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A Review on Experimental Study on Partial Replacement of Cement with GGBS in Addition of Steel and Polypropylene Fibers

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ABSTRACT: Concrete is a mixture of cement ,fine aggregate, coarse aggregate and water. Concrete plays a vital role in the development of infrastructure like 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 leadings to usage of economically alternative materials in its production. This requirement is drawn the attention 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 of using in concrete. In the experimental the compressive strength, split tensile strength tests were conducted by adding GGBS in various percentages of 0%, 10%, 15%, 20%, 25%, 30% to the cement weight and 0.5%, 0.75%, 1%, 2% of crimped steel fibers and polypropylene fibers.

I.INTRODUCTION

Concrete is probably the most extensively used construction material in the world with about 6 billion tons being produced every year. It is only next to water in terms of per capita consumption. How ever environmental sustainability is at stack both in terms of damage caused by the extraction of raw material and co2 emission the during cement manufacture. This brought pressures on researcher for the reduction of cement consumption by partial replacement of cement by supplementary materials. These materials may be naturally occurred, industrial waste or by product they are less energy intensive. These materials and combined with calcium hydroxide, exhibits cementicious properties. Most commonly used pozzalonas are fly ash, silica fume, metacolin, GGBS. This needs to examine the admixture performance when blended with concrete so as to ensure a reduced life cycle past. GGBS is a waste product in the manufacture of iron by blast furnace method. The molten slag is lighter and floats on the top of molten iron. This process of granulating the slag involves cooling the molten slag through high pressure water jets this rapid cooling of slag results in formation of granular particles generally not lager than 5mm in diameter. The granulated slag is further process by drying and then ground to very fine powder, which is GGBS.
Recron fiber is the only hollow fibers specially designed for filling and insulation purpose. .Made with technology from dupont, usa, recron fiber fill adheres to world class quality standards to provide maximum comfort , durability and easy of use to prevent shrinkage cracks developed during curing making the structure.
Crimped steel fibers are used to increase the split tensile strength, ductility, toughness, blast resistance and impact value.

II.LITERATURE REVIEW

Shariq et al. (2008) studied the effect of curing procedure on the compressive strength development of cement mortar and concrete incorporating ground ground granulated blast furnace slag. The compressive strength development of cement mortar incorporating 20, 40 and 60 percent replacement of GGBFS for different types of sand and strength development of concrete with 20, 40 and 60 percent replacement of GGBFS on two grades of concrete are investigated. Tests results show that the incorporating 20% and 40% GGBFS is highly significant to increase the compressive strength of mortar after 28 days and 150 days, respectively.

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Peter et al. (2010) studied the BS 15167-1 which requires that the minimum specific surface area of GGBS shall be 2750 cm^2/g (BS 15167-1:2006). In China, GGBS is classified into three grades; namely S75, S95 and S105. The GB/T18046 requires ad minimum surface area of 3000 cm^2/g for grade S75 GGBS, 4000 cm^2/g for grade S95 and 5000 cm^2/g would significantly improve the performance of GGBS concretes.

Mojtaba Valinejad Shoubi et al. (2013) reviewed in their research the specifications. Production method and degree of effectiveness of some industrial byproducts such as GGBS, Silica Fume and PFA as cement replacement to achieve high performance and sustainable concrete which can lead not only improving the performance of the concrete but also to the reduction of EC02 by reducing the amount of PC showing how they affect economical, environmental and social aspects positively.

Aveline Darquennes et al. (2011) determined the slag effect on cracking. Their study focuses on the autogenous deformation evolution of concretes characterized by different percentages of slag (0 and 42% of the binder mass) under free and restraint conditions by means of the TSTM device (Temperature Stress Testing Machine).

Elsayed (2011) investigated experimentally in his study the effects of mineral admixtures on water permeability and compressive strength of concretes containing silica fume (SF) and fly ash (FA). The results were compared to the control concrete, ordinary Portland cement concrete without admixtures. The optimum cement replacement by FA and SF in this experiment was 10%. The strength and permeability of concrete containing silica fume, fly ash and high slag cement could be beneficial in the utilization of these waste materials in concrete work, especially in terms of durability.

Reginald Kogbara et al. (2011) investigated the potential of GGBS activated by cement and lime for stabilization / solidification (S/S) treatment of a mixed contaminated soil. The results showed that GGBS activated by cement and lime would be effective in reducing the leachability of contaminants in contaminated soils. Martin et al. (2012) studied the influence of pH and acid type in the concrete. The conclusions were that concrete tested cannot adequately address the durability threat to all parts of wastewater infrastructure over a significant life span due to the extraordinarily harsh nature of this form of attack.

Wang Lign et al . (2004) analyzed the performance of GGBS and the effect of GGBS on fresh concrete and hardened concrete. GGBS concrete is characterized by high strength, lower hear of hydration and resistance to chemical corrosion.

Venu Malagavelli et al. [1] studied on high performance concrete with GGBS and robo sand and concluded that the percentage increase of compressive strength of concrete is 11.06 and 17.6% at the age of 7 and 28 days by replacing 50% of cement with GGBS and 25% of sand with ROBO sand.

Luo et al. [2] experimentally studied the chloride diffusion coefficient and the chloride binding capacity of Portland cement or blended cement made of Portland cement and 70% GGBS replacement with or without 5% sulphate. They found that (i) chloride coefficient decreased; (ii) chloride ion binging capacity improved in samples of blended cement.

Clear [3] concluded that higher the proportion of GGBS, the slower the early age strength development.

Oner and Akyuz studied on optimum level of GGBS on compressive strength of concrete and concluded that the optimum level of GGBS content for maximizing strength is at about 55-59% of the total binder content.

Qian Jueshi and Shi Caijun [5] Studied in high performance cementing materials from industrial slang and reviewed the recent progresses in the activation of latent cementicious properties of different slag. They opined that Alkali – activated slag, such as blast furnace slag, steel slag, copper slag and phosphorus slag should be a prime topic for construction materials researchers.

III..EXPERIMENTAL PROGRAMMING

Test series conducted for M-35 grade of concrete of different mixes of % replacement of GGBS of 0%, 10%, 15%, 20%, 25%, 30%e with cube size of 150x150x150 and cylinder size 300mm height and 150mm diameter were casted and at 25% replacement of GGBS crimped and polypropylene fibers are used with a percentage of 0.25%, 0.5%, 0.75%, 1%, 2% and for cylinders at 20% replacement of GGBS fibers with percentage of 0.25%, 0.5%, 0.75%, 1%, 2% and cubes were casted.

IV.RESULTS AND DISCUSSION

Replacement of cement with GGBS with different percentages the strength of cubes and cylinders is getting the same strength when compared with full cement concrete. The cube and cylinder strengths with steel and polypropylene fibers is also increased and the values are shown in below table.

Average compressive and split tensile strength of cubes and cylinders of 28 days:

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% of GGBS	28 days compressive strength N/mm2	28 days split tensile strength N/mm2
0%	39.23	3
10%	38.25	3.2
15%	38.25	3.2
20%	38.15	3.3
25%	38.85	3.4
30%	38	3.4

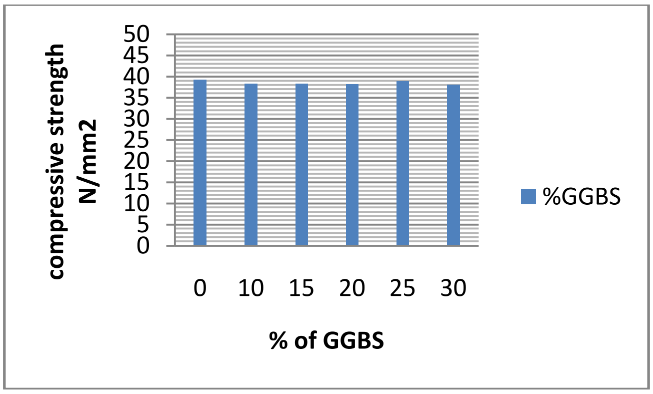

Fig shows compressive strength of GGBS of 28 days

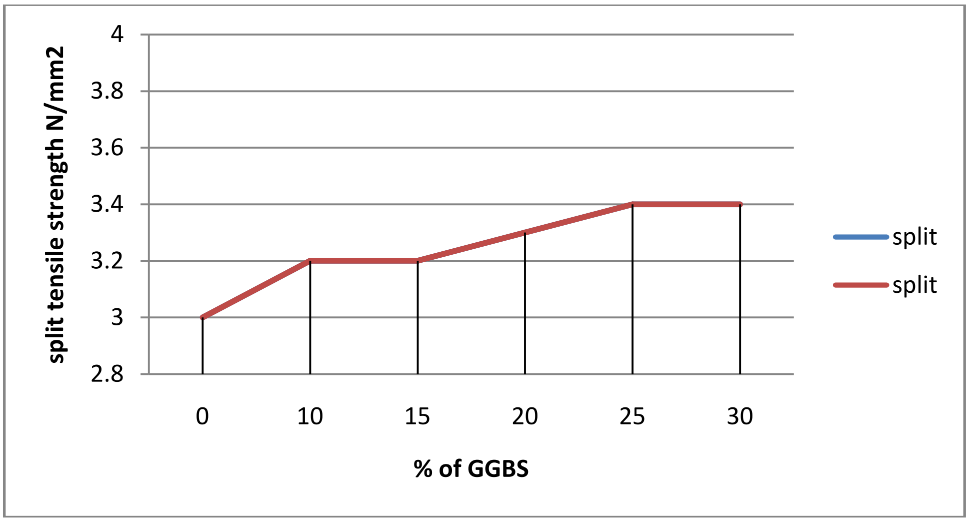

Figure shows split tensile strength of concrete

Average compressive and split tensile strength with different % steel fibers of 28 days

% 0f steel fibers	28 days compressive strength	28 days split tensile strength
0%	39.23	3
0.25%	42.83	3.30
0.5%	45.12	3.39
0.75%	46.99	3.56
1%	48	3.85
2%	48.7	4.25

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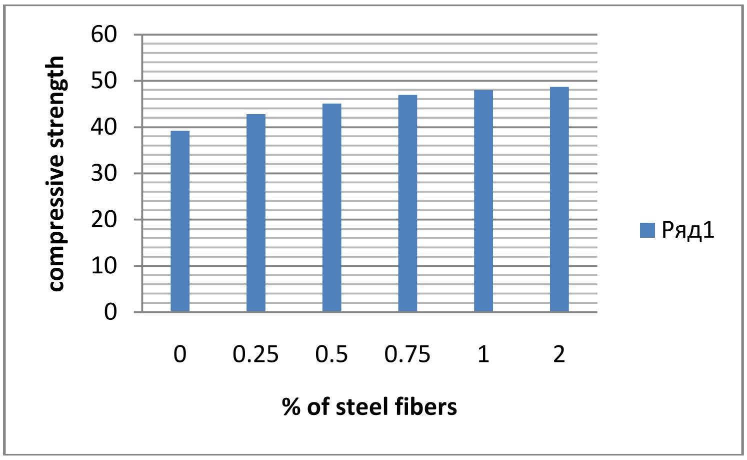
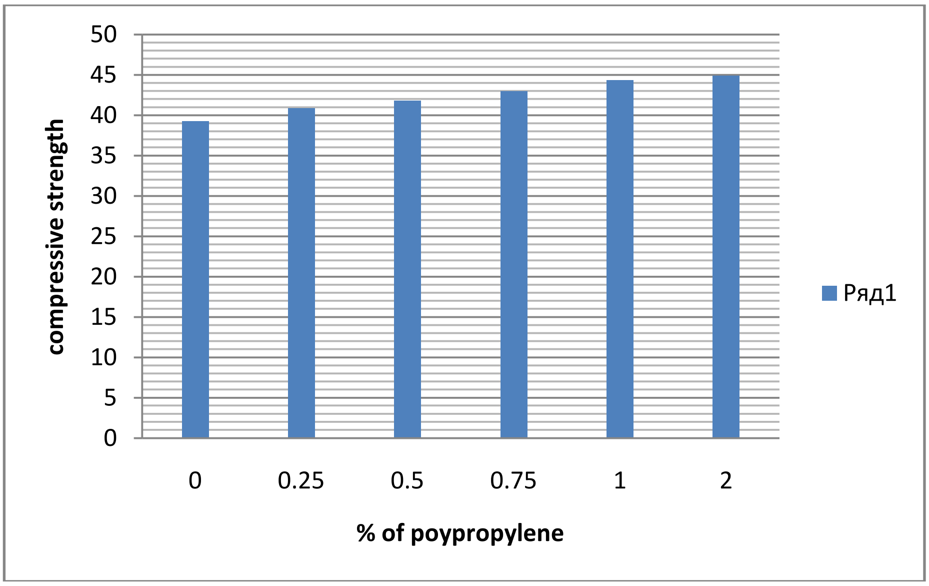


Average compressive and split tensile strength of different % of polypropylene fibers

% of polypropylene fibers	28 days compressive strength	28 days split tensile strength
0%	39.23	3
0.25%	40.85	3.3
0.5%	41.79	3.3
0.75%	42.99	3.4
1.%	44.34	3.45
2%	44.89	3.53



Graph shows compressive strength of polypropylene fibers

V.CONCLUSION

The normal consistency increases with replacement of cement by pozzolanic materials Such as GGBS. Incase of normal concrete , part replacement of cement by GGBS satisfactory results are obtained with 20% to 30%. Addition of steel fibers to 25% of GGBS compressive strength increases up to 2% of steel fibers and at 20% of GGBS split tensile

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strength increases up to 2% addition of steel fibers Addition. Addition of Polypropylene fibers at same percentage of GGBS up to 2% of polypropylene fibers to the concrete compressive strength increases the increase is less when compared to steel fibers. Split tensile strength also increases but increase is less when compared to steel fibers.

REFERENCES

[1]Alhozaimy A. M., Soroushian P. and Mirza F., "Mechanical Properties of Polypropylene Fiber Reinforced Concrete and the Effects of Pozzolanic Materials", Cement & Concrete Composite, vol. 18, pp 85-92, 1996.
[2]BIS 383, Specification for Coarse aggregate and Fine aggregate from Natural Sources for Concrete, Bureau of Indian Standards, New Delhi, 1970.
[3]BIS 456, Indian Standard Code of Practice for Plain and Reinforced Concrete, Bureau of Indian Standard, New Delhi, 2000.
[4]BIS 5816, Splitting Tensile Strength of Concrete Method of Test, Bureau of Indian Standards, New Delhi, 1999.
[5]BIS 9103, Indian Standard Concrete Admixture Specification, Bureau of Indian Standards, New Delhi, 1999.
[6]BIS 9399, Specifications for Apparatus for Flexural Testing of Concrete, Bureau of Indian Standards, New Delhi, 1959.
[7]BIS 10262, Recommended Guidelines for Concrete Mix design, Bureau of Indian Standards, New Delhi, 1982.
[8]Bhanja S. and Sengupta B., "Influence of silica fume on the tensile strength of concrete, Cement and Concrete Research", vol.35, pp 743-747, 2005.
[9]Bozkurt N. and Yazicioglu S., "Strength and capillary water absorption of light weight concrete under different curing condition", Indian Journal of Engineering and Material Sciences, Vol. 17, pp 145-151, 2010.
[10]Caijun Shi and Jueshi Qian, "High Performance cementing materials from industrial slags, Resources Conservation & Recycling", Vol. 29, pp195-207, 2000.
[11]Ganesh Babu K, and Sree Rama Kumar V., "Efficiency of GGBS in Concrete, Cement and Concrete Research", Vol. 30, pp 1031-1036, 2000.
[12]Safiuddin Md. and Hearn N., "Comparison of ASTM saturation techniques for measuring the permeable porosity of concrete", Cement and Concrete Research, . vol. 35, pp 1008-1013, 2005. Zollo Ronald F., "Fiber-reinforced Concrete: an Overview after 30 Years of Development", Cement & Concrete Composite, vol. 19, pp 107-122, 1997.