Ilkogretim Online - Elementary Education Online, 2020; Vol 19 (Issue 3): pp. 4279-4288
http://ilkogretim-online.org
doi: 10.17051/ilkonline.2020.03.735580

Experimental Investigation Of Geopolymer Concrete Using Ggbs And Fly Ash With Hybridfibers

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Abstract- Cement manufacturing causes significant pollution. The production of cement is responsible for 4% of man-made global warming. To reduce such pollution, investigation into alternative materials for concrete production is an important research topic. Geo polymers are potentially effective substitute for cement production in concrete production. In this study, cement is totally replaced by Ground Granulated Blast furnace Slag (GGBS) and Fly ash with the addition of hybrid fibres (Glass fibers and steel fibers).

Keywords- Flyash, GGBS, ConplastSP430, Hybrid fibers, Hot air oven.

I. INTRODUCTION

Construction in the present century is growing very rapidly. Hence the concrete is the second most commonly used material next to the basic human needs. Demand for cement and concrete is goes on increasing as the construction is increasing day by day. So the demand for Ordinary Portland cement also increases. Due manufacturing of OPC around 1.35 billion tons annually or approximately 7% of the total greenhouse gas emissions to the earth's atmosphere. Carbon dioxide is the major source for Greenhouse effect. The geo polymer concrete technology was introduced by DAVIDOVITS. To improve the performance of the concrete and to improve the mechanical performance of geo polymer concrete GGBS (ground granulated blast furnace slag), fly ash and hybrid fibres in concrete.

II. LITERATURE REVIEW

R. Anuradha studied that Geopolymer is a new development in the world of concrete in which cement is totally replaced by pozzolanic materials like fly ash and activated by highly alkaline solution s to act as a binder in the concrete mix. For the selection of suitable ingredients of geopolymer concrete to achieve desire strength at required workability, an experimental investigation has been carried out for the gradation of geopolymer concrete and a mix design procedure is proposed on the basis of quantity and fineness of fly ash, quantity of water, grading of fine aggregate, fine to total aggregate ratio.

III. MATERIALS USED

A.Fly ash

Flyash, the fine particulate waste material produced by pulverized coal-based thermal power station, is an environmental pollutant, it has a potential to be a resource material.

Fig 1 Flyash

B.GGBS

Ground Granulated blast furnace slag is obtained by quenching molten iron slag from a blast furnace in water or steam, to produce a glassy, granular product that is then dried and grounded into a fine powder.

Fig 2 GGBS

C. Alkaline solution

An alkaline solution is a mixture of base solids dissolved in water. Some examples of alkaline solutions include sodium hydroxide, potassium hydroxide, magnesium hydroxide and calcium carbonate. Here, Sodium silicate and Sodium hydroxide are used.

Fig 3 Alkaline solution

D. Steel fibers

Steel fiber is a metal reinforcement. A certain amount of steel fibers in concrete can cause qualitative changes in concrete's physical property, greatly increasing resistance to cracking, impact, fatigue, and bending, tenacity, durability, and other properties.

Fig 4 Steel fibers

E. Glass fibers

Glass fiber is a form of fiber- reinforced plastic. The glass fiber is usually flattened into a sheet, randomly arranged or woven into a fabric. It is lightweight, strong, and less brittle.

Fig 5 Glass fibers

F. Super plasticizer

ConplastSP430(NE) is used where a high degree of workability and its retention are required, where delays in transportation or placing are likely or when high ambient temperatures cause rapid slump loss.

Fig 6 Super plasticizer

IV. MIX DESIGN

A. Unit weight of concrete = 2400kg/m^3

B. Mass of combined aggregates = 77% of mass of concrete

= 1848kg/m^3

C. Fine aggregates = 30% of combined aggregates

= 554.4kg/m^3

Coarse aggregates = 1293.6kg/m^3

D. Mass of other components = 552kg/m^3

E. Mass of fly ash and GGBS = 408.89kg/m^3

[Let the ratio of alkaline solution to fly ash and GGBS be 0.35]

Mass of alkaline solution = 143.11kg/m^3

[Let the ratio of Na_2SiO_3 to NaOH solution be 2.5]

F. Mass of Sodium Hydroxide = 40.89kg/m^3

Mass of Sodium Silicate = 102.22kg/m^3

G. Super plasticizer = 2% of total mass of fly ash

= 81.78ml

V. MANUFACTURE OF BLOCKS

After all the ingredients were ready, the dry mix is done. Fly ash, GGBS and aggregates are mixed, which is dry mix. Sodium silicate solution and sodium hydroxide solution are mixed in the dry mix. Cement is the binding material in the concrete. Since, cement is fully replaced by fly ash and ground granulated blast furnace slag, alkaline solution is added for the concrete to get binded without cement. Then, hybrid fibers i,e glass fibers and steel fibers are added.



Fig 7 Dry mix Fig 8 Steel fibers mix Fig 9 Glass fibers mix



Fig 10 Final mix Fig 11 Compaction Fig 12 Casting of blocks


Fig 13 Blocks in all ratios Fig 14 Polymerization

VI. TESTING OF BLOCKS

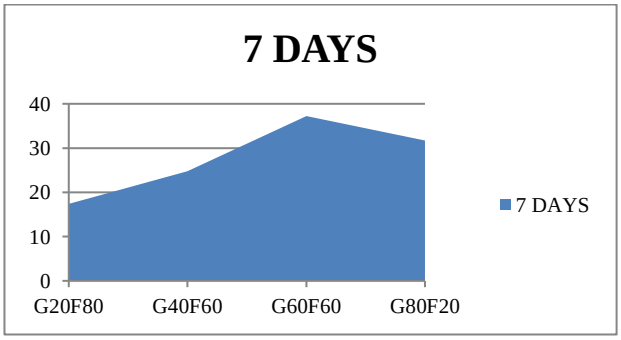
A. Compression test

Compressive strength is the capacity of a material or structure to withstand loads tending to reduce size, as opposed to tensile strength, which withstands loads tending to elongate. In other words, compressive strength resists compression.

1) Strength results of sample without fibers

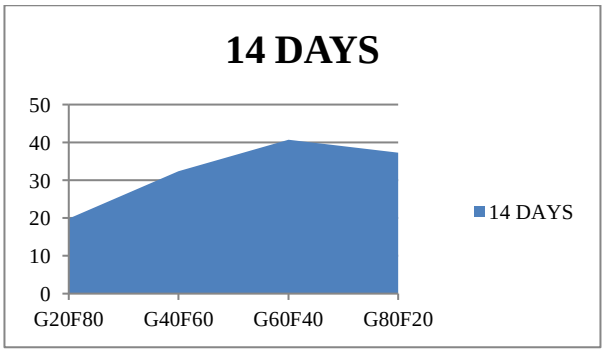
Results for 7 days

GGBS (%)	FLY ASH (%)	STRENGTH (N/mm^2)
20	80	17.43
40	60	24.80
60	40	37.23
80	20	31.65



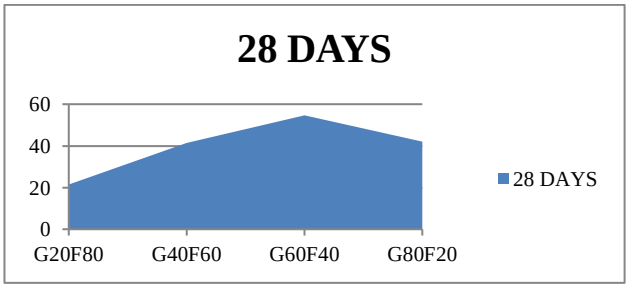
Results for 14 days

GGBS (%)	FLY ASH (%)	STRENGTH (N/mm^2)
20	80	19.77
40	60	32.34
60	40	40.7
80	20	37.26



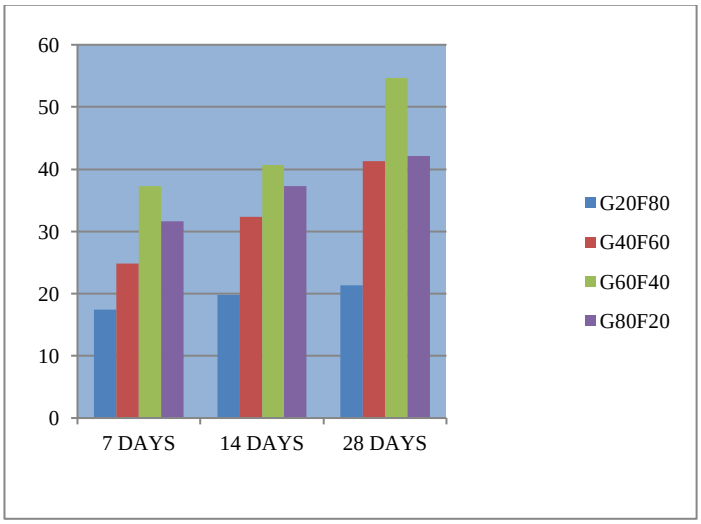
Results for 28 days

GGBS (%)	FLY ASH (%)	STRENGTH (N/mm^2)
20	80	21.34
40	60	41.29
60	40	54.64
80	20	42.15



Without hybrid fibers (Comparison)

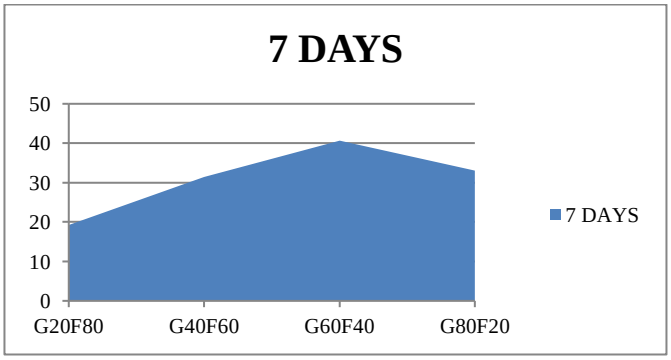
GGBS (%)	FLY ASH (%)	7 DAYS	14 DAYS	21 DAYS
20	80	17.43	19.77	21.34
40	60	24.80	32.34	41.29
60	40	37.23	40.7	54.64
80	20	31.65	37.26	42.15



2) Strength results of sample with fibers

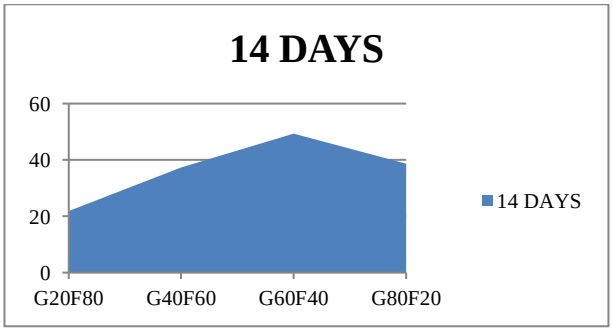
Results for 7 days

GGBS (%)	FLYASH (%)	STRENGTH (N/mm²)
20	80	19.25
40	60	31.49
60	40	40.65
80	20	33



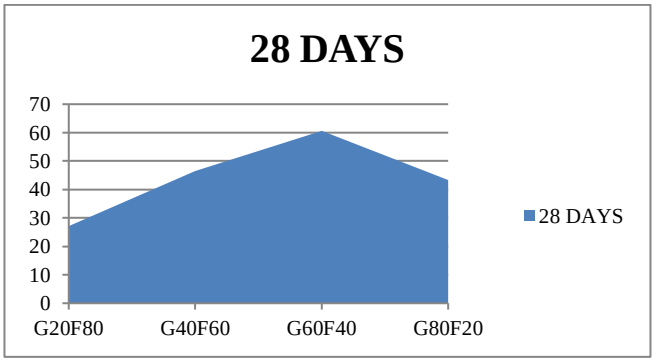
Results for 14 days

GGBS (%)	FLY ASH (%)	STRENGTH (N/mm²)
20	80	21.92
40	60	37.37
60	40	49.34
80	20	38.70



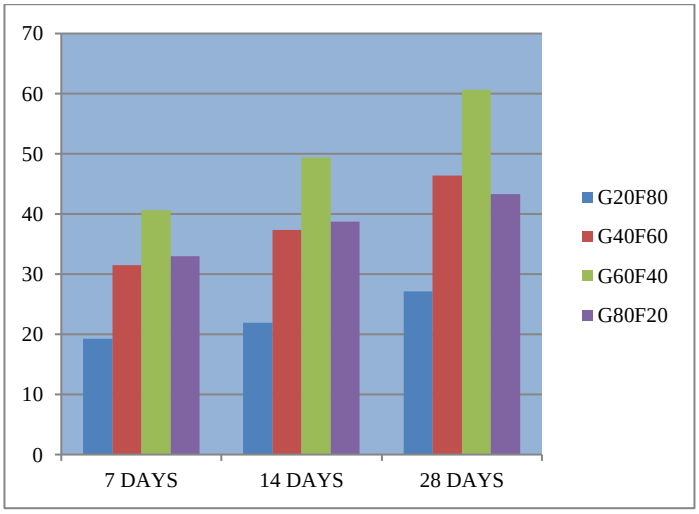
Results for 28 days

GGBS (%)	FLY ASH (%)	STRENGTH (N/mm^2)
20	80	27.18
40	60	46.42
60	40	60.62
80	20	43.28



With hybrid fibers (Comparison)

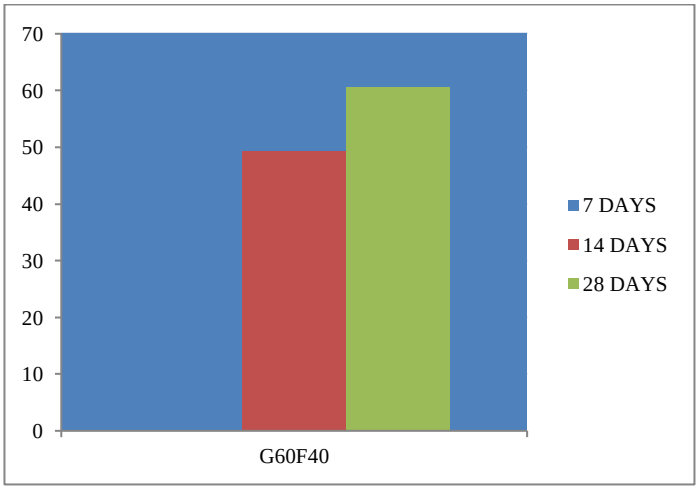
GGBS (%)	FLY ASH (%)	7 DAYS	14 DAYS	28 DAYS
20	80	19.25	21.92	27.18
40	60	31.49	37.37	46.42
60	40	40.65	49.34	60.62
80	20	33	38.70	43.28



VII. RESULTS AND CONCLUSION

As per compression test results, geopolymer concrete with hybrid fibers are stronger than geopolymer concrete without fibers. The ratio of fly ash and GGBS, G60F40 has more compression strength when compared to other ratios (G20F80, G40F60 and G80F20).

RATIO	7 DAYS	14 DAYS	28 DAYS
G60F40	40.65	49.34	60.62



Geopolymers are potentially effective substitutes for cement in concrete production. Through a polymerization reaction with fly ash and alkaline solution, the geopolymer concrete matches that of the conventional concrete in mechanical properties as well as durability charecteristics. Thus from this

project we conclude by saying that the compressive strength of geopolymer concrete with fly ash and ground granulated blast furnace slag and hybrid fibers shows increasing results in its strength from batch 1 mix (20% GGBS and 80% Fly ash) to batch 3 mix (60% GGBS and 40% Fly ash). But, the results got decreased in the batch 4 (80% GGBS and 20% Fly ash). This shows the maximum strength attains in the batch 3 (60% GGBS and 20 Fly ash). The second maximum strength attains in the batch 4 (80% GGBS and 20% Fly ash).

VIII. REFERENCES

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