

# Performance of Copper Slag on Strength as Partial Replacement of Fine Aggregate in Concrete

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**Abstract** - Sustainability and resource efficiency are becoming increasing important issues within today's construction industry. This study reports the potential use of granulated copper slag from Sterile Industries as a replacement for sand in concrete mixes. The effect of replacing fine aggregate by copper slag on the compressive strength and split tensile strength are attempted in this work. Leaching studies demonstrate that granulated copper slag does not pave away for leaching of harmful elements like copper and iron present in slag. The percentage replacement of sand by granulated copper slag were 0%, 5%, 10%, 15%, 20%, 30%, 40% and 50%. The compressive strength and split Tensile Strength will increase.

**Keywords:** High performance concrete, Copper slag, Waste material, Industrial by-products, Strength, Durability.

## 1 INTRODUCTION

Copper slag, which is the waste material produced in the extraction process of copper metal in refinery plants, has low cost and its application as a fine aggregate in concrete production have many environmental benefits such as waste recycling and solves disposal problems. It has been observed that up to 100 % replacement, copper slag can be effectively used as replacement for fine aggregate. The compressive strength increases with increase in percentage of combine mixes (copper slag and ferrous slag). copper slag is a glassy granular material with high specific gravity. Particle sizes are of the order of sand and have a potential for use as fine aggregate in concrete. In order to reduce the accumulation of copper slag and also to an alternate material for sand, copper slag was used as a replacement material for sand in cement concrete. It shows that the water consumed by the copper slag during mixing is very less as compared with river sand.



Fig.1. Copper slag

2 AIM: To improve the compressive and split tensile strength of concrete by using copper slag.

### 3 OBJECTIVES:

✓ This research was intended to examine the influence of copper slag additions in concrete and RCC elements for M20 mixes. The same word can be extended to higher grades of concrete mixes with varying water/cement ratio.

✓ Copper slag can be effectively replaced in making bricks, hollow blocks and pavement blocks.

✓ Since copper slag has higher shear strength value it can be used for soil stabilization.

✓ Copper slag can be replaced along with fly ash, silica fume and granulated blast furnace slag in concrete and RCC members which can be tested for mechanical performances.

**4 METHODOLOGY:**

- Step 1: SELECTION OF SUBJECT
- Step 2: DECIDE TITLE
- Step 3: IDENTIFICATION OF OBJECTIVES
- Step 4: LITRATURE SURVEY + CASE STUDY
- Step 5: CASTING & TESTING
- Step 6: RESULT
- Step 7: CONCLUSION

partial replacement for fine aggregate (sand). In order to achieve the objectives of present study, an experimental program was planned to investigate the effect of copper slag on compressive strength, split tensile strength, flexure strength and durability strength test of concrete. The experimental program consists of casting, curing and testing of controlled and copper slag concrete specimen at different ages.

**5 EXPERIMENTAL WORK:**

- To select proper mixed design method, test, properties and constituents material.
- To check the fresh and hardened properties of SSC using copper slag as a fine aggregate.
- To check the water absorption.
- To compare the Compression result with normal Concrete.
- To Check the Slump Value.
- To check the result of Rebound hammer with normal concrete.

- Collection of material
- Testing physical properties of materials
- Concrete mix (M20)
- Mixing of materials
- Casting and curing of specimens

- ✓ Test to determine the,
  - 1) Workability of concrete
  - 2) Compressive strength of concrete
  - 3) Split tensile strength of concrete
  - 4) Flexural strength of concrete
  - 5) Durability strength of concrete

**6 RESULTS AND DESIGN:**

This Chapter deals with the presentation of results obtained from various tests conducted on concrete specimens cast with and without copper slag. The main objective of the research program was to understand the strength and durability aspects of concrete obtained using copper slag as

**7 COMPRESSIVE STRENGTH OF CONCRETE IN CUBE:**

% Replacement	Compressive Strength (Mpa)		
	3 <sup>rd</sup> Day	7 <sup>th</sup> Day	28 <sup>th</sup> Day
0%	346	392	557
25%	352	432	593
50%	383	448	617
75%	420	515	623
100%	425	520	630

Table.1: Compressive Strength of Concrete (CUBE)

**8 REBOUND HAMMER TEST OF CONCRETE IN `CUBE:**

SR NO.	% REPLACEMENT	3rd DAY (N/mm <sup>2</sup> )	7th DAY (N/mm <sup>2</sup> )	28th DAY (N/mm <sup>2</sup> )
1	0	10	12	14
2	25	10	10	13
3	50	12	10	13
4	75	10	10	13
5	100	10	14	18

Table.2: Rebound Hammer Test of concrete in cube

9 COMPRESSIVE STRENGTH OF CONCRETE IN CYLINDER:

% Replacement	Compressive Strength (Mpa)		
	3 <sup>rd</sup> Day	7 <sup>th</sup> Day	28 <sup>th</sup> Day
0%	188	270	303
25%	210	277	428
50%	227	243	415
75%	262	353	377
100%	272	260	405

Table.3: Compressive Strength of Concrete (CYLINDER)

10 REBOUND HAMMER TEST OF CONCRETE IN CYLINDER:

SR NO.	% REPLACEMENT	3rd DAY (N/mm2)	7th DAY (N/mm2)	28th DAY (N/mm2)
1	0	11	14	18
2	25	11	11	21
3	50	10	11	16
4	75	11	15	21
5	100	11	20	21

Table.4: Rebound Hammer Test of concrete in Cylinder

11 CONCLUSIONS:

In the present scenario, the use of copper slag is increasing day by day both in research as well as in the construction companies. Since, the physical and mechanical properties of copper slag have maximum advantages. Therefore, replacement or reuse of it can be done in several manners. Keeping in mind about the rapid urbanization in the country, the safe disposal and judicial resource management is the important issue which can be balanced by the reuse of slag. The well defined scope in the future studies of copper slag is that it can also be replaced by cement and fine aggregate very easily and has an application in concrete as a admixture. Maximum compressive, tensile and flexural strength is obtained when copper slag is replaced with fine aggregate up to 100%. With such important properties of copper slag, further research is advised.

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