific gravity 3.15. Initial and Final setting time of cement are 80 minute and 275 minute respectively.

3.2. Slump Results

Sr.No.	Mix proportion	Slump (mm)
1	CS & FS -0%	110
2	CS & FS-5%(Each)	115
3	CS & FS-10%(Each)	125
4	CS & FS-15%(Each)	120
5	CS & FS-20%(Each)	125

Table 2

2) Fine aggregate- Fine aggregate used was sand passing through 4.75mm sieve. Specific gravity was found to be 2.66 with water absorption of 2%.

3) Coarse aggregate-Coarse aggregate used was sand passing through 20mm sieve. Specific gravity was found to be 2.87 with water absorption of 0.5%

4) Copper slag- Copper slag used was passing through 4.75mm sieve. Specific gravity was found to be 3.43 with water absorption of 1.86%

5) Foundry sand- Foundry sand used was passing through 4.75mm sieve. Specific gravity was found to be 2.59with water absorption of 3.5%

6) Water - Ordinary clean potable water free from the suspended particles and chemicals were used for mixing and curing

3. Mix Proportions and Test Results

3.1. Concrete proportions of M20 grade for 6cubes

Table 1

Sr. No.	Material	Nominal mix (Kg)
1	cement	10.350
2	water	4.77
3	Fine aggregate	27.178
4	Copper slag	-
5	Foundry sand	-
6	10mm CA	14.605
7	20mm CA	18.201

3.3. Compressive strength results

A) Compressive Strength of "3" Days Cube

Sr. No.	Mix proportion	3days compressive strength (N/mm^2)		
1	CS & FS -0%	14.37	16.88	12.44
2	CS & FS-5%	25.63	13.11	16.00
3	CS & FS-10%	16.22	16.27	17.33
4	CS & FS-15%	18.22	17.67	18.00
5	CS & FS-20%	20.84	18.66	17.77

Table 3

B) Compressive Strength of "7" Days Cube

Table 4

Sr. No.	Mix proportion	7days compressive strength (N/mm^2)		
1	CS & FS - 0%	22.07	21.33	22.67
2	CS & FS-5%	24.00	25.11	23.55
3	CS & FS-10%	23.11	24.88	24.67
4	CS & FS-15%	27.33	26.67	29.33
5	CS & FS-20%	25.11	25.33	26.44

C) Compressive Strength of "28" Days Cube

Table 5

Sr. No.	Mix proportion	28days compressive strength (N/mm^2)		
1	CS & FS -0%	32.88	32.00	34.22
2	CS & FS-5%	32.88	35.11	36.00
3	CS & FS-10%	35.55	36.44	37.11
4	CS & FS-15%	36.86	38.22	37.33
5	CS & FS-20%	38.77	39.55	37.33

4. Conclusions

4.1. Increase in Compressive Strength

A) Increase in 3 days Compressive Strength of Cube

Table 6

No.	Mix proportion	3days compressive strength(N/mm^2) (Avg)	Increase in strength (%)
1	CS & FS - 0%	13.39	100
2	CS & FS-5%(Each)	15.99	119.41
3	CS & FS-10%(Each)	16.74	125.01
4	CS & FS-15%(Each)	17.96	134.12
5	CS & FS-20%(Each)	19.09	142.25

B) Increase in 7 Days Compressive Strength Of Cube

Table 7

No.	Mix proportion	7days compressive strength (N/mm^2) (Avg)	Increase in strength (%)
1	CS & FS - 0%	22.07	100
2	CS & FS-5%(Each)	24.22	109.74
3	CS & FS-10%(Each)	24.22	109.74
4	CS & FS-15%(Each)	27.70	125.02
5	CS & FS-20%(Each)	25.62	116.08

C) Increase in 28 Days Compressive Strength of Cube

Table 8

No.	Mix proportion	28days compressive strength(N/mm^2) (Avg)	Increase in strength (%)
1	CS & FS - 0%	33.03	100
2	CS & FS-5%(Each)	34.66	104.93
3	CS & FS-10%(Each)	36.36	110.81
4	CS & FS-15%(Each)	37.48	113.47
5	CS & FS-20%(Each)	38.55	116.71

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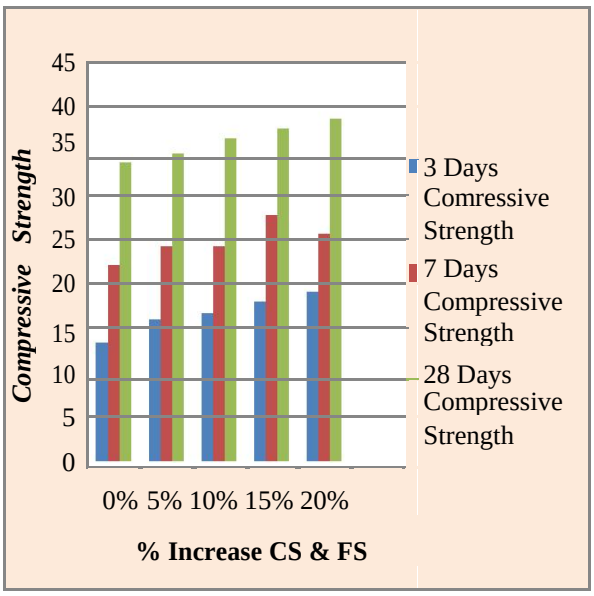

Conclusion:-

1.The results of compressive test have indicated that the strength of concrete increases with respect to the percentage of copper slag and foundry sand added by weight of fine aggregate with 20% of additions at 3,7 and 28 days.

2.The results of slump test have indicated that the workability of concrete increases with respect to the percentage of copper slag and foundry sand added by weight of fine aggregate with 20% of additions.

3. Compressive strength is found to be increased at 20% replacement of copper slag and foundry sand.

4. We can save the fine aggregate in large quantity if we replace those 20% of copper slag and foundry sand which also reduces waste quantity of copper slag and foundry sand. Certain proportions of copper slag and foundry sand can be done by increasing their proportion of as a replacement of fine aggregate.

Future scope – Percentage variation of copper slag and foundry sand can be increased upto 50% each. Durability of concrete cubes can be taken into account. Corrosion properties of concrete can be taken into account.

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