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Enhancement of fiber concrete strength by using GGBS and RHA

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Abstract : *It is known from the adverse Environmental effects that there is a need for the use of various industrial products because these are the main causes for rapid increase in Environmental Pollution. It is also observed from the growth of Urbanization and Infrastructure that strong, Durable and cost effective construction materials are required for Structures. In the present study an attempt has been made to prepare economical and tough concrete material. High-performance concrete is defined as concrete that meets special combinations of performance and uniformity requirements that cannot always be achieved routinely using conventional constituents and normal mixing, placing, and curing practices. Ever since the term high-performance concrete was introduced into the industry, it had widely used in large-scale concrete construction that demands high strength, high flow ability, and high durability.*

Key words: *man-made, materials, furnace Slag, Metakaolin*

Introduction :

Concrete is the most widely used man-made construction material for the construction of structures. It is obtained by mixing cementitious materials, water, aggregate and sometimes admixtures in required proportions. Fresh concrete or plastic concrete is freshly mixed material which can be moulded into any shape hardens into a rock-like mass known as concrete. The hardening is because of chemical reaction between water and cement, which continues for long period leading to stronger with age. Strength was emphasized without a thought on the durability of structures. The Ordinary Portland Cement (OPC) is one of the main ingredients used for the production of concrete and has no alternative in the civil construction industry. Unfortunately, production of cement involves emission of large amounts of carbon-dioxide gas into the atmosphere, a major contributor for green house effect and the global warming, hence it is inevitable either to search for another material or partly replace it by some other material. The search for any such material, which can be used as an alternative or as a supplementary for cement should lead to global sustainable development and lowest possible environmental impact.

Fly ash, Ground Granulated Blast furnace Slag, Rice husk ash, High Reactive Metakaolin, silica fume are some of the pozzolanic materials which can be used in concrete as partial replacement of cement. A number of studies are going on in India as well as abroad to study the impact of use of these pozzolanic materials as cement replacements and the results are encouraging. The strength, durability and other characteristic of concrete depends on the properties of its ingredients, proportion of mix, method of compaction and other controls during placing and curing.

Nowadays the construction industry turning towards pre-cast elements and requirement of post-tensioning has made the requirement of the high strength of concrete invariable and the engineers had to overcome these drawbacks, which to a great extent we have been able to do. The construction today is to achieve savings in construction work. This has now turned into one of the basic requirement of concreting process.

High performance concrete:

In recent years, the terminology "High-Performance Concrete" has been introduced into the construction industry. The American Concrete Institute (ACI) defines high-performance concrete as concrete meeting special combinations of performance and uniformity requirements that cannot always be achieved routinely when using conventional constituents and normal mixing, placing and curing practices. Concrete materials most high-performance concretes produced today contain materials in addition to Portland cement to help achieve the compressive strength or durability performance. These materials include fly ash, silica fume and ground-granulated blast furnace slag used separately or in combination. At the same time, chemical admixtures such as high-range water-reducers are needed to ensure that the concrete is easy to transport, place and finish. For high-strength concretes, a combination of mineral and chemical admixtures is nearly always essential to ensure achievement of the required strength.

Salient Features of HPC:

- High Compressive strength
- Low water-binder ratio
- Reduced flocculation of cement grains
- Wide range of grain sizes
- Densified cement paste

Considering the grade of cements high strength of cement of grades 43 & 53 are desirable for design of High strength concretes. To achieve the quest of high performance

RESULTS AND DISCUSSIONS :

The basic properties of Port land Slag Cement (PSC) , Fine aggregate, Coarse aggregate, Ground Granulated Blast furnace Slag (GGBS) and Rice Husk ash were determined in the laboratory . The experimental results are as follows

Table 1. Properties of Portland slag cement:

Specific gravity	3.01
Initial setting time (min)	135
Final setting time (min)	240

Table 2. Properties of fine Aggregate:

Specific gravity	2.68
Water absorption	0.7 %
Fineness modulus	2.49

Table 3. Properties of coarse aggregate:

Specific gravity	2.64
Water absorption	0.3 %
Fineness modulus	4.08

Table 4. Effect of GGBS in Normal consistency of cement:

% of cement replaced by GGBS (%)	Consistency (%)
0	31
10	31.5
20	32
30	33.4
40	36.5

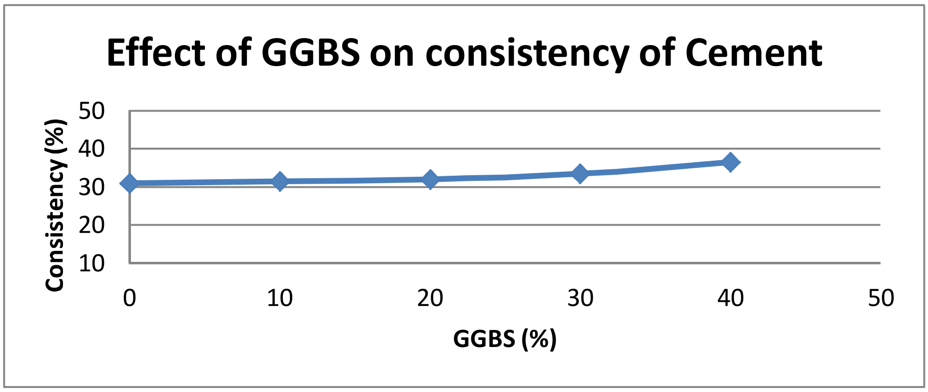

Fig.No 1

It is observed from the fig No1 that consistency values were increased with increase in percentage of GGBS. The increase in dosage of GGBS results in taking more water so that the values of normal consistency were increased.

Table 5. Effect of GGBS on Compressive strength of cement

% of GGBS with cement Replacement	3 days strength (MPa)	7 days strength (MPa)
0	11.2	24.4
10	9.8	16.3
20	6.9	11.9
30	6.2	10.6
40	4.68	8.8

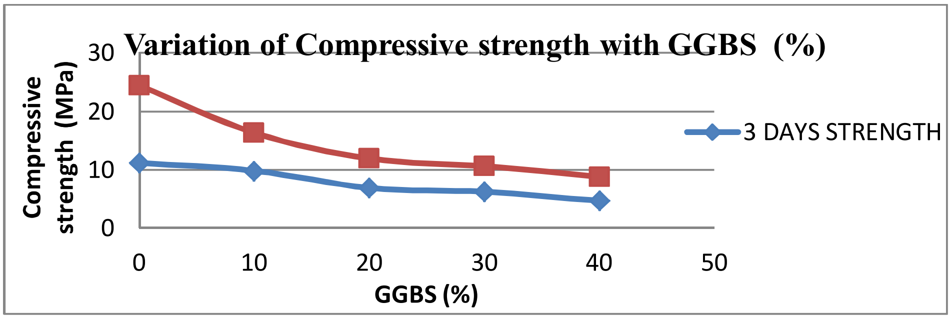

Fig.No 2

It is noted from the fig No2 that increase in dosage of GGBS results in decrease of compressive strengths. This is due to reduction in Calcium oxide content in the mixes. The variation in strengths are less for 7days cured samples compared to 3days cured samples.

Table 6 . Effect of RHA on Normal Consistency of cement:

% of cement replaced by RHA	Consistency (%)
0	31
10	46
20	48
30	53

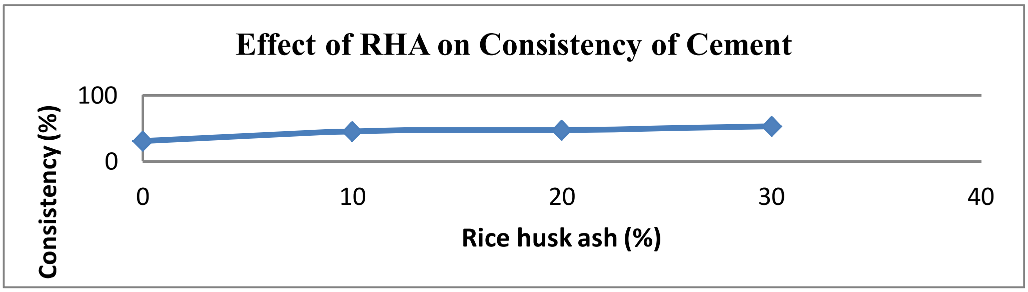

Fig.No 3

It is known from the table No 6 and figure No 3 that the increase in normal consistency values is due to increase in dosage of RHA. The particles of RHA took more water to interact with the particles of cement.

Table 7 . Effect of RHA on Compressive strength of cement:

% of cement replaced by RHA	3 days strength (MPa)	7 days strength (MPa)
0	1.17	4.31
10	2.3	4.8
20	3.8	7.8
30	4.1	8.2

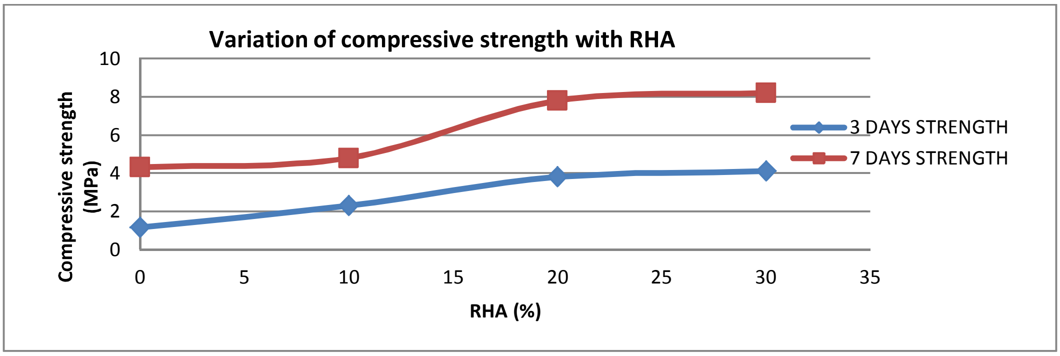

Fig.No 4

The addition of RHA in various percentages leads to the increase in compressive strengths of the mixes. The increase in Calcium oxide content is the main cause for improvement of strengths.

The concrete cubes, cylinders and beams were tested for compressive, tensile and flexural strengths respectively. The experimental findings are as follows

Table 8. Effect of Recron fiber on Compressive strength using slag cement:

Fiber content (%)	7 days compressive strength (N/mm2)	28 days compressive strength (N/mm2)
0	29	36.8
0.1	25.4	28.6
0.2	27.2	33.8
0.3	18.1	27.2

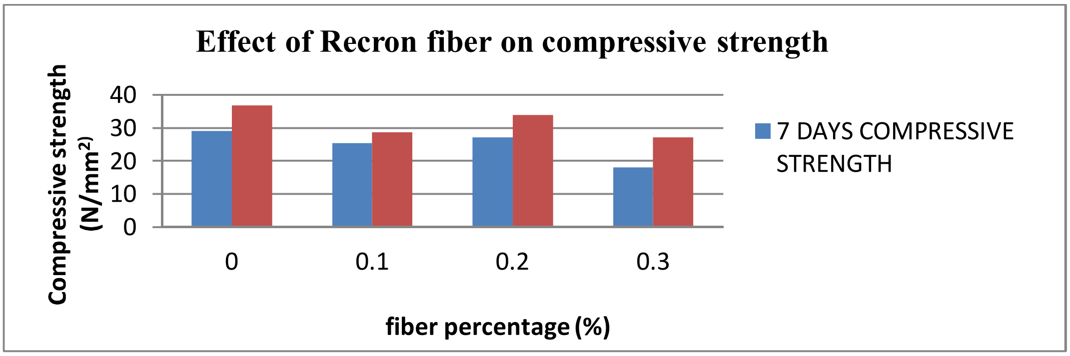

Fig.No 5

It is observed from the table No 8 and figure No 5 that higher strength values were attained at 28 days curing period compared to 7 days curing period. With increase in fiber content the strengths have been increased up to 0.2% addition later on a decreased trend was observed due to increase in void ratio.

Table 9. Effect of recron fiber on Splitting Tensile Strength using slag cement:

Fiber content (%)	7 days splitting tensile strength (N/mm2)	28 days splitting tensile strength (N/mm2)
0	2.6	2.9
0.1	2.23	2.52
0.2	2.6	3.12
0.3	1.74	2.48

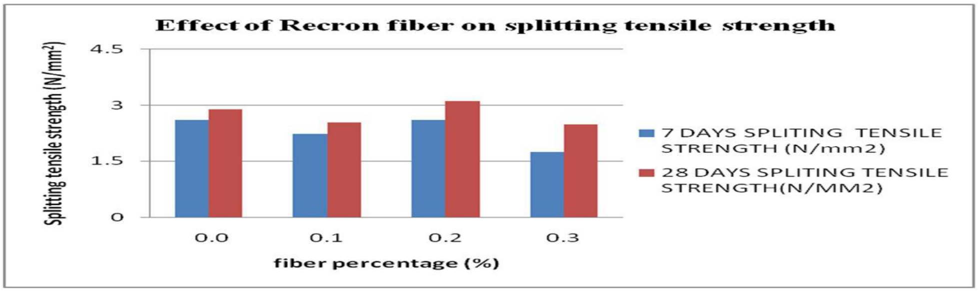

Fig.No 6

It is observed from the table No 9 and figure No 6 that higher strength values were attained at 28 days curing period compared to 7 days curing period. With increase in fiber content the tensile strengths have been increased up to 0.2% addition later on a decreased trend was observed due to increase in void ratio.

Table 10. Effect of recron fiber on Flexural Strength using slag cement:

Fiber content (%)	7 days flexural strength (N/mm2)	28 days flexural strength (N/mm2)
0	5.8	7.8
0.1	5.89	6.4
0.2	6.6	8.18
0.3	4.6	6.16

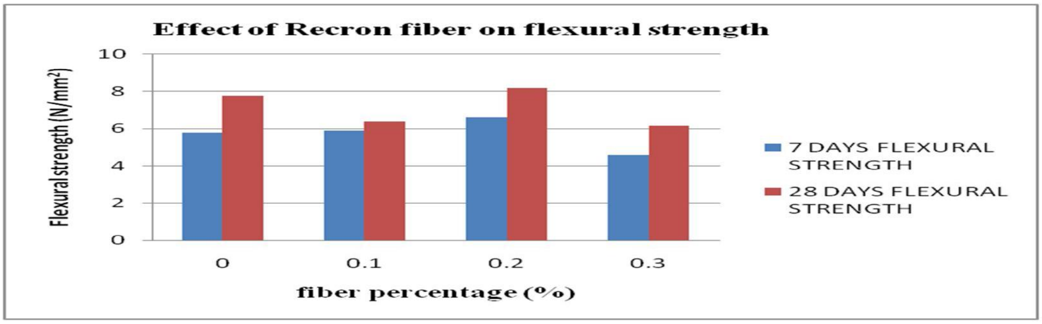

Fig.No 7

It is observed from the table No 10 and figure No 7 that higher strength values were attained at 28 days curing period compared to 7 days curing period. With increase in fiber content the flexural strengths have been increased up to 0.2% addition later on a decreased trend was observed due to increase in void ratio.

Conclusions :

- Maximum strengths were attained at 28 days curing period for all proportions of mixes.
- Normal consistency values have been increased with increase in both GGBS and Rice Husk Ash.
- The compressive strengths have shown maximum values at 30% addition of RHA.
- The compressive strengths were decreased with increasing percentage of GGBS at both 3days & 7 days curing.
- The maximum values of compressive strength shown at 0.2% addition of Fiber for all proportions of mixes.

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