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Comparative study on Conventional and Geo-polymer concrete without Alkaline liquids using Polypropylene Fibre

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Abstract – *Concrete is prepared by mixing various constituents like cement, aggregates, water, etc., which are economically available. In Geo polymer concrete the study on strength of fiber reinforced concrete with fly ash and GGBS fully replacement of cement and alkaline liquids like Na OH and Na2Sio3 is fully replaced of water by weight of M20 grade of concrete. 0.9Kg/m3 density of Polypropylene fibers were used. In present study moulds are prepared of without alkaline liquids with ratio of 30%, 40%, 60%, 70%and 80%of fly ash and GGBS. The tests are conducted on concrete in order to study the strength characteristics such as compressive strength, and split tensile strength are to be studied.*

Key Words: **Ground Granulated Blast furnace Slag, Fly ash, Polypropylene fibres, Conventional concrete, Geo-polymer concrete.**

1. INTRODUCTION

1.1 General

Geo polymer concrete is a concrete consisting of materials like fly ash and GGBS instead of cement, aggregates and liquids instead of water. Fly ash based Geo polymer concrete is a new material that does not need the presence of Portland cement as a binder. The role of Portland cement is replaced by low calcium Fly ash.

GGBS is a by-product by the blast furnaces used to make iron. The molten slag is rapidly chilled by quenching in water to form the sand like granulated materials. GGBS is a glassy granular, non metallic materials consisting of silicates and aluminates of calcium and other bases. GGBS is also used s a binder component in geo-polymer concrete.

High alkaline liquids are used to induce the silicon and Aluminum atoms in the source materials to dissolve and form the geo-polymeric binder. This attempt results in two benefits. i.e., effective utilization of industrial waste products such as Fly ash, GGBS etc. by decreasing the use of OPC and reducing Co2 release from production of OPC.

1.2 Stages in Polymerization Process

The polymerization process involves a substantially fast chemical reaction under highly alkaline condition on Si-Al minerals, results in a three dimensional polymeric chain and ring structure consisting of Si-O-Al-O bonds, as follow.

M n [-(SiO2) z- AlO2] n wH2O

2. LITERATURE REVIEW

2.1 Kamalesh. C. Shaha et.al studied the several factors effects on properties of fly-ash based geo-polymer concrete on compressive strength. The alkaline liquids to fly ash ratio used for experimental work is 0.40, 0.45 and 0.50. Similarly the sodium hydroxide to sodium silicate ratio is 2.0 and 2.5. Sodium hydroxide molarities used is 10M, 12M, 14M, 16M.The specimens were cured in ambient temperature of 60°C, 90°C, and 120°C. The results show that 16M specimen gives more compressive strength compared to all Molarity specimens. GPC specimens give better durability because these specimens has less Ca O content compare to Ordinary Portland cement

2.2 K. Murahari and Rama Mohan Rao 2013 studied effect of polypropylene fiber on fly ash based concrete. In this investigation they used class C fly ash replaces with cement varying in ratio of 30%, 40%, and 50% and polypropylene fibers of volume fraction 0.15%, 0.2%, 0.25% and 0.30%, in M40 grade of concrete with varying w/c ratio of0.35, 0.40, 0.45. They did an investigation for compressive strength, split tensile strength, flexural strength of concrete. From the test results they concluded that compressive strength of concrete increases gradually by addition of polypropylene fiber from 0.15% to 0.3% and even the split tensile, flexural strength also increases gradually with addition of polypropylene fiber at volume fraction of 0.15% to 0.3%.

3. OBJECTIVE

- To compare the performance study carried out with conventional concrete.
- The concrete used is eco-friendly and economical.
- To enhance the compressive strength of geo polymer concrete compare with conventional concrete without alkaline liquids using polypropylene fibers.
- To determine the split tensile strength of geo polymer concrete compare with conventional concrete without alkaline liquids using polypropylene fiber.
- To determine the Durability aspects.

4. MATERIALS AND METHODOLOGY

4.1 Materials

The materials used for manufacture of Geo-polymer concrete specimens are low-calcium class F fly ash, GGBS, River sand as fine aggregates, 20mm down size coarse aggregate, alkaline liquids of 8M (Sodium hydroxide and Sodium silicate) and water.

4.1.1 Basic tests

4.1.1.1 Normal consistency

Table -4.1

SL No.		1	2	3	4
1.	Percentage of water	28	30	32	34
2.	Initial reading	40	40	40	40
3.	Final reading	28	25	22	6

The Normal consistency of cement =34%

4.1.1.2 Setting time of cement

Table -4.2

SL No.		Time in minutes
1	Initial setting time	28 minutes
2	Final setting time	480 minutes

4.1.1.3 Specific gravity test for cement

Table-4.3

Particulars	Specific gravity
Kerosene	0.8
Cement	3.15
Fly ash	2.82
GGBS	2.9

4.1.1.4 Shape tests for coarse aggregate

Flakiness test= 10.75%

Elongation test =6.70%

4.1.2 Fly ash

It is the waste obtained as a residue from burning of coal in furnaces and locomotives. In present study class F fly ash is used, it is the burning bituminous coal, it consists of alumina and silica and has higher loss of ignition than class C fly ash and also it has lower calcium content than class C fly ash.

Fig: 4.1.2 class F fly ash

4.1.3 Ground Granulated Blast-furnace Slag (GGBS)

Ground Granulated Blast-furnace slag is a by- product of iron and steel making from a blast-furnace in water or steam,, to produce a granular , glassy product then that is dried and ground into fine powder.

Fig: 4.1.3 GGBS

4.1.4 Fine Aggregate

River sand used in the present investigation conforming to Zone II as per IS: 383-1970 specifications.

Table 4.4-Properties of river sand

Particulars	River sand
Specific gravity	2.63
Water absorption	3%
Fineness	2.4%
zone	II

4.1.5 Coarse Aggregate

Crushed stone of fraction 20mm down size aggregates on IS: 480 sieves has been used.

Table 4.5-Properties of crushed stone

Particulars	Crushed stone
Specific gravity	2.6
Bulk density	Compacted=1690Kg/m3 Loosen=1490Kg/m3
Water absorption	0.5%

4.1.6 Polypropylene fibers

Polypropylene fibers are new generation chemical fibers. The application of polypropylene fibers are increased largely because addition of polypropylene fibers in concrete improves the tensile strength, flexural strength, toughness, impact strength and also failure mode of concrete.

Table 4.6-properties of Polypropylene fiber

Particulars	Values
Tenacity	3.5-8g/den
Density	0.9g/cc
Elasticity	Very good
length	47mm
Colour	White
Moisture Regain	0%
Resiliency	Good

4.2 Mix Design

The table shows total quantities of material for 1m^3 of Area.

Table 4.2- Mix proportion

w/c	C	FA	CA
0.55	1	1.5	3

Table 4.2- Some important properties

Grade designation	M20
Type of cement	OPC 43 grade
Maximum nominal size if aggregate	20mm down size
Maximum water cement ratio	0.55
Workability	100mm slump

4.3 Methodology

4.3.1 Mixing

The solid constituents coarse aggregate, river sand, Fly ash, GGBS, Polypropylene fibers are dry mixed for 3-4 min and then water is added and this mixed for 4-5 minutes in wet.

4.3.2 Casting

Moulds are well cleaned and oiled inner surface with fully fitted. The fresh concrete was filled into the moulds using the tamping rods with three layers of compaction.

4.3.3 Curing

After casting of geo-polymer concrete cubes and cylinders are kept for rest period of 1 day without demoulding. Then the demoulded specimens were kept for sunlight curing for a period of 14 days to get its target strength. But conventional concrete specimens are kept for 28 days of water curing to get target strength.

5. TEST ON CONCRETE

5.1 Workability tests

- Slump cone test
- Compressive strength
- Split tensile strength test

6. RESULT AND DISCUSSION

6.1 General

The compressive strength tests on Geo polymer and Conventional concrete was performed using concrete cubes. Average of three specimens for the same configuration was considered. The Durability was studied in terms of Mass loss, Compressive strength, split tensile strength.

6.2 Compressive strength of Cubes

Totally Twenty one GPC cubes without Alkaline solutions, and Conventional concrete cubes were casted and cured. Three cubes from GPC and three from CC were tested adding Polypropylene Fibers. Table 6.2 shows summarized values from age of 7, 14, 28 days of curing.

Table 6.2-Compressive strength for 7 day

SL No	Type of cube	Average weight (Kg)	Average Compressive strength (N/mm2)
1	CC cube	8.64	20.02
2	GPC cube of 70G30F	7.76	7.24
3	GPC cube of 60G40F	7.28	2.37
4	GPC cube of 80G20F	7.76	2.16

Table 6.2-Compressive strength for 14 days

5	CC cubes	8.53	27.02
6	GPC cube of 70G30F	7.94	10.65
7	GPC cube of 60G40F	7.5	2.54
8	GPC cube of 80G20F	8.03	5.86

Table 6.2-Compressive strength for 28 days

9	CC cubes	8.24	40.03

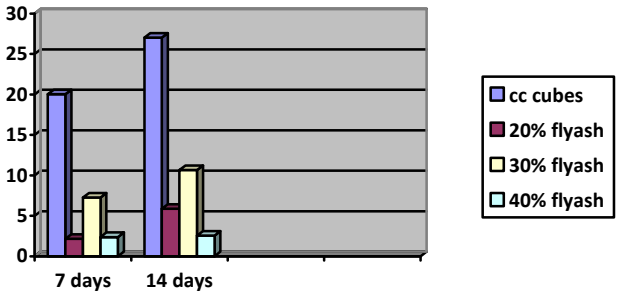

Chart-6.2-Compressive strength

6.3 Split tensile strength test

Totally twenty one cylinder are of GPC without alkaline solutions and conventional concrete were casted and cured. Table 6.3 shows the result of tensile strength.

Table 6.3-splite tensile for 7 days

SL No	Type of cubes	Average weight (Kg)	Average Compressive strength(N/mm2)
1	CC cubes	12.42	1.77
2	GPC cubes of 70G30F	12.3	0.89
3	GPC cubes of 60G40F	11.5	0.53
4	GPC cubes of 80G20F	12.64	0.67

Table 6.3 Split tensile test for 14 days

5	CC cubes	12.60	3.2
6	GPC cubes of 70G30F	12.42	1.98
7	GPC cubes of 60G40F	12.57	0.67
8	GPC cubes of 80G20F	12.54	0.92

Table 6.3 Split tensile strength for 28 days

9	CC cubes	13.1	12.4

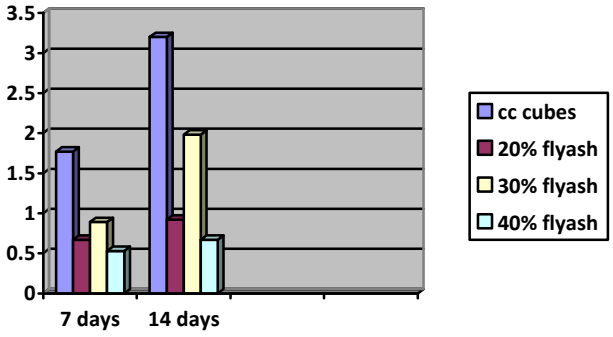

Chart 6.3- Split tensile strength

7. CONCLUSION

- Compressive strength of geo-polymer concrete of 20%, 30%, 40% fly ash for 7 days makes89.2%, 63.8%, 88.16%, difference compared to 7 days strength of conventional concrete.
- Compressive strength of geo-polymer concrete of 20%, 30%, 40% fly ash for 14 days makes 78.3%, 60.76%, 90.59% difference compared to 14 days strength of Conventional concrete.
- Split tensile strength of geo-polymer concrete of 20%, 30%, 40% of fly ash for 7 days makes 62.14%, 49.7%, 70.05% difference compared to 7 days strength of conventional concrete.
- Split tensile strength of Geo-polymer concrete of 20%, 30%, 40% of fly ash for 14 days makes 71.25%, 38.12%, 79.06% of difference compared with Conventional concrete
- Therefore, the ratio of 70GGBS 30 Fly ash without alkaline solutions gives minimum difference in strength to conventional concrete.
- As like Conventional concrete water curing is not done for GPC only sun light curing is done.

8. REFERENCE

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