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Research Paper

Compressive Strength Development of Admixture Mixed Concrete Made by Replacing OPC By GGBS, Basaltic Ca and Jewargi Sand

Engineering

KEYWORDS : GGBS slag, Cement, Material Test

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ABSTRACT

The study of concrete in civil engineering is increasing day by day and the amount of cement required for the construction of concrete is also increasing by which the production of cement results in emission and pollutes the environment. Therefore by researches, it has been concluded that the replacement of cement can be done partially with waste products like GGBSwhich is by product of molten iron which have inherent Cementitious property, It gives compressive strength of concrete without compromising on its strength, stability and durability, which result in decrease of cement production and reduces global warming thus reduction in emission in greenhouse gases, in addition to sustain¬able management of the waste. This paper presents an experimental study of compressive strength of M30 grade of concrete prepared with Ordinary Portland Cement, partially replaced by ground granulated blast furnace slag in different proportions varying 0%, 7.5%, 22.5%, and 37.5%. curing period of concrete is taken as 3,7, and 28 days and compressive strength has been tested The curing period required for GGBS admixtures added in concrete should require more compare to standard concrete. It is observed from investigation that the degree of workability is normal and the strength of concrete decreases as the percentage of GGBS increases.

I. INTRODUCTION

The study of concrete with an admixture called GGBS has been studied in the experiment. Which has been taken from Bangalore steel industry. As the fine aggregate is easily available in local area of Gulbarga from bheema river of jawargi which is allowed to pass from 4.75mm sieve which Is used in concrete of this experiment and 20mm size of coarse aggregate, opc of 53 grade Ultratech (syed barey agency of Ultratech cement) which is allowed to pass from 90 micron sieve and mixed with concrete. As the cement production *results in emission of many greenhouse gases in atmosphere, which are responsible for global warming*hence the waste materials coming from industries like GGBS can be partially replaced with cement to make the binding property with concrete. In this experiment, M30 grade of concrete with proportions of 1:1.5:2.7 with water cement ratio of 0.45. The replacement of cement with GGBS is done varying 0%, 15%, and 30%. This can increase workability in less curing period and increases compressive strength in longer period of curing.in this experiment 3, 7, and 28 days of curing has been studied. The availability and usage of secondary cementitious materials like GGBS ect to make the RMC concrete products more sustainable and durable and scope for green marketing [4]

In sea water curing the GGBS when replaced with 20% of cement shows good response for durability criteria [7]

The gain in early strength is compared to less GGBS concretes then conventional concrete [7]

II. AIMS AND OBJECTIVES

The aim of this experiment is to study the partial replacement of cement with concrete. in this experiment, ggbs is partially replaced with cement in different proportions of M30 grade of concrete and compressive strength has been tested which results in good strength after 28 days of curing.

III. METHEDOLOGY

The GGBS is a by-product in the manufacture of iron and the amounts of iron and slag obtained are of the same order. Iron ore, coke and limestone are fed into the furnace and the resulting molten slag floats above the molten iron at a temperature of about 1500°C to 1600°C. After the molten iron is tapped off, the remaining molten slag, which consists of mainly siliceous and aluminous residue is then water-quenched rapidly, resulting in the formation of a glassy granulate. This glassy granulate is dried and ground to the required size, which is known as GGBS. The GGBS required in this study obtained from steel plant of Bangalore. The GGBS which is used passes, 90% through 90 micron sieve. The aim of this work is to ascertain the performance of concrete mix containing GGBS as replacement of OPC and to compare it with the plain concrete mix of M30 grade of concretes

The chemical composition of GGBS is obtained from X-ray analysis at laboratory and is shown in Table – 1.

Table – 1: Chemical Composition of GGBS

Constituents	%
SiO_2	34.4
Al_2O_3	21.5
Fe_2O_3	0.2
CaO	33.2
MgO	9.5
K_2O	0.39
Na_2O	0.34
SO_3	0.66

The cement is a material that has cohesive and adhesive properties in the presence of water, consist primarily of silicates and aluminates of lime. The OPC (53 Grade) of ultratech (taken from syed barey cement agency) is used for this study. The fine aggregate are material passing through an IS sieve that is less than 4.75 mm gauge beyond which they are known as coarse aggregate. The main function of the fine aggregate is to provide workability and uniformity in the mixture. The fine aggregate uses in this study is locally available river sand of Jawergi Gulbarga district which conforms to zone II as per IS code. The coarse aggregate form the main matrix of the concrete, whereas fine aggregate form the

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filler matrix between the coarse aggregate. The maximum size of aggregate used in this study is 20 mm. The coarse aggregate is confirmed by IS 383:1977 and is 20 mm maximum size. The cement, fine and coarse aggregates required for experimentation are tested in the laboratory and the results are shown

Table – 2 : Properties of OPC, Fine and Coarse Aggregate

Properties	Value
(a) Cement	
Specific gravity	3.10
Initial setting time	75 min
Final setting time	360 min
(b) Fine Aggregate	
Specific gravity	2.61
Water absorption	1%
Fineness modulus	4.84
(c) Coarse Aggregate	
Specific gravity	2.72
Water absorption	0.5%
Fineness modulus	2.83

IV. EXPERIMENTAL PROGRAMS

The cement concrete mix is prepared as per the procedure given in the BIS 10262:2009. For optimal dosage selection of GGBS in concrete mix, modified cubes (percentage 0%, 7.5%, 22.5%, and 37.5%) are prepared and compared with plain cement concrete cubes with mix proportion of 1:1.5:2.7 are prepared of M30 grade of concrete. The replacements of OPC with GGBS are made on an equal weight basis. The w/c ratio is taken 0.45%,for all the mixes. The result of mix design of the concrete is shown in Table – 3.

Table – 3 : Mix Specification for 1 m_3 Concrete

Particulars	Plain concrete mix	7.5%	22.5%	37.5%
Cement in kg/m3	425.73	393.80	325.95	266.08
Sand in kg/m3	648.95	648.95	648.95	648.95
Coarse aggregate in kg/m3	1151.53	1151.53	1151.53	1151.53
GGBS in kg/m3	0	31.92	95.78	159.64
Water in kg/m3	191.58	191.58	191.58	191.58

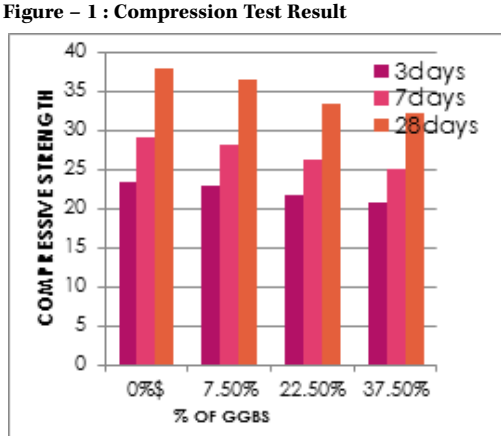
in this investigation36 cubes specimen are tested. The Cubes with the dimension of 150 x 150 x 150 mm are prepared for each batch of mixes to measure compressive strength and of concrete respectively at the age of 3 days, 7 days and 28 days of curing.

All the specimens are kept in water tank for curing and thereafter tested as per BIS norms and standard. All the cube specimens are tested for compressive strength in compression testing machine (CTM) .

V. RESULTAND DISCUSSION

The compressive strength of cement concrete containing various % of GGBS at the age of 3,7, 28 days are given in Table 4

Figure – 1 : Compression Test Result



Concrete Types	Compressive Strength		
	3 Days	7 Days	28 Days
100%OPC	23.48	29.08	37.96
7.5%GGBS 92.5%OPC	22.98	28.12	36.48
22.5%GGBS 77.5%OPC	21.72	26.19	33.49
37.5%GGBS 62.5%OPC	20.85	24.96	32.08

VI. CONCLUSIONS

As per as the obtaining the suitability of GGBS as replacement of OPC in concrete. The results of compression test are shown in graphical form in Figure – 1. It may be observed from the plots that the properties of can be maintained with GGBS as partial replacement of cement.

- The increase in % of GGBS results in decrease in strength of concrete.
- Increase in percentage of GGBS increase workability
- The reduction in the cost of concrete is achieved.
- It reduces emission which is helpful for environment

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