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Explorative Research and Experimentation on Polypropylene Fibres and Glass Fibres in High Performance Concrete using Ggbs as Partial Replacement of Cement

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Abstract:This paper presents that the experimental investigation on High Performance Concrete (HPC) using GGBS as partial replacement of cement in various percentages (0% 10%, 20%, 30%, 40% & 50%) of concrete. The past research works were bring to promote an ordinary concrete into special concrete (HPC). Material properties are evaluated by conducting a laboratory tests (physical properties and mechanical properties). The addition of glass fibre in different percentages (0%, 1%, 2%, 3% & 4%) and polypropylene fibre in different percentages (0%, 0.1%, 0.2%, 0.3% & 0.4%) by volume of cement content. To achieve higher workability CONPLAST SP 430 is added in concrete mix. The grade of concrete M_{35} is used. The two different fibres of concrete mixes were casted by in the form of cubes, cylinders and prisms. Thus the experimental results shows that polypropylene fibre in HPC concrete mix is more effective than glass fibre in HPC concrete mix.

Key words: GGBS (Ground Granulated Blast Furnace Slag), Glass fibre, Polypropylene fiber, High Performance Concrete (HPC), Super plasticizer.

I. INTRODUCTION

Concrete is possibly the most popular building material in the world. Concrete is a combination of water, cement, and aggregates, with or without admixtures. Just for particular purpose the concrete level could be raised to 50 Mpa and over. This Particular function of high performance concrete (HPC) can't be accomplished by Ordinary Portland Cement (OPC). It's achieved not Just by reducing water cement ratio but also by replacement of cement with some mineral admixture such as Silica fume Earth admixtures. The primary constituent in the concrete is Portland cement. Cement manufacturing is consuming substantial number of organic resources. The incorporation of supplemental cementitious material is GGBS is a mineral Admixture, which enhances Chiefly the mechanical properties of concrete and lessens the cement Ingestion by substituting part of cement using all these pozzolanic materials

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Additionally, only limited studies have been completed in India on using slag to the evolution of high performance concrete with inclusion of polypropylene fibers and glass fibers. Portland cement concrete owns a less tensile strength, limited ductility and small resistance to breaking. Propagation of inner micro cracks in the cement that reduces the tensile strength.

It's been identified that the Inclusion of Little, firmly dispersed and equally dispersed fibers into concrete could behave as crack arrester and dispersed fibers into concrete would behave as crack cease and would substantially enhance its mechanical properties of the concrete would substantially improve its mechanical properties of the concrete. Inside this study the inclusion of polypropylene and glass fibers have been added to concrete, which leads to progress in hammering and tensile strength. In HPC, materials and admixtures are sensibly selected and proportioned to produce large early strengths and Higher durability beyond traditional Portland cement concrete . The admixtures such as fly ash, silica fume, ground granulated blast furnace slag (GGBS), are added for durability and strength and functions as an eco friendly item. A high-range water-reducing admixture can provide a essential low water/cement ratio, as low as 0.30. This paper presents the analysis of High performance cement by substituting the 10%, 20%, 30%, 0.3% glass fiber and polypropylene fiber replacement. Tests were conducted Concrete block, cylinder and prism to examine compressive strength, The Results are contrasted with the typical conventional concrete And also to figure out the optimal Mix proportions.

II. LITERATURE REVIEW

investigated the effect of the functionality of HPC utilizing admixtures i.e. fly ash along with GGBS using M-60 level of concrete block specimen. Here partly replaced Portland cement by weight of the pozzolanic Materials like Fly ash and GGBS replacement differ from 10% to 30 percent. The workability for high performance concrete was improved by using Conplast SP430-Sulphonated Naphthalene based Superplasticizer. Superplasticizer dosage is same for all mix proportions. Also the fine aggregate was replaced in different proportions with foundry sand. It was researched that the compressive strength, split tensile strength and flexural strength for most different combinations.

Praveen Kumar et. Al. (2016) analyzed a high strength SCC of tier M60 by partly replacing the cement material together with the compressive
strength, divide tensile strength and flexural strength of SCC to get several proportions of powder contents together with the inclusion of glass fibers at 0 percent, 0.1% & 0.2percent to the entire quantity of the concrete mixture.
In this research two forms, SCC combinations were ready specifically, Traditional SCC where cement material has been replaced by 30 percent with fly ash and Triple blended SCC where cement content was diminished to 50 percent & the rest cement material has been replaced with fly ash & GGBS by 25 percent each. Saidani et al. (2017) suggested the behavior of the Standard concrete and concrete with Various Kinds of fiber (steel, macro-polypropylene and micro-polypropylene fibres) have been analyzed. The test result indicates that the optimum use of steel, macro-fibre, and micro polypropylene fiber included in concrete that extends the standard collapse zone to ductile failure zone, also boosts the split tensile strength. Arivalagan et al. (2016) analyzed the replacement of cement from GGBS of 20%, 30% and 40 percent by weight of cement. It was discovered that 20 percent of cement replacement from GGBS reveals high compressive strength, flexural strength and split tensile strength Vijaya Sekhar Reddy et al., (2015) performed an experimental study to explore durability of top performance concrete utilizing rapid chloride permeability tests. The authors reasoned that the use of pozzolanic materials like fly ash, silica fume, metakaoline and GGBS in concrete that improves the pore structure in the cement and reduces the permeability.

III. METHODOLOGY

Step 1: Literature collection - To collect the past related works of journals and implement to this research work, to fulfill the aim of the work.

Step 2: Material property study - The material (GGBS) was collected from JSW steel plant at Salem and physical properties are determined by conducting lab tests.

Step 3: Specimen preparation - All the specimens (cubes, cylinders and prisms) are casted by adding in two (glass and polypropylene) fibers. Also increase the high strength of concrete added a 3% of volume of cement content.

Step 4: Testing of specimen - The concrete have taken for curing periods at after completion of 7 days and 28 days. The testing of all the specimens (cubes, cylinders and prisms) were determined by compressive strength test, split tensile strength test and flexural strength test.

Step 5: Results - Finally, all the test results are compared to adding of both glass and polypropylene fibres in HPC.

IV. MATERIALS USED

Cement

Regular Portland cement, 43 Grade conforming to IS: 8112 1989[4] has been used. The specific Performance of cement was 3.15.

Fine aggregate

Locally accessible river sand adapting to Grading zone II of IS: 383 1970[5] has been used. Its particular gravity has been 2.6.

Coarse aggregate

Locally available smashed granite stones adapting to ranked aggregate of minimal size 20 mm have been used. Its particular gravity was 2.84.

Ground Granulated Blast furnace Slag (GGBS)

Ground granulated blast furnace slag obtained from local steel plant together with its reveals high pozzolanic and transmitting territory. Molten iron slag (a product of iron and steel production) from a burst furnace in plain flow or water, to create a glassy, granular product that's then dried and ground to a fine powder. The specific gravity of earth granulated

Super Plasticizer

Commercially available sulfonated naphthalene formaldehyde-based superplasticizer (CONPLAST SP430) was utilized as a compound Admixture to improve the workability of the concrete.

Glass fibers

Glass fiber is a light weight, exceptionally strong & solid substance. The glass fiber glass with 50mm fiber span & 0.1 millimeter diameter. The aspect ratio of this glass fiber is 500.

Polypropylene fibers

RECRON 3S kind polypropylene fibers (figure 1 (b)) of density 946 Kg/m3 are employed in experimental analysis.

(a)

(b)

(c)

Figure 1 Material Collection (a) Glass fibre (b) Polypropylene fibre (c) GGBS

1. MIX PROPORTION

The concrete mix is designed for M_{35} grade as per IS 10262-2009 and IS 456-2000.Table 1 show that Ingredients for High Performance Concrete.

Table 1 Ingredients for High Performance Concrete

Description / MIX ID	Mix proportion	Cement kg/m^3	GGBS kg/m^3	F.A kg/m^3	C.A kg/m^3	Chemical admixtures kg/m^3	Water /
M 3 5	1:2.0 4:2.8 6	309	131 (40% of weig ht of ceme nt)	786	110 8	0.92 (0.3% of weight of cement)	0.4

2. SPECIMEN PREPARATION

The experimental evaluation contains testing and casting of 9sets together with control mixture. Each pair consists of 15 cubes, 6 knots and 6 beams for determining compressive, tensile and flexural strengths. By taking different Proportion of GGBS, Together with glass & steel fibers separately as a partial Replacement of cement will be replaced consequently with the various proportions by weight of slag and unique proportions by weight of iron fiber and glass fiber. The concrete was full of layers and compacted. The specimens were removed after 24 hours.

V. EXPERIMENTAL WORK

The mechanical properties of HPC were determined by conducting tests i.e (i) compressive strength test of concrete cubes (figure 2 show that cube compressive strength test set up for (a) 3% of polypropylene fibre added (b) 0.3% of glass fibre added), (ii) split tensile strength test of concrete cylinders (figure 3 show that cylinder spilt tensile strength test set up for (a) 3% of polypropylene fibre added (b) 0.3% of glass fibre added), (iii) flexural strength test of concrete prisms (figure 4 show that prism flexural strength test set up for (a) 3% of polypropylene fibre added (b) 0.3% of glass fibre added).

Figure 2 (a) 0.3% of Glass fibre in HPC

Figure 2 (b) 3% of Polypropylene fibre in HPC

Figure 3 Cylinder Split Tensile Strength test results for M35 grade with 40% of GGBS (a) 0.3% of Glass fibre in HPC

Figure 3 Cylinder Split Tensile Strength test results for M35 grade with 40% of GGBS (b) 3% of Polypropylene fibre in HPC

Figure 4 Prism flexural strength test results for M35 grade with 40% of GGBS (a) 0.3% of Glass fibre in HPC

Figure 4 Prism flexural strength test results for M35 grade with 40% of (b) 3% of Polypropylene fibre in HPC

VI. RESULTS AND DISCUSSION

The different percentages (0%, 10%, 20%, 30%, 40% & 50%) of GGBS as partial replacement of cement added in concrete cubes are conducting by compressive strength test (figure 5 show that optimizing the results for GGBS in HPC).The 40% of GGBS in concrete mix obtain maximum compressive strength for 7 days and 28 days of curing period. The optimum mix of 40% GGBS with 3% polypropylene fibre in concrete mix shows maximum compressive strength, split tensile strength and flexural strength (figure 6 show that Cube results for % of Polypropylene fibre added , figure 8 show that cylinder results for % of Polypropylene fibre added and figure 10 show that prism results for % of Polypropylene fibre added). The optimum mix of 40% GGBS with 0.3% glass fibre in concrete mix shows maximum compressive strength, split tensile strength and flexural strength (figure 7 show that Cube results for % of glass fibre added in HPC figure 8 show that cylinder results for % of Polypropylene fibre added, figure 9 show that cylinder results for % of glass fibre added and figure 10 show that prism results for % of Polypropylene fibre added in HPC figure 11 show that prism results for % of glass fibre added).

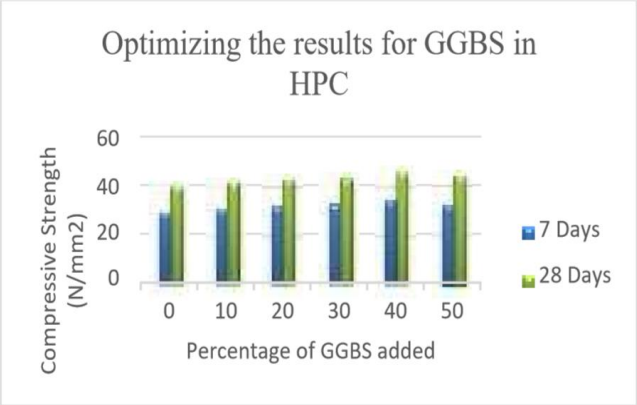

Figure 5 Optimizing the results for GGBS in HPC

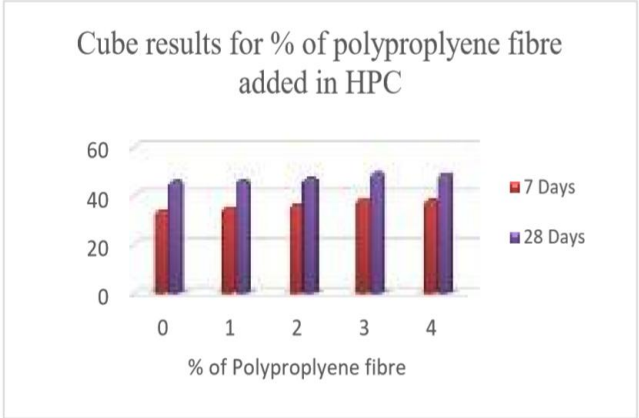

Figure 6 Cube results for '% of Polypropylene fibre added

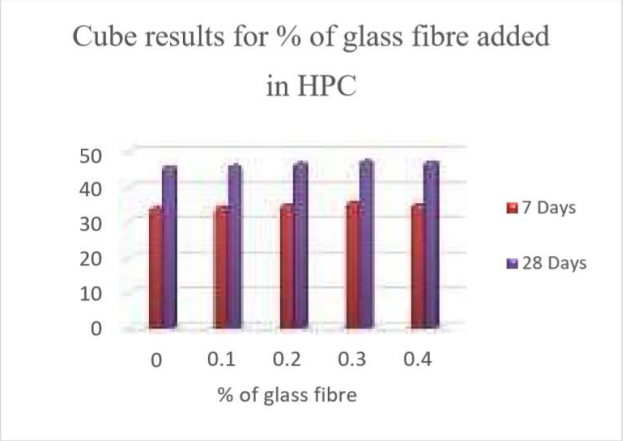

Figure 7 Cube results for % of glass fibre added

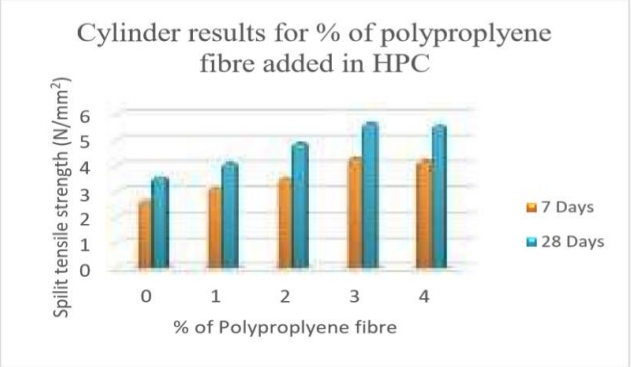

Figure 8 Cylinder results for % of Polypropylene fibre added

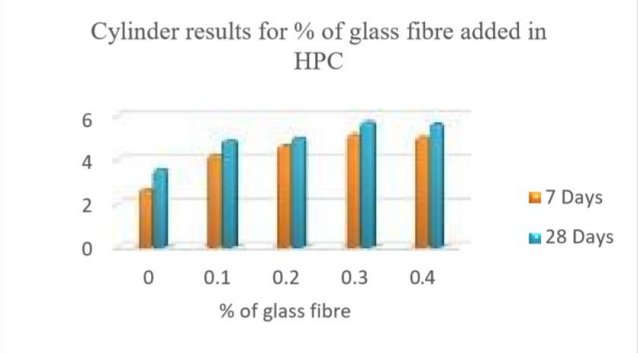

Figure 9 Cylinder results for % of glass fibre added

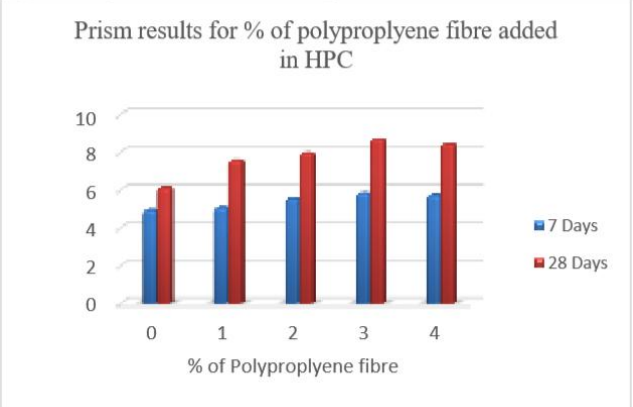

Fig 10

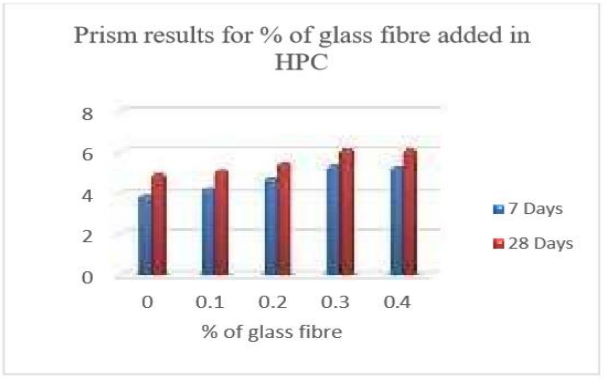

Figure 11 Prism results for % of glass fibre added

VII. CONCLUSION

In the Analysis of experimental results and Debate there upon the following conclusions can be drawn,

- The best amount for partial replacement of cement by GGBS has been acquired at 40 percent of weight of concrete.
- The partial replacement of cement in the sense of to reduce a cement content in the concrete and also to save the construction costs.
- The concrete mix of 40% GGBS and 0.3% glass fibre has the maximum compressive strength, Split tensile strength and Flexural Strength.
- The concrete mix of 40% GGBS and 3% polypropylene fibre has the maximum compressive strength, Split tensile strength and Flexural Strength.
- The experimental test results show that the polypropylene fibre more effective than glass fibre

FUTURE EXTENDING WORK

A. Based on experimental investigation the optimum mix was identified and further development of this research work, to evaluate the durability property and ultimate load behavior of the beam element in future study.

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