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A Review on properties of Geo-polymer concrete

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Abstract—*Concrete demand is increased day by day due to increase in infrastructure development and construction industries and Ordinary Portland Cement (OPC) is conventionally used as the binder to produce concrete hence the consumption of Cement is also increased. But the environment effect associated with the OPC is also well known. About 1 ton production of cement produce 1 ton of co2 in atmosphere which adversely affect the environment. Hence there is a need of using a alternate binder to make concrete which is eco- friendly. Hence an effort has been made to make new generation concrete called "GEOPOLYMER CONCRETE" synthesized from the materials of geological origin or by product such as fly ash which is rich in silica and aluminium and Alkali solutions which act as a binder to bind fine and coarse aggregate together.*

Keywords- *Fly ash, Alkali solution, Strength, Durability, Economy, Structural application*

I. INTRODUCTION

Concrete is the most common used construction material its usage by the communities across the globe is second only to water. Customarily concrete is produced by using the Ordinary Portland Cement as binder. The usage of OPC is on increasing in future due to increase in infrastructure development. It is well known that cement production deplets significant amount of natural resources and release large volume of carbon dioxide which adversely affect the atmosphere and also the production of cement is high energy intensive. Hence effort has been made to make environmentally friendly concrete called "GEOPOLYMER CONCRETE" by replacing the Portland cement in concrete with bye-product generated from coal burning power generation like fly ash which is rich in silica and aluminium and Alkali solution like sodium hydroxide/potassium hydroxide and sodium silicate/potassium silicate. The term "GEOPOLYMER CONCRETE" is first introduce by Davidovits in 1978 to describe a family of mineral binders with chemical composition similar to zeolites but with an amorphous microstructure. The fly ash which is rich in silica and aluminium react with sodium hydroxide/potassium hydroxide and sodium silicate/potassium silicate to form a gel which bind the fine and coarse aggregate. The polymerisation process involve a substantially fast chemical reaction under alkali condition of Si-Ai minerals ; that results in three dimensional polymeric chain and ring structure consisting of Si-O-Al-O bond.

$$Mn\,[-(SiO2)\,z–AlO2]\,n\,.\,wH2O$$

Where M is a monovalent cation such as potassium or sodium, the symbol " –" indicates the presence of bond , n is the degree of poly-condensation and z is 1,2,3 or higher as reported by (Hardijito D, Wallah)(1) The schematic formation of geopolymer materials can be shown in fig 1, as described equation (A) and (B).[1]

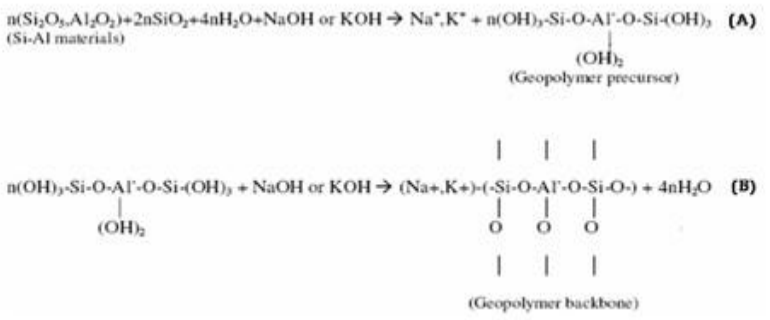

Fig. 1 schematic formation of geopolymer materials

II. LITERATURE REVIEW

A. C.D. Budh and N.R. Warhade, "EFFECT OF MOLARITY ON COMPRESSION OF GEOPOLYMER CONCRETE, " INTERNATIONAL JOURNAL OF CIVIL ENGINEERING, VOI,5, NUMBER 1 (2014)

C.D. Budh and N.R. Warhade, "Effect of Molarity on Compression of Geopolymer Concrete" they investigated the effect of Molarity on compression strength of geopolymer concrete. Test has been carried out on 70mm *70mm cubes of geopolymer concrete specimen with different Molarity like 8M, 10M, 12M, 14M. The ratio of alkali liquid to fly ash is taken as 0.5 and curing temperature maintained at 85c for 48 hour in hot air oven. The compression strength of each sample has been carried out and validated by NDT results. They had found out that morality increase the compression strength and UPV also increase. The UPV result for different molarity are 2.48km/s, 2.58km/s, 2.64km/s, 2.85km/s and compression strength are 14.34N/mm2, 19.67N/mm2, 22.00N/mm2, 24.67N/mm2.

Table.1 Ultra sonic pulse velocity after 48hours of hot curing at 85c.

Sample	8M	10M	12M	14M
UPV(km/s)	2.48	2.58	2.64	2.85

Table.2 Compression strength of geopolymer concrete at 48 hours.

Samples	8M	10M	12M	14M
COMPRESSION STRENGTH($N/mm^{2)}$	14.34	19.67	22.00	24.67

B. AMOL A. PATIL, H.S. CHORE AND P.A. DODE, "INVESTIGATED THE EFFECT OF CURING CONDITION ON STRENGTH OF GEOPOLYMER CONCRETE", ADVANCE IN CONCRETE CONSTRUCTION, VOL.2, NO.1 (2014)

AMOL A. PATIL, H.S. CHORE AND P.A. DODE "Effect of curing condition on strength of geopolymer concrete" In these experiment concrete cubes were casted and cured for 7 and 28 days for Ambient curing and Hot curing. They concluded from the result that compression strength is on higher side with respect to Hot curing as compared to Ambient curing.

Table. 3 Value of compression strength($N/mm^{2)}$ for various curing conditions

Curing period	Ambient curing	Hot curing
7 days	3.8	26.18
	4.1	25.45
	3.9	26.64
28 days	17.34	36.12
	17.6	35.98
	17.56	36.48

C. NEETA SINGH, SAMEER VYAS, R.P. PATHAK, PANKAJ SHARMA, N.V. MAHURE, "INVESTIGATED THE EFFECT OF AGGRESIVE CHEMICAL ENVIRONMENT ON DURABILITY OF GEOPOLYMER CONCRETET",INTERNATIONAL JOURNAL OF ENGGINERING AND INNOVATIVE TECHNOLOGY", VOL.3, ISSUE.4, OCT 2013.

NEETA SINGH, SAMEER VYAS, R.P. PATHAK, PANKAJ SHARMA, N.V. MAHURE, "Effect Of Aggressive Chemical Environment On Durability Of Geopolymer Concrete" The GPC and OPC cube were cast and immersed in 0.005M and 0.05M sulphuric acid, 10% sodium sulphate solution and 10% sodium chloride solution for test period of 30, 60 , 90 days. Then all the specimen were tested for compression strength and %loss of weight are studied. The test result show that geopolymer concrete has excellent resistant to sulphate and acid attack as compared OPC. The % wt loss and compression strength after immersion in above acid is also less for GPC as compared to OPC.

D. RUBY ABRAHAM, DEEPA RAJ S, VARGHASE ABRAHAM, "THEY CARRIED OUT A EXPERIMENTAL WORK TO DETERMINE THE FLEXURAL BEHAVIUIOR OF GEOPLYMER CONCRETE BEAMS WITH COVENTIONAL CONCRETE BEAMS OF SAME GRADE", "INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN SCIENCE ENGGINERING AND

TECHNOLOGY", VOL.2, ISSUE 1, DEC 2013

RUBY ABRAHAM, DEEPA RAJ S, VARGHASE ABRAHAM, "they carried out experimental work to determine the flexural behaviour of geopolymer conceret and conventional concrete" A total of twenty beams consisting of twelve GPC beam specimens and eight PCC beams specimens were considered in study. The beam were designed as under reinforced with tensile reinforcement ratio 0.55%, 0.83%, 1.02%, 1.3%. The beam were tested under two point monotonic loading. Performance aspect such as load carrying capacity, first crack load, load deflection behavior, crack width, crack spacing and mode of failure of both types of beams were studied. The test result showed that the geopolymer concrete exhibit better performance compared to conventional concrete of same grade.

E. STENNIE EDWARD WALLAH, "INVESTIGATED THE RESULT OF EXPAN EXPERIMENTAL STUDY ON DRY SHRINKAGE AND CREEP BEHAVIUOR OF FLY ASH BASED GEOPOLYMER CONCRETE", "MODERN APPLIED SCIENCE RUBY ABRAHAM", VOL.3, NO. 12, DEC 2009.

STENNIE EDWARD WALLAH, "investigated the result of an experiment study on dry shrinkage and creep behaviour of fly ash based geopolymer concrete". The test result then compared with the calculated results of drying shrinkage and creep as predicated by Gilbert Method which is normally used for ordinary Portland cement concrete. Results of the investigation indicated that fly ash based geopolymer concrete undergoes very little drying shrinkage and low creep.

III. DISCUSSION

Based on various literature review, it is observed that Fly ash based Geopolymer concrete is a new era in the construction industries. It posses good compression strength, flexural strength, durability, very little drying shrinkage and low creep, economy and eco friendly compared to Ordinary Portland Cement. Hence it is suitable for various infrastructure and structural application.

IV. CONCLUSION

Based on various literature review it could be conclude that:

1) The effect of Molarity of NaOH, Curing effect, Curing temperature and Curing duration has significant effect on strength of geopolymer concrete.

2) Fly ash-based geopolymer concrete has excellent compression strength and suitable for structural application.

3) Due to high early strength Geopolymer concrete shall be effectively used in precast industries, so that huge production is possible in short duration and breakage during transportation shall also be minimized.

4) Fly ash based geopolymer concrete has an excellent resistance against sulphate and acid attack. Hence it is suitable in sea water area.

5) The geopolymer concrete shall be effectively used for some retrofitting work and beam column junction of reinforced concrete structure.

6) It reduces the amount of cement hence it is cost effective.

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