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A Study of Fiber Reinforced Geopolymer Concrete by Using Admixer Equi Proportional Flyash and Ggbs

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***Abstract*:**

Manufacture of Portland cement produces large volumes of carbon dioxide and other gases. Releasing these gases causes atmospheric pollution and subsequent environmental degradation. Concrete is widely used and reliable material for construction. Some of challenges in enterprise are worldwide warming and insufficiency of creation cloth.One of the strategies for replacing concrete elements is using geo-polymer which helps in the use of very less amount of cement in concrete. Geo polymer results from the reaction of a source fabric that is wealthy in silica and alumina with alkaline liquid. It is basically cement unfastened concrete. This fabric is being studied considerably and suggests promise as a greener replacement for everyday Portland cement concrete in some programs. Research is shifting from the chemistry domain to engineering programs and commercial production of geopolymer concrete. It has been located that geo polymer concrete has desirable engineering houses with a discounted global warming potential as a consequence of the overall alternative of regular Portland cement. This project represents study at the flexural behavior of fiber bolstered Geopolymer concrete.

In this examine, Geopolymer concrete is produced with fly ash, GGBS and sodium hydroxide and sodium silicate is used as a binder. Fly ash and GGBS are taken in identical percentage to beautify properties of concrete and the fiber used in this undertaking is polypropylene fiber (Recron 3s). For this assignment, the combination design is done for 8M and 16M awareness of sodium hydroxide. Alkaline activator solution ratio of 2.0 is selected for this investigation. The specimen of size 500x100x100mm prisms were casted of M10, M20, M30 and M40 grade of concrete and the specimens of geo-polymer concrete are cured at ambient temperature for 7days and 28 days. The cured specimens were then tested for flexural strength and high strengths are achieved.

Introduction:

Cement concrete is manmade fabric which prepared by means of blending of cement, water, herbal fine and coarse combination. The past century advanced cement concrete as cloth for production paintings. In 1902 August Perret, first designed building in Paris with structural additives beams, slabs and columns. Construction form of infrastructure and industrial zone by means of concrete makes it is an essential product. It is extensively used artificial material within the globe.

It is produced with the aid of natural materials it is reliable cloth, offers architectural freedom. After water most extensively fed on fabric is concrete as greater than ton produced each yr for absolutely everyone within the world. But, the environmental hazard resulting from production of concrete fabric has worried to make an green material for creation. It is been studied that embodied carbon dioxide (ECO2) degrees from 700-800 kg CO2 for a tone of concrete. The embodied carbon dioxide varies relying upon methods and type of blend layout. In cement industry, a study has been finished in series of new cloth and up gradation of era.

In India 93% of cement industry uses dry process technology which is environment friendly. The old dry process technology and semi dry process technology is being used by 7% of cement industry. There is reduction in emission level of CO2 due to the Waste warmness recuperation in cement plant. After metal and aluminum, cement is the subsequent cloth which produces excessive energy. It also uses an adequate quantity of non renewable

substances Coal, lime stone and many others. About 65% of global warming is because of CO2. The cement enterprise isn't always suitable for sustainable enterprise because it causes excessive pollutants to the environment.

Necessity of the Work:

Construction is considered one in every of the fast developing fields international. As consistent with the prevailing global statistics, every 12 months around 260,00,00,000 plenty of Cement is wanted. This quantity may be improved via 25% inner a span of some other 10 years. Since the Lime stone is the principle source fabric for the everyday Portland cement an acute shortage of limestone also can come after 25 to 50 years. More over at the same time as generating one ton of cement, approximately one ton of carbon di oxide can be emitted to the surroundings, that is a chief threat for the environment. In addition to the above massive quantity of energy is likewise required for the production of cement. Hence it's far maximum important to locate an possibility binder. The Cement production generated carbon di oxide, which pollutes the surroundings. The Thermal Industry produces a waste known as fly ash it truly is without a doubt dumped on the earth, occupies larges areas. The waste water from the Chemical Industries is discharged into the ground which contaminates ground water.

By producing Geopolymer Concrete all of the above said troubles can be solved by manner of rearranging them. Waste Fly Ash from Thermal Industry + Waste water from Chemical Refineries = Geo polymer concrete. Since Geopolymer concrete doesn't use any cement, the producing of cement shall be decreased and hence the pollution of environment by using the emission of carbon dioxide shall additionally be minimized.

Objectives of the work:

In the present experimental investigation, main objective of study is the evaluation of strength characteristics of the fiber reinforced geopolymer concrete under flexural strength. The parameters like Fluid binder ratio and basic materials standards are kept constant throughout study and molarity of alkali solution are 8M and 16M .The study conducted on M10, M20, M30 and M40 grade of concrete. The fiber used in the study is Recron 3s. The strength results are obtained at different ages (7^{th} and 28^{th} days) compared and conclusions are drawn.

Scope of the work

The study builds on and contributes to the development of new environmentally friendly binders in concrete. Although there are numerous studies that assess the suitability of GGBS and fly ash based geopolymer to replace OPC as a binder in concrete, many of these studies have focused on the strength properties and durability of 'ambient cured' fiber reinforced geopolymer concrete .

Methodology:

Introduction:

In this study the basic concept is to reduce the emission of CO2 to the environment. Bond industry is a noteworthy benefactor in the discharge of CO2 and additionally spending elevated amounts of vitality assets in the creation of concrete. By supplanting bond with a material of pozzolanic trademark, for example, the ground granulated impact heater slag (GGBS) and fly fiery remains (mechanical waste), the concrete and solid industry together can take care of the developing demand in the construction industry as well as help in reducing the environmental pollution.

It also describes the experimental work. The geopolymer concrete is prepared and mixed in the same manner as it is done for a conventional cement concrete. The same sequence is followed except that cement is replaced by GGBS and water which is used to form the binder is replaced by alkaline liquid. The alkaline liquid is a mixture of sodium silicate solution and sodium hydroxide of desired molarity.

Mix design of Geopolymer Concrete

The primary difference among geopolymer concrete and Portland cement concrete is the binder. To

shape geopolymer paste alkaline activator answer used to react with silicon and aluminium oxides which might be present in fly ash and

GGBS. This alkaline activator answer helps to bind coarse aggregate and high-quality mixture to shape geopolymer blend.The quality and coarse combination occupy almost seventy five% to 80% mass of geopolymer concrete. The excellent mixture became taken as 30% of total combination. The density of geopolymer concrete is taken 2400 kg/m3.The workability and electricity of concrete are motivated by way of houses of materials that make geopolymer concrete. Fly ash and GGBS are taken in equi percentage. The ratio of sodium silicate to sodium hydroxide is two.Zero and is stored consistent in the course of this look at. The ratio of alkaline

Activator to the fly ash and GGBS is varies according to the mix. The required data for a particular grade of concrete is obtained.

Nominal mix calculations

The proportions of materials for nominal mix concrete shall be in accordance with table 9 of IS 456:2000

Table 3.1 Proportions for Nominal Mix Concrete

Grade of concrete	Total quantity of dry aggregates by mass per 50 kg of cement, to be taken as the sum of the individual masses of fine and coarse aggregates, kg Max	Proportions of fine aggregate to coarse aggregate (by mass)	Quantity of water per 50 kg of Cement, Max (l)
M 5	800	Generally 1:2 but subject to an upper limit of 1:11/2 and a lower limit of 1:21/2	60
M 7.5	625		45
M 10	480		34
M 15	330		32
M 20	250		30

Preparation of Alkali Solution

The practise of solution is executed by way of dissolving sodium hydroxide in water. The attention of sodium hydroxide modifications with molarity. The quantity of sodium hydroxide solution with a concentration of 8M and 16M is calculated. The mass of NaOH solids in answer varied depending on the awareness of the solution expressed in terms of molar, M. The NaOH solution with concentration of 8M consisted of 8*40 = 320gm of NaOH solids per liter of the solution, where 40 is the molecular weight of NaOH. Similarly, for 16M consisted of 640gm of NaOH solids per liter of the solution. The mass of NaOH solids in a solution varies depending on the concentration of the solution. The mass of NaOH solids per kg of the solution for other concentrations is measured and expressed as percentage. In Table 3.2 percentage of NaOH flakes percentage in various Molarity are given.

Table 3.2 Percentage of NaOH flakes in various Molarity

NaOH solution	Percentage (%)
8M	26.23
10M	31.37
12M	36.09
14M	40.43
16M	44.44

The mass of solid NaOH was measured as 255 g/kg in the 8 M NaOH solution and 444.6 g/kg in the 16 M NaOH solution. The sodium hydroxide is added to the water and stirred about fifteen minutes to get cool down. Then the sodium silicate is added to solution. This solution is used after 24 hours of its preparation. . The ratio of sodium silicate to sodium hydroxide is kept at 2.0 throughout this study.

Experimental investigation:

Introduction:

This chapter deals with the experimental programme particulars. The materials used, concrete mix details, casting procedure, curing and testing procedures and explained

Materials

The properties and specifications of various materials used in the preparation of test specimens are as follows.

Fly ash

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Fly ash (FA) is a derivative of the combustion of pulverized coal in thermal strength plant life. It is a fine grained, powdery and glassy particulate fabric this is accumulated from the exhaust gases by electrostatic precipitators or bag filters. When pulverized coal is burnt to generate warmness, the residue consists of 80 in keeping with cent fly ash and 20 in line with cent backside ash. The size of particles is basically dependent on the form of dirt collection device. Diameter of fly ash particles levels from much less than 1 µm–a hundred and fifty µm. It is typically finer than Portland cement. Their floor area is normally three hundred to 500 m2/kg, even though a few fly ashes will have surface regions as little as two hundred m2/kg and as excessive as seven hundred m2/kg. How given.

Chemical composition of fly ash

Oxides	Fly ash	Requirements as perIS 3812-2003
SiO_2	63.24%	SiO_2 > 35% Total - > 70%
Al_2O_3	17.35%	
Fe_2O_3	2.63%	
CaO	2.05%	_
Na_2O	0.24%	<1.5%
K_2O	0.32%	
MgO	0.96%	< 5%
LOI	0.95%	<12%

Ground granulated blast furnace slag (ggbs):

Ground-granulated blast-furnace slag (GGBS) Is obtained by quenching molten iron slag (a derivative of iron and metal-making) from a blast furnace in water or steam, to provide a glassy, granular product that is then dried and ground right into a first-rate powder. GGBS cement may be delivered to concrete inside the concrete manufacturer's batching plant, along side Portland cement, aggregates and water. The normal ratios of aggregates and water to cementitious cloth within the mix stay unchanged. GGBS is used as a right away replacement for Portland cement, on a one-to-one foundation by weight. Replacement levels for GGBS range from 30% to up to 85%. Typically forty to 50% is used in maximum instances. The use of GGBS in addition to Portland cement in concrete in Europe is covered inside the concrete wellknown EN 206:2013. This trendy establishes categories of additives to concrete together with regular Portland cement: nearly inert additions (Type I) and pozzolanic or latent hydraulic additions (Type II). GGBS cement falls inside the latter class. As GGBS cement is slightly less luxurious than Portland cement, concrete made with GGBS cement may be in addition priced to that made with normal Portland cement.

Table 4.2 Test results on GGBS

Particulars	Test results	Requirements as per BS:6699:1992
Fineness (m^2/Kg)	335	275.0 min
Soundness-Le Chatlier Expansion (mm)	NIL	10.0 max
Initial setting time (min)	150	>of OPC
Insoluble residue (%mass)	0.6	1.5 max
Magnesia content(%mass)	9.12	14.0 max
Sulphide content (%mass)	0.6	2.0 max
Sulphite content (%mass)	0.56	2.5max
Loss on ignition	NIL	3.0 max

(%mass)			
Manganese content (%mass)		0.58	2.0 max
Chloride content		0.018	0.1 max
Moisture content		0.2	1.0 max
Compressive strength(N/mm^2)			
•	7 days	26	12.0 min
•	28 days	46	32.5 min
Chemical moduli			
a.	Cao+MgO +SiO2	78.56	66.7 min
b.	(CaO +MgO) / SiO2	1	> 1.0
c.	CaO/ SiO2	0.98	>1.4

SODIUM HYDROXIDE (NaOH)

Generally the Sodium Hydroxides are to be had in stable kingdom with the aid of pellets and flakes. The fee of the Sodium Hydroxide is specifically various in line with the purity of the substance. Since our Polypropylene Fibre Reinforced Geopolymer Concrete is homogeneous cloth and its predominant technique to activate the Sodium Silicate so it's miles endorsed to use the lowest price i.e. Up to ninety four% to 96% purity. In this research the Sodium Hydroxide pellets had been used.

Sodium hydroxide is used in many industries, primarily as a sturdy chemical base in the manufacture of pulp and paper, textiles, ingesting water, soaps and detergents and as a drain cleanser. Worldwide production in 2004 became about 60 million tonnes, even as call for was 51 million tonnes. Gloves should be used while handling sodium hydroxide. . Whose physical property are given by manufacturer are as follows for solid Sodium Hydroxide.

Picture of NaOH flakes

Table 4.3 Physical Properties of Sodium Hydroxide

Colour	Colour less
Specific gravity	2.13
Ph	14

Table 4.4 Data of composition of sodium hydroxide.

DESCRIPTION	RESULTS
Sodium hydroxide as NaOH(%)	99.8
Sodium carbonate as Na2CO3 (%)	0.16
Chloride as NaCl (%)	0.01
Sulphate as Na2SO4(%)	0.001
Silica as SiO2(%)	0.0008
Iron as Fe (ppm)	2.86
Copper as Cu (ppm)	0.002
Manganese as Mn (ppm)	0.002
Chlorate as NaClO3 (ppm)	1
Matter insolubles (%)	0.0009

Results and discussions:

In this chapter the results based on experimental work are presented and discussed. The Reinforced geopolymer concrete prisms made were tested in laboratory according to the procedures of the tests as explained in previous chapter. The tests are carried out on the concrete cubes on 7 days and 28 days of curing. The results obtained from experimental work include sieve analysis, specific gravity, and unit weight of aggregate and flexural strength.

Sieve analysis of fine aggregate

The sieve analysis performed on fine aggregate showed that it belongs to zone

A plot between the percent finer and sieve size is shown below in the Figure 5.1.

The sieve analysis of fine aggregate resulted out that it belongs to zone II.

Table 5.1 Results of sieve analysis

Sl.no	IS Sieve size (mm)	% Passing
1	10	100
2	4.75	98.8
3	2.36	96.5
4	1.18	69.6
5	0.6	55

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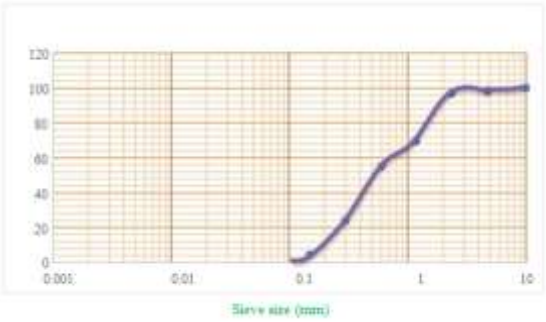
6	0.3	28
7	0.15	6



Logarithmic graph for sieve analysis of fine aggregate

Flexural strength test:

The standard sized prisms of dimensions 500mm x 100mm x100mm were tested. The test results are tabulated for 8 molar and 16 molar mixes separately. Simple graphs are plotted from this data and are presented.**16 molar**

Table 5.2 16 molar mixes 7th-day and 28th-day strength

Mix Type	Strength on 7th day (MPa)	Strength on 28th day (MPa)
M10	3.2	4.05
M20	5.2	6.5
M30	7	7.7
M40	8.25	8.4

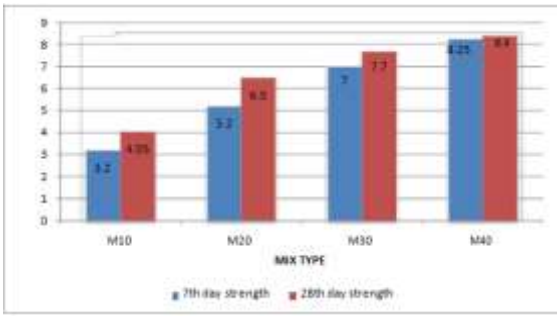
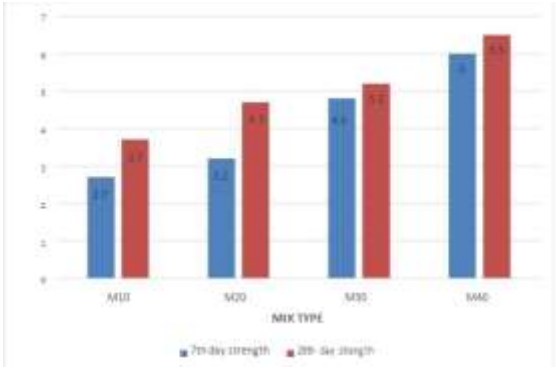


Figure 5.2 Variation of 7th day and 28th day flexural strength for 16 Molar

8 Molar

Table 5.3: 8 molar mixes 7th-day and 28th-day strength

Mix Type	Strength on 7th day (MPa)	Strength on 28th day (MPa)
M10	2.7	3.7
M20	3.2	4.7
M30	4.8	5.2
M40	6.0	6.5



Variation of 7th day and 28th day flexural strength for 8 Molar

Generalised curve for 28th day strength for 16 molar

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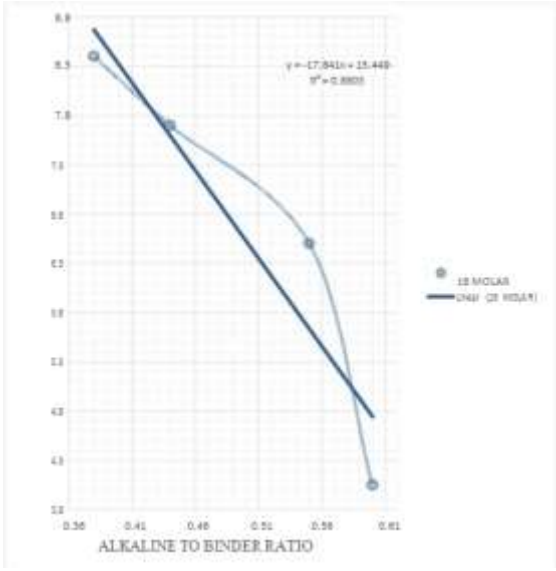
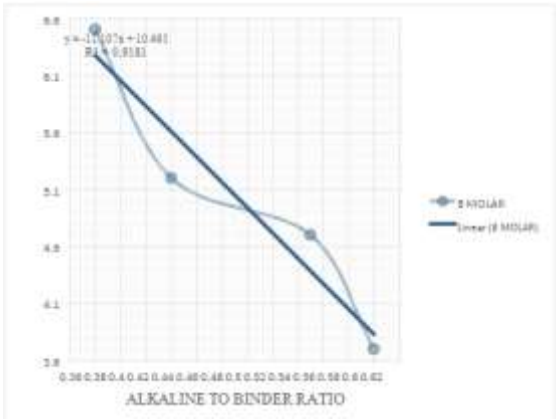


Generalised curve for 28th day strength for 8 molar



CONCLUSIONS AND RECOMMENDATIONS

Introduction

This study discuss an experimental program carried out to investigate the effects of using by products and industrial waste in preparing concrete. M10, M20, M30 and M40 grades of concrete are adopted for the study. Where M10 and M20 are nominal mixes, M30 and M40 are design mixes of conventional concrete.

Conclusions

- The flexural strengths obtained on 7thday and 28thday testing of prism specimens of 16 molarity are greater than the 8 molarity in both nominal and design mixes.
- In 8 molarity the highest flexural strength is achieved for Mix4 and the strength is 6.5 MPa obtained on 28th day. The lowest flexural strength is achieved for Mix1and the strength is 2.7 MPa obtained on 7th day.
- In 16 molarity the highest flexural strength is achieved for Mix4 and the strength is 8.4 MPa obtained on 28th day. The lowest flexural strength is achieved for Mix1 and the strength is 3.2 MPa obtained on 7th day.
- The generalized curve shows that the lowest ratios of Alkaline liquid to Fly ash and GGBS ratio gives the highest flexural strengths, for both 8 molarity and 16 molarity.
- Generalized curve obtained for 8 molarity is linear than generalized curve obtained for 16 molarity.
- It is observed that in 8 molarity flexural strengths increased for 28 days is 1.2 times greater than 7 days, in 16 molarity flexural strengths increased for 28 days is 1.125 times greater than 7 days.

REFERENCES

[1]. Siva Konda Reddy, B, Varaprasad, J and Naveen Kumar Reddy, K, (2009)," Strength and workability of low lime fly-ash based geopolymer concrete", Indian Journal of Science and Technology Vol.3, pp 12.

[2]. Fareed, Ahmed, Memon, Muhd, Fadhil, Nuruddin, Samuel, Demieand, (2011) "Effect of Curing Conditions on Strength of fly ash-based Self Compacting Geopolymer Concrete", International Journal of Civil and Environmental Engineering Vol 3, pp 3.

[3]. V. Supraja, and M.Kanta Rao "Experimental study on Geo-Polymer concrete incorporating GGBS" ISSN:2277-9477, Volume2

[4]. Andi Arham Adam (2009)" Strength and Durability Properties of Alkali Activated Slag and Fly Ash-Based Geopolymer Concrete" thesis.

[5]. Rohit Zende, and Mamatha. A (2015) "Study On Fly Ash and GGBS Based Geopolymer Concrete beneath Ambient Curing" JETIR (ISSN-2349-5162)

[6]. B. Vijaya Rangan, Djwantoro Hardjito, Steenie E. Wallah, and Dody M.J. Sumajouw, "Studies on fly ash-primarily based geopolymer concrete", Geopolymer: green chemistry and sustainable development solutions.

[7]. A.R. Krishnaraja, N.P. Sathishkumar, T.Sathikumar, P.Dineshkumar. "Mechanical

Behavior of Geopolymer Concrete below Ambient Curing" International Journal of Scientific Engineering and Technology, quantity No.3, Issue No.2 (1 Feb 2014).
[8]. Davidovits J., High-Alkali Cements for 21st century Concrete in Concrete Technology, Past, Present and Future,,
[9]. Proceedings of V.Mohan Malhotra Symposium, ACI SP-one hundred forty four, pp.383-397, 1994

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