Studies on Properties of Concrete By Partial Replacement of Cement &Coarse Aggregates with Copper Slag & Aerocon Block Waste

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Abstract - This project presents the usage of copper Slag and aerocon block waste forthe partial replacement for cement and coarse aggregates, the experimental procedure is conducted for the replacing percentage of 10%,20%and 30%. For this above replacement percentage M25 grade concrete is used. The main objective of this project is to know the strength of partial replaced concrete. To evaluate the strength various test were conducted .these resulted that the concrete strength is increased with addition of copper slag with concrete.

Keywords: copper slag, aerocon block waste, concrete, replacement, compressive strength.

I. INTRODUCTION

The utilization of industrial waste or secondary materials has encouraged the production of cement and concrete in construction field. New by products and waste materials are being generated by various industries. Dumping or disposal of waste materials causes environmental and health problems. Therefore, recycling of waste materials is a great potential in concrete industry. For many years, by products such as fly ash, silica fume and slag were considered as waste materials. Concrete prepared with such materials showed improvement in workability and durability compared to normal concrete and has been used in the construction of different types of buildings and other structures.

Copper slag is an industrial by-product material produced from the process of manufacturing copper.

Although copper slag is widely used in the sand blasting industry and in the manufacturing of abrasive tools, the remainder is disposed of without any further reuse or reclamation.

The use of copper slag in the concrete industry as a replacement for cement can have the benefit of reducing the costs of disposal and help in protecting the environment.

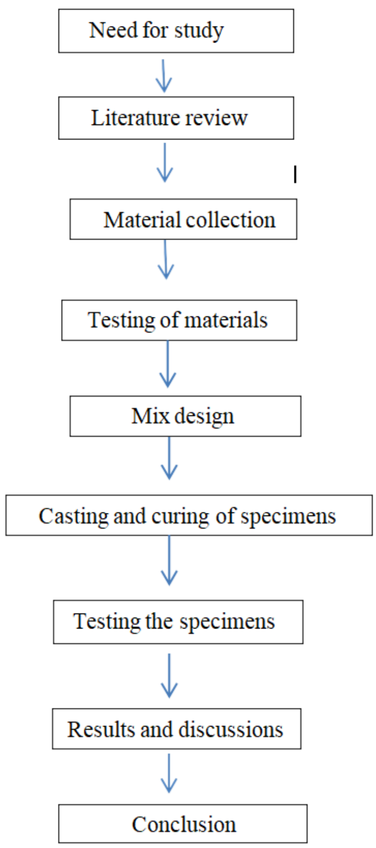
The unique characteristics of these aerocon bricks or blocks like light-weight, fire resistance, etc., not only grabbed the attention of construction industry, but also made users more curious about its performance. Though there is hype in the industry about this new innovation, only few are clear about what exactly Aerocon is all about.

In this project we are adding aerocon block as a constant partial replacement of coarse aggregates.

II. MATERIALS AND METHODOLOGY

The various journals were collected and studied on the partial replacement of the cement by different materials. According to these journals the process of the experiment and the method of the experimentation and the different tests conducted in those journals were studied and learned. On the basis of the studies of the journals collected for the experiment the experimental methodology for the project was choose.

Flow chart:



MATERIALS USED AND ITS PROPERTIES USED MATERIALS

2 Cement: Ordinary Portland cement Grade43

3 Fine Aggregate: Naturalsand

4 Coarse Aggregate: Crushed aggregate maximum size of 20mm

5 Water: Tapwater.

6 Copperslag

7 Aeroconblock

TABLE.1.CEMENT PROPERTIES

Test particulars	**Results obtained**
Specific gravity	3.16
Initial setting time	90 min
Final setting time	660min
Compressive Strength	43

TABLE 2: FINE AGGREGATE PROPERTIES:

Test particulars	**Results obtained**
Specific gravity	2.66
Sieve analysis Cu and Cc	9.31 and 0.42
Water absorption	0.7%

TABLE 3: COARSE AGGREGATE PROPERTIES

Test particulars	**Results obtained**
Specific gravity	2.75
Impact value	10.28
Water absorption	1%

2.2. TESTS ON HARDENED CONCRETE

Compressive strength on cubic specimens (150X150X150mm), were determined for 3,7, 14 and 28 days. Split tensile strength on cylinders (150mmX300mm) was found for 3, 7, 14 and 28 days.

TABLE 4: MIX DESIGN

% of copper slag	Cement	Copper slag	Fine aggregates	Coarse aggregates	Aerocon block
0	490	0	746.11	1004.3	0
10	441	49	746.11	602.58	401.42
20	392	98	746.11	602.58	401.42
30	343	147	746.11	602.58	401.42

TABLE 5:

Sl.No	% Of Copper Slag	Slump Values
1	0	40
2	10	35
3	20	45
4	30	30

4.2 Compaction factor test:

Compacting factor of fresh concrete is done to Mix design for M25 grade of concrete (1 m^3) in kg

III. WORKABILITY TESTS

4.1 Slump cone test:

The slump test is the most commonly used method. Consistency is a term very closely related to workability. It is a term which describes the state of fresh concrete. It is used for the determination of the consistency of freshly mixed concrete, where the maximum size of the aggregate does not exceed 20 mm. The slump test is suitable for slumps of low to medium workability, slump in the range of 25 – 50 mm.

determine the workability of fresh concrete. This test gives behavior of concrete under the action ofexternal forces. If measures the compatibility of concrete, by measuring the amount of compaction. This test is suitable for mixes having medium and low workability i.e. compaction factor in between 0.83 to 0.89, but is not suitable for concretes with very low workability, the compaction factor below0.71

TABLE 6:

Sl.No	%Copper Slag	Compaction Factor
1	0	0.834
2	10	0.851
3	20	0.896
4	30	0.825

IV. RESULT AND DISCUSSION

5.1. COMPRESSIVE STRENGTH

For the determination of cube compressive strength of concrete. Specimens, of size 150X150X150mm size were cast and cured for3, 7, 14 and 28 days in tap water. After the specimens are dried in open air, subjected to cube compression testing under digital compressive testing machine.

Compression test is the most common test conducted on hardened concrete, because it is an easy test to perform, and most of the desirable characteristic properties of concrete are qualitatively related to its compressive strength. All the concrete Specimens that are tested in a 2000 tons capacity of the compression testing machine.

Concrete cubes of size 150mm x 150mm x 150mm were tested for compressive strength.

After 3, 7, 14 and 28 days of curing, cube specimens were removed from the curing tank and cleaned to wipe off the surface water. Cubes were tested at the specified age using compression testing machine as shown in Fig1. The maximum load to failure at which the specimen breaks and the pointer starts moving back was noted. The test was repeated for three specimens and the average value was taken as the meanstrength.

The cube compressive strength (f) was computed from the fundamental principleas

$$F = P/A$$

Where

f =load at failure /cross sectional area (N/mm2) P = load at failure (N)

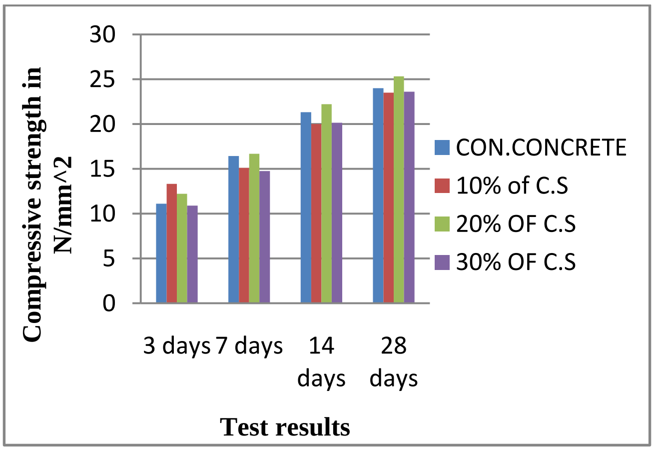
A = Area of the specimen (mm2)

Fig.1 Compressive testing machine

Compressive strength results:

The average compressive strength for cube at different percentages (10% and 20%) at age 3,7, 14and 28 days are given in table, it Can be noted that, concrete strength compare with conventional concrete. The graphical representation shows the compressive strength of copperslag.

Sl. No	Curing days	Average compressive strength			
		Conventional concrete	10%	20%	30%
1	3 days	11.11	13.3	12.22	10.88
2	7days	16.44	15.117	16.667	14.74
3	14days	21.33	20.0	22.22	20.14
4	28days	24.00	23.5	25.33	23.62



On X axis % change in copper slag

On Y axis compressive strength inN/mm^2

4.2. SPLIT TENSILE STRENGTH

For the determination of splitting tensile strength of concrete, cylinder specimens of diameter to length ratio 1:2 was selected , with diameter as 150 mm and the length as 300 mm specimens were dried in open air after 3 days of curing and subjected to splitting tensile test under compressive testing machine.

Fig. 2 Split tensile strength by using CTM

This test is conducted in a 2000 tones capacity of the compression testing machine by placing the cylindrical specimen of the concrete, so that its axis is horizontal between the plates of the testing machine. Experimental setup for Split Tensile Test is shown in fig2. The load was applied uniformly at a constant rate until failure by splitting along the vertical diameter takes place. Load at which the specimen failed is recorded and the splitting tensile stress is obtain educing.

The splitting tensile strength (f) was obtained using the formula,

F =2P/πdl (N/mm2) Where

P= load at failure (N)

d = diameter of specimen (mm) l= length of specimen (mm)

Conducted split tensile strength for the conventional and as well as for replacement of 10%,20%,30%of copper slag for cement and constant replacement of coarse aggregates with aerocon block waste that is 40% for the curing of 7,14,28 days.

% of replacing the copper slag	Split tensile strength		
	7 days	14 days	28 days
0% of C.S	1.84	2.05	2.70
10 %of C.S	2.1	2.18	2.92
20% of C.S	2.22	2.31	3.08
30% of C.S	2.2	2.07	2.62

V. CONCLUSION

The following conclusions can be drawn from the experimental investigation carried out

1. The slump of the concrete increased as the percentage of copper slag increases up to 20% and further increasing of copper slag slump reduces
2. The compaction factor increased as the percentage of copper slag increases and increased in comparison with the conventional concrete up to20%.
3. The specific gravity of copper slag is more as compared tocement.
4. 40% of coarse aggregate is replaced with Aerocon block waste and 10%, 20%, 30% of cement is replaced with copper slag resulted that the compressive strength is increased when compared with the conventionalconcrete.
5. Split Tensile strength at 3 days was increased with 10% and 20% replacement of copper slag when compared with conventionalconcrete.
6. The compressive strength and split tensile of the concrete is increased up to the 20% replacement of cement with copper slag and decreased further increasing the copper slag i.e., 30%.

VI. FUTURE SCOPE

The study can be carried out with varying percentage replacement of the copper slag and by reduced the aerocon block percentage or without aerocon block may be it will give good results.

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