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HIGH STRENGTH CONCRETE USING GGBS: A REVIEW

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Abstract - The cement industry can be one of the key sources of environmental pollution, so reducing the demand for cement should be improved. Silica fume (SF) and ground granulated blast furnace slag (GGBS) are industrial by-products and should be reused to reduce waste pollution. Therefore, this study is aimed at developing a better understanding of the combined performance of SF and GGBS on the strength properties of ternary concrete versus regular concrete. This work mainly deals with strength characteristics such as compression test, shear test and bending strength. In order to find the optimal replacement of cement with the above-mentioned material, different mixture ratios were tested to check the influence of waste material on the mechanical properties of high-strength concrete. On different days, compression, bending and shear tests will be performed. In this study, we include the concept of triple mixing of cement with silica and GGBS. This triple cement utilizes the beneficial properties of both pozzolanic materials to produce better concrete.

***Key Words*: high strength, super plasticizer, GGBS, flyash, silica.**

1. INTRODUCTION

Concrete is a mixture of ingredients such as cement, sand, aggregate and water that are natural, affordable and readily available. Cement is the second most widely used commodity in the world after water. The rapid processing of cement causes huge pollution problems. The first environmental problem is the emission of carbon dioxide during the cement production process. Carbon dioxide emissions are very harmful and cause major environmental changes. It is estimated that 1 ton of carbon dioxide is released into the atmosphere when 1 ton of regular Portland is produced. [1]

The strength of the concrete structure (bearing capacity) is the most important aspect when assessing concrete. Deteriorating agents can be chemical sulfates, chlorides, CO2, acids, etc., or mechanical causes such as abrasion, impact, temperature, etc.[2]. Strong concrete steps include structural design and detailing, mixing ratio and processing, adequate on-site quality control, and selection of proper concrete admixtures.[1]

A concrete structure can meet different modes of loading and exposure depending on the operational environment in which it is intended to operate. Different strengths of cement are required to meet performance requirements.

The development to date can be divided into three phases. See; Normal strength concrete (NSC), containing only four primaries. The development to date can be divided into three phases. See; Normal strength concrete (NSC), containing only four basic components (cement, water, fine aggregate and coarse aggregate). Increased demands for housing in the form of high-rise buildings; long bridges etc. required increased compressive strength. The next stage was therefore to develop a cement with an inherently higher compressive strength, i.e. the development of high strength concrete (HSC). However, over time it became clear that high compressive strength was not the only major factor in designing concrete mixes. The last stage was to optimize everything. to the maximum extent possible in the economy and these properties A gentle way to the environment. The triple mix concept is given here Concrete mix.[1]

2. LITRATURE REWIEW

1. Vijaya Bhaskar Reddy, Dr.P.Srinivasa Rao, “Experimental study of compressive strength of ternary blended concretes at different levels of microsilica and ggbs”@2016 Elsevier Ltd. All rights reserved.

In this article, the world finds alternative materials in concrete technology that are partially able to replace ordinary Portland cement (OPC) and also meet industrial requirements for strength and durability. Optimization of ordinary Portland cement (OPC)/GGBS/micro silica for the development of ternary blended concrete is carried out using paper based experimental analysis.

In this paper, experimental work has been provided to evaluate the compressive strength of ternary mixed concrete after 7, 28, 60 and 90 days for different combinations of Micro Silica and GGBS. Micro Silica 0%, 5%, 10% and 15% along with GGBS is replaced by 20%, 30%, 40% and 50%. A water-cement ratio of 0.45 was used for all mixes.

Experimental results

Improved workability of fresh concrete by up to 30 percent by replacing GGBS and improved density of fresh mixes of micro silica and GGBS. 7 days of ternary mixing compression by increasing MS content by 5 percent GGBS and increasing MS by 10 to 15 percent. The mixture (MS 10% + GGBS %) offers greater compressive strength and workability compared to ordinary concrete at all setting days.

Experimental studies show that mineral mixtures perform very well in the economic development of ternary mixtures. We can make the environment more sustainable by using industrial waste materials.

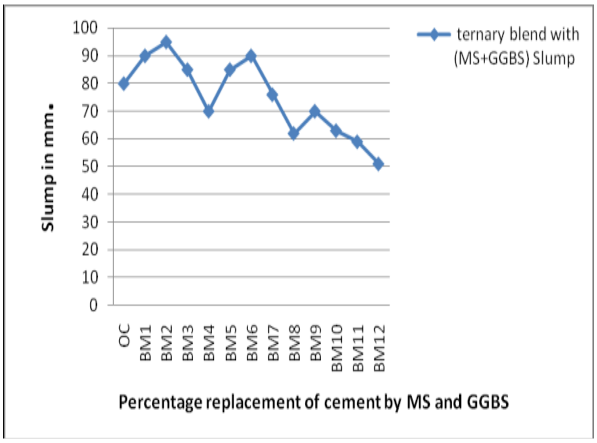


Fig. 1: Slump values with various proportions of MS and GGBS

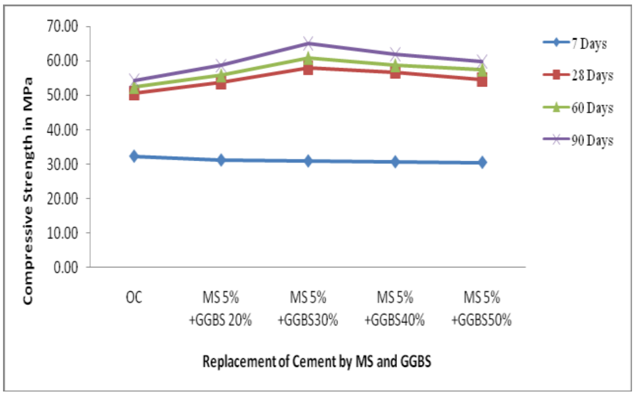


Fig. 2: Compressive Strength of TBC w.r.t Normal Concrete with 5% Micro Silica and different % of GGBS.

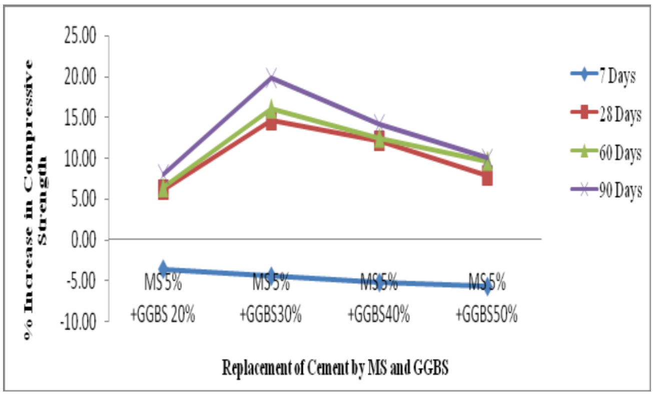


Fig .3: % Increase in Compressive Strength of TBC w.r.t Normal

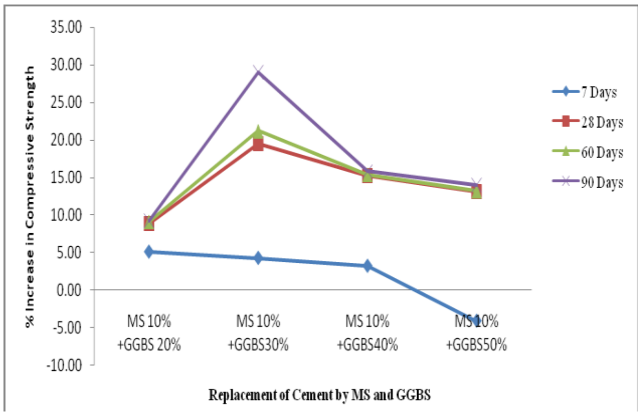


Fig .8: % Increase in Compressive Strength of TBC w.r.t Normal Concrete (MS 10% and GGBS 20%, 30%, 40%50%)

2. Balakrishna Y, V. Lavanya, Naresh A, S. Vijaya Bhaskar Reddy, "Triple Blending Of Cement Concrete with Micro Silica and Ground Granulated High Furnace Slag" @2016 international research journal of engineering and technology (IRJET). All rights reserved.

The author stated in this analysis that Micro Silica (MS) and Ground granulated blast furnace slag (GGBS) became a by-product and could be reused to reduce emissions from the waste. Within this article, a better understanding of the success of the MS and GGBS connection is established regarding the strength properties of triple concrete compared to conventional concrete.

This paper mainly focuses on strength properties such as compressive strength, split tensile strength and flexural strength. A total of 12 different concrete mixes were cast and tested with different substitution levels (5%, 10% and 15%) for Micro Silica with GGBS (20%, 30%, 40% and 50%). At the age of 7, 28, 60 and 90 days for different combinations

Micro Silica and GGBS. All mixtures were studied at a water-cement ratio of 0.55. The mixes have the compressive strength, tensile strength and flexural strength of Blend Concrete.

Experimental results

• Micro silica is applied to concrete, which significantly increases the performance of buildings at an early age. Optimum 7-day strength was achieved with 15% micro silica, but after 28 days the strength was reduced to 10%.

• Ternary concrete with a maximum compressive strength of 7 days replaces OPC with MS and GGBS in a maximum amount of 35%. And 8.36% higher than the concrete control. While the maximum compression capacity is 28, 60 days and 90 days, it is 21.02%, 22.84% and 24.56%.

• The increase in compressive strength in ternary concrete is 67.32%, 76.20% and 87.27% with respect to 7 days.

• Tensile strength of ternary concrete is highest at 35% replacement of OPC MS and GGBS, which is 5.39% more than control concrete at 7 days. But at 30% cement replacement after 28 days, 60 days and 90 days, it is 15.47%, 18.10% and 21.44% more than the concrete controls.

• The increase in split tensile strength of ternary concrete is 46.28%, 53.35% and 60.33% with respect to the value of 7 days.

• 7 days Ternary concrete has optimal flexural strength at 35% cement replacement and 6.05 percent greater than control concrete. Although 28 days, 16.52%, 18.91% and 22.24% were replaced by 30% of the strength of 28 days, 60 days and 90 days.

• Flexural strength increases by 46.85%, 55.07% and 62.19% compared to 7 days strength of triple concrete.

3. Zuraidah Hashim and Roszilah Hamid, "Effect of silica fume on strength and pore size distribution of concrete" @ (2015) Trans Tech Publications, Switzerland. All rights reserved.

This work would investigate the effect of silica cement replacement (0%, 7%, 9% and 12%) on compressive strength at 3, 7, 14 and 28 days Water/cement ratio for wet cured concrete 0.4 and design capacity 40 MPa. The work properties of the new concrete were assessed by settlement and compaction test factor.

Experimental results

• The effect of cement substitution by 7%, 9%, and 12% MK reduced the workability of all MK mixtures by almost 80% compared to the control concrete.

• With an increase in the MK cement replacement, the intensity also increases with 12% of the MK replacement, the created compressive strength is 48.5 MPa compared to

41.5 MPa. The rate of increase is 7%.

• The maximum pore diameter of the 9% MK substitute is the lowest. This amount is 93% smaller than the average pore diameter of the control concrete, which improved the strength.

4. Yatin h Patel, p.j.patel, prof. Jignesh m Patel, Ph.D. Hs Patel, "Study On the durability of high-performance concrete with Alcofin and fly ash"@2013 International Journal Of Advanced Engineering Research And Studies. All rights reserved.

In this article, evaluate the properties of concrete (HPC) containing additional cementitious material such as fly ash and Alccofine. This research evaluates the performance of concrete mix in compressive strength, chloride test, seawater test and accelerated corrosion tests at 28 and 56 days of age. Find out more about the mixed ratio, the optimal dosage of Alccofine and fly ash.

Experimental results

• Alccofine (8%) and fly ash (20%) achieved compressive strengths of 54.89 MP and 72.97 MP for 28 and 56 days, respectively.

• Less weight reduction and loss of concrete compressive strength in chloride resistance test and sea water test due to fine application. As a specific result of Chloride, Attack becomes a more robust and less penetrating attack. This converts the leachable calcium hydroxide into a non-leachable, insoluble cementitious product. This pozzolanic action is responsible for the impermeability of concrete. Second, the removal of calcium hydroxide reduces the susceptibility of concrete to chloride attack.

• M70 grade concrete with an RCPT value below 500 coulombs can be developed. The RCPT value in Alccofine was found to be lower due to pore filling and particle pore refinement.

• The weight loss of steel was found to be lower in an accelerated electrical corrosion test with Alccofine, which means that the usual alkaline cover prevents the steel from corroding due to its pores and particle refinement.

5. Sunny A. Jagtap, Mohan N. Shirsath, Sambhaji L. Karpe, "Effect of Silica Fume on Properties of Concrete."@2017 International Research Journal of Engineering and Technology (IRJET). All rights reserved

Silica Fume is also used as a binder in this article, in which it partially replaces the cement and part of the response during the hydration reaction. Silica Fume cement replacement should be studied in the range of 5% to 25% with an interval of 5%. At the age of 7.28 days it was tested for compressive strength, tensile strength and flexural strength and compared with the results of conventional concrete.

Experimental results,

• Silica concrete effectively increases compressive and flexural strength compared to conventional concrete. An increased amount of siliceous fumein concrete reduces workability.

• The strength of concrete increases with an increase in silica content in the cement substitute by up to 15%.

• As the amount of Silica Fume powder in the concrete increases, the workability of the concrete decreases.

3. MATERIAL

Cement: Cement is the primary ingredient for making concrete. Pozzolanic Portland cement (53 grade) conforming to IS12269-1987 was used here. The specific gravity of cement is 3.15

Fine Aggregate: Locally available silt-free river sand as per IS 383-1970 with a specific gravity of 2.65 is used

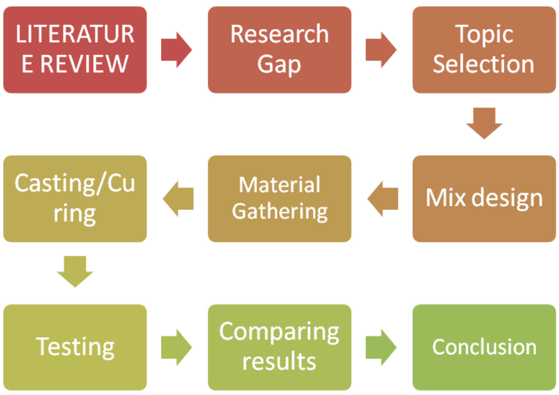
Coarse Aggregate: Crushed aggregate of 10-12 mm size is added from nearby quarry with specific gravity of 2.74 as per IS 383-1970

Super plasticizer: The hyper plasticizer must be ADDMIX 389, a highly water-reducing polycarboxylic ether super plasticizer. The product must have a specific weight 1.1 and a solids content of not less than 40% by weight.

Mineral additives: GGBS, silica fume, fly ash , Super plasticizers.

4. METHODOLOGY

- Collection of Material like Pozzolana Portland Cement, Coarse aggregate, Fine aggregate, Metakaolin, Fly ash, silica fume, Admixture.
- Laboratory test on basic ingredients of concrete like Cement, Coarse aggregate, Fine aggregate.
- Finalize Mix design for concrete.
- Partial replacement of cement with Metakaolin, Fly ash, Silica fume in carious percentages.
- Check workability of concrete.
- Casting of cube specimen
- Determine Compressive strength of concrete.



4. CONCLUSIONS

1) Since the water-cement ratio is expected to be low in high-strength concrete formulations, high performance water reducing agents are required for workability.

2) Concrete with 12mm crushed granite aggregate has higher compressive strength.

3) The strength of concrete increases with decreasing water-cement ratio and decreases with increasing water-cement ratio.

4) The use of metakaolin as a partial cement substitute reduced the plastic density of the mixture.

5) It is also observed that increasing the addition rate of silica fume and metakaolin decreases the machinability, while adding fly ash increases the machinability.

6) The optimum percentage of cement to cementations material is 10-20%.

7) Higher concrete quality lowers steel costs. For high-strength concrete, the water-to-cement ratio should be kept low.

8) Fly ash gives green concrete from metakaolin.

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