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Behaviour and Experimental Study on Concrete as Partial Replacement of Fine Aggregate with Copper Slag and Cement with GGBS

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Abstract

The substitution of normal assets in the produce of cement furthermore, sand is the present issue in the present. development situation. 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 endeavor has been made to restrain the cost of cement and sand with concrete blend grade M40 by focus 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 regard halfway replacing of Cement with GGBS and Sand with Copper Slag is considered. Exploratory review is directed to assess the workability and quality attributes of solidified concrete, properties of concrete have been surveyed by halfway supplanting cement with GGBS, and sand with Copper Slag. The cement has been replaced with GGBS in 0% , 5%, 10%,and 15% with weight of cement for M40 mix. For M40 mix the sand is replaced with Copper slag in 0%,10%, 20%, 30%,by weight of cement . Concrete mixes are prepared ,tested and analyzed regarding compressive, flexural, split tensile strength and durability of concrete with the conventional concrete.

Keywords: Ground-granulated blast furnace slag (GGBS), Copper slag, M40 mix

Introduction

The usage of modern waste or optional materials has empowered the creation of bond and cement in development field. New by-product and waste materials are being produced by different enterprises. Copper slag is 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. 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.

Objectives

- 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 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

METHODS

This part manages the philosophies in this report. The properties of concrete like standard consistency, specific gravity, fineness and so forth, and the properties of fine aggregate and coarse aggregate like specific gravity, grain size ,water absorption, and so on is computed. As indicated by the above properties of materials according to IS 10262-2009, the extents of water: cement: fine aggregate: coarse aggregate for review (M40) are executed.

Figure 1: cement and GGBS

Specific gravity of cement =3.068 Specific gravity of GGBS=3.4745

Figure 2: M-sand and copper slag

Specific gravity of fine aggregate=2.556 & Specific gravity of copper slag=3.34

Mix design of M40 grade concrete

The mix design is made for M40 grade by using the values of basic tests and the code book as been used for designing. In this design we are going to adopt 0.4 of water cement ratio as per the calculations.

MIX PROPORTION= 1:1.92586:2.78176:0.4

Table 1: Amount of materials required for 6 cubes of size 150*150*150mm for copper slag.

materials	0% replacement of copper slag	10% replacement of copper slag	20% replacement of copper slag	30% replacement of copper slag
cement	9.7566 kg	9.7566 kg	9.7566 kg	9.7566 kg
Fine aggregate	18.79008 kg	16.91102 kg	15.03228 kg	13.15308 kg
Copper slag	-	1.8789 kg	3.7578 kg	5.637 kg
Coarse aggregate(20mm,12mm)	27.1404 kg	27.1404 kg	27.1404 kg	27.1404 kg
Water	3.90264 liters	3.90264 liters	3.90264 liters	3.90264 liters
Super plasticizer	175.6188 ml	175.6188 ml	175.6188 ml	175.6188 ml

Table 2: Amount of materials required for a 6 cylinder of size 150*300mm for copper slag

Materials	0% replacement of copper slag	10% replacement of copper slag	20% replacement of copper slag	30% replacement of copper slag
Cement	14.6284 kg	14.6284 kg	14.6284 kg	14.6284 kg
Fine aggregate	28.1715 kg	25.35408 kg	22.5372 kg	19.72014 kg
Copper slag	-	2.81712 kg	5.6343 kg	8.45136 kg
Coarse aggregate(20mm,12mm)	40.6929 kg	40.6929 kg	40.6929 kg	40.6929 kg
	5.8512 liters	5.8512 liters	5.8512 liters	5.8512 liters
Super plasticizer	263.304 ml	263.304 ml	263.304 ml	263.304 ml

Table 3: Amount of materials required for 6 prisms ofsize 500*100*100mm for copper slag

materials	0% replacement of copper slag	10% replacement of copper slag	20% replacement of copper slag	30% replacement of copper slag
Cement	14.454 kg	14.454 kg	14.454 kg	14.454 kg
Fine aggregate	27.8358 kg	25.05222 kg	Water	19.48506 kg
Copper slag	-	2.78358 kg	5.56716 kg	8.35074 kg
Coarse aggregate(20mm,12mm)	40.2087 kg	40.2087 kg	40.2087 kg	40 2087 kg
Water	5.7816 liters	5.7816 kg	5.7816 liters	5.7816 liter s
Super plasticizer	260.172 ml	260.172 ml	260.172 ml	260.172 ml

Table 4: Amount of materials required for 6 moulds of size 150*150*150mm for GGBS

materials	0% replacement of copper slag	10% replacement of copper slag	20% replacement of copper slag	30% replacement of copper slag
Cement	14.454 kg	14.454 kg	14.454 kg	14.454 kg
Fine aggregate	27.8358 kg	25.05222 kg	22.26864 kg	19.48506 kg
Copper slag	-	2.78358 kg	5.56716 kg	8.35074 kg
Coarse aggregate(20mm,12mm)	40.2087 kg	40.2087 kg	40.2087 kg	40 2087 kg
Water	5.7816 liters	5.7816 kg	5.7816 liters	5.7816 liter s
Super plasticizer	260.172 ml	260.172 ml	260.172 ml	260.172 ml

Table 5: Amount of materials required for a 6 cylinder of size 150*300mm for GGBS

Materials	0% replacement of GGBS	5% replacement of GGBS	10% replacement of GGBS	15% replacement of GGBS
Cement	9.7566 kg	9.26874 kg	8.78094 kg	8.2932 kg
GGBS	-	0.48783 kg	0.97566kg	1.4634 kg
Fine aggregate	18.79008 kg	18.79008 kg	18.79008 kg	18.79008 kg
Coarse aggregate(20mm,12mm)	27.1404 kg	27.1404 kg	27.1404 kg	27.1404 kg
Water	3.90264 liters	3.90264 liters	3.90264 liters	3.90364 liters
Super plasticizer	175.6188 ml	175.6188 ml	175.6188 ml	175.6188 ml

Table 6: Amount of materials required for 6 prisms of size 500*100*100mm for GGBS

Material	0% replacement of GGBS	5% replacement of GGBS	10% replacement of GGBS	15% replacement of GGBS
Cement	14.62848 kg	13.8966 kg	13.1652 kg	12.4338 kg
GGBS	-	0.7314	1.4628 kg	2.1942 kg
Fine aggregate	28.1724 kg	28.1724 kg	28.1724 kg	28.1724 kg
Coarse aggregate(20mm,12mm)	40.6926 kg	40.6926 kg	40.6926 kg	40.6926 kg
Water	5.8512 liters	5.8512 liters	5.8512 liters	5.8512 liters
Super plasticizer	263.304 ml	263.304 ml	263.304 ml	263.304 ml

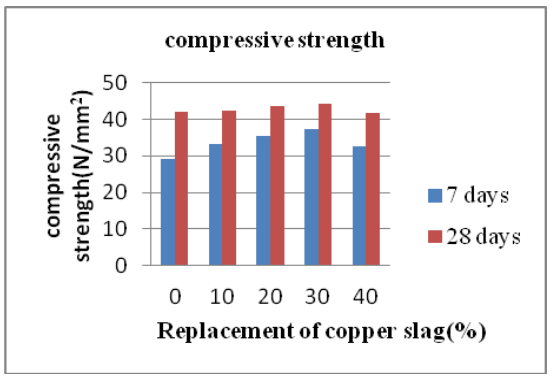
Tests on hardened concrete

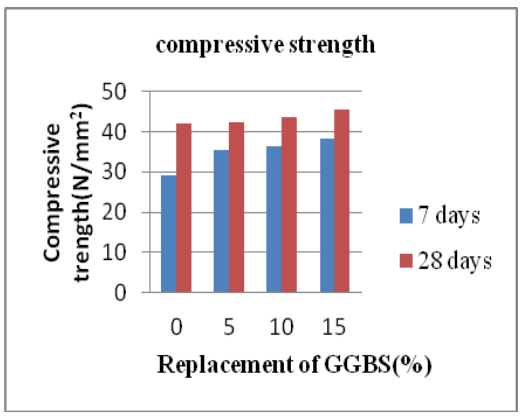
Compressive strength

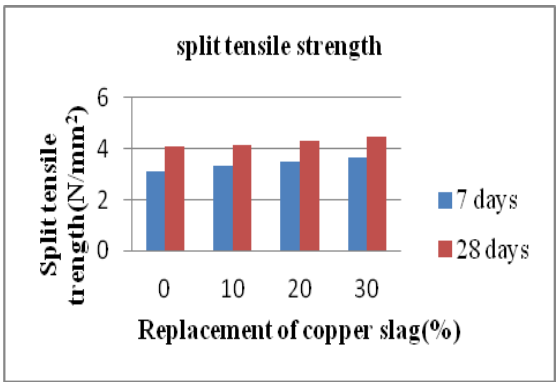
Figure 5: compression testing machine

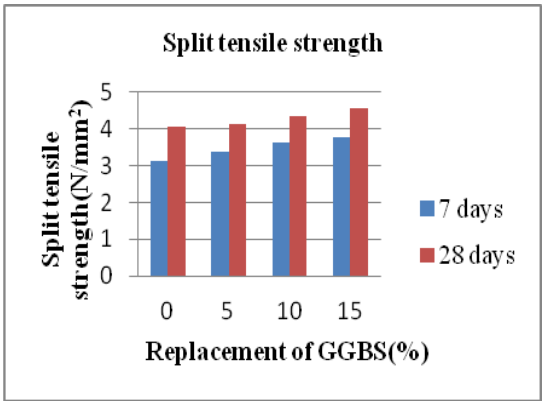
Figure 6: Split tensile test

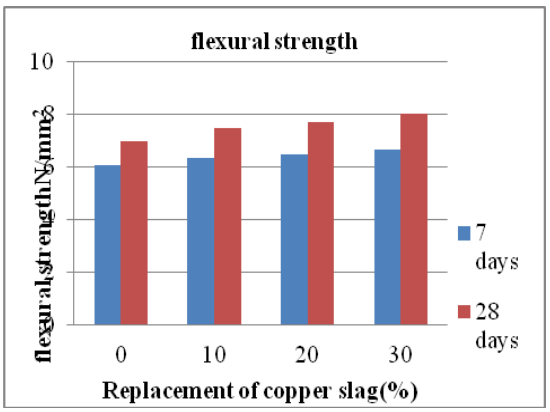
Results and discussion

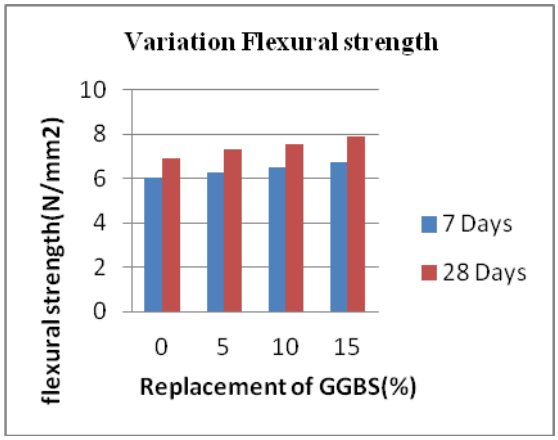












CONCLUSIONS

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 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.

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