International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

IJIEMR Transactions, online available on 9th Dec 2019. Link :http://www.ijiemr.org/downloads.php?vol=Volume-08&issue=ISSUE-12

Title **PARTIAL REPLACEMENT OF CEMENT WITH GGBS (M20 GRADE CONCRETE)**

Volume 08, Issue 12, Pages: 24-30.

Paper Authors

GARAGA NAGABABU, AMISIGADDA SAI NAGA MANIKANTA

KAKINADA INSTITUTE OF TECHNOLOGICAL SCIENCES, RAMACHANDRAPURAM, ANDHRAPRADESH, INDIA, 533287

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

PARTIAL REPLACEMENT OF CEMENT WITH GGBS (M20 GRADE CONCRETE)

[1]GARAGA NAGABABU, [2]AMISIGADDA SAI NAGA MANIKANTA
[1]M-TECH, DEPT OF CIVIL, KAKINADA INSTITUTE OF TECHNOLOGICAL SCIENCES, RAMACHANDRAPURAM, ANDHRAPRADESH, INDIA, 533287
[2]ASSOCIATE PROFESSOR, KAKINADA INSTITUTE OF TECHNOLOGICAL SCIENCES, RAMACHANDRAPURAM, ANDHRAPRADESH, INDIA, 533287

ABSTRACT:
It is confined to the study and comparison of the effects of replacement of cement by fly ash and GGBS on the 28 days compressive strength and split tensile strength. To evaluate the compressive strength of concrete by replacing cement with GGBS at varying percentages of 0,10, 20,30 and 40% for M20 grade of concrete. To evaluate the compressive strength of concrete by replacing cement with GGBS at varying percentages of 0,10, 20,30 and 40% for M40 grade of concrete. To evaluate the strength Efficiency factors for GGBS at varying percentages of 0,10, 20,30 and 40 for M20 and M40 grade of concretes. To achieve the objectives of the investigation the experimental program was planned to cast and test the cubes to study the compressive strength. Concrete is a mixture of cement, fine aggregate, coarse aggregate and water. Concrete plays a vital role in the development of infrastructure Viz., buildings, industrial structures, bridges and highways etc. leading to utilization of large quantity of concrete. On the other side, cost of concrete is attributed to the cost of its ingredients which is scarce and expensive, this leading to usage of economically alternative materials in its production. This requirement is drawn the attention of investigators to explore new replacements of ingredients of concrete. The present technical report focuses on investigating characteristics of concrete with partial replacement of cement with Ground Granulated Blast furnace Slag (GGBS). The topic deals with the usage of GGBS and advantages as well as disadvantages in using it in concrete. This usage of GGBS serves as replacement to already depleting conventional building materials and the recent years and also as being a byproduct it serves as an Eco Friendly way of utilizing the product without dumping it on ground.
Keywords: SCC, Fibers, carbon fibers, Compacting, Crack, strength, M30 grade.

1. INTRODUCTION:

Concrete is the most widely used construction material having several advantages such as high strength, good mould ability durability weather and fire resistance. The use of ground granulated blast furnace slag (GGBS) in mortar has increased in recent years. Records indicate that blast furnace cement was used for the mortar during the construction of the Empire

State Building in the 1930s. On its own, ground granulated blast furnace slag (GGBS) hardens very slowly and, for use in concrete, it needs to be activated by combining it with Portland cement. Atypical combination is 50 per cent GGBS with 50 per cent Portland cement, but percentages of GGBS anywhere between 20 and 80 per cent are commonly used. The greater the percentage of GGBS, the greater will be the effect on concrete properties. 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. We know that CO2 emission is very harmful which creates lots of environmental changes. 1 tone of carbon dioxide is estimated to be released to the atmosphere when 1 tone of ordinary Portland cement is manufactured. Peoples working in the environmental field creates awareness in the public about the energy sources like petrol, diesel are limited in earth crest and for future generation we have to save it or we have to find alternative energy sources. But the peoples working in the construction field are having the same awareness about the lime consumption? This is second environmental problem related to consumption of lime. As there is no alternative binding material which totally replace the cement so the utilization of partial replacement of cement is well accepted for concrete composites. In order to fulfill its commitment to the sustainable development of the whole society, the concrete of tomorrow will not only be more durable, but also should be developed to satisfy socioeconomic needs at the lowest environmental impact. So the problem is related to environment, problem is related to cost minimization but structural engineer will give the solution by proper analysing the properties of concrete made by using industrial waste material. 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 to 1600oC. 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). It is a well-known fact that the causes of damage in concrete are freezing, water penetration, chemical degradation and erosion. Therefore, it is important that durability of concrete be enhanced. This can be accomplished by some additives which improve the properties of both freshly mixed concrete and hardened concrete by pozzolanic reaction. Benefits of using additional binder materials on the durability of concrete are well established. High-performance concrete may contain materials such as fly ash, silica fume, ground granulated GGBS, natural pozzolana , fibers, chemical admixtures and other materials, individually or in various combinations. These materials can enhance the strength and durability of concrete, simultaneously, rendering them recommendable for use in concrete industry.

2. RELATED STUDY:

Investigated on the effect of using copper slag as a replacement of fine aggregate on the strength properties. In this study, M25 grade concrete was used and tests were conducted for various proportions of copper slag replacement with sand of 0 to 100% in concrete. It concluded that the maximum compressive strength of concrete increased by 55% at 40% replacement of fine aggregate by copper slag and flexural strength of concrete at 28 days is increased by 14%. Arivalagan [2] investigated to explore the possibility of using copper slag as a replacement of sand in concrete mixtures in various percentages ranging from 0%, 20%, 40% 60%, 80% and 100%. It was observed that, the flexural strength of concrete at 28 days is higher than design mix (without replacement) for 40% replacement of fine aggregate by Copper slag. Atul et al [3] observed that 7 days, 14 days and 28 days compressive strength on 30% replacement of cement reduces about 30% that is from 21.03 N/mm2 to 15.40N/mm2, 23.70 N/mm2 to 16.74 N/mm2 and 26.9 N/mm2 to 18.81 N/mm2 respectively and finally concluded that as the % of BFSP increase, the strength tends to decrease. Brinda. D et al [4] investigated on various corrosion and durability tests on concrete containing copper slag as partial replacement of sand and cement. In this paper, M20 grade concrete was used and the tests were conducted for various proportions of copper slag replacement with sand of 0% to 60%, cement 0% to 20% and combination. The results of compressive, split tensile strength test have indicated that the strength of concrete increases with respect to the percentage of slag added by weight of fine aggregate up to 40% of additions of 15% of cement. Water permeability in concrete reduced up to 40% replacement of copper slag with that of sand. The cubes and cylinders are tested for both compressive and tensile strengths. He finally concluded that by the partial replacement of cement with GGBS and sand with ROBO sand helped in improving the strength of the concrete substantially compared to normal mix concrete.

3. METHODOLOGY:

Ground granulated blast furnace slag is obtained during the manufacturing process of pig iron in blast furnace. The slag is a mixture of lime, silica, and alumina, the same oxides that make up Portland cement, but not in the same proportion. The composition of blast-furnace slag is determined by the ores, fluxing stone and impurities in the coke charged into the blast furnace. The silicon, calcium, aluminum, magnesium and oxygen constitute 95% or more of the blast furnace slag. This material is rapidly cooled to form a granulate and then ground to a fine white powder (GGBS), which has many similar characteristics to Portland cement. When GGBS is blended with Portland cement further recognized

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

cementations materials such as Portland-slag cement and blast furnace cement are produced as shown in Fig.1. In the UK, GGBS is manufactured and generally sold as a separate powder which is then batched and blended within the mixer. It is used extensively in the construction industry to produce concretes, grouts and mortars.

The hydration mechanism of a combination of GGBS and Portland cement is slightly more complex than that of a Portland cement. This reaction involves the activation of the GGBS by alkalis and sulfates to form its own hydration products. Some of these combine with the Portland cement products to form further hydrates which have a pore blocking effect. The result is a hardened cement paste with more of the very small gel pores and fewer of the much larger capillary pores for the same total pore volume. Generally, the rate of strength development is slower than for a Portland cement mortar.The work reported in this study, Copper slag & GGBS are used as a sand & cement as partial replacement of material in concrete mix. Optimal dosage range of this Copper slag & GGBs are chosen based on concrete mix studies .The ultimate focus of this work is to ascertain the performance of concrete mix containing Copper slag & GGBS and compare it with the controlled concrete mix. This is expected to provide:-

- To partially replace sand with Copper slag and cement GGBS in concrete as it directly influences economy in construction.
- To design and proportion the concrete mix for M25 grade concrete, As per the recommendation of IS: 10262:2009.
- To find the Volume proportions of the concrete mixes by partially replacing Sand with Copper slag and cement GGBS in one phase.
- To check the variation of Compressive Strength, Split Tensile Strength and Flexural Strength results by partial replacing the sand 0% to 40% with Copper Slag and the cement 0% to 20% with GGBS compared with controlled concrete and plotting the corresponding graphs separately in another phase.
- Environmental friendly disposal of waste copper and steel slag.

4. EXPERIMENTAL RESULTS:

The Experimental investigation is planned as follows.

1. To find the properties of the materials such as cement, sand, coarse aggregate, water and GGBS.

2. To obtain Mix proportions of OPC concrete for M20 and M40 by IS method (10262-2009).

3. To calculate the mix proportion with partial replacement such as 0%,30%, 40% and 50%of GGBS with OPC.

4. To prepare the concrete specimens such as cubes for compressive strength, cylinders for split tensile test, prisms for flexural

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

strength and also cubes for durability studies in laboratory with 0%, 10%, 20% and 30% replacement of GGBS with OPC for M20 and M40 grade concrete.

5. To cure the specimens for 28 days and 90 days.

6. To evaluate the mechanical characteristics of concrete such as compressive strength, split tensile test, flexural strength.

7. To evaluate the durability studies of M20 and M40 grade GGBS replacement concrete, with 1% and 5% concentrations of Hydro chloric acid (HCl) and Sulphuric acid (H2So4).

8. To evaluate and compare the results.

9. To check the economic viability of the usage of GGBS, Keeping in view of the safety measures.

The setting time of concrete is influenced by many factors, in particular temperature and water/cement ratio. With GGBS, the setting time will be extended slightly, perhaps by about 30 minutes. The effect will be more pronounced at high levels of GGBS and/or low temperatures. An extended setting time is advantageous in that the concrete will remain workable longer and there will be less risk of cold joints. This is particularly useful in warm weather.

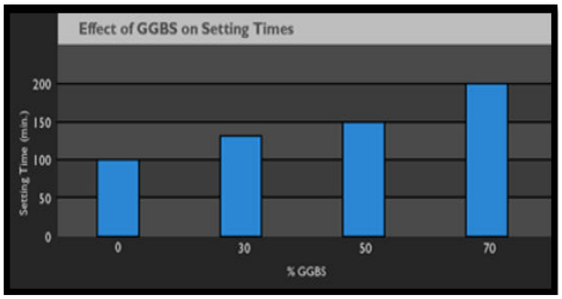

Fig.4.1. with GGBS graph.

It is seen that for plain concrete the 28-day compressive strength has been decreasing up to 40% GGBS replacement. However, it is seen from table2, that for plain concrete with 40% replacement of cement by GGBS, the compressive strength is 20.92 Mpa, which is in between the target mean strength of M40 concrete. Hence from economy consideration, cement can be replaced up to 40% by GGBS. Results of 3 days compressive strength of cubes of plain and GGBS are shown in table2.It is observed that strength is gradually increasing from 26.59N/mm2 to 28.76N/mm2 at 10% replacement of cement with GGBS and then a gradual decrease of 20.92N/mm2. It is graphically represented.

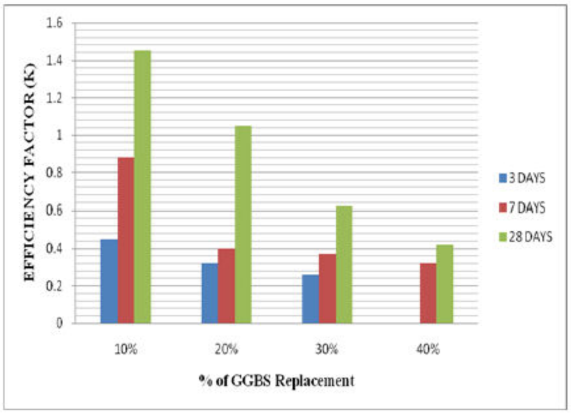

Fig.4.2. graphical representation.

5. CONCLUSION:

The movement of moisture of GGBS mixes, probably due to the dense and strong microstructure of the interfacial aggregate/binder transition zone are probably responsible for the high resistance of GGBS mixes to attack in aggressive environments such as silage pits. The mineral composition of GGBS cement paste (with less aluminates and portlandite than Portland cement) probably contributes to this resistance. As we have seen GGBS is a good replacement to cement in some cases and serves effectively but it can't replace cement completely. But even though it replaces partially it gives very good results and a greener approach in construction and sustainable development which we are engineers are keen about today.

The compressive strength of M20 grade of concrete was found to be maximum at 10 % replacement of cement with GGBS when compared with 20%, 30% and 40 % replacement of cement with GGBS.

- The compressive strength of M20 Grade of concrete by 10 % replacement of cement with GGBS is found to be 56% more than 40% replacement of cement with GGBS.
- The compressive strength for M40 grade of concrete was found to maximum at 10% replacement of cement with GGBS when compared with 20%, 30% and 40 % replacement of cement with GGBS.
- The compressive strength of M20 Grade of concrete by 10 % replacement of cement with GGBS is found to be 87% more than 40% replacement of cement with GGBS.
- The efficiency factor for M20 grade of concrete was found to be maximum at 10% replacement of cement with GGBS at 28 days is 1.21.
- The efficiency factor for M40 grade of concrete was found.

REFERENCES:

[1] M.C. Richardson (1996) : The optimal striking of formwork when using CEM II(A-L)/GGBS concrete requires reliable early age strength estimates.

[2] B. Fournier (2001): The alkali-silica reaction (ASR) is one of the various deterioration processes that can affect the serviceability and the service life of concrete structures.

[3] M.V. Malhotrac (2002): This paper presents the results of a study on the mechanical properties and durability of concrete made with High-Volume Fly Ash (HVFA) blended cement produced in a cement plant.

[4] V. M. Malhotra (2002): This paper presents results on the compressive strength of mortars in which 10 and 20% of ASTM Type I cement has been replaced by ground fly ash from two different sources, pp 350 – 375.

[5] N. Bouzoubaâ (2004): This report outlines the preliminary results of a research project aimed at optimizing the fly ash content in concrete.

[6] N. Bouzoubaâ (2005): This paper reports the development at CANMET of high-

volume fly ash blended cements, and their performance in concrete, pp 137 – 153.

[7] P.T. Seabrook (2005): In view of the global sustainable development, it is imperative that supplementary cementing materials be used to replace large proportions of cement in the concrete industry.

[8]. Subramani.T, Sharmila.S, "Prediction of Deflection and Stresses of Laminated Composite Plate with Artificial Neural Network Aid", International Journal of Modern Engineering Research, Volume 4, Issue 6 (Version 1), pp 51 -58, 2014.