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EXPERIMENTAL STUDIES ON BEHAVIOUR OF GEOPOLYMER CONCRETE

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Abstract- *In the construction industry mainly the production of cement has increased carbon dioxide emissions into the atmosphere results in environmental pollution. We can reduce the pollution effect on environment, by increasing the usage of industrial by-products in our construction industry. The effort which we used is to produce more environmentally friendly concrete is the development of inorganic alumino-silicate polymer, called geopolymer, synthesized from materials of geological origin or by-product materials such as fly ash and ground granulated blast furnace slag that are rich in silicon and aluminum. In the present study, to produce the geo-polymer concrete the Ordinary Portland cement is fully replaced with fly ash and ground granulated blast furnace slag (GGBS) and alkaline liquids are used for the binding of materials. To increase the strength and workability we have added the super plasticizer that is Conplast sp430.*

Key Words: Geopolymer concrete, Fly ash, GGBS, Alkaline solution etc...

1. INTRODUCTION

The production of ton of cement emits approximately a ton of carbon dioxide to atmosphere where the use of geo polymer concrete reduces the carbon considerably as compared to ordinary Portland cement. One ton of carbon dioxide is estimated to be released to the atmosphere when one ton of ordinary Portland cement is manufactured. Also the emission by cement manufacturing process contributes 7 – 8% to the global carbon dioxide emission. It is important to find an alternate binder which has less carbon footprint than cement. The geo polymer technology is proposed by Davidovits and gives considerable promise for application in concrete industry as an alternative binder to the Portland cement concrete is the second most used material in the world after water. In this technology, the source material that is rich in silicon (Si) and Aluminium (Al) is reacted with a highly alkaline solution through the process of geo polymerization to produce the binding material. Geopolymer concrete is made from the waste materials such as fly ash and GGBS. Geopolymer concrete possess better engineering properties like higher compressive strength, split tensile strength, fire resistance, modulus of elasticity, flexural strength. The drying shrinkage is much less when compared to cement concrete and also it has low heat of hydration in comparison with OPC concrete. Geopolymer concrete have more creep resistance, sulphate resistance, sulfuric acid resistance than OPC concrete.

1.1 Fly Ash

Fly ash is defined as "the finely divided residue that produce from the combustion of ground or powdered coal and that is transported by flue gases from the combustion zone to the particle removal system". Low-calcium (ASTM Class F) fly ash is preferred as a source material than high calcium (ASTM Class C) fly ash. The presence of calcium in high amount may interfere with the polymerization process and alter the microstructure. Low calcium fly ash has been successfully used to manufacture geopolymer concrete when the silicon and aluminum oxides constituted about 80% by mass, with Si to Al ratio of about 2.

1.2 GROUND GRANULATED BLAST FURNCE SLAG

GGBS is a by-product from the blast furnace used for iron manufacturing, about 1500˚C coke, iron ore and limestone are fed into the furnace. By the above process molten iron is formed at the bottom of the blast furnace, on the top surface molten iron molten slag is formed and this slag is taken out from the furnace and rapid quenching with water is done after that it forms like granulated slag and this slag is grinded, after this process ground granulated blast furnace slag (GGBS) is formed. GGBS is used as a direct replacement for Portland cement, on a one-to-one basis by weight. Replacement levels for GGBS vary from 30% to up to 85%. Typically 40 to 50% is used in most instances.

2. MATERIALS USED

2.1.1 Ground granulated blast furnace slag (GGBS) The samples is analysed for specific gravity, fineness and wet analysis through a 45 micron.

Table 1 Physical properties of GGBS

SI. no.	TEST	RESULT
1.	Specific gravity of GGBS	2.85
2.	Fineness by Blaine's air permeability	321 m^2/kg
3.	Wet Analysis % retained on 45micron	2.9%

2.1.2 Fly Ash

The fly ash sample was collected from Chandrapura Thermal Power Station. The sample is analysed for bulk density, moisture content, specific gravity, fineness

Table 2 Physical properties of Fly ash

S.No.	Property	Value
1	Specific gravity	2.40
2	Fineness	390
3	Bulk density	920 m^2/kg

2.1.3 Coarse aggregate

Locally available crushed stone aggregate with maximum grain size of 20 mm down will be used as per IS 383-1970.

Table 3 Tests of Coarse aggregate

S.NO	Property	Value
1	Specific gravity	2.79
2	Impact value	16.0%
3	Crushing value	23.43%
4	Fineness modulus	6.62

2.1.4 Fine aggregate

The locally available river sand, passing through 4.75 mm was used in this experimental work. The properties of fine aggregate were determined as per IS 2386-1963.

Table 4 Tests of fine aggregate

S.NO	Property	Value
1	Specific gravity	2.54
2	Fineness modulus	3.07(Zone II)
3	Water absorption	0.60%

2.1.5 Alkaline solution

In this project, we have used two solutions that is Sodium Silicate Solution and Sodium Hydroxide pellets. In geo polymer concrete we have used this as alkaline solution to give better strength in the concrete and have better and good durability.For the project, we have used a formula that says the number of quantity of solution to be used for a proportion.

Sodium Silicate Solution ⁄ Sodium Hydroxide pellets =2.5

2.1.6 Chemical admixture

In our project we have used a admixture by name CONPLAST SP430. It improves the workability of fresh concrete. This admixture is specifically formulated to give high water reduction up to 25% without loss of workability or to produce high quality concrete of reduced permeability. . It has specific gravity value of 1.20 – 1.21 at 300 C.

3. TEST AND RESULT

3.1 Test on fresh Geopolymer concrete

Workability Test

The workability of the fresh concrete was measured by means of the conventional slump test as per IS: 1199(1989). Before the fresh concrete was cast into moulds, the slump value of the fresh concrete was measured using slump cone. In this project work, the slump value of the fresh GPC was 100mm.

3.2 Tests on Harden Geo polymer concrete

3.2.1 Compressive Strength

Cubical specimens of size 150mm x 150mm x 150mm was casted and tested for the compressive strength at the age of 7days and 28days.

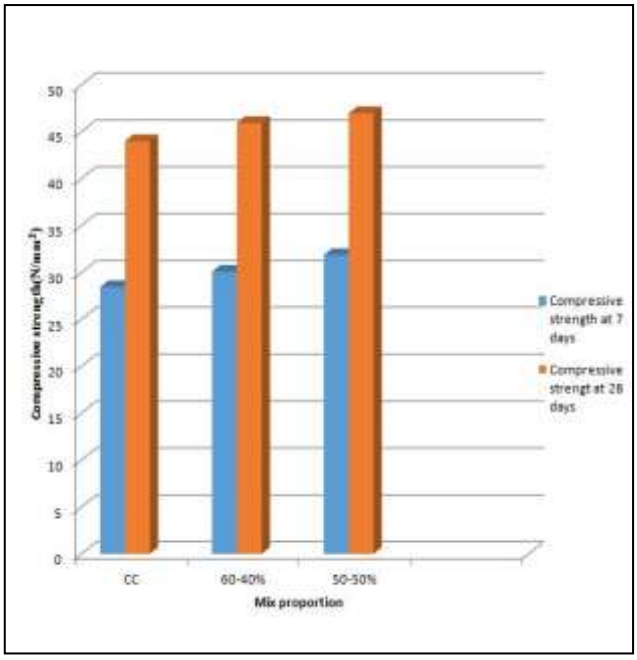

Fig. 3.2 Compressive strength variation at 7 & 28 days

3.2.2 Flexural Strength Test

Beams size 100mm100mm500mm casted and tested for the flexural strength at the age of 7and 28days and using 200KN universal testing machine.

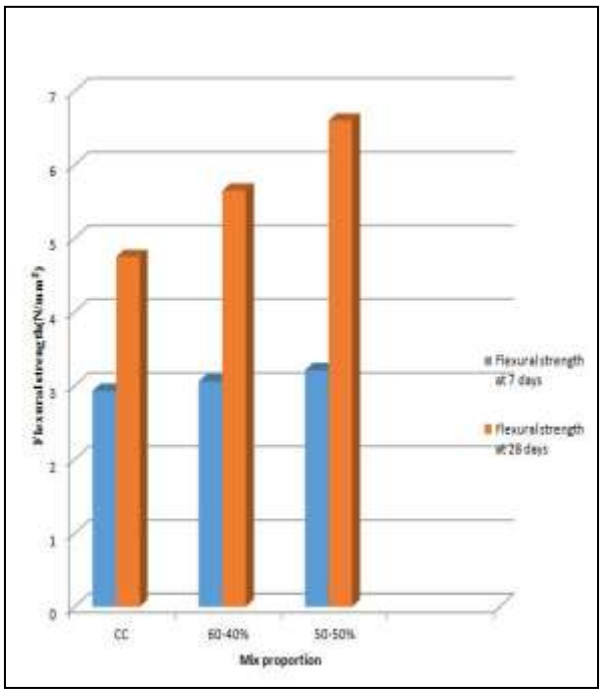

Fig. 3.2 Flexural strength variation at 7 & 28 days

3.2.3 Split Tensile Test.

Cylindrical moulds of size 150mm diameter and 300mm height casted and tested for the flexuralstrength at the age of 7days and 28days.

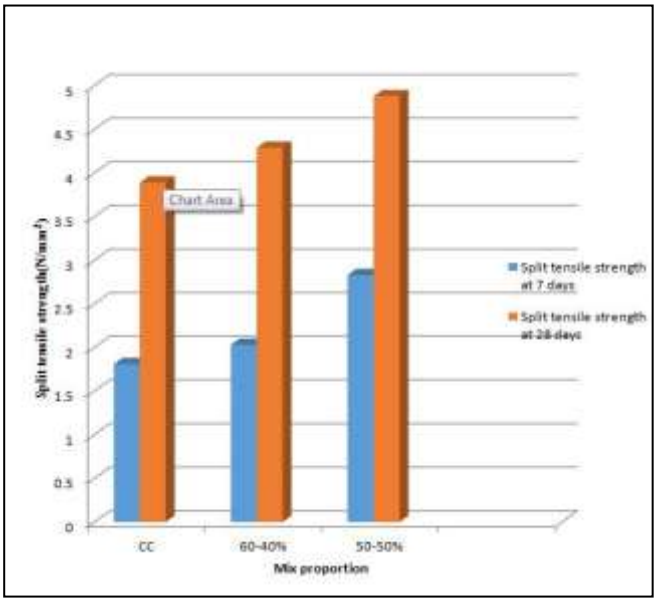

Fig.3.3 Split tensile strength variation at 7 & 28 days

4. CONCLUSIONS

1 By using the super plasticizer, the strength of the concrete increase as seen in one of the study of geo polymer concrete.
2 By this study, we can say that using the optimum usage of water content and alkaline solutions the strength of the concrete can be increased.
3 Geo polymer concrete made from Fly ash and GGBS requires less sodium silicate solution in order be activated.
4 Saving the environmental natural resources, its sustainability, cost and production, its maintenance and other geo polymer concrete properties. We can say recommend it as a innovative material for construction purpose.

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REFERENCES

[1] Boopalan.C and Rajamane. N.P.,(2017), An Investigation of Bond Strength of Reinforcing Bars in Fly Ash and GGBS Based Geopolymer Concrete, MATEC Web of Conferences 97.
[2] Rajarajeswari.A and Dhinakaran.G, (2016),Compressive Strength of Thermal Cured GGBFS Based Geopolymer Concrete, Asian Journal Of Civil Engineering (BHRC) vol. 17, no. 3, pp. 347-355.
[3] S. Marathe, Mithanthaya, N. Bhavani, A Review on Strength and Durability Studies on Geopolymer Concrete, Vol. 5, Special Issue 9, May 2016.
[4] IS 10262-2009, Indian Standard Concrete Mix Proportioning- guidelines (First Revision)
[5] IS: 5816-1970 Method of test for splitting tensile strength of concrete cylinders.
[6] IS: 383-1970, Indian Standard specification for coarse and fine aggregates from natural sources for concrete (Second Revision).
[7] Shetty, M.S. (2009) “Concrete technology”, Third Edition,S.Chand Publishers, New Delhi.

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