www.ijemr.net ISSN (ONLINE): 2250-0758, ISSN (PRINT): 2394-6962

Volume-7, Issue-2, March-April 2017

International Journal of Engineering and Management Research

Page Number: 237-241

Strength Charasteristics of Class F Fly-Ash Based Geo Polymer Concrete

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ABSTRACT

Cement an intensive energy construction material with production increase of 5% annually. The production of one ton of cement liberates about one ton of carbon dioxide to the atmosphere. So, one way to produce eco-friendly concrete to reduce the use of Cement is by replacing fly-ash with alkaline liquids.

In this work comparison of compressive strength of Geopolymer concrete with Control concrete. Trial mix proportion the cement is fully replaced by fly-ash with alkaline liquids. Sodium silicate (Na_2Sio_3) and Sodium hydroxide (Na OH) solution are used as Alkaline liquids in different mix proportions. Concentration of Na OH was kept 8M. Both the liquids were mixed together and alkaline solution was prepared.

In this work split tensile strength and flexural strength were found. The cubes, cylinder and beam are tested at 3, 7, 14 & 28 days. And then the strength Geopolymer concrete compared with control concrete.

Keywords-- Fly ash-based geopolymer, alkaline solution, compressive strength

I. INTRODUCTION

Geopolymer concrete (GPC) is extremely different from that of ordinary concrete. In concrete instead of cement we are using fly ash and alkaline solution. we can control the emission of CO_2 which is a green house gas produced during the production of cement and fly ash which is a waste material from thermal power plants can be effectively used as a building material. In Geopolymer concrete the result of polymerization process of mineral containing Si-Al; water is released during the chemical process. Thus it is self curing concrete. By using geopolymer concrete we can reduce the emission of carbon dioxide during cement production and manufactured sand can be used in an effective manner to produce the concrete. The fly ash usage will reduce the amount of environmental pollution.

II. EXPERIMENTAL INVESTIGATION

In this work it has been added hundred percentage of Fly-ash and Alkaline liquid as a replacement of cement. Sodium silicate (Na_2Sio_3) and Sodium hydroxide (Na OH) solution were used as Alkaline liquids in different trial mix proportions. Concentration of NaOH was kept 8M. Both the liquids were mixed together and alkaline solution was prepared. Cylinders and beams were cast . The specimen's were tested at 3, 7, 14 & 28 days and then the strength Geopolymer compared with conventional concrete.

III. PROPERTIES OF MATERIALS

FLY ASH

Fly ash is one of the important substances which is required for the preparation of GPC. Class F Flyash with specific gravity 2.2 was used in this work

ALKALINE LIQUID

Sodium silicate and sodium hydroxide are used in GPC and the combinations of these solutions are called as alkaline liquid. Instead of sodium silicate and sodium hydroxide, potassium silicate and potassium hydroxide can also be used. In this work sodium silicate and sodium hydroxide where used

FINE AGGREGATE

In this work river sand with specific gravity 2.63 was used

COARSE AGGREGATE

The 12.5 mm size of aggregate with specific gravity 2.83 was used

WATER

For this preparation of GPC, locally available water was used

Mix design

Trial mix was done and alkaline to fly ash ratio was shown in table 1

Table 1 shows Mix ratio

MIX RATIO
Control concrete
Al/F=0.25
Al/F=0.28
Al/F=0.30
Al/F=0.32
Al/F=0.35
Al/F=0.38
Al/F=0.40

SPLIT TENSILE STRENGTH TEST

This test method is used for the determination of splitting tensile strength of cylindrical concrete specimen Load is found and calculated using the formula $T=2P/(\pi dl)$. 3,7,14,28 days results were shown in table 2,3,4,5

TABLE 2 3-DAYS SPLIT TENSILE STRENGTH

MIX	SPLIT TENSILE STRENGTH IN N/mm^2
	Average
Control concrete	2.20
Al/F=0.25	1.91
Al/F=0.28	2.85
Al/F=0.30	2.21
Al/F=0.32	2.73
Al/F=0.35	2.11
Al/F=0.38	1.85
Al/F=0.40	1.74

TABLE 3 7-DAYS SPLIT TENSILE STRENGTH

MIX	SPLIT TENSILE STRENGTH IN N/mm^2
	Average
Control concrete	2.72
Al/F=0.25	2.81
Al/F=0.28	2.85
Al/F=0.30	2.92
Al/F=0.32	2.98
Al/F=0.35	2.51
Al/F=0.38	2.75
Al/F=0.40	2.23

TABLE 4 14-DAYS SPLIT TENSILE STRENGTH

MIX	SPLIT TENSILE STRENGTH IN N/mm^2
	Average
Control concrete	3.64
Al/F=0.25	3.75
Al/F=0.28	3.42
Al/F=0.30	3.67
Al/F=0.32	3.69
Al/F=0.35	3.58
Al/F=0.38	3.36
Al/F=0.40	3.24

TABLE 5 28-DAYS SPLIT TENSILE STRENGTH

MIX	SPLIT TENSILE STRENGTH IN N/mm^2
	Average
Control concrete	4.60
Al/F=0.25	4.31
Al/F=0.28	4.25
Al/F=0.30	4.42
Al/F=0.32	4.78
Al/F=0.35	4.41
Al/F=0.38	4.24
Al/F=0.40	4.18

FLEXURAL STRENGTH TEST

- Beam mould of size 15 x 15x 70cm was used to cast specimen and find the flexural properties. Curing was done for 3,7,14,28 days . results were tabulated in table 6,7,8,9

TABLE 6 3-DAYS FLEXURAL STRENGTH

MIX	FLEXURAL STRENGTH IN N/mm^2
	Average
Control concrete	3.5
Al/F=0.25	3.8
Al/F=0.28	3.3
Al/F=0.30	3.1

Al/F=0.32	3.8
Al/F=0.35	3.6
Al/F=0.38	3.0
Al/F=0.40	2.9

TABLE 7 7-DAYS FLEXURAL STRENGTH

MIX	**FLEXURAL STRENGTH IN N/mm^2**
	Average
Control concrete	4.2
Al/F=0.25	4.0
Al/F=0.28	4.1
Al/F=0.30	3.9
Al/F=0.32	4.9
Al/F=0.35	4.4
Al/F=0.38	4.2
Al/F=0.40	3.8

TABLE 8 14-DAYS FLEXURAL STRENGTH

MIX	**FLEXURAL STRENGTH IN N/mm^2**
	Average
Control concrete	5.6
Al/F=0.25	5.1
Al/F=0.28	5.2
Al/F=0.30	5.5
Al/F=0.32	5.8
Al/F=0.35	4.9
Al/F=0.38	4.6
Al/F=0.40	4.4

TABLE 9 28-DAYS FLEXURAL STRENGTH

MIX	**FLEXURAL STRENGTH IN N/mm^2**
	Average
Control concrete	6.1
Al/F=0.25	5.4
Al/F=0.28	5.7
Al/F=0.30	5.9

Al/F=0.32	6.6
Al/F=0.35	6.3
Al/F=0.38	6.0
Al/F=0.40	5.6

Here the optimum condition is given by the 0.32 mix proportion of GPC for all the four curing periods of control concrete sample.

This proves that GPC can be a viable and reliable alternative for OPC Concrete. Split tensile strength for 0.32 proportions gives good strength. Flexural strength was also found to be increasing in 0.32 proportions

IV. CONCLUSION

In Geopolymer concrete (Alkaline liquid /fly ash = 0.32) the maximum strength was obtained.

The compressive strength, Split tensile strength and flexural strength of Geopolymer concrete increased up to Alkaline liquid to fly ash ratio 0.32 and then decreased.

The compressive strength of Geopolymer concrete in Alkaline liquid to fly ash ratio 0.32 increase over controlled concrete.

Split tensile strength and flexural strength was found to be good when compared to control concrete

Effective use of Class F Fly-Ash can reduce pollution, energy consumption and saves the Environment. If the cost of the alkaline liquids gets reduced in our country, like the foreign countries, we can use GPC effectively.

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