International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878 (Online), Volume-8 Issue-4, November 2019

Behavior of Geo-Polymer Concrete by using Fly Ash and GGBS

K.Madhan Gopal, G.Sreenivasulu, C.Sashidhar, D.V.Prudhvi Raj

Abstract*: Today the Serious issue, the world is confronting is the ecological contamination. In the development business primarily the generation of Portland concrete will causes the emanation of toxins which brings about high ecological contamination. But as we all known that Cement is the most consumed product in the world.And, 7% of the global carbon dioxide is going to be emitted by this process. Thus, we can diminish the contamination impact on condition, by expanding the utilization of modern side-effects in our development industry. Subsequently, Geopolymer concrete (GPC) is a unique kind of more eco-friendlier solid option in contrast to Ordinary Portland Cement (OPC) concrete. The main aim of this project is to study of effect of class F fly ash (FA) and ground granulated blast furnace slag (GGBS) of geopolymer concrete (GPC) mechanical properties at different replacement levels (MIX-1: FA100%-GGBS0%,MIX-2: FA75%-GGBS25%, MIX-3: FA50%-GGBS50%, MIX-4: FA25%-GGBS75%,MIX-5: FA0%-GGBS100%) utilizing Sodium silicate (Na2SiO3) and sodium hydroxide (NaOH) arrangements as an antacid activators.By considering diverse molaritys of sodium hydroxide asan alkaline activators.By considering different molaritys of sodium hydroxide as 0M,5M & 10M.And the Specimens were casted and cured for different curing periods at ambient room temperature to decide the GPC mechanical properties viz. compressive, split tractable and flexural quality. Test outcomes shows that so an expansion in GGBS substitution it will improve the mechanical properties of GPC at all ages at surrounding room temperature.

***Keywords* : Geopolymer concrete; FA, GGBS, Mechanical properties**

I. INTRODUCTION

We as a whole realized that, the most generally utilized development material is Concrete. The generation of Portland bond making a significant commitment emanation of carbon dioxide.

Manuscript published on November 30, 2019.
* Correspondence Author
K.Madhan Gopal*, Research Scholar in Department of Civil Engineering, JNTUA, Andhra Pradesh, India.
Dr.G.Sreenivasulu, professor, Department of civil engineering, RGMCET, Andhra Pradesh, India.
Dr.C.Sashidhar , professor in JNTUA, Ananthapuramu, Andhra Pradesh, India.
D.V.Prudhvi Raj, PG Student, Department of Civil Engineering, RGMCET, Andhra Pradesh, India.

The a worldwide temperature alteration is brought about by the emanation of ozone depleting substances, for example, carbon-dioxides and so forth. Among the ozone depleting substances, carbon-di-oxide they contributes about 65% of a worldwide temperature alteration. Since from past years, Many endeavors are being made so as to decrease the these sort of issues. These endeavors incorporate the valuable use of establishing materials, for example, fly debris, silica rage, granulated impact heater slag, rice-husk debris and metakaolin, and discovering some other elective fasteners to Portland bond. As far as decreasing
the a dangerous atmospheric devation, the geo-polymer innovation would diminish the carbon-di-oxide outflow to the climate brought about by Cement about 85%. In this undertaking ,the fundamental exertion was made by to think about the distinctive quality parameters of geo-polymer concrete.

A. 'Geopolymer':-

Davidovits , The term ''Geopolymer'' was first introduced to the world by him and he is from France. He discovered a new field of research and technology. It is also known as 'inorganic polymer', which has emerged as a 'green' binder with various potentials for to manufacture sustainable materials for environmental, refractory and various construction applications.

B. Geo-Polymer Concrete Properties:-

These are inorganic fasteners, which are recognized by the accompanying diverse fundamental properties:
Relieving time and restoring temperature depends Compressive quality. As the relieving time and temperature expands, the compressive quality increments.Protection from consumption, since no limestone is utilized as a material, Geopolymer bond includes phenomenal properties inside both corrosive and salt conditions. It is particularly entirely appropriate for different intense diverse ecological conditions. Geopolymer materials gives better toughness and warm strength attributes..

C. Geo-Polymer Concrete Features:

- Geopolymer concrete reduce the CO_2 emissions of geopoland to ymer.
- Acceptable mechanical behaviour.
- High Durability property.
- Eco-Friendly.
- Less Water absorption.

D. Need For The Study:

- To find an alternative for the OPC
- To provide high strength concrete.

II. REVIEW OF LITERATURE

A. General:

In this section investigation of geo-polymer concrete and the use of are talked about utilizing following exploration articles are displayed

B. Geo-Polymers:

In 1978, Davidovits et al recommended that an antacid fluid could be utilized to respond with the silicon (Si) and the aluminum (Al) in a source material of various land root or in result materials, for example, fly debris and GGBS for delivering fasteners.

III. MATERIALS

A. Materials Used:

- ✓FA.
- ✓ (GGBS).
- ✓Chemicals -Sodium hydroxide & Sodium silicate.
- ✓Super-plasticizer.
- ✓Fine & Coarse aggregate.

B. Fly Ash:

Fly debris, the most plenteous material on this Earth. It assumes an essential job as a fixing in the production of geopolymer solid procedure. A pozzolan is a sort of material that can shows different cementitious properties when joined with the calcium hydroxide. The fundamental result of influenza debris made from the ignition of coal in coal-terminated power plants. There are two sorts classes of fly debris, Class F and Class C. Each class of fly debris has its own special properties. The following are chemical composition of fly ash which are shown in the table-1.

Table-1 Chemical Properties of flyash

OXIDES	PERCENTAGE (%)
Sio_2	52.0
Al_2o_3	33.9
Fe_2o_3	4.0
Cao	1.2
K_2o	0.83
Na_2o	0.27
Mgo	0.81
So_3	0.28
LOI	6.23
$Sio_{2/Al2o3}$	1.5

C. Ground Granulated Blast Furnace Slag:

Ground granulated impact heater slag contains for the most part of calcium oxide, silicon dioxide, aluminum oxide, magnesium oxide. It has indistinguishable fundamental compound constituents from like a standard portland bond yet in various sort of extents. What's more, the expansion of G.G.B.S in Geo-Polymer Concrete builds the quality of the solid and furthermore restoring of Geo-Polymer concrete at room temperature is conceivable.

Table-2 Chemical Properties of cement @ GGBS

Chemical Constitution	Cement (%)	GGBS (%)
Cao	65	40
Sio_2	20	35
Al_2o_3	5	10
Mgo	2	8

Table-3 Physical Properties of Fly Ash & GGBS

S.No	Material	Name Of The Test	Result
1.	Fly Ash	Specific Gravity	2.60
2.	GGBS	Specific Gravity	2.84

E. Alkaline Liquid:

It's a blend of basic silicate arrangement and basic hydroxide arrangement which was picked as the basic fluid. In this way, these sort of Sodium-based arrangements were picked in light of the fact that they were less expensive than Potassium-based arrangements.

F. Sodium Hydroxide:

The sodium hydroxide solids accessible in pellets structure. (NaOH) arrangement was set up by dissolving in water. Sodium hydroxide arrangement with a centralization of 5M comprised of 5x40 = 200 grams of sodium hydroxide solids (in pellet structure) per liter of the arrangement, where 40 is the atomic load of sodium hydroxide.

G. Sodium Silicate:

Sodium silicate arrangement which was gotten so from nearby providers was utilized in this undertaking. The concoction arrangement of the sodium silicate arrangement was Na_2O=8%, SiO_2=28%, and water 64% by mass. The blend of sodium silicate arrangement and sodium hydroxide arrangement will frames the basic fluid.

H. Mechanical action of Super plasticizer:

Superplasticizers are called as water reducers. In this present investigation, used namely CONPLAST SP 430 has been used for obtaining good workable concrete at low w/c ratio. CONPLAST SP 430 will be based upon NSF condensates used for this study.

I. Fine Aggregate: The fine aggregate used which was locally available and it is conformed to the grading zone II as per IS: 383:1970.

Table-4 Physical Properties of Fine Aggregate

S.No	Name Of The Test	Result
1.	Specific Gravity	2.67
2.	Water Absorption	2 %
3.	Sieve Analysis Test	2.98
4.	Zone	Zone -2

I. *Coarse Aggregate:* *Locally available coarse aggregate having the maximum size of (10 - 20mm) .*

Table-5 Physical Properties of Coarse Aggregate

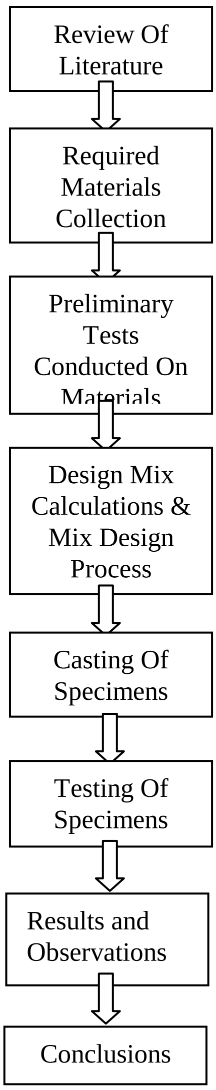
S.No	Name Of The Test	Result
1.	Specific Gravity	2.62
2.	Water Absorption	0.63 %
3.	Aggregate Impact Value	9.23 %
4.	Shape Tests: (a)Flakiness (b)Elongation	 13.25 % 11.08 %

IV. METHODOLOGY

A. Mix Design Of GeoPolymer Concrete: Binder is the major difference between GPC and PPC.Alkaline activator solution is used to react with silicon and aluminium oxides to form a geopolymer paste.The density of GPC is 2400 Kg per meter cube.In this flyash and ggbs are taking different replacements.The ratio is 2.5 for sodiumsilicate to sodium hydroxide and the ratio of alkaline activator to the flyash is taken as 0.4 percent constant.

B. Preparation of tests specimens: The solution of alkaline activator is to be prepared before 24 hours of casting. After 24 hours the moulds were demoulded and were kept in a room temperature for curing.The sizes of moulds used are cube (150mmx150mmx150mm); cylinder (150mm dia and 300 mm height); beam(500mmx100mmx100mm) considered.

C. FLOW CHART



V. RESULTS AND DISCUSSIONS

Table-6. 28 days strength Data

Type Of Mix	Binding Materials (%)		Molarity (M)	Compressive Strength (Mpa)	Split Tensile Strength (Mpa)	Flexural Strength (Mpa)
	Fly Ash	GGBS				
Mix-1	100	0	0 M	3.41	1.42	1.62
			5 M	23.76	2.27	2.38
			10 M	26.29	2.54	2.97
Mix-2	75	25	0 M	6.32	1.87	2.16
			5 M	31.27	2.42	2.84
			10 M	35.46	2.97	3.96
Mix-3	50	50	0 M	9.48	2.14	2.53
			5 M	40.17	2.86	3.85
			10 M	43.65	3.11	4.38
Mix-4	25	75	0 M	11.23	2.38	3.07
			5 M	46.18	3.12	4.18
			10 M	51.83	3.34	4.75
Mix-5	0	100	0 M	13.69	2.73	3.23
			5 M	49.54	3.20	4.30
			10 M	53.27	3.69	4.96

It was clearly observed that for all the five mixes i.e. M1,M2,M3,M4&M5 for 10 Morality the strength was increased.

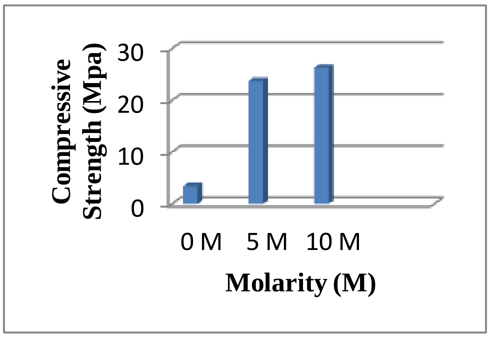


Fig-1.Mix-1: (FA 100 %-GGBS 0 %) Compressive Strength

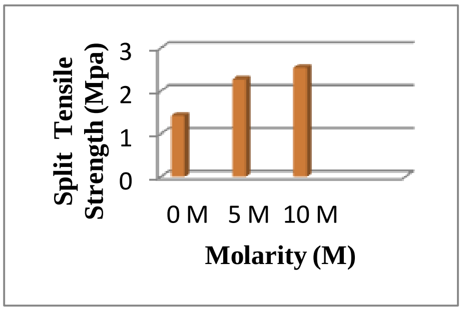


Fig-3.Mix-1Split Tensile Strength

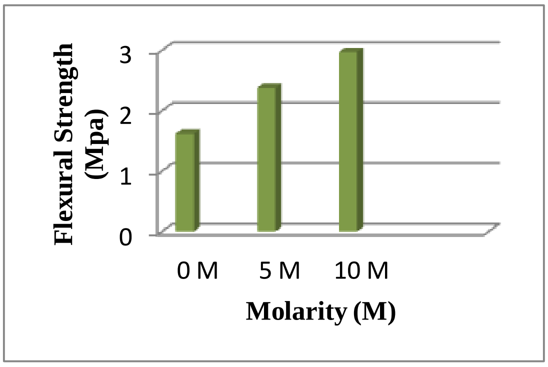


Fig-5.Mix-1Flexural Strength

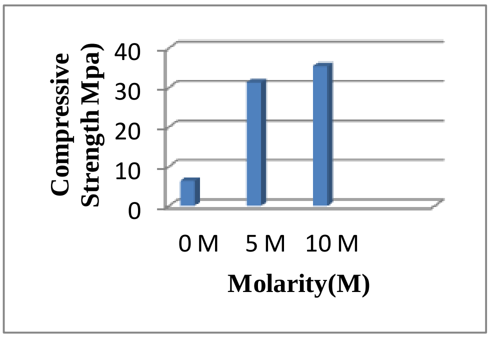


Fig-2.Mix-2: (FA 75 % - GGBS 25 %) Compressive Strength

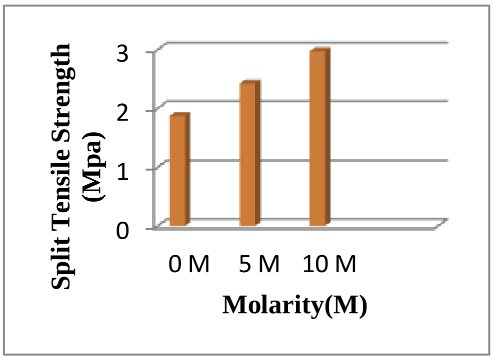


Fig-4.Mix-2Split Tensile Strength

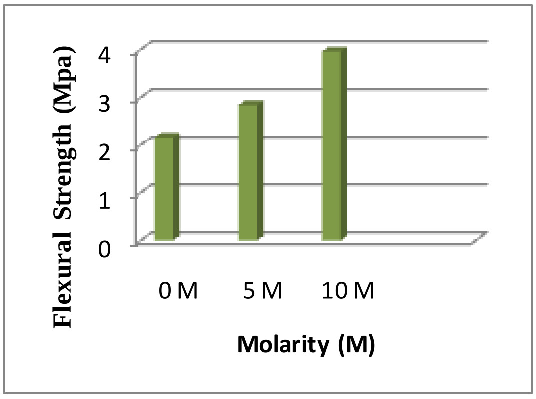


Fig-6.Mix-2Flexural Strength

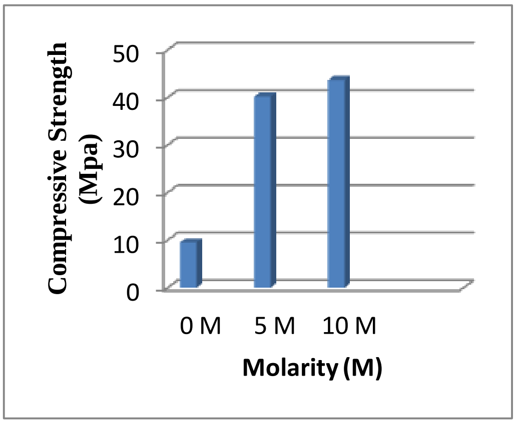


Fig.7.Mix-3: (FA 50 % - GGBS 50 %) Compressive Strength

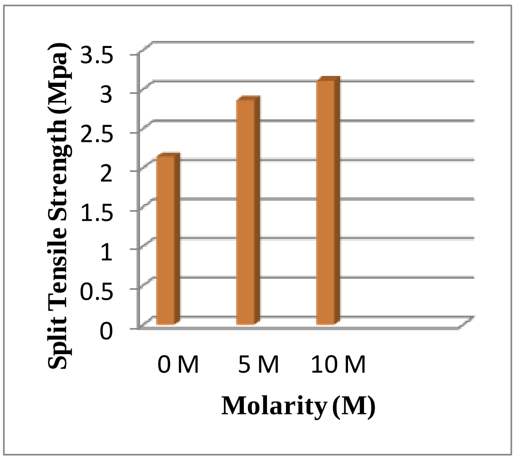


Fig-9.Mix-3Split Tensile Strength

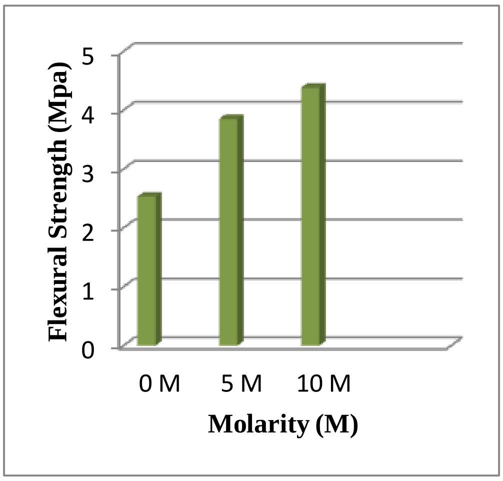


Fig-11.Mix-3Flexural Strength

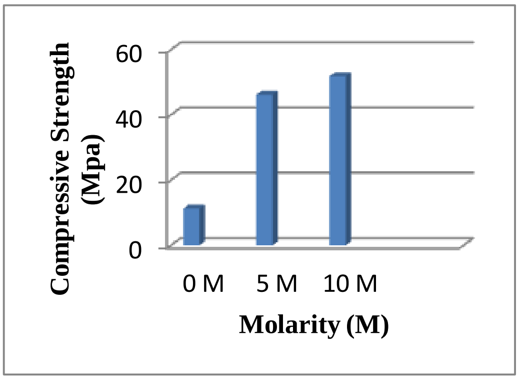


Fig.8.Mix-4: (FA 25 % - GGBS 75 %) Compressive Strength

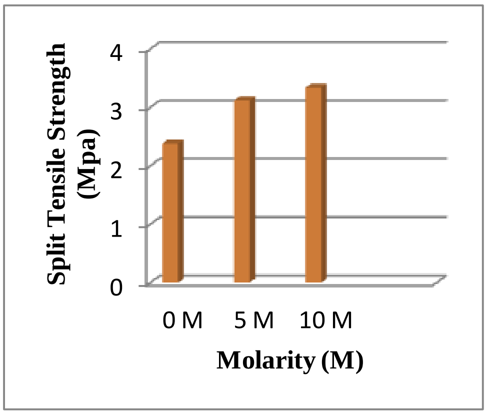


Fig-10.Mix-4Split Tensile Strength

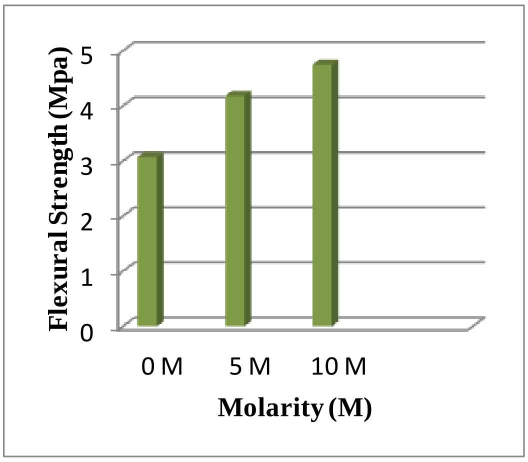


Fig-12.Mix-4 Flexural Strength

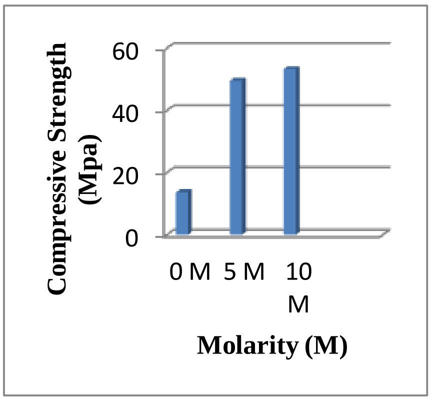


Fig13.Mix-5:- (FA 0 % - GGBS 100 %) Compressive Strength

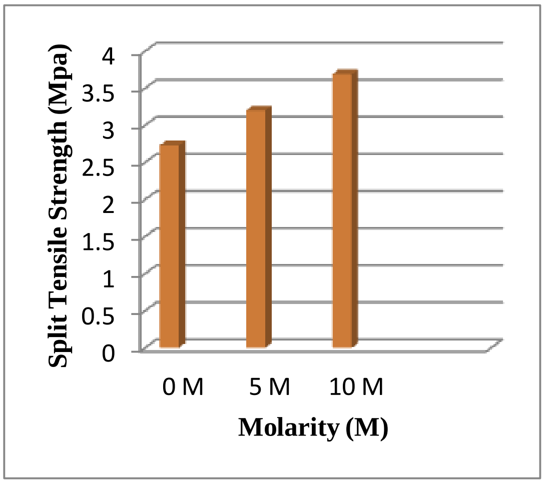


Fig-13.Mix-5Split Tensile Strength

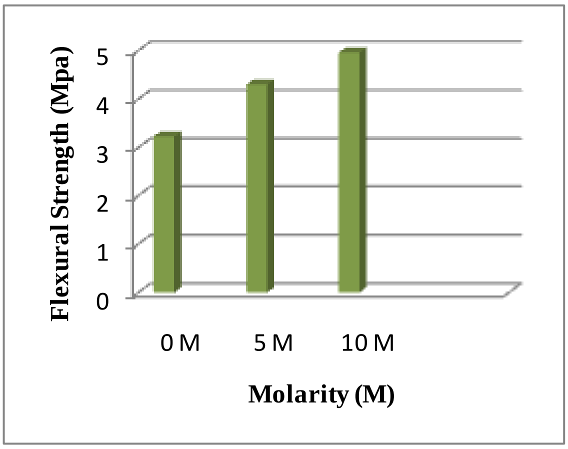


Fig-14.Mix-5 Flexural Strength

VI. CONCLUSION

✓ In present work instead of cement we used GGBS and Fly Ash. So, as to reduce the carbon dioxide emission.
✓ It is observed that by increasing the GGBS content there will be decreasing the setting time and increasing the degree of workability.
✓ While compare to all mixes, mix-5 (FA 0 % - GGBS 100 %) will get higher compressive, split tensile and flexural strengths.
✓ This is because due to by increasing the GGBS replacements and also by increasing the molaritys the strength will be goes on increasing.

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AUTHORS PROFILE

First Author K.Madhan Gopal, Research Scholar in Department of Civil Engineering,JNTUA, He was doing research work on the concrete materials.

SecondAuthor.Dr.G.Sreenivasulu professor in Department of civil engineering, RGMCET,Nandyal, He done his PhD at IISc,Bangalore. He having a 13 years research experience and he published many SCI Journals.

Third Author Dr.C.Sashidhar he was working as professor in JNTUA, Ananthapuramu, having a lot of research experience in concrete materials and he published research work on many reputed jouranals.

Fourth AuthorD.V.Prudhvi Raj, PG Student in the Department of Civil Engineering,RGMCET,Nandyal He pursuing master degree in structural Engineering.