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AN ECO FRIENDLY CONSTRUCTION MATERIAL GEOPOLYMER CONCRETE

Pavithra[1], Keerthi.V.B[2], Preethika.P[3], Anne Mary J[4]

[1]UG Student, [2]UG Student, [3]UG Student, [4]Asst Professor Dept of Civil Engineering, Veltech DR.RR & SR Technical University,Chennai

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Abstract - *In recent years, concrete usage around the world is second only to water, Ordinary Portland cement (OPC) is conventionally used as the primary binder to produce concrete. However Portland Cement concrete generates problem such as durability and carbon dioxide emission. There are several ways to reduce Co2 causes by production of Portland cement and by the increases waste materials. Million tonnes fly ash get assembled ever year at the thermal power stations in India. It became a serious problem due toinadequacy of land disposal Pozzolanic material that is rich in silicon and aluminium like fly ash referred as "Geo polymer concrete". Fly ash is a byproduct of coal obtained from the thermal power plants .fly ash is rich in silica and aluminum reacted wish alkalines solution producing aluminosilicate get that acted as the binding material for the concrete . The addition GGBS shows considerable gain in strength .The alkaline solutions used in this study for the polymerization process are the solution sodium hydroxide and sodium silicate (Na2 Sio3) .This study is continued to investigate the behavior geopolymer concrete under the room temperature for strength. Cubes of size 100mm*100mm*100mm are tested for their residual compressive strengths.*

Keywords: Fly ash, GGBS, CO2, Pozzolanic, Geo polymer concrete

1. INTRODUCTION

The world is facing today environmental pollution as a major problem .The emission of CO2 during the production of ordinary Portland cement is tremendous because the production of one ton of Portland cements emits approximately one ton of CO2 into atmosphere .In terms of global warming the Geopolymer concrete significantly reduce the CO2 emission to the atmosphere causes by cement industries alkaline liquid could be used to react with the silicon (Si) and aluminum (Al) in a source material of geological origin or in by products binders .The geo polymeric concrete or formed by alkali activation of industrial alumina silicate waste material such as fly ash and GGBS and has very small foot prints of greenhouses gasses when compared to traditional concrete fly ash is plentifully available to replace totally manufactured cement and make a concrete like material. It is an excellent alternatives construction material to the existing plain cement concrete. Geopolymer concrete is manufacturing without any use of ordinary Portland cement. The advancement of Geopolymer concrete is an important step towards the production on of environmentally friendly concrete .The Geopolymer concrete has two limitations such as delay in setting .These two limitations of geo polymer concrete and was eliminated by replacing 10% of fly ash by OPC on mass basis with alkaline liquids resulted in Geopolymer concrete composite (GPCC MIX) .The aim of this paper is to study the compressive strength characteristics of geo polymer concrete using fly ash and GGBS which are producing vat ambient temperature without water using and also to eliminated the necessity of heat using of concrete.

2. MATERIALS USED

Fly ash was taken from thermal power plant.The properties of fly ash and GGBS are giving in table 1.and table 2. Locally available river sand having fineness modulesof 2.73 and a specific gravity 2.67 was used . Crushed granite coarse aggregate of 20mm maximum size having a fineness modulus of 6.94 and specific gravity of 2.81 was used distilled water was used in a concrete mix .super plasticizer CONPLAST SP 430 was used for workability.

2.1 ALKALINE SOLUTIONS

The solution of sodium hydroxide and sodium silicate are used as alkaline solutions in the present study. Commercial grade sodium hydroxide in pellets form and sodium silicate solution are used.

2.2 PREPARATION OF ALKALINE SOLUTIONS

In this research work the compressive strength of Geopolymer concrete is examined for the mixes of 12 molarity of sodium hydroxide .The molecular weight of sodium hydroxide is 40.To prepare 12 molarity of solution 480 g of sodium hydroxide flakes are weighted and they can be dissolved in distilled water to form 1 liter solution. Volumetric flask of 1 liter capacity is taken, sodium hydroxide flakes are added slowly to distilled water to prepare 1 liter solution.

2.3 MIX PROPORTIONS

As there are no code provisions for mix design of Geopolymer concrete the density of geo-polymer concrete is assumed as 2400 kg/m^3.The rest of the calculations are done by considering the density of concrete. The total volume occupied by fine and coarse aggregate is adopted as 77%.The alkaline liquid to fly ash and CGBS ratio kept as 0.4 .The ratio of sodium hydroxide to sodium silicate is kept as 2.5 .The

conventional method used in the making of normal concrete is adopted to prepare geopolymer concrete.

2.4 CASTING AND CURING

Firstly, the fine aggregate, coarse aggregate,fly ash and CGBS are mixed in dry condition for 3-4 minutes and then the alkaline solution which is a combination of sodium hydroxide solution and sodium silicate solution with super plasticizer is added to the drymix. Water is taken as 10% of the cementious material (fly ash and CGBS).The super plasticizer is taken as 3% of the cementious material. The mixing is done for about 6-8 mins for proper bonding of all the material. After the mixing is don, cubes are casted by giving proper compaction in three layers.

Table-1: Material requirements for 1 m^3

Fly ash + CGBS	Sodium hydroxide	Sodium silicate	Fine Agg.	Coarse Agg.
394.30kg/m^3	45.14 kg/m^3	112.86 kg/m^3	555.0 kg/m^3	1293.00 kg/m^3
Distilled water: 10% of the total cementious material				
Super plasticizer :3% of the total cementious material				

3. TEST RESULTS

The cubes are tested in compressive testing machine (100 tone capacity) to determine their compressive strength at the age of 1 day, 7days , 28 days of curing. The result have shown that the mix combination of F60 G40 gave maximum strength compared with rest.The splitting tensile strength and flexural strength for the mix combination of F60G40 was done. The results are shown in table 4 and table 5 respectively. It was found that as the age the concrete increase the compressive strength of the geopolymer concrete is enhanced at ambient temperature without water curing. The mixing, casting, testing, and failure modes of geopolymer concrete specimen are shown in figure 1,2,3,4,5,6,7and 8 respectively.

Mix Id	Compressive strength (N/mm^2)		
	7 day	21days	28 days
$F_{90}G_{10}$	22.00	27.25	28.50
$F_{80}G_{20}$	30.32	43.78	52.00
$F_{70}G_{30}$	40.06	54.61	65.00
$F_{60}G_{40}$	55.05	69.51	78.50

4. CONCLUSIONS

Based on the results obtained in the experimental investigation, the following are drawn.

1. The geo polymer gained strength within 24 hours at ambient temperature without water curing.
2. The necessity of heat curing of concrete was eliminated by incorporating GGBS and fly ash in the concrete mix.
3. The strength of Geopolymer concrete was increased with increase in percentage of GGBS in mix.
4. It was observed that the mix Id F60G40gave maximum compressive strength.

REFERENCES:

[1]. Aslani (2015); Thermal Performance Modelling of Geopolymer Concrete, Journal of Materials in Civil Engineering
[2]. Shankar H Sanni (2012); Performance of Geopolymer Concrete under severe environmental conditions, International Journal on Civil and Structural Engineering
[3]. Ramujee et al(2014), Development of Low Calcium Fly Ash BasedGeopolymer Concrete, IACSIT International Journal of Engineering and Technology, Volume 6
[4]. 4.Lloyd et al (2010);Geopolymer concrete: A review of development and opportunities
[5]. Bakharev, T., (2005(a)), Resistance of geopolymer materials to acid attack, Cement and Concrete
[6]. K.Parthiban, K.saravanarajamohan, S.Sobana, A.Anchal Bhaskar, "Effect of Replacement of Slag on the Mechanical Properties Of Fly ash based Geopolymer Concrete", International Journal of Engineering and Technology (IJET),2013, ISSN: 0975-4024 , Page 2555-2559
[7]. Ganapati Naidu, A.S.S.N. Prasad, S. Adiseshu ,P.V.V.satayanaray "A study on strength properties of Geopolymer Concrete with the addition of GGBS",International Journal of Engineering

Research and Development (IJERD),2012 ISSN: 2278-800, Page 19-28

[8]. Partha Sarathi Deb,Pradip Nath, Prabir kumar sarker, "The Effects of GGBFS blending with Flyash and activator content on the workability and strength properties of Geopolymer concrete cured at ambient temperature ", Elsevier, Material and design,62(2014),page 32-39

[9]. V.supraja , M.kantarao , "Experimental study on Geopolymer concrete incorporating GGBS", International Journal of Electronics, Communications and Self Computing Science and Engineering (IJECSCSE), 2012, ISSN : 2277-9477, Page 11-15

[10]. Madheswaran C.K,Gnansundar G, Gopalkrishnan, "Effect of molarity in Geopolymer concrete", International Journal of Civil and Structural Engineerimg, ISSN09764399 , Vol. 4, No. 2,2013 page106-115

[11]. Ravindra N.Thakur, Somnath Ghosh, "Effect of mix composition on compressive strength and microstructure of flyash based geopolymer concrete ",ARPN Journal of Engineering and Applied Sciences, vol4,No4, june2009,ISSN1819—6608, page 68-71

[12]. Pradip Nath,Prabir kumar Sarker "Effect of GGBFS on Setting, Workability and early Strength properties of flyash Geopolymer Concrete ", Elsevier, construction and building materials, 2014 , 66, page 163-171

[13]. Mr. Bennet Jose Mathew, Mr. M Sudhakar, Dr. C Natarajan, "Strength, Economic and Sustainability Sustainability Characteristics of Coal Ash –GGBS Based Geopolyme Concrete", International Journal Of Computational Engineering Research (ijceronline),ISSN 2250-3005 Vol. 3 Issue. 1,page 207-212.