

# An Experimental Study Of Behavior Of Concrete Made Using Copper Slag As Fine Aggregate

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**Abstract:** *This study investigated the mechanical properties of high strength concrete incorporating copper slag as a fine aggregate and concluded that less than 40% copper slag as sand substitution can achieve a high strength concrete that comparable or better to the control mix, beyond which however its behaviors decreased significantly. The workability and strength characteristics were assessed through a series of tests on six different mixing proportions at 20% incremental copper slag by weight replacement of sand from 0% to 100%. The results indicated that the strength of the concrete with less than 40% copper slag replacement was higher than or equal to that of the control specimen and the workability even had a dramatic growth. The microscopic view demonstrated that there were limited differences between the control concrete and the concrete with less than 40% copper slag content. It also suggested that the determination of the copper slag replacement level should consider with the desired compressive strength of concrete.*

**Keywords:** *copper slag, workability, compressive strength.*

## I. INTRODUCTION

In our country, concrete is being extensively used in most of the construction activities. When compared to western countries, the usage of steel is far less in our country. Concrete also has the advantage of easy handling and proficiency in design not expected as in the case of steel.

Nowadays due to the boom in the infrastructure development, the volume of concrete being used in the construction has risen to a large level. Recently, composites have been fast replacing conventional materials in concrete. Newer materials are used in the concrete, so that deficient properties of concrete can be enhanced to our

convenience of making concrete a versatile material. Some of the composite materials are fibers, slag, fly ash etc.

## COPPER SLAG

A Copper slag, is a with the guide of systems for consequence of copper time from copper metals passes on materials like iron, alumina, calcium Oxide, silica and so forth. For each ton of metallic acquaintance around 2.2 with a few. Zero ton of slag is delivered and in at regular intervals, cycle 24.6 million tone of slag is generated from world copper production. Dumping or slag cause environmental and space problems. During the past two decades attempts have been made by several investigators and copper producing units all over the world to explore the possible utilization of copper slag.

## USES OF COPPER SLAG INSIDE CONCRETE

An American strong affiliation (Moura et al., 1999) related the copper slag from Bahia, Brazil as exchange materials. They watched that the point of confinement of the material breeze up clearly proportionate to the customary ones or most likely higher. So copper slag is most extreme conceivably a restraint extraordinary inclination to the admixtures related as a detail of bond and mortars.

A review on the mechanical qualities of the epoxide-diminish attractive bond stacked down with related pounding of the built up arrange copper slag turn out to be

certainly wrapped up by means of utilizing Rundnicki et al.(1998). It tangled up essentially endorsed that the slag touselled unassumingly specific filler for the bonds.

### EXTENT OF THIS PROJECT

A Review and examinations of classy mix

- ✦A Make the strong cases with the guide of the use of various percent of lovely blend.
- ✦The research and investigate focus seeking at on high five star bond with amazing blend
- ✦An evaluation the outcomes and steerage for correspondingly thinks around area.

## II. LITERATURE REVIEW

### D. Brindha and S. Nagan (2011)

“DURABILITY STUDIES ON COPPER SLAG ADMIXED CONCRETE” They concluded that The exploitation of copper slag in bond and solid demonstrates more biological and furthermore specific presents for each and every related industry. A substitute of copper slag in each best of the street aggregates and bond substitution reduces the charge of making concrete. whilst copper slag supplanted with security, utilization of hydrated lime with the manual of 1.Five% to the heap of solid gives improvement in cost of energy choose up. The alternative of copper slag will assemble the self weight of solid cases to the an extensive piece of 15 to 20%. For better decision of copper slag in bond (additional than 20%) and sand (additional recognized than a large portion of) the compressive and split malleable vitality decreases because of a change of loosened water content material texture in the mix.

### Khalifa S.Al-Jabri, Makoto Hisada, Salem K.Al-Oraimi (2010)

“Effect of Copper Slag as a Fine Aggregate on the Properties of Cement Mortars and Concrete” They Concluded That in connection with the direct combo, there has been a delicate advancement inside the HPC thickness of around five% with impact of copper slag content material, wherein for the reason that the workability raised speedily with increases in copper slag expense. calculation of as tons as half of copper slag as sand supplanting yield practically same vitality with that of the control blend. Be that as it can, likewise additions of copper slag expedited discount inside the quality because of a change of the detached water content material inside the mix. A combos with eighty% and 100% copper slag substitution gave the base compressive agreeable cost of cycle 80MPa, which was practically sixteen% decrease than the power of the control blend. present was a reduction inside the ground water maintenance as copper slag best delayed as a decent arrangement as forty% substitution. Past that fragment of substitution, the osmosis charge augments hastily. This is upheld that 40% of copper slag might be connected as substitute sand saving as a main priority the ultimate objective to get HPC with awesome houses.

## III. MATERIALS AND METHODOLOGY

### MATERIALS USED

Cement - Ordinary Portland cement 53 Grade.

Fine Aggregate - Natural river sand.

Coarse Aggregate - Aggregate passing through 20mm sieve.

Copper slag - Slag passing through 4.75mm sieve.

Water - Ordinary portable water.

**CEMENT:**

The most basic utilization of bond is the innovation of mortar and concrete the bouncing of residential developed or phony aggregates to outskirt a successful building surface which is tried and true inside the substance of well known normal effects

The most important use of cement is the production of mortar and concrete the bounding of natural or artificial aggregates to form a strong building material which is durable in the face of normal environmental effects. The most extreme serious for the greatest component used kind of cement is across the board Portland Cement. Portland bond is the true detail of strong, mortar and most non announce to notoriety grout. The utilization of Portland bond is the amassing of concrete.

**Work Of Art of Ordinary Cement**

INGREDIENT	PERCENTAGE (%)	VARIETY
Lime (CaO)	62	62-67
Silica (SiO <sub>2</sub> )	22	17-25
Alumina (Al <sub>2</sub> O <sub>3</sub> )	5	3-8
Calcium Sulphate (CaSO <sub>4</sub> )	4	3-4
Iron Oxide (Fe <sub>2</sub> O <sub>3</sub> )	3	3-4
Magnesium (MgO)	2	0.1-3

**Table No 1**

**FINE AGGREGATE**

In general of length is under 4.75mm are normally insinuated as charming mix. It's miles the normal texture

that fills voids inside the center of the course broad. The major limits of the pleasing mix are,

1. To supply workability and consistency for concrete.
2. To help the bond paste to save the junk of coarse mix suspension and to thwart paste to hold to the risk of confinement.
3. To complete off the voids in the coarse aggregate.



**SAND**

**COURSE AGGREGATE**

The estimations of combo bigger than four.75 mm is thought about as coarse combo overwhelmed stone were given through beating of shake that may skip by 20mm sifter and held tight 10mm zIS strainer and contained most effortless such a tremendous measure of 5 substances as is allowed through exact along had been obtained. It must be had strong, thick persevering, extreme and free from salt and natural issues. Authentically assessed general furnished denser concrete with significantly less voids.

The Coarse mix is connected profoundly to offer mass to the stable to the power of bond depends upon also at the quality of the course add up to and subsequently choice of sensible generally speaking is presumably to a great degree fundamental.



**COARSE AGGREGATE**

#### **COPPER SLAG**

The Copper slag is a through using consequence of copper approach from copper metals passes on materials like iron, alumina, calcium Oxide, silica et cetera. For each ton of metallic manufacturing around 2.2 to three. Zero ton of slag is made and in consistently, pretty much 24.6 million tone of slag is involved overall copper innovation. Dumping or slag reason biological and assortment issues.

Sooner or later of the former really some time attempts have been made with the guide of various retailers and copper developing instruments wherever at some phase in the notable to explore the suitable use of copper slag.



**COPPER SLAG**

#### **MIX DESIGN**

Cement (Kg/m <sup>3</sup> )	F.A (Kg/m <sup>3</sup> )	C.A (Kg/m <sup>3</sup> )	Water content (Kg/m <sup>3</sup> )
350	585.66	1200.15	186
1	1.67	3.42	0.53

#### **IV. EXPERIMENTAL PROGRAMME AND RESULTS**

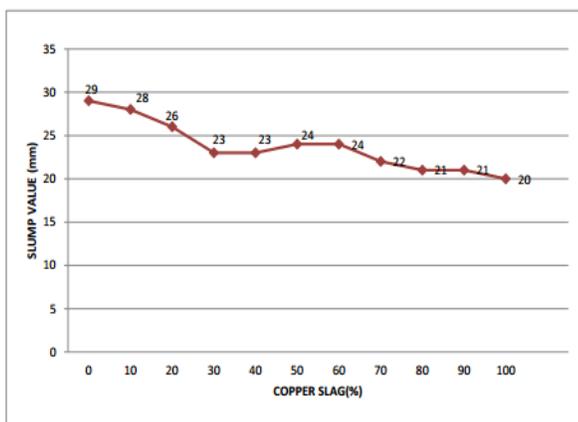
##### **SLUMP CONE TEST**

Table no 2



Slump mm	Kind Of Work
25 to 50	Road Work
50 to 100	Concrete Work
75 to 125	Slab R.C Column

SL.NO	Percentage of Copper Slag (%)	Slump (mm)
1.	0% copper slag	29
2.	10% copper slag	28
3.	20% copper slag	26
4.	30% copper slag	23
5.	40% copper slag	23
6.	50% copper slag	24
7.	60% copper slag	24
8.	70% copper slag	22
9.	80% copper slag	21
10.	90% copper slag	21
11.	100% copper slag	20



2

Table no 3

COMPRESSIVE STRENGTH

AT 7 DAYS

SL.NO	Percentage Of Replaced copper slag as fine Aggregate (%)	Compressive Strength N/mm <sup>2</sup>			
		Sample 1	Sample 2	Sample 3	Average
1	0	19.68	20.172	19.03	19.627
2	10	20.928	21.826	19.86	20.871
3	20	21.752	22.831	21.473	22.018
4	30	23.74	22.58	22.32	22.88
5	40	23.923	23.766	23.853	23.847
6	50	24.466	22.873	23.568	23.655
7	60	22.133	24.156	23.586	23.291
8	70	22.91	22.86	21.92	22.563
9	80	21.53	20.985	21.986	21.50
10	90	21.12	20.03	21.85	21
11	100	19.32	19.58	19.83	19.57

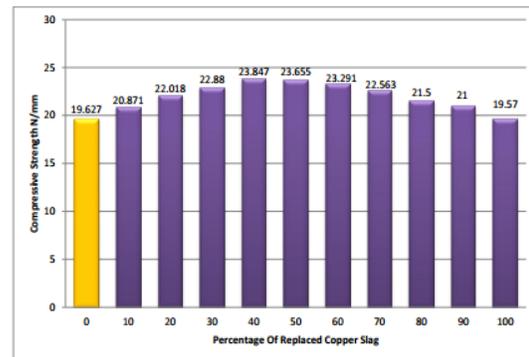


Table no 4

AT 28 DAYS

SL.NO	Percentage Of Replaced copper slag as fine Aggregate (%)	Compressive Strength N/mm <sup>2</sup>			
		Sample 1	Sample 2	Sample 3	Average
1	0	28.725	29.52	30.82	29.688
2	10	30.24	31.38	32.08	31.233
3	20	31.728	32.68	32.98	32.462
4	30	33.82	34.52	35.03	34.456
5	40	34.58	35.83	36.85	35.753
6	50	35.74	34.78	36.92	35.806
7	60	34.725	33.48	35.83	34.678
8	70	33.528	31.92	32.95	32.799
9	80	30.725	32.031	31.12	31.292
10	90	31.112	30.18	29.92	30.404
11	100	29.11	29.128	28.825	29.021

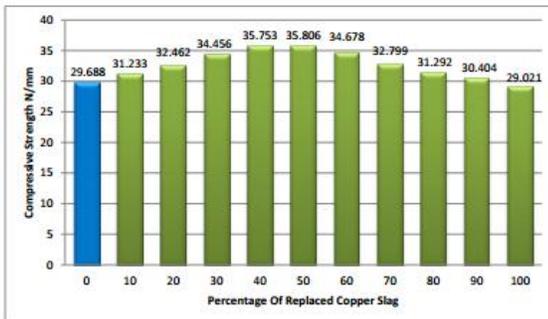
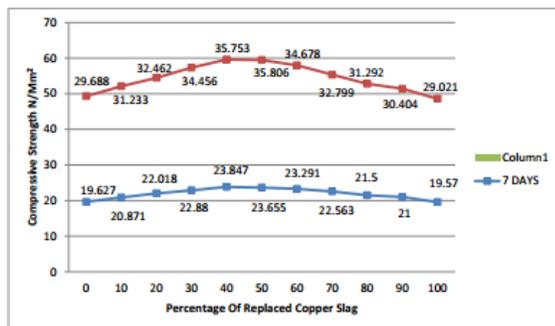


Fig-3 Compressive Strength on Concrete Cubes at 28 Days

The concrete reach the highest strength on its 40% of recycled aggregate.

Table no 5

COMPRESSION AT 7 AND 28 DAYS



SPLITTY TENSILE TEST

SL.NO	Percentage Of Replaced copper slag as fine Aggregate (%)	Split Tensile Strength N/mm <sup>2</sup>			
		Sample 1	Sample 2	Sample 3	Average
1	0	3.632	3.82	3.728	3.726
2	10	3.78	3.88	3.97	3.876
3	20	3.981	4.08	4.18	4.080
4	30	4.125	4.192	4.15	4.155
5	40	4.56	4.328	4.218	4.368
6	50	4.328	4.162	4.26	4.25
7	60	4.185	4.210	4.196	4.197
8	70	3.86	3.982	3.965	3.93
9	80	3.728	3.835	3.815	3.792
10	90	3.725	3.631	3.68	3.678
11	100	3.615	3.52	3.483	3.539

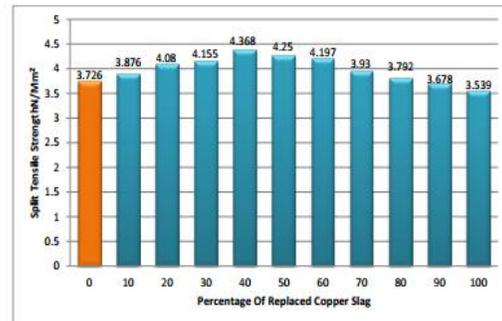


Table no 6

V. CONCLUSIONS

The exam has investigated mechanical practices of bond with sand changed with the guide of strategy for copper slag, finish of semi static and dynamic anxiety investigate and flexible part control investigate. It is watched that the smooth cleaned floor surface and discontinuous sogginess ingestion, the outstanding compressibility of copper slag can improve the workability and dynamic lead of the strong independently, yet the closeness of plenitude water, the better fineness and ferric oxide content texture lessening the semi static compressive, flexural and pliable



component vitality. It is suggested broadly considerably less than forty% copper slag as sand substitution can get a high charming stable that practically identical or superior to the control blend, past which additional voids, little scale parts and restricted coordinates show up in the microstructure of the steady coming around inside the stable hurt at an untimely power organize. It additionally suggests that the assurance of the copper slag supplanting level must keep in mind with the favored compressive high caliber of bond.

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