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Characteristics Study on Compressive Strength of Concrete With Ggbs

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ABSTRACT

Concrete could be a mixture of cement, fine mixture, coarse mixture and water. Concrete plays a significant role within the development of infrastructure Viz., buildings, industrial structures, bridges and highways etc. resulting in utilization of huge amount of concrete. On the opposite aspect, value of concrete is attributed to the price of its ingredients that is scarce and overpriced, this resulting in usage of economically various materials in its production. This demand is drawn the eye of investigators to explore new replacements of ingredients of concrete. This usage of GGBS is replacement to already depleting typical building materials and therefore the recent years associate degreed also as being a byproduct it is an Eco Friendly manner of utilizing the merchandise while not merchandising it on ground. This gift technical report focuses on investigation characteristics of concrete with partial replacement of cement with Ground coarse furnace dross (GGBS).

KEYWORDS: *Cement, GGBS, GGBS in concrete, Compressive Strength.*

1. INTRODUCTION

In cement production Asian nation stands next to china that is that the largest producer of cement within the world. Cement demand can rise to 550-600 million tones every year (MTPA) by 2025 in Asian nation. Cement industries is one among the most cause for warming as they're the most contributors of CO2. Thence there's Associate in nursing pressing have to be compelled to cut back the usage of cement. This challenge are often self-addressed by victimization different materials that area unit less energy intensive and having lower carbon emissions like ground coarse furnace scum (GGBS), fly ash, oxide fume, rice husk ash, wood ash, etc. furnace scum is obtained as a by-product throughout manufacture of atomic number 26 in steel plants. It’s expected that Asian nation can turn out concerning 439

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Million Tons Per Annum (MTPA) steel by 2020. About 0.45-0.50 weight unit of furnace scum are going to be generated per weight unit of steel. This may be a threat to the setting if it's disposed of as waste. Therefore, utilizing GGBS as a replacement to cement may be a key to the environmental considerations of each the cement business and industry. GGBS is analogous to normal hydraulic cement (OPC) in chemical composition. Since the benefits of GGBS area unit a lot of, there's Associate in nursing pressing have to be compelled to promote the usage of GGBS. The atomic number 20 content in GGBS is incredibly little compared to cement so GGBS concrete can take longer attaining strength. The presence of lime stone powder or dolomite, or fast lime in GGBS could increase the quantity of Ca-OH bond which is able to enhance the first age strength while not moving pH of the concrete. So replacement of cement by GGBS and alternative applicable materials can offer high early age strength and extremely sturdy concrete.

Ground coarse furnace scum (GGBS) may be a byproduct from the blast furnaces accustomed create iron. These operate at a temperature of concerning 1500 degrees centigrade and area unit fed with a rigorously controlled mixture of ore, coke and stone. The ore is reduced to iron and therefore the remaining materials from a scum that floats on prime of the iron. This scum is sporadically tapped off as a melted liquid and if it's to be used for the manufacture of GGBS it's to be quickly quenched in giant volumes of water. The ending optimizes the building material properties and produces granules just like coarse sand. This „granulated‟ scum is then dried and ground to a fine powder. Though commonly selected as “GGBS” within the GB, it may also be remarked as “GGBS” or “Slag cement” Concrete is essentially a combination of fine mixture, coarse mixture and cement. The most drawback is that the original typical materials area unit depleting and that we area unit in look for alternate building materials that lands United States here on the aim of GGBS. Being a byproduct and waste victimization it effectively up to some extent is a step for a greener setting and at an equivalent time keeping in mind that the strength of the concrete doesn’t degrade by the usage GGBS.

MATERIALS AND METHODS

The materials used in experimental investigation include:

Cement

Ordinary Portland cement of 43-grade conforming to IS: 8112-1989 was used in this project under the brand name Reliance Cement.

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GGBS

Ground Granulated Blast-furnace Slag (GGBS) used in this project is collected local vendor. The physical & mechanical properties of cement and GGBS are given in Table 1.

Table-1: Physical & Chemical properties of cement & GGBS

Test	Cement	GGBS
Color	Gray	Off white
Consistency	25%	33%
Soundness	4 mm	--
Initial setting time	110 minutes	--
Final setting time	290 minutes	--
Specific gravity	3.13	2.95
Fineness (sieving on 90µm)	8.5 %	0%
Bulk density	1.48 gm/cm^3	1.29 gm/cm^3

Fig. 1 Ground Granulated Blast furnace Slag (GGBS).

Chemical Properties

The test for Chemical Properties of Cement & GGBS has been performed using X-Ray Fluorescence Machine at K.S.Rangasamy college of Technology, Tiruchengode. The results are given in Table 2.

Table-2: Chemical Properties of Cement & GGBS

Chemical	Cement	GGBS
Ca O	63.20	35.27
SiO_2	21.06	34.72
Al_2O_3	5.72	19.11

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MgO	1.90	8.46
Fe_2O_3	4.38	0.5
SO_3	2.04	0.18
Na_2O	0.25	0.16
K_2O	0.87	0.58
Cl	0.01	0.01
TiO_2	0.40	0.65
P_2O_5	0.09	0.01
Mn_2O_3	0.07	0.14
Glass Content	--	95

Fine and Coarse Aggregate

The aggregate passing through the sieve size four.75mm is termed as fine mixture and people that maintained on four.75 metric linear unit sieve is termed as coarse mixture. stream sand obtained from Barakar stream were used as fine mixture whereas automatically crushed angular coarse mixture from a quarry placed in Baliyapur, Dhanbad were used coarse mixture. All the properties of aggregates were tested in accordance with IS: 2386 (part I to IV) -1963 and therefore the results obtained were confirmed with IS 383-1970. Table three summarizes the properties of fine and coarse mixture.

Table-3: Properties of fine and coarse aggregate

Test	**Fine Aggregate**	**Coarse Aggregate**
Zone/type	II	Crushed angular
Free (surface) moisture	0.60%	0.20%
Water Absorption	1.10%	0.45 %
Fineness Modulus	2.78	7.25(fraction I- 20mm) 6.29(fraction II- 10mm)
Specific gravity	2.62	2.89

EXPERIMENTAL PROCEDURE

Experimental procedure has been described in the following paragraphs.

Mix Design

Proportioning of concrete mix for M30 grade of concrete has been achieved by concrete mix design as per IS 10262:2009. Composition of constituent material per cubic meter of concrete for different batches is given in table 5.

Table-5: Proportioning of the concrete mix

Mix Designation	**Cement %**	**GGBS %**	**Water (Kg)**	**Cement (Kg)**	**GGBS (Kg)**	**FA (Kg)**	**CA (Kg)**
R_0	100	0	188	425	0	653	1236
R_{10}	90	10	188	383	42	653	1236

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R_{20}	80	20	188	340	85	653	1236
R_{30}	70	30	188	298	127	653	1236
R_{40}	60	40	188	255	170	653	1236
R_{50}	50	50	188	213	212	653	1236

Fig. 2 GGBS and Cement Fig. 3. Mixture of GGBS and Aggregate

RESULTS AND DISCUSSION

Properties of Fresh Concrete

The property of fresh concrete has been assessed by workability in terms of slump value. The test of which has been performed in accordance with IS 1199:1959. The results of which are given below in table 6.

Table-6: Slump test of concrete

Mix type	R_0	R_{10}	R_{20}	R_{30}	R_{40}	R_{50}
Slump (mm)	60	63	65	68	70	73

Fig. 4. Slump test

Properties of Hardened Concrete

Hardened concrete properties are analyzed within the terms of compressive, flexural & split durability, dry & damp density and water absorption. Because the development of strength is time dependent thus these tests has been performed when a distinct action amount.One sample every of cube and cylinder has been tested at seven and twenty eight days for compressive strength and split durability of concrete severally whereas the beam has been tested when action amount of twenty eight days for flexural strength of concrete.

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Compressive Strength

This test was performed in accordance with IS 516:1959 on the cube of size 150mm x 150mm x 150mm. The result of which is given below in table 7.

Table -7: Compressive strength of concrete

Mix type	7 days		28 days	
	Avg. Compressive Strength (N/mm^2)	% variations over R_0	Avg. Compressive Strength (N/mm^2)	% variations over R_0
R_0	26.22	0	38.74	0
R_{10}	25.04	-4.50	40.30	+4.03
R_{20}	24.00	-8.47	41.78	+7.84
R_{30}	23.56	-10.14	43.11	+11.28
R_{40}	23.26	-11.29	47.26	+21.99
R_{50}	22.96	-12.43	49.85	+28.68

Fig. 5. Casted Cube **Fig. 6. Compressive Test**

CONCLUSIONS

Some salient conclusions based on the studies of different researchers on partial replacement of cement with GGBFS, are as follows:-

1. Slump value of concrete increases as the percentage of GGBS increases up to 50% replacement and then decreases. The increase in slump value is due to the higher smoothness and fineness of slag increases the entrainment of air in the matrix, subsequently increasing the volume of paste.
2. Compressive strength of concrete with increasing percentage of GGBS decreases after 7days but increases after 28 days with optimum percentage of 50% replacement by GGBS. It indicates the slower rate of reaction of matrix by incorporation of GGBS. At optimum percentage of GGBS the compressive strength is 28.68% higher than that of conventional cement concrete.

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3. Split tensile strength of concrete with increasing percentage of GGBS decreases after 7days but increases after 28days with optimum percentage of 60% replacement by GGBS. It indicates the slower rate of reaction of matrix by incorporation of GGBS. At optimum percentage of GGBS the Split tensile strength is 22.58% higher than that of conventional cement concrete.
4. Flexural strength of concrete with increasing percentage of GGBS increases after 28 days with optimum percentage of 50% replacement by GGBS. At this stage of replacement of cement with GGBS flexural strength is 27.13% higher than that of conventional cement concrete.
5. Dry and moist density of concrete decreases as the percentage of GGBS increases. From the above results, it is concluded that the GGBS can be used to produce the concrete of lower density.
6. Water absorption of concrete decreases as the percentage of GGBS increases. From this results, it is concluded that the GGBS can be used to improve the water impermeability characteristics of structure. Hence the corrosion of reinforcement may be retarded & durability of R.C.C. structure may be increased.
7. Use of GGBS in concrete saves money up to 40.82% over the conventional cement concrete. This is a significant saving of money. Hence GGBS concrete is more economical.

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