Asian Journal of Applied Science and Technology (AJAST)

(Peer Reviewed Quarterly International Journal) Volume 3, Issue 2, Pages 25-30, April -June 2019

Studies of Strength on Geo-Polymer Concrete by Using Fly Ash and Granite Waste

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Article Received: 16 September 2018 Article Accepted: 29 January 2019 Article Published: 18 April 2019

ABSTRACT

The major problem the world is facing today is the environmental pollution. In the construction industry mainly the production of Portland cement will causes the emission of pollutants results in environmental pollution. We can reduce the pollution effect on environment, by increasing the usage of industrial by-products in our construction industry. To produce the geo-polymer concrete the Portland cement is fully replaced with fly ash and the fine aggregate is replaced with granite dust and alkaline liquids are used for the binding of materials. 8M, 10M and 12M are taken to prepare different mixes. And the compressive strength is calculated for each of the mix. The beam specimens are taken of size 1000mm x 100mm x 150mm. The Geopolymer concrete specimens are tested for their compressive strength at the age of 7days,mixes of varying sodium hydroxide molarities i.e.8M,10M and 12M are prepared and they are cured by direct sun-light and strengths are calculated for 7 days. The result shows that the strength of Geopolymer concrete is increasing with the increase of the molarity of sodium hydroxide.

1. INTRODUCTION

Concrete has been quit longer used in construction industries for its derived advantages like mouldbility, viability and feasibility. But the increasing demands on the strength and durability. Characteristics, tends to make concrete accompanied with some additives or admixtures or both for specific purpose. A new generation concrete having durability and in addition to strength is the current thinking of the concrete researchers. And also, the cement is manufactured by using the raw materials such as lime stone, clay and other minerals. Granite of these raw materials is also causes environmental degradation. To produce 1 ton of cement, about 1.6 tons of raw materials are required and the time taken to form the lime stone is much longer than the rate at which humans use it. But the demand of concrete is increasing day by day for its ease of preparing and fabricating in all sorts of convenient shapes. So to overcome this problem, the concrete to be used should be environmental friendly.

2. OBJECTIVE

In order to increase the strength of geo-polymer concrete with granite powder. 1. In order to reduce the construction cost by replacing the waste materials into the concrete, similarly to attain the maximum strength. 2. The use of GP into concrete will reduce certain percentage of Fine aggregate.

3. MATERIAL SPECIFICATION

CEMENT:

Table 3.1 Properties of cement

Type of Geo-polymer	Specific gravity	Initial setting time
OPC-53 grade	3.15	30 minutes

CITE THIS ARTICLE: V.Vignesh, Dhilipkumar B & S.Gobinath, "Studies of Strength on Geo-Polymer Concrete by Using Fly Ash and Granite Waste", *Asian Journal of Applied science and Technology,* Volume 3, Issue 2, Pages 25-30, April -June 2019

COARSE AGGREGATE

Table 3.2. Properties of coarse and fine aggregate

Size of aggregate	Specific gravity	Fineness
Passing through 20mm sieve	2.70	1.5
Passing through 4.75mm sieve	2.64	II

MIX PROPORTION

Table 3.3. Mix proportion table

Name Of the Mixture	Fly ash (kg/m^3)	Granite Dust (kg/m^3)	Coarse Aggregate (kg/m3)		Sodium Silicate solution (kg/m^3)	Sodium Hydroxide solution (kg/m^3)	Super-Plasticizer (kg/m^3)
			20mm	12mm			
GP1	450	700	400	600	200	100(8M)	3.375
GP2	450	700	400	600	200	100(10M)	3.375
GP3	450	700	400	600	200	100(12M)	3.375

4. COMPRESSIVE STRENGTH

Compressive strength is the capacity of a material or structure to withstand axially directed pushing forces. Cubes of 150mm×150mm×150mm were casted and compressive strength test was conducted on specimens at 7 days. To conduct the test the specimens are placed in a compression testing machine and the load is applied to the cube and the load at failure is noted as failure load. The compressive strength is calculated by using the formula given.

TABLE 4.1 Compressive strength table

Name of the mix	Compressive strength in N/mm^2 of specimens Cured by		
	7days	14days	28days

Online ISSN: 2456-883X

CC	18.6	23.4	27
GP1	19.23	23.6	27.5
GP2	20.26	24.2	28.2
GP3	21	25.2	29.4

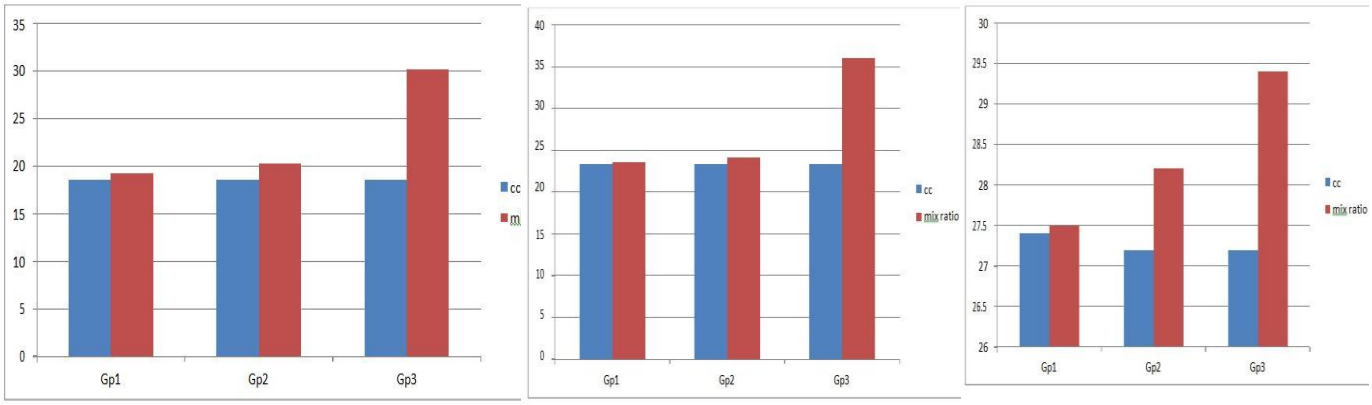

Figure 1: Compressive strength of specimens at the age of 7, 14 &28days

5. WATER ABSORPTION

Water absorption characteristics of the concrete plays an important role for the durability of the structure. Ingress of water detoriates concrete and in reinforced concrete structure, corrosion of the bars took place which results it no cracking and spalling of the concrete and ultimately reduce the life span of the structure. Test results of water absorption test are shown in Table.

The result indicates that the water absorption of geopolymer concrete is less compared to control concrete. Although the difference in % of gain in weight is very less.

5.1 Water Absorption Test Results

Type of Concrete	Notation	Initial Wt.(kg)	Oven Dry Wt.(kg)	Wt. after immersion	Gain %	Avg. gain %
GC	GC-1M	8.35	8.27	8.51	2.90	2.76
	GC-2M	8.30	8.22	8.44	2.68	
	GC-3M	8.25	8.17	8.39	2.69	
CC	CC-1M	8.60	8.47	8.68	2.48	2.91
	CC-2M	8.59	8.46	8.69	2.72	
	CC-3M	8.47	8.23	8.52	3.52	

Online ISSN: 2456-883X

Workability test

Workability of concrete is defined as the ease and homogeneity with which a freshly mixed concrete or mortar can be mixed, placed, compacted and finished. Strictly, it is the amount of useful internal work necessary to produce 100% compaction. Another similar term used to describe a freshly prepared concrete is 'consistency' which is the ease with which it will flow. It is the wetness of the concrete and the measure of fluidity or mobility. Wet concretes are more workable than dry concrete, but concretes of the same consistency may vary in workability.

A concrete which has high consistency and which is more mobile, need not be of right workability for a particular job. Type of work, thickness of section, reinforcements and mode of compaction are the aspects to be considered while specifying the workability for any particular job. Water absorption characteristics of the concrete plays an important role for the durability of the structure. Ingress of water detoriates concrete and in reinforced concrete structure, corrosion of the bars took place which results it no cracking and spalling of the concrete and ultimately reduce the life span of the structure. Test results of water absorption test are shown in Table 6. The result indicates that the water absorption of geopolymer concrete is less compared to control concrete. Although the difference in % of gain in weight is very less.

Table 5.2: Work ability

S.NO	Name of the Mix	Workbility in mm
1	Cc	65
2	Gp1	75
3	Gp1	82
4	Gp1	92

6. CONCLUSIONS

- Based on the experimental work reported in this study, the following conclusions are drawn.
- Higher concentration (in terms of molar) of sodium hydroxide solution results in higher compressive strength of fly ash & granite dust based geo-polymer concrete.
- Longer curing time, in the range of 4 to 96 hours (4 days), produces higher compressive strength of fly ash &quarry dust based geo-polymer concrete. However, the increase in strength beyond 24 hours is not significant.
- The fresh flyash-based geo-polymer concrete is easily handled up to 120 minutes without any sign of setting and without any degradation in the compressive strength.

- The mix GP3 gives higher compressive strength, as it has high molarity of NaOH
- We observe that the compressive strength is increased with the increase in the molarity of the sodium hydroxide.
- After three days of curing the increase the compressive strength is not sufficient
- The geo-polymer concrete shall be effectively used for the beam column junction of the reinforced concrete structure
- Geo-polymer concrete shall also be used in the Infrastructure works.
- In addition to that fly ash shall be effectively used and hence no land fills are required to dump the fly ash

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