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"PRODUCTION OF GEOPOLYMER CONCRETE USING FLY ASH"

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***Abstract*— Concrete industry is growing rapidly. With it the availability of new materials for construction work is needed. Different types of concrete such as self compacting concrete, polypropylene fibre reinforced concrete is a new addition to it. In the present study an attempt has been made to produce geopolymer concrete by using fly ash and for activating it a solution of a combination of sodium silicate and sodium hydroxide of 8 M and 14 M is used**

Keywords :*Geopolymer concrete, Molarity, NaOH Solution, *Compression, Split Tensile, Flexural Strength

I. INTRODUCTION

Geopolymer concrete is a new addition to concrete industry. The main advantage of it is it does not need Portland cement as binding material. However it requires other admixtures such as silicon, fly ash and aluminium by using alkaline liquids without using Portland cement

In this paper an attempt has been made to produce geopolymer concrete by using fly ash. Although there is limited literature available on this the method of trial and error is being employed in this study. The various parameters affecting the production of geopolymer concrete are studied in detail. Fly ash is used as a primary material for activation of geopolmerization process. In order to activate fly, Silicon and Aluminium content a combination of sodium silicate and sodium hydroxide is used

II. LITERATURE REVIEW

In this case, concrete binder can be produced without using any OPC; in other words, the role of OPC can be totally replaced by the activated fly ash. Palomo et al (1999) described two different models of the activation of fly ash or other by-product materials.

A well known example of the first model is the activation of blast furnace slag, which has a long history in the former Soviet Union, Scandinavia and Eastern Europe (Roy 1999).
On the other hand, studies on the second model are limited (Palomo, Grutzeck et al. 1999). Many aspects of the material characteristics and reaction mechanisms are still not clear. For the second model, Davidovits (1999) coined the term Geopolymer in 1978 to describe the alkali activated material from geological origin or by-product materials such as fly ash and rice husk ash.
Geopolymers are a member of the family of inorganic polymers, and are a chain structures formed on a backbone of Al and **Si** ions.

III.EXPERIMENTAL PROGRAMME

3.1 Materials used

In this experimental study, cement, aggregates, water, fly ash, alkaline activators are used.

Fly Ash
In the present experimental work, low calcium, Class F dry fly ash was used as the base material. Three different batches of fly ash were used; the first batch was obtained in the beginning, the second batch in the middle, and the last batch was obtained in last of the experimental work.

Alkaline Activators
sodium hydroxide and sodium silicate was chosen as the alkaline activators.

Aggregates
Aggregates currently used by the local concrete industry and Asphalt were used. Both coarse and fine aggregates were in saturated surface dry (SSD) condition.

Super plasticiser

To improve the workability of the fresh geopolymer concrete, a naphthalene sulphonate super plasticiser in liquid form, under the brand name of Rheobuild 1000, was used in nearly all cases. Another type of super plasticiser, a polycarboxylic ether hyper plasticiser in liquid form, under the brand name of Glenium 27, this type of super plasticiser was not used due to the cost.

Water

Potable water free from impurities was used.

IV. EXPERIMENTAL METHODOLOGY

The test specimens in this study were mainly of 100x200 mm cylinders; larger size 150x300 mm cylinders were used to measure the indirect splitting tensile strength. 8 M and 16 M sodium hydroxide was used. The solution to fly ash ratio by mass was approximately 0.35 in most cases, except for the Mixtures with extra-added water.

In order to study the effect of mixture composition on the compressive strength of fly ash-based geopolymer concrete, the test variables were the H2O-to-Na2O molar ratio in the range between 10.00 and 14.00, and the Na2O-to-SiO2 molar ratio between 0.095 and 0.120. These ranges of variable were selected after several trials. Outside these ranges, geopolymer concrete mixtures were either too dry for handling or too wet causing segregation of aggregates. For these ranges of variables, the water to geopolymer solids ratio by mass in the geopolymer paste varied from 0.17 to 0.22.

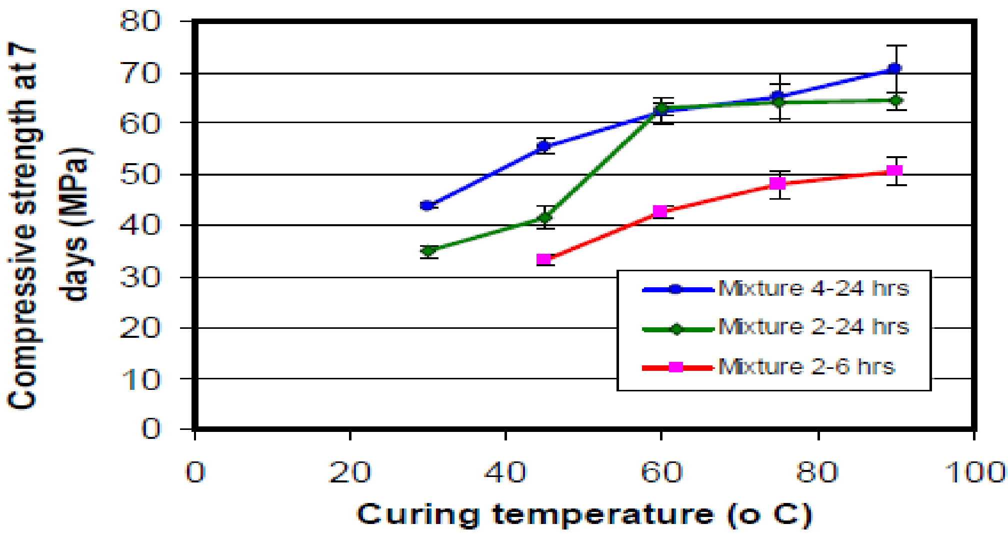
The mass of naphthalene sulphonate-based super plasticiser varied from 0% to 4% of the mass of fly ash. Workability was measured by the conventional slump test.The influence of water content on the slump value was also studied by varying the mass of extra water added to a reference mixture in the range of 0 to 26.5 kg/m3.

The range mixing time studied was between two and sixteen minutes.For curing, temperature ranges from 30 deg C to 90 deg C were studied. The curing time ranged from four hours to four days, either in the dry curing environment in the oven or in the steam curing chamber. The influence of age at test was studied up to the age of 90 days

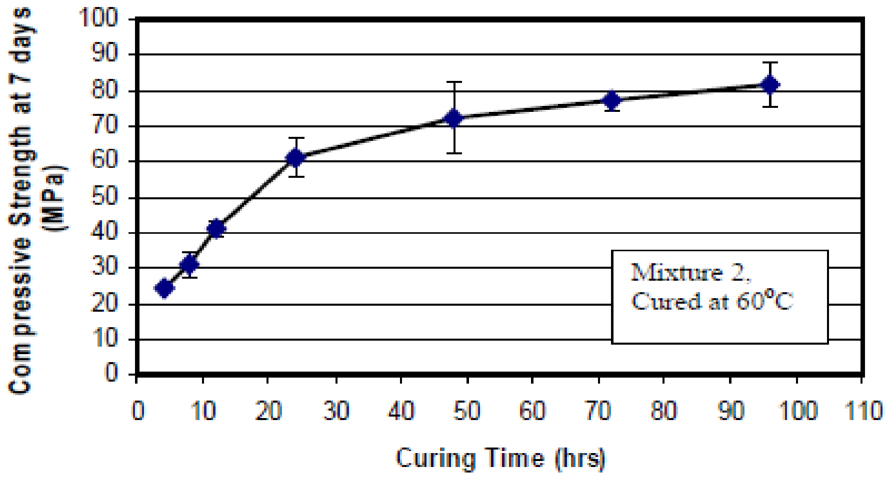
V.RESULTS AND DISCUSSIONS

Table 4.9: Mixtures 1 to 4

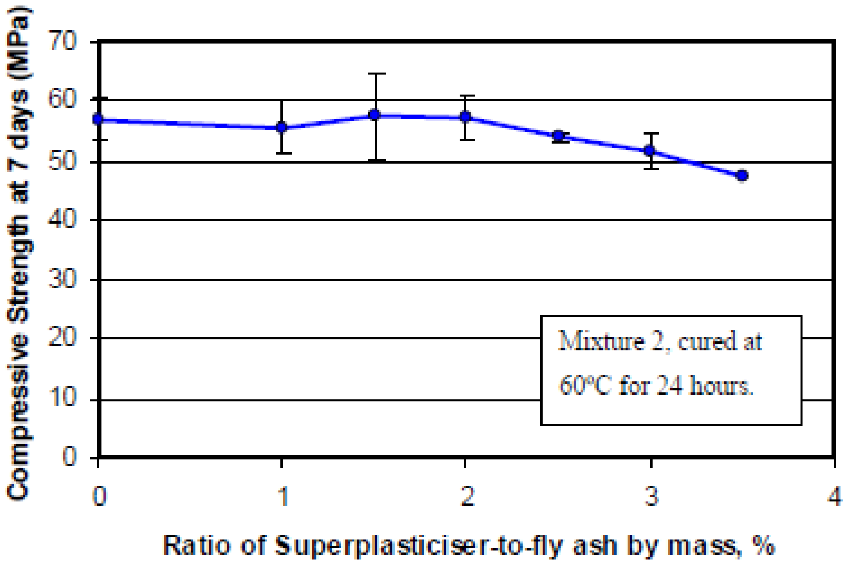
Mixture	Concentration of NaOH liquid (in Molars)	Ratio of sodium silicate to NaOH solution (by mass)	Compressive strength at 7th day (MPa)
			Cured for 24 hours at 60°C
1	8M	0.4	17
2	8M	2.5	57
3	14M	0.4	48
4	14M	2.5	67



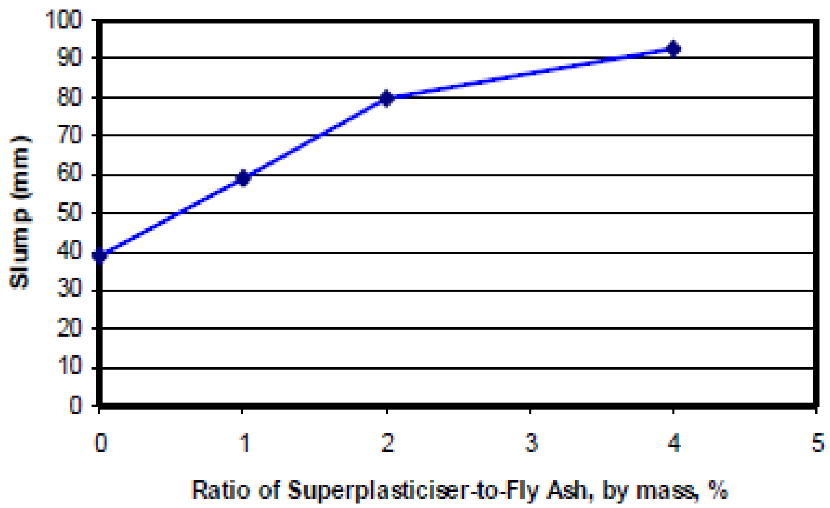
Graph 5.1: Compressive strength Vs curing temperature (Mixture 1)



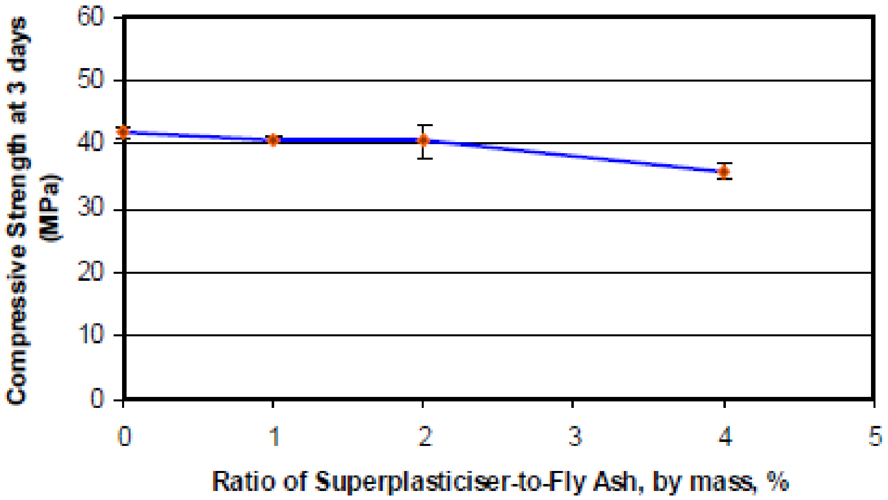
Graph 5.2: Compressive Strength Vs Curing Time (Mixture 2)



Graph 5.3: Compressive Strength Vs Super plasticiser



Graph 5.4: Slump of Concrete Vs Superplasticiser Content



Graph 5.5: Compressive Strength Vs Super plasticiser Content

VI CONCLUSIONS

1.Mix containing higher molarity solution of sodium hydroxide gives maximum values of geopolymer concrete
2.Mix containing higher ratio of sodium silicate-to-sodium hydroxide ratio by mass gives maximum values of fly ash based geopolymer concrete
3. With increase in temperature from 30^0 C to 90 there is a considerable increase in the compressive strength of geopolymer concrete
4. With increase in curing time from 4 hours to 96 hours produces higher compressive strength of fly ash-based geopolymer concrete
5. The optimum dosage of superplasticizer was found to be 4% which gives maximum value of compressive strength

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