A Review on Effect of Cementitious Waste Material (GGBS) As a Replacement in Cement

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Abstract— Ground Granule Blast Furnace Slag (GGBS) is an industrial waste material, which shows cementitious properties. This paper briefly describes the history of GGBS in the use of High Strength Concrete. The various application of the GGBS are also described. This review paper also deals with the techniques and replacements of the Cement and to find out the optimum percentage of replacement on which concrete gains high Strength. The purpose of this review paper is to study the Compressive Strength, Flexural Strength and the Tensile Strength of high performance concrete for experimental comparison of concrete with GGBS or without GGBS.

Key words: Compressive Strength, Flexural Strength, Tensile Strength, Workability, Stress on concrete

I. INTRODUCTION

Cement is major constituent material of the concrete which produced by natural raw material like silica and lime. Once situation may occurs there will be no lime on earth for production of cement for concrete. This situation leads to think all people working in construction industry to do research work on cementitious material and use of it in high performance concrete. (Eshmaiel Ganjian et al. 2002) concluded that the Concrete has basic naturally, cheaply and easily available ingredients as cement, sand, aggregate and water. After the water, cement is second most used material in the world. But this rapid production of cement creates two big environmental problems for which we have to find out civil engineering solutions. First environmental problem is emission of CO2 in the production process of the cement.

- This is second environmental problem related to consumption of lime.

According to ACI 116R Granulated blast-furnace slag is the glassy granular material formed when molten blast-furnace slag is rapidly chilled, as by immersion in water. GGBS means the ground granulated blast furnace slag is a by-product of the manufacturing of pig iron. Iron ore, coke and Lime-stone are fed into the furnace and the resulting molten slag floats above the molten iron at a temperature of about 1500oC to1600oC. The molten slag has a composition close to the chemical composition of Portland cement. 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 ground granulated blast furnace slag (GGBS).

According to (IS 12089.1987) Researched that It is a by-product of iron production. Process: Granulation – rapid quenching with water on molten slag. Rapid cooling prohibits crystals and glassy, non-metallic, silicates and aluminosilicates of calcium formation. Granules is Ground–dried granules and ground to suitable fineness, using ball mills, vertical mills or high pressure roller press mill. Ground Granulated Blast furnace Slag The chemical composition is almost similar to OPC.

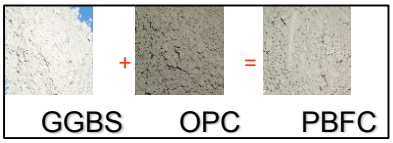

Fig. 1: OPC & PBFC

II. LITERATURE SURVEY

A. Effect of Steel Slag and Portland Cement in the Rate of Hydration and Strength of Blast Furnace Slag Pastes

This paper presents an experimental study of the influence of steel basic oxygen slag (BOS) and ordinary portland cement (OPC) on the compressive strength and the hydration mechanisms of grounded granule blast furnace slag (GGBS) pastes. the test performed are

- The compressive strength test.
- The Initial and Final setting time test.

No aggregate is used as it was tested on the pastes

- OPC + GGBS = 100%
- OPC + GGBS + BOS = 100%
- BOS + GGBS = 100%

The controlled curing is done of 20+2· C, It is concluded that GGBS can also be used as an activator and the optimum percentage of those materials was determined with a proposed parameter called "slag index." (Eshmaiel Ganjian et.al, 2011)The properties measured in blended OPC-BOS-GGBS mixes showed encouraging results to be used industrially. The mechanisms of hydration of the blended GGBS mixes are discussed.

B. Relationships between Compressive Strength Cement-Slag Concrete under Air and Water Curing Regimes:

Mineral admixtures have been used more and more for concrete due to their benefits in terms of strength and durability. Slag-based blended cements are now marketable worldwide and slag has been incorporated in quantities up to 85% by weight in different mix designs (Asim, 1992). Ground granulated blast-furnace slag (GGBFS) is a by-product of the iron making process and is produced by water quenching molten blast furnace slag. Use of GGBFS as a cement replacement in mortar and concrete is a common practice due to technological and environmental benefits. A lower cost and lower environmental impact, per unit volume, its application can perform similar properties of concrete as compared to ones with pure Portland cements (Ekaputri, 2010). Replacement of clinker by slag not only offers energy savings and cost reduction compared to ordinary Portland cement (OPC), but also has other advantages such as low heat of hydration, high sulfate and acid resistance, better workability, and good ultimate

strength and durability (Boldyrev, 1996). GGBFS is commonly used in combination with Portland cement in concrete for many applications (ACI, 2003; Bijen, 1996).

C. Analysis of strength characteristics of GGBS concrete:

Today's construction industry, use of concrete is going on increasing rapidly. Cement is major constituent material of the concrete which produced by natural raw material like lime and silica. Once situation may occurs there will be no lime on earth for production of cement (Kayvan Aghabayk and William Young et.al, 2012). This situation leads to think all people working in construction industry to do research work on cement replacing material and use of it. Industrial wastes like Ground Granulated Blast Furnace Slag (GGBS) show chemical properties similar to cement. Use of GGBS as cement replacement will simultaneously reduce cost of concrete and help to reduce rate of cement consumption. (Fathollah Sajedi et.al, 2011)This study report of strength analysis of GGBS concrete will give assurance to encourage people working in the construction industry for the beneficial use of it. This research work focuses on strength characteristics analysis of M20 grade concrete with replacement of cement by GGBS with 20%, 30%, 40% and 50% and compare with plain cement concrete. Now days crush sand is used to replace natural sand, so study area extends to find best percentage of replacement by using both crush and natural sand (Vinayak Awasare 2011).

D. Evolution of mechanical properties of concrete containing ground granulated blast furnace slag and effects on the scaling resistance test at 28 days:

Compressive strength, ultrasonic pulse velocity (UPV), non-evaporable water content and the interplay between them were investigated at 1, 3, 7 and 28 days to determine the effects of using ground granulated blast furnace slag (GGBFS) as cement replacement. The variables considered include percentage of GGBFS as cement replacement (0–60%), total binder content (270–450 kg/m3), water to-binder ratio (0.31, 0.38) and curing period. The dilution effect was observed at day 3, at which point, increasing the amount of GGBS as cement replacement yielded lower compressive strengths. The results show that the evolution of mechanical properties is affected by the amount of water, percent of GGBFS added and curing regime. By 28 days, the benefit of using GGBFS as cement replacement owing to its effect on the concrete's packing density and hydration processes was reflected in the compressive strength and UPV measurements when used up to 50% cement replacement. Compressive strength of concrete containing GGBFS is found to increase on average by 10% from 28 days to 120 days. Measurements of non-evaporable water content and mass loss due to scaling revealed that the scaling resistance test for concrete at 28 days is more favourable towards OPC concrete and discriminates against concrete containing high percentages of GGBFS as cement replacement(M. S. SHETTY et.al, 2012).

E. Effects of ground granulate blast-furnace slag on corrosion performance of steel embedded in concrete:

Corrosion of steel in concrete is one of the most important causes of premature deterioration of reinforced concrete structures, leading to structural failure. To prevent the failure of concrete structures because of corrosion, impermeable and high performance concretes should be produced various mineral admixtures. In this study, plain and reinforced concrete members are produced with mineral admixtures replacing cement. Ground granulated blast-furnace slag (GGBFS) has replaced cement as mineral admixture at the ratios of 0%, 25% and 50%. (S. Pavía and E. Condren ,2012).The related tests have been conducted at the ages of 28 and 90, after exposing these produced plain and reinforced concrete members to two different curing conditions. (Peter Claisse et.al, 2011)The unit weight, ultrasonic pulse velocity, splitting tensile and compressive strength tests are conducted on plain concrete members. Half-cell potential and accelerated corrosion tests are also conducted on reinforced concrete members. According to the test results, it is concluded that the curing age and type are important and corrosion resistant concrete can be produced by using GGBFS mineral admixture at the ratio of 25%.

III. CONCLUSION

- It can have made possible to reduce the load on natural resources.
- To reduce the Emission of co2 in the atmosphere without compromising with the strength of high performance concrete and to full fill the need for new age development.

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