THE EXPERIMENTAL STUDY AND BEHAVIOUR OF CONCRETE BY PARTIAL REPLACEMENT OF CEMENT WITH GGBS AND FINE AGGREGATE WITH COPPER SLAG

AISHWARYA P G

M-Tech student, department of civil engineering(computer aided structural engineering), REVA university Bangalore

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ABSTRACT: The substitution of normal assets in the produce of cement and sand is the present issue in the present development situation. Copper slag and Ground Granulated Blast furnace Slag (GGBS) are mechanical by-product materials created from the way toward assembling copper and iron. Utilization of Copper slag and GGBS does decrease the cost of development as well as diminishes the effect on condition by devouring the material by and large considered as waste product. Henceforth in the present review an attempt has been made to limit the cost of cement and sand with concrete mix grade M40 by concentrate the mechanical conduct of this concrete blend by halfway supplanting with cutting edge mineral admixtures, for example, Copper slag and GGBS in concrete mix. In this review, halfway supplanting of Cement with GGBS and Sand with Copper Slag considered. Exploratory review is directed to assess the workability and quality attributes of hardened concrete, properties of concrete have been surveyed by halfway supplanting cement with GGBS, and sand with Copper Slag. The cement has been supplanted by GGBS in like manner in the scope of 0% (), 5%, 10%,and 15% by weight of cement for M40 mix. The sand has been supplanted by Copper slag in like manner in the scope of 0% ,10%, 20%, and 30%,by weight of cement for M40 mix. Concrete mixes were delivered, tried and analyzed regarding compressive, flexural, split tensile strength and durability of concrete with the conventional concrete.

Key words: Copper slag, GGBS, compressive, split tensile , flexural strength, durability tests, workability

I. INTRODUCTION

In the present situation, accordingly of ceaseless development in populace, fast industrialization and the going with innovations including waste transfer, the rate of release of poisons into the air, copper slag and GGBS are few of the mechanical by-product which turns out from blast furnace during metal extraction handle. In numerous nations, there is a shortage of natural aggregate that is appropriate for development, though in different nations the utilization of aggregate has expanded lately, because of increments in the development Industry. Keeping in mind the end goal to lessen consumption of characteristic aggregate because of development, falsely made aggregate and some mechanical waste materials can be utilized as choices. Accordingly for the inquiry of options, copper slag and GGBS are viewed as best alternatives accessible. One of the principle goal of this proposition is to decide the solid quality of M40 Grade by halfway substitution of sand from 0% to 30% and cement from 0% to 15% with copper slag and GGBS. The other target is to lessen the cost of development additionally diminishes the effect on condition by expending the material by and large considered as waste product. Copper slag is a by-product of copper extraction by refining. Amid purifying, polluting influences progress toward becoming slag which drifts on the liquid metal. Slag that is extinguished in water produces precise granules which are discarded as waste. Copper slag can be utilized as a part of concrete creation as a halfway swap for sand. Copper slag is utilized as a building material, shaped into pieces. In Sweden (Skelleftea locale) seethed and settled granulated copper slag from the Boliden copper smelter is utilized as street development material. The granulated slag (<3 mm measure division) has both protecting and waste properties which are usable to dodge ground ice in winter which thus averts asphalt breaks. The utilization of this slag lessens the use of essential materials and also decreases the development profundity which thusly diminishes vitality request in building. Because of similar reasons the granulated slag is usable as a filler and protecting material in house establishments in an cold atmosphere. Ground-granulated blast furnace slag (GGBS) is acquired by extinguishing liquid iron slag (a by-result of iron and steel-production) from an blast furnace in water or steam, to deliver a smooth, granular product that is then dried and ground into a fine powder GGBS is utilized to make concrete structures in mix with common Portland cement and additionally other pozzolanic materials. GGBS has been broadly utilized as a part of Europe, and progressively in the United States and in Asia (especially in Japan and Singapore) for its predominance in concrete hardened, broadening the life expectancy of structures from fifty years to a hundred years. Two noteworthy employments of GGBS are in the generation of value enhanced slag cement, to be specific Portland Blast furnace cement (PBFC) and high-slag blast furnace cement (HSBFC), with GGBS content running normally from 30 to 70%; and in the creation of prepared blended or site-clustered concrete cement. Concrete made with GGBS cement sets more gradually than concrete made with ordinary Portland cement, contingent upon the measure of GGBS in the cementitious material, additionally keeps on picking up quality over a more extended period underway conditions. This outcomes in lower warmth of hydration and lower temperature rises, and makes maintaining a strategic distance from cool joints less demanding, however may likewise influence development plans where speedy setting is required. Utilization of GGBS essentially diminishes the danger of harms created by alkali–silica response (ASR), gives higher imperviousness to chloride entrance — decreasing the danger of fortification consumption — and gives higher imperviousness to assaults by sulphate and different chemicals

II. OBJECTIVES

In this review, Copper slag and GGBS are utilized as a sand and cement as incomplete substitution of material in concrete blend. A definitive concentration of this work is to find out the execution of concrete blend containing Copper slag and GGBS and contrast it and the controlled concrete blend. furthermore, ideal estimation of copper slag and GGBS is additionally contrast and controlled concrete blend. This is required to give:-

- To halfway supplant sand with Copper slag and cement with GGBS in concrete as it straightforwardly impacts economy in development.
- To outline and extent the concrete blend for M40 Grade concrete, according to the proposal of IS :10262:2009.
- To discover the Volume extents of the concrete blends by incompletely supplanting Sand with Copper slag and cement with GGBS.
- To check the variety of Compressive Strength, Split Tensile Strength and Flexural Strength, durability test, comes about by incomplete supplanting the sand 0% to 30% with Copper Slag and the cement 0% to 15% with GGBS contrasted and controlled concrete and plotting the comparing graphs independently.
- Environmental amicable transfer of waste copper and steel slag

III. Material used in experimental work

4.1 Cement: 53 grade ordinary port land cement is used

4.2 Fine aggregate: The material which finishes through BIS test sieve number 4 (4.75mm) is named as fine aggregate typically regular sand is utilized as a fine aggregate at spots where characteristic sand is not accessible crushed stone(M-sand) is utilized as fine aggregates. It fits in with IS 383 1970 goes under zone II

4.3 Coarse aggregate: The material which is held on BIS test sieve number 4 (4.75mm) is named as coarse aggregate. The crushed stone is by and large utilized as a stone aggregate. Coarse aggregate utilized is locally accessible crushed angular aggregate of size 20mm and 10mm are utilized for this test work.

4.4 Copper slag: Copper slag is a industrial by-product material created from the way toward manufacturing copper.

4.5 Ground granulated blast furnace slag(GGBS): GGBS is a waste industrial by-product from the blast furnace used to make iron

4.6 Water: distilled water can be used for making concrete

4.7 Super plasticizers: Conplast SP 430

Table 4.1:Physical properties of copper slag

SPECIFIC GRAVITY OF	VALUE OF 'G'
FINE AGGREGATE	2.53
COPPER SLAG	3.34
COARSE AGGREGATE	2.69
CEMENT	3.068
GGBS	3.47
SUPERPLASTICIZERS	1.21

WATER ABSORPTION OF	%
FINE AGGREGATE	1.39
COPPER SLAG	0.83
COARSE AGGREGATE	0.43

FINESS MODULUS	**%**
FINE AGGREGATE	3.26
COPPER SLAG	4.135
COARSE AGGREGATE	8.191

Table4.2: chemical composition of copper slag

Constituents	**In %**
Sio2	34.94
Tio2	0.15
Al2o3	5.80
Total iron as Fe	39.29
Na2o	1.51
K2o	0.98
Sulphates as So3	1.35
Mno	0.12

Table4.3: chemical composition of GGBS

Constituents	In %
SiO2	33.52
FeO	1.28
Al2O3	19.81
CaO	34.77
MgO	7.38
MnO	0.45
TiO2	0.88
S	0.89
K2O	0.39
Na2O	0.23

IV. MIX DESIGN

Mix Design The blend extent decided for this review is M40 grade (**1:1.92586:2.78176:0.4**) with water-cement proportion of 0.4. In this test Cubes of standard size 150x150x150mm and Cylinders of standard measurement 150mm and stature 300mm and Prisms of size 500x100x100mm were threw and cured for 7 and 28 days and tried according to code Seems to be: 516-1959.

V. Result and discussion

5.1 Compressive Strength Test

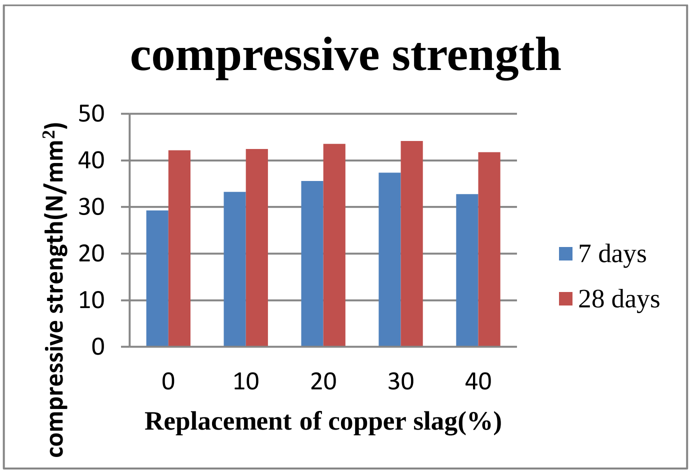
Compressive strength of cubes 150*150*150mm size.

Compressive strength formula

$$\text{Compressive strength} = \frac{\text{ultimate load}}{\text{area of cross section(mm2)}}$$

Table5.1: compressive strength of copper slag and GGBS

Compressive strength 150*150*150mm 0f cubes	0%	10% CS	20% CS	30% CS	40% CS	5% GGBS	10% GGBS	15% GGBS
7 days	29.2777	33.2183	35.5533	37.3851	32.74	35.407	36.333	38.333
28 days	42.1481	42.4444	43.5184	44.1851	41.77	42.518	43.555	45.4070



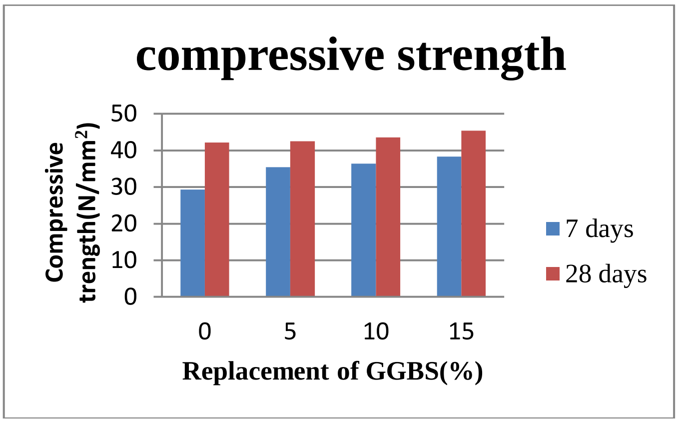


Fig 5.1:compressive strength of copper slag and GGBS

Table5.2:compressive strength of 30% GGBS and 15% copper slag(optimal value)

Compressive strength 150*150*150mm 0f cubes	0%	30% CS and 15% GGBS
7 days	29.2777	38.2592
28 days	42.1481	45.5920

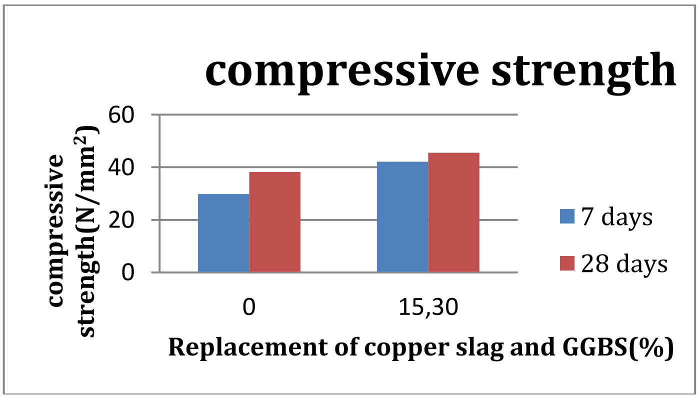


Fig 5.2: compressive strength of optimal value

5.2 Split tensile Test

Split tensile strength of cylinder 150*300mm size.

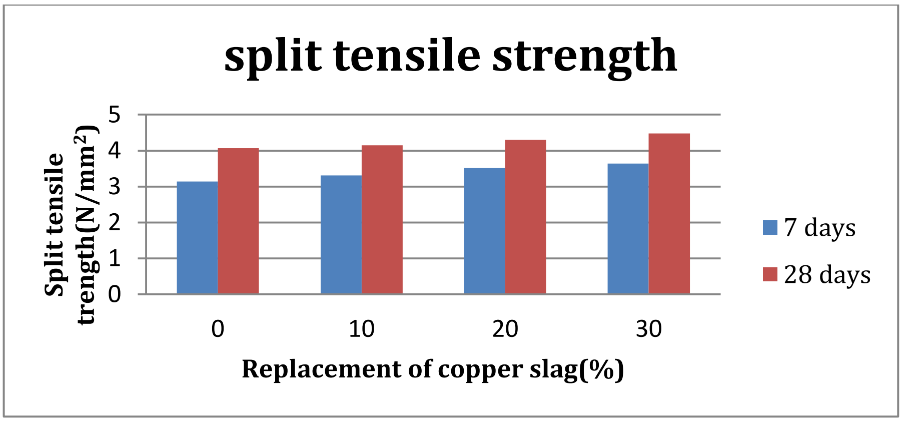
Split tensile Strength Test formula.

Split Tensile Strength Test $= \frac{2P}{\pi DL}$

Where P = applied load
D = diameter of the specimen
L = length of the specimen

Table6.3:Split tensile strength of copper slag and GGBS

Split tensile strength 150*300mm cylinders 0f	0%	10% CS	20% CS	30% CS	5% GGBS	10% GGBS	15% GGBS
7 days	3.1358	3.3127	3.5130	3.6420	3.3952	3.6426	3.7607
28 days	4.0672	4.1497	4.3030	4.4798	4.1496	4.3620	4.5623



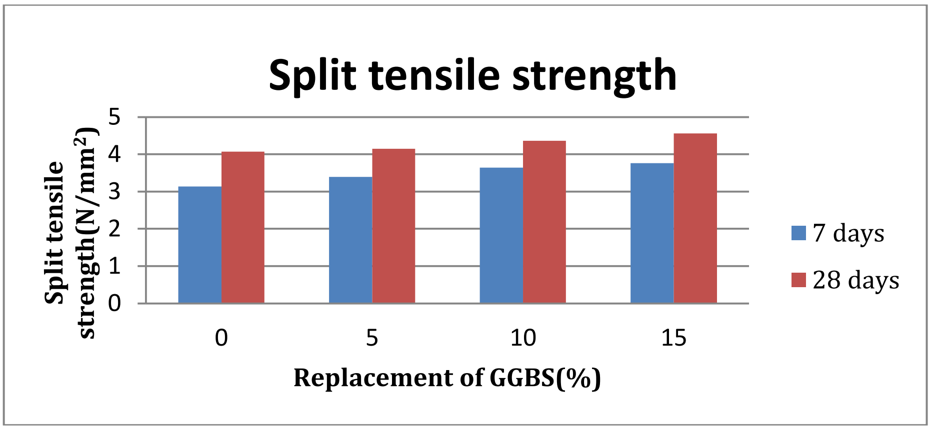


Fig 5.3:Split tensile strength of copper slag and GGBS

Table5.4:Split tensile strength of 30% of copper slag and 15% of GGBS(Optimal value)

Split tensile strength 150*300mm cylinders 0f	0%	30% CS and 15% GGBS
7 days	3.1358	3.8078
28 days	4.0672	4.5624

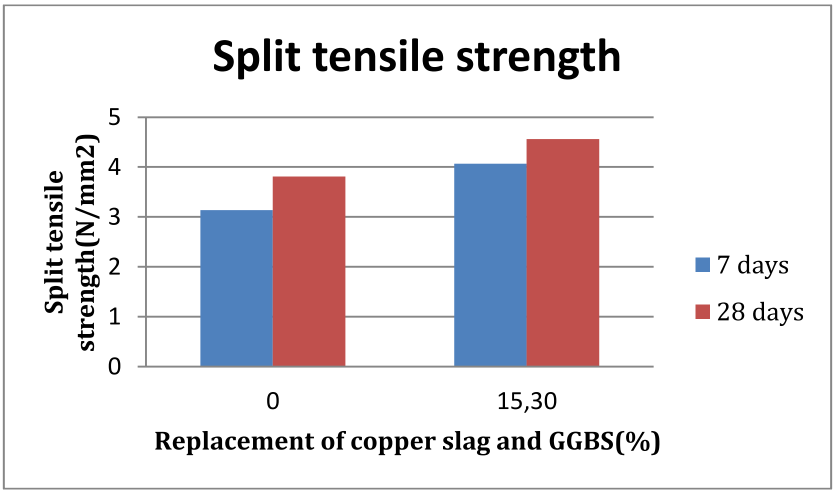


Fig 5.4 split tensile strength(Optimalvalue)

5.2 flexural strength

Flexural strength of prism 500*100*100mm size

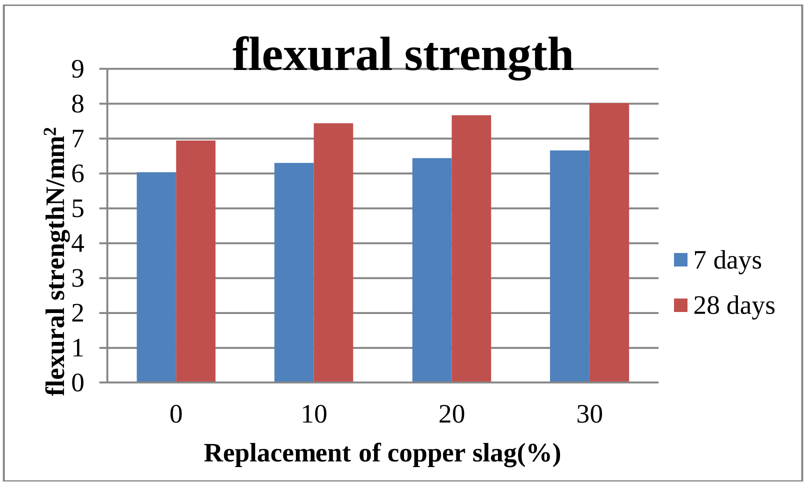
Flexural strength formula

Flexural Strength Test $= \frac{PL}{BH2}$

Where,
P = load in Newton
l = length of rectangular prism in mm
b = breadth of rectangular prism
h = height of rectangular prism

Table5.5:Flexural strength of copper slag and GGBS

Flexural strength 500*100*100mm prisms 0f	0%	10% CS	20% CS	30% CS	5% GGBS	10% GGBS	15% GGBS
7 days	6.0333	6.3075	6.4433	6.6625	6.2985	6.4890	6.7258
28 days	6.9433	7.4458	7.6683	8.0250	7.3441	7.5666	7.9300



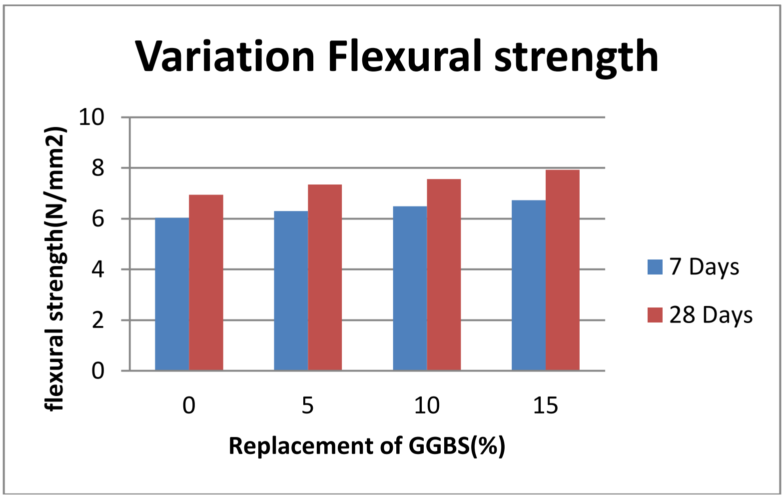


Fig 5.5 Flexural strength of copper slag and GGBS

Table5.6: Flexural strength of 30% of copper slag and 15% of GGBS(Optimal value)

Flexural strength 500*100*100mm prisms 0f	0%	30% CS of 15% GGBS
7 days	6.0333	6.6883
28 days	6.9433	8.0777

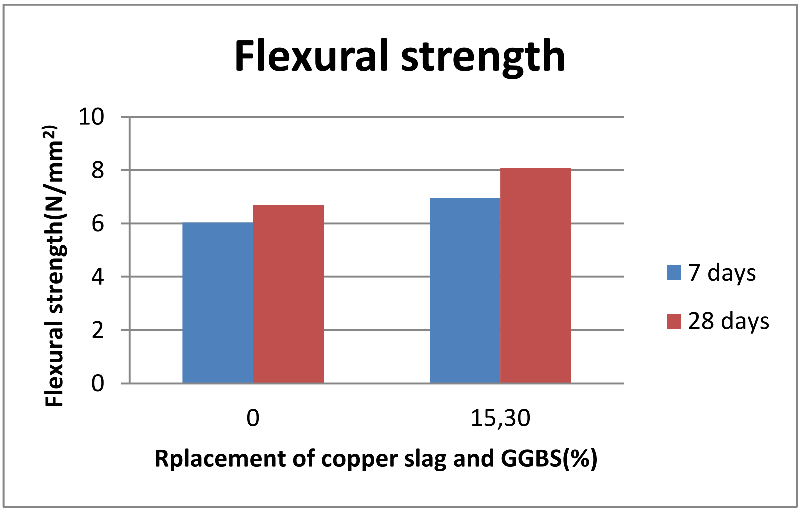


Fig 5.6 Flexural strength of optimal value

VI. CONCLUSION

- The partial replacement of cement by GGBS and sand by Copper slag gives the economy in the development however it additionally encourages effective usage of the CS and GGBS which is produced in enormous amounts from the steel and iron industries.
- The workability of concrete was observed to be increments with the expansion in GGBS in concrete
- The workability of concrete was observed to be increments with the expansion in Copper slag up to 30% in cement.
- Maximum compressive strength, split tensile and flexural strength has been acquired for substitution of cement by 15% of GGBS and sand by 30% of copper slag. Compressive strength of GGBS and copper slag was accomplished more quality than the control Mix.
- The expansion of copper slag and GGBS for the replacement of sand and cement shows resistance against sulphate attack contrasted with control blend

- The replacement of cement by GGBS and sand by CS builds the compressive strength as well as decreased the use of cement substance and sand content.

VII. References

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