AN EXPERIMENTAL INVESTIGATION ON PARTIAL REPLACEMENT OF CEMENT BY GGBFS WITH ADMIXTURE

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ABSTRACT

This paper is a part of experimental investigation to study the characteristic of concrete by using the industrial waste material, GGBFS as partial replacement of cement with Master Set AC 100. Ground Granulated Blast Furnace Slag (GGBFS) is a byproduct from the blast furnaces used to make iron. Chloride based ingredients are used in the manufacturing of Master Set AC 100 admixture. Master Set AC 100 is formulated for use as accelerator to facilitate high early and higher ultimate strengths in concrete, also to speed up the setting times in normal or especially in cold weather concreting. GGBFS is a non-metalic product consisting essentially silicates and aluminates of calcium and other bases. The replacement percentage of cement by GGBFS is 20%, 30% and 40% by the weight of M30 grade concrete. The concrete cubes and cylinders were casted with varying percentage of GGBFS. The specimens were cured and tested for compressive strength and split tensile strength in 7 days, 14 days and 28 days for concrete. The tests result shows the remarkable enhancement in the strength.

KEY WORDS*: Granulated Blast Furnace Slag (GGBFS), Master Set AC 100, Unconfined Compression Test (UCC)*

1.INTRODUCTION

The concrete industry is constantly looking for supplementary cementitious material with the objective of reducing the solid waste disposal problem. The rapid production of cement creates two big environmental problems for which have to find out civil engineering solution. First environmental problem is emission of CO_2 in the production process of the cement. The CO_2 emission is very harmful which creates lots of environmental changes. One tone of dioxide is estimated to be released to the atmosphere when 1 tons of carbon ordinary Portland cement is manufacture. Since the addition of replace materials in concrete is essential. [1]

Master Set AC 100 is ready to use liquid accelerating admixture for use in concrete and Portland cement. Master Set AC 100 admixture brings down setting times in general and specially under cold weather, leading to early high and ultimate increased strengths. In addition, it reduces bleed and segregation while improves workability.[2]

Ground Granulated Blast Furnace Slag (GGBFS) is a byproduct from the blast furnace used to make iron. GGBFS is a non-metalic product consisting essentially silicates and aluminates of calcium and other bases. The chemical composition of blast furnace slag is similar to that of cement clinker. India produces about 7.8 million tons of blast furnace slag. All the blast furnace slags are granulated by quenching the molten slag by high power water jet, making 100% glassy slag granules of 0.4mm size. It is a granular product with very limited crystal

formation. It is highly cementations in nature and hydrates like Portland Cement.[3]

1.1 OBJECTIVES:

1. To study the Workability, physical and chemical properties of ingredients used and to develop a suitable mix proportion.
2. To study the mechanical properties such as compressive strength, split tensile strength and flexural strength by casting cubes and cylindrical specimen.
3. To check the durability of cast specimen under acid alkali environment and check the corrosion resistance.

1.2 PROPERTIES OFGROUND GRANULATED BLAST FURNACE SLAG:

In general GGBFS has a rather positive influence on fresh concrete characteristics. In this base substitution rates, the fineness of the GGBFS the type and volume of the sulphate carrier of the cement is significant. Bleeding is reduced with the use of higher fineness GGBFS.

1.3 APPLICATIONS AND USES OF GGBFS

GGBFS is used to make durable concrete structures in combination with ordinary Portland Cement and /or other Pozzolanic materials. It is used in the production of quality-improved slag cement, namely Portland Blast Furnace Cement (PBFC) and high-slag blast-furnace cement (HSBFC), with GGBFS content ranging typically from 30 to 70% and in the production of ready-mixed or site-batched durable concrete.

2. EXPERIMENTAL INVESTIGATION:

The aim of the experimental investigation is to ascertain and compare the improvement in the performance of concrete by the partial replacement of cement with GGBFS, fine aggregate and coarse aggregate to find optimum percentage of replacement of GGBFS and to study the durability of concrete mix this experiment deals with the experimental programs which include material characterization, mix design and calculating the number of specimens to be tested.

2.1 MATERIALS USED

The various materials used in the experiment are

i. Cement: Ordinary Portland Cement (53grade)

ii. Ground Granulated Blast Furnace Slag (GGBFS) in this experiment GGBFS will be used as replacement of cement varying at levels of 20%,30% and 40%

iii. Fine aggregate, coarse aggregate

2.2 TEST ON CONSTITUENT MATERIALS

Cement: Fineness test, Standard consistency test

Fine aggregate :Specific gravity test, sieve analysis test

Coarse aggregate: Specific gravity test

MIX PROPORTION= 1:1.9:2.2

Water	Cement	Fine aggregate	Coarse aggregate
197	437.78	869.31	966.78
0.45	1	1.9	2.2

3. MIXING OF CONCRETE

The mixing of concrete is made by two different stages they are dry mix and wet mix. The common material of concrete such as cement, aggregate and the replacement material such as GGBS is mixed together is dry mixing.

3.1 COMPACTING OF CONCRETE

The test specimens shall be made as soon as practicable after mixing, and in such a way as to produce full compaction of the concrete with neither segregation nor excessing laitance. The concrete shall be filled into the mould in layers approximately 5 cm deep. In placing each each scoopful of concrete, the scoop shall be moved around the top edge of the mould as the concrete slides from mould. Each layer shall be compacted either by hand or by vibration. After the top layer has been compacted, the surface of the concrete shall be finished level with the top of the mould, using a trowel.

3.2 CURING OF CONCRETE

The test specimens shall be stored on the site at a place free from vibration, under damp matting, sacks or other similar materials for 24 hours from the addition water to the other ingredients. The temperature of the place of storage shall be 27^0 C.

4. TEST ON SPECIMEN

i) Study on Workability
- Slump test
- Compacting factor test

ii) Study on strength
- Compressive strength test
- Split tensile strength test

5. TESTS ON HARDENED CONCRETE

5.1 COMPRESSIVE STRENGTH TEST FOR CONCRETE

Calculate the material required for preparing the concrete of given proportion. Mix them thoroughly in hand mixing until uniform colour of concrete is obtained. Pour concrete in the oiled with medium viscosity oil fill concrete is cube mould in two layer each of approximate 75mm and ramming each layer with 35 blows evenly distributed over the surface of layer. After 24 hours of casting cylinder specimen are capped by neat cement paste 35 percent water content on capping apparatus after 24 hours the specimen are immersed into water for final curing.Compression test for cube specimen are made as soon as practicable after removal from the curing pit test specimen during the period of their removal from the curing pit and till testing are kept moist by a wet blanket covering and tested in a moist condition. Placed the specimen centrally on the location mark of the compression testing machine and load is applied continuously uniformly and without shock.Compressive strength test for M30 concrete of GGBS 20%, 30% and 40% with master set AC100

5.2 SPLIT TENSILE STRENGTH TEST FOR CONCRETE

Calculate the material required for preparing the concrete of given proportion. Mix them thoroughly in hand mixing until uniform colour of concrete is obtained. Pour concrete in the oiled with medium viscosity oil fill concrete is cube mould in two layers each of approximate 75mm and ramming each layer with 32 blows evenly distributed over the surface of layer. After 24 hours of casting cylinder specimen are capped by neat cement paste 35 percent water content on capping apparatus after 24 hours the specimen are immersed into water for final curing. Compression test for cylinder specimen are made as soon as practicable after removal from curing pit test specimen during the period of their removal from the curing pit and till testing are kept moist by a wet blanket covering and testing in a moist condition. Placed the specimen centrally on the location mark of the compression testing machine and load is applied continuously uniformly and without shock.

6.RESULTS AND DISCUSSION

6.1 EFFECT OF GGBFS AND MASTER SET AC 100 ON CONCRETE PROPERTIES

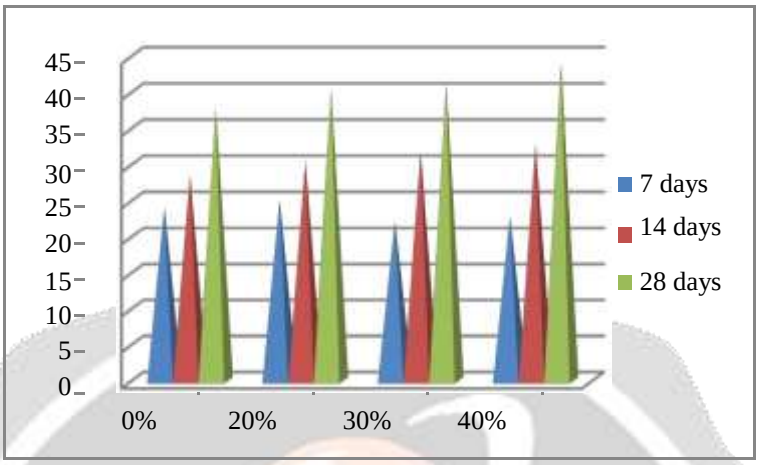

Chart-1:compressive strength of concrete in N/mm^2

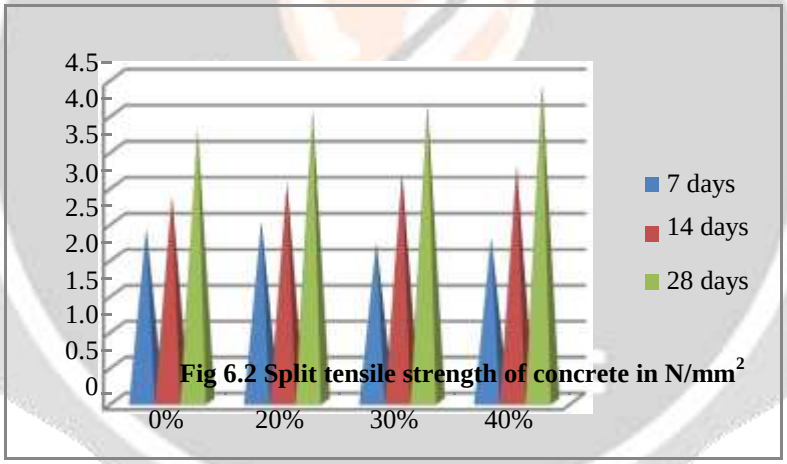

Fig 6.2 Split tensile strength of concrete in N/mm^2

Chart-2: Split tensile strength of concrete in N/mm^2

7.CONCLUSION

The use of GGBFS in concrete as part of cement with master set AC 100 improves the properties of concrete. The workability of concrete is increased by partial replacement of GGBFS. The compressive strength of concrete increased when cement is replaced by GGBFS with Master Set AC 100 for M30 grade of concrete. At 40% replacement of cement by GGBFS with Master set AC 100 the concrete attained maximum compressive strength for M30 grade of concrete. The split tensile strength of concrete is increased when cement is replaced by GGBS with Master Set AC 100. The split tensile strength is maximum at 40% replacement of GGBFS with Master Set AC 100.By using GGBFS as partial replacement of cement with Master set AC 100 improves the workability and also compressive strength test and split tensile test. Our concrete has stronger and more aggressive in usual concrete.

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