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## EXPERIMENTAL STUDY ON GGBS AGGREGATE IN CONCRETE

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### ABSTRACT

The concern about the depletion of natural sources and the effect on environment has particularly focused attention on synthetically produced material (aggregate manufactured from waste material) as an alternative to naturally occurring materials. In order to find alternatives over natural resources, the waste products has to be used effectively. Due to the high volume consumption, all the natural resources were facing depletion. On the other hand, safe disposal of industrial waste material becomes difficult task. In the present study, manufacturing process of cement bonded GGBS aggregate using ordinary concrete mixer and its properties were studied. The GGBS aggregates were manufactured in various different proportions of GGBS and ordinary Portland cement was selected 85:15. The mix design was done for M30 grade with partial replacement of cement bonded GGBS aggregates into the conventional aggregate were made in three different percentage 25%, 50% and 100%. It can be found that up to 100% replacement of GGBS aggregate is can be utilized in production of concrete. The physical properties and strength characteristics of cement bonded GGBS aggregate concrete was studied and compared with the conventional concrete.

*Keywords: conventional, GGBS aggregate, proportions, replacement, synthetically.*

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### I. INTRODUCTION

Due to the high volume consumption, all the natural resources are facing depletion. On the other hand, safe disposal of the industrial waste becomes difficult task. In this context, it is of immense help to the environment, that the industrial waste products were used in place of natural materials for the production of aggregate. GGBS is used to make durable concrete structure which gives better workability and making placing and compaction easier. GGBS having chemical composition as like cement therefore GGBS is called cementitious material, contains more silica content which responsible for strength gain in the concrete and as the GGBS is the waste material it gives the economic structure. Because of the above reasons, the study on GGBS aggregate concrete was taken in this research work.

Ground granulated blast furnace slag or GGBS is processed from granulated slag which is cementitious material that consist of lime, silica, alumina and magnesia. They are essentially the same constituents which are also present in cement. The combination of above constituents results in the formation of calcium alumino silicate which is the reactive component of GGBS. In the presence of lime available from cement, glass break and produces cementing compounds similar to the one produced by Portland cement. In the presence of manufacture of pig iron, the essential raw materials are iron ore, limestone or dolomite and coke which is used as fuel, During the process, two products are formed, molten iron which is the top layer. This molten slag is instantaneously tapped and quenched by water. The rapid quenching of molten slag from the temperature of 1400<sup>0</sup> C facilitates formation of “Granulated Slag” a granular material.

### II. LITERATURE REVIEW

A brief review of previous studies on fly ash aggregate in concrete is presented in this section. This literature survey focuses the recent contribution related to experimental study on fly ash aggregate in concrete work. Very eminent researcher have worked on fly ash aggregate that is preparation of fly ash aggregate, check strength characteristics and other parameters. This literature is very useful in understanding behavior of fly ash aggregate in concrete.

### III. MANUFACTURING PROCESS

In this study experimental investigation was done that is information regarding raw materials used for concreting work and formation of GGBS aggregate. Materials like cement, fine aggregates, coarse aggregates, GGBS, GGBS aggregates etc. were used for concreting work. GGBS aggregates were prepared by using GGBS, cement and water in general concrete mixer.

#### 1. Formation of GGBS aggregate

The constituents like ordinary Portland cement, GGBS and water produce the fly ash aggregates. Water is the binding material that paves the way for the function of the aggregate with good bond property. Cement and GGBS are constituents for preparation of the aggregates. Also, water is the Binder when it is added to increase the workability. The proportion of ordinary Portland cement and GGBS such as 85:15.

#### 2. Preparation of GGBS aggregate

GGBS and Ordinary Portland cement was mixed into the ordinary concrete mixer. Those proportions were thoroughly dry mixed in a concrete mixer. After dry mix in a mixer, water was sprinkled until the formation of GGBS aggregate. The contents were thoroughly mixed in concrete mixer until the formation of GGBS aggregate. This method of formation is called as pelletization.



*Fig 1. Preparation of aggregate*

#### 3. Drying of curing of GGBS aggregate

The GGBS aggregates were taken out from the mixer and allowed to dry for one day. Then the aggregates were cured in a water tank for about 7 days.



*Fig 2. Drying of aggregate*

#### 4. Segregation of aggregate

After curing, they were segregated into fine and coarse aggregates based on size of pellets as shown in Figure. The aggregates having size less than 4.75 mm were sieved as fine aggregates and size more than 4.75 mm were sieved as coarse aggregate. From them 20 mm size coarse aggregates were sieved separately to use them as coarse aggregates.



Fig 3. Segregation of aggregate

#### 5. Physical properties of GGBS aggregate and conventional aggregate

The physical properties like specific gravity, water absorption, bulk density, impact value, crushing value and fineness modulus were studied for GGBS aggregates.

Table 1. Physical properties

Sr. No	Testing Particular	GGBS aggregate
1.	Specific gravity	2.03
2.	Bulk density	1.17
3.	Water absorption	6.83
4.	Impact value	33.57
5.	Crushing value	25
6.	Fineness modulus	7

## IV. RESEARCH METHODOLOGY

### 1. Tensile strength test

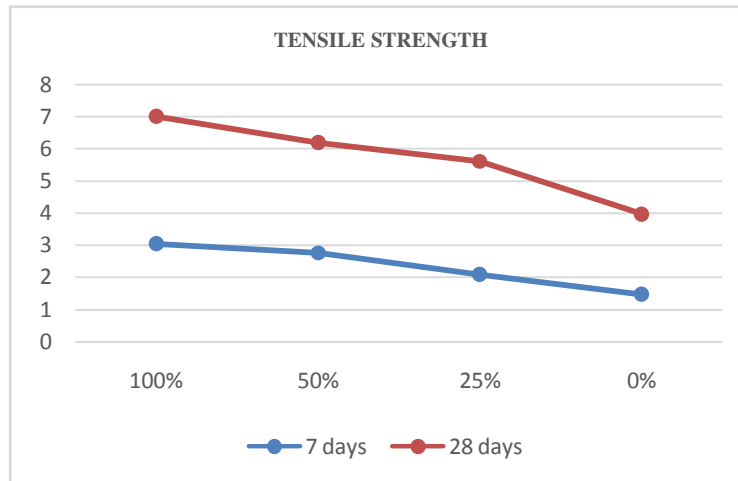
The tensile strength test is used to determine the tensile strength of concrete can be broadly classified as direct and indirect method. The direct methods suffer from a number of difficulties related to holding the specimen properly in the testing machine without introducing stress concentration and to the application of uniaxial tensile load which is free from eccentricity to the specimen. In this test, in general a compressive force is applied to the concrete specimen fails due to tensile stresses introduced in the specimen. The tensile stress at which failure occurs is tensile strength of concrete.

Table 2. Tensile strength test

GGBS : Cement (85 : 15)	7 days	28 days
100%	3.03	3.96
50%	2.76	3.43
25%	2.09	3.52
Conventional concrete	1.47	2.50

### 2. Graphical representation

From the graphical representation it is cleared that tensile strength of 100%, 50% and 25% is more than conventional concrete.



## V. CONCLUSION

- The specific gravity of GGBS aggregate is lower than the specific gravity of conventional aggregate.
- The density of GGBS aggregates is lower than the density of conventional aggregate.
- The GGBS aggregates shown better crushing and impact value as compare to natural aggregates.
- The tensile strength of M30 grade GGBS aggregate with 100% replacement of 85:15 GGBS aggregate is more as compare to other proportion and conventional concrete.

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