International Journal of Engineering Research-Online
A Peer Reviewed International Journal
Articles available online http://www.ijoer.in; editorijoer@gmail.com

Vol.5., Issue.3, 2017
May-June

RESEARCH ARTICLE

ISSN: 2321-7758

COMPARISION ON STRENGTH CHARACTERISTICS OF FLYASH BASED GEOPOLYMER CONCRETE WITH 14 MOLAR NaOH ACTIVATOR

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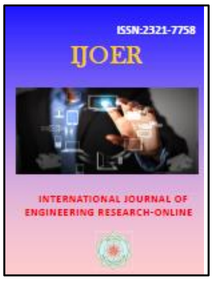

ABSTRACT

Now a day the demand of concrete is increasing to satisfying the need and development of infrastructure facilities. The manufacturing of Ordinary Portland cement depletes natural resources and energy and also expels carbon dioxide to the atmosphere. So that necessary to choose alternative to attain the concrete eco-friendly. Geopolymer is an inorganic material and combination of alumino-silicate compound, synthesized from fly ash. For geopolymer binders fly ash is the one of the source materials, it is available profusely in India, but date to date its usage is limited. So that it's crucial to use this by-product in concrete manufacturing to make the concrete more prosperous. And this paper accounts the experimental work carried to assess the effect of various parameters i.e. sodium hydroxide concentration, ratio of alkaline solution to fly ash and ratio of Na_2SiO_3 to NaOH, curing time and curing temperature. In this paper Na_2SiO_3 to NaOH ratios of 1:2, 1:2.5, 1:3 and Sodium hydroxide solution with 14M concentration and 0.45 is the ratio of alkaline liquid to fly ash. And room temperature is used. The tests have been conducted to evaluate split tensile strength, flexural strength and compressive strength. The outcomes indicated the increment in the strengths with the increase of activator ratio at the age of 7, 14 & 28 days.

Keywords: fly ash, Geopolymer concrete, sodium silicate, molarity, sodium hydroxide, strength.

1. INTRODUCTION

In manufacturing of concrete OPC becomes an important material and its binds all the aggregate together which act as its binder. Nevertheless, the usage of cement creates contamination to the world and it reduces the raw material (limestone). Decayed lime stone and large quantities of burned fuel are required for the production of OPC, it results carbon dioxide emissions (Kong and Sanjayan, 2008). So for reducing the carbon gases geopolymer concrete had been introduced. Geopolymer concrete gives excellent properties such as effective acid resistance, high compressive strength, and low shrinkage (Lodeiro, 2007). The binder which plays a vital role in geopolymer concrete is replaced by fly ash which contains pozzolanic properties same as OPC and high with alumina and silicate. Fly ash is the residue which is obtained from the burning of coal is widely available which leads to waste management.

Therefore, fly ash based geopolymer concrete is a excellent alternative to get over the abundant of fly ash. In fly ash-based geopolymer concrete, the silica and the alumina are the source materials and they are first induced by alkaline activators to form a gel known as aluminosilicate. Alkaline gel binds the loose aggregates and other unreacted materials in the mixture to form the geopolymer concrete (Wallah, 2009). Apart from that, a few parameters like size of aggregates, amount of vitreous phase in fly ash , chemical composition of fly ash, nature, concentration and pH of activators are the important in reaction. In the development of microstructure, curing process of geopolymer concrete shows a great influence and on the mechanical characteristics of geopolymer (Komljenovi, 2010). This paper summarizes the behaviour of geopolymer concrete which makes it better compared to normal concrete.

1.1 OBJECTIVE

The intention of this paper Was to find the strength characteristics of fly ash based geopolymer concrete with varied ratios of alkaline solutions at the age of 7,14&28 days.

1.2 MATERIALS USED

1.2.1. Fly ash: It is a by-product obtaining from the coal-burning electric yielding plants. It can also be used in OPC to raise the concrete function. And in this study class-F fly ash is used.

1.2.2. AGGREGATES: Gravels are used as a coarse aggregate of sizes 10mm taken from a local supplier and river sand used as a fine aggregate from Vijayawada surroundings are used in the present study.

1.2.3. Alkaline Solution: In this study, the alkaline liquid with the combination of sodium silicate and sodium hydroxide (flakes form) was used. The purity of sodium silicate and the sodium hydroxide solution is 97%-98% bought in from the local supplier. The NaOH flakes were dissolved in water to make the solution.

2. EXPERIMENTAL PROCEDURE

A. Preparation of Alkaline Solutions: This study carried by using the 14M i.e mix of molarity of Sodium hydroxide to examined the strength of geopolymer concrete. 40 is the molecular weight of sodium hydroxide. For sodium hydroxide solution , 560g of sodium hydroxide flakes are taken ,weighed and flakes can be melted in 1 liter solution of distilled water. The sodium hydroxide solution and the sodium silicate solution were mixed together at least one day anterior for the preparation of alkaline liquid. While casting the specimens, to prepare the liquid component of the mixture extra water is added based on requirement.

B. Mix Proportion: For the mix design of geopolymer concrete there are no code provisions, 2400 Kg/m^3 is assumed as the density of geopolymer concrete. And remaining are based on done by following the concrete density and the fine and coarse aggregates volume occupation adopted as 70%. 0.45 is the water content to fly ash ratio. To prepare the geo polymer concrete he conventional method of normal concrete is adopted.

C. Mixing and casting of Geopolymer concrete

Initially in a container materials were mixed after that alkaline solution is added. This mix is placed in moulds those are cubes, cylinders beams.

Figure 1. Mixing of geopolymer concrete

D. Curing: The cubes were Demoulded after one day of casting and the casted cubes are laid in the ambient temperature for seven, fourteen and 28 days.

Figure 2. Casting and curing of specimens

3. Testing: The specimens are tested according to IS 516:1959 and the strengths were calculated for seven,fourteen&28 days and the equipments measured those strengths are shown below.

Figure 3.Testing of specimens

4. RESULTS AND DISCUSSION

The below table shows that various strength parameters

Table 1: various strength parameters of geopolymer concrete

S.NO	NO.OF DAYS	Compressive Strength (N/mm^2) CUBES			Splittensile Strength (N/mm^2) CYLINDERS			Flexural Strength (N/mm^2) BEAMS		
		01:02	01:02.5	01:03	01:02	01:02.5	01:03	01:02	01:02.5	01:03
1	7 days	8.5	10	10.96	0.156	0.196	0.225	0	0.24	0.39
2	14 days	11.03	12	12.44	0.667	0.716	0.784	0.48	0.97	1.56
3	28 days	15.06	16.5	17.52	1.22	1.5	1.8	1.52	1.6	1.62

Compressive Strength: The sizes of specimens for cubes are 150 x 150 x 150(mm) are casted for each mix. One day after the specimens were laid and Cured for 7,14&28days. And the below figure shows the compressive strength of various activator ratios for 7,14&28 days.

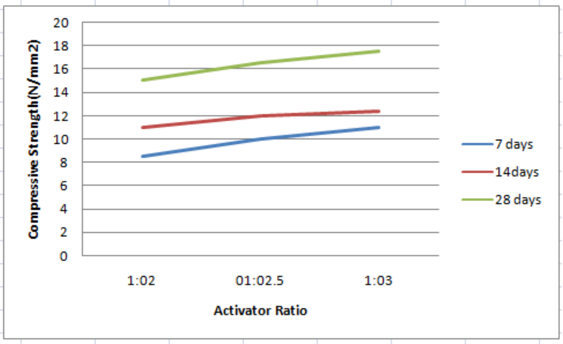

Fig 4.Compressive strength of various activator ratios

For 7days15% of Compressive strength is raised for ratio 1:2.5 compared to 1:2, and 22% of compressive strength is increased for activator ratio 1:3 compared to 1:25.And for 28days15% of Compressive strength is raised for activator ratio 1:2 compared to 1:25. Average compressive strength value is 13.64 for 28days and is higher than the 7&14 days. So we can concluded that higher activator ratio gives higher compressive strength and longer curing time results higher compressive strength.

Flexural Strength: The beam (specimens) of size 100mm × 100mm × 500mm were used and are casted for each mix.

$T = 3P/ BD^{2.}$

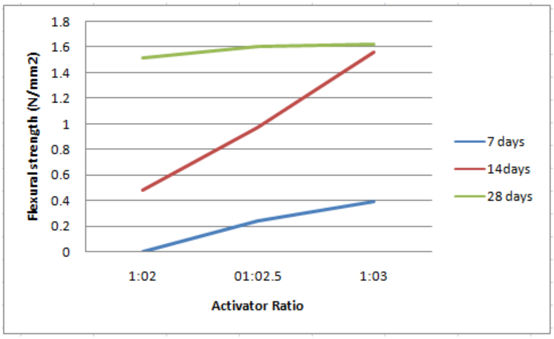

Fig 4.Flexuralstrength of various activator ratios

For 7days 38% of flexural Strength is increased for activator ratio 1:3 compared to 1:25 and 6.17% for twenty eight days. For fourteen days Average flexure strength value is 0.66kn/mm^2 and 1.19kn/mm^.2 for 28 days. So we can concluded that the flexural strength increases for longer curing period.

Split Tensile Strength: Used Sizes of Cylinders are 150 x 150 x 300 (mm) are casted for each mix. After 24 hours the specimens were de molded and cured for 7,14 and 28days. The average of three identical cylinders are indicated the split tensile strength.

T = 2P/ π LD.

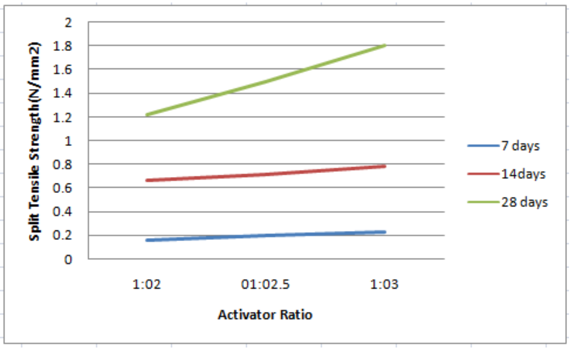

Figure 5.Split Tensile strength of various activator ratios

At the age of 7days 20% of split tensile strength is increased for activator ratio 1:2.5 compared to 1:2, and 13% of split tensile strength is increased for activator ratio 1:3 compared to 1:25. And at the age of 14 days15% of split tensile strength is increased compared to 7days. Average split tensile strength value is 0.936 for 28days and is higher than the 7&14days. So we can concluded that higher activator ratio gives higher split tensile strength and longer curing time results higher split tensile strength.

5. CONCLUSION

Based on the experimental investigations carried out on geopolymer concretes, it can be concluded that

i. Activator ratio is important in strength of GPC. Obtained results indicates for ratio of 1:3 the strength was maximum than the 1:2 &1:2.5.
ii. 22% of compressive strength is increased for activator ratio 1:3 compared to 1:25.
iii. Average compressive strength value is 13.64 for 28days and is higher than the 7&14 days.
iv. Average split tensile strength value is 0.936 for 28days and is higher than the 7&14days.
v. At the age of 7days Average flexure strength value is 0.66kn/mm^2 and 1.19kn/mm^.2 for 28 days.

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