EXPERIMENTAL INVESTIGATION ON GEOPOLYMER CONCRETE BY USING GGBS AND MARBLE POWDER

Sahebagouda

Assistant Professor, Dept of Civil Engineering,
Veerappa Nisty Engineering College, Shorapur, Yadgir, Karnataka, India

Dr. Shreenivas Reddy Shahapur

Professor, Department of Construction Technology
VTU Regional Centre, PG Studies, Kalaburagi, Karnataka, India.

ABSTRACT

This paper contains study of experimental investigation on geopolymer concrete by using GGBS and marble powder with basic fluids Sodium Hydroxide (NaOH) and Sodium Silicate (Na_2SiO_3). Distinctive molarities of sodium hydroxide arrangement i.e. 8M, 10M and 12M are taken to get ready diverse blends and the compressive strength is ascertained for each of the blend. In this study we compared results of marble with fly ash to GGBS with fly ash for 8M, 10M and 12M. the compressive strength of concrete, flexure strength and split tensile strength are tabulated. conclusions draw on from these tests.

Keywords: Fly ash, Geopolymer, GGBS, Marble Powder

Cite this Article: Sahebagouda and Dr. Shreenivas Reddy Shahapur, Experimental Investigation on Geopolymer concrete by Using GGBS and Marble powder, *International Journal of Civil Engineering and Technology*, 11(11), 2020, pp. 35-39.
<https://iaeme.com/Home/issue/IJCET?Volume=11&Issue=11>

1. INTRODUCTION

1.1. General

The biggest problem to the human beings on this planet is environmental pollution. Environmental pollution means adding impurities to the atmosphere. Ecosystem is badly affected by this kind of pollution. This Pollution is caused by so many reasons. In the construction field, Cement is the main ingredient for the production of concrete. But the production of cement requires large amount of raw material. burning limestone. Concrete is used globally second only to water. Due to increase in demand of concrete there is increase in production of cement which results in increase in environmental pollution and global warming.

The demand for Portland cement is increasing day by day and hence we need alternate material binders in concrete

Fly ash-based Geo polymer concrete is a new material that does not need the Portland cement as a binder. There are two main constituents of geo polymers, namely the source materials and the alkaline liquids. The source materials for geopolymers are based on alumina-silicate which should be rich in silicon and aluminum. Fly ash is rich in silicate and alumina; it reacts with alkaline solution to produce aluminosilicate gel. This gel binds the loose aggregates and other unreacted materials in the mixture to form the geo polymer concrete [S.E.Wallah and B. V. Rangan 2006].

1.2. Objectives of the Study

In this Paper main objective is to study the mechanical properties of geopolymer concrete using Marble powder and Flyash with Molarity variation for M20 concrete. Second objective of this paper is to study the mechanical properties of geopolymer concrete using GGBS and Flyash with Molarity variation for M20 concrete. Ultimate goal is to produce economical and eco-friendly concrete with all desired properties and strength which one obtains by regular concrete ingredients.

2. MATERIALS AND METHOD

2.1. Marble Powder

Marble powder is produced from the marble processing plants during the cutting, shaping and polishing. During this process, about 20-25% of the process marble is turn into the powder form. India

being the topmost exporter of marble, every year million tons of marble waste form processing plants are released. The disposal of this waste marble on soils causes reduction in permeability and contaminates the over ground water when deposited along catchment area.

2.2. Physical properties

Colour - Grey

Form - Powder

Odors – Odour less

Specific gravity - 2.68 gm/cm³

Fly Ash: The Fly ash was obtained from Raichur Thermal Power Station, and the Sp is 2.4. Fly ash confirming to IS 3812-2003 was used. The major constituents of fly ash are silica (Si), Alumina (Al), Ferric oxide (Fe₂O₃) and calcium oxide (CaO). And the other minor constituents of the fly ash are MgO, Na₂O, K₂O, SO₃, MnO, TiO₂ and the un burnt carbon

Table 1 Constituents of Fly Ash

Element	C	O	Mg	Al	Si	K	Ca	Ti	Fe
Weigh%	8.3	50	0.37	13	21	0.8	0.5	2	2

2.3. Ground granulated blast furnace slag (GGBS)

The GGBS which we used here was obtained from JSW steel Bellary, and the specific gravity of GGBS is 2.9. GGBS is widely used as a cement replacement material because of its latent hydraulic properties.

GGBS is obtained by a by-product of iron and steel in blast furnace to produce a glassy, granular product that is then dried and ground into a fine powder.

Table 2 Properties of GGBS

SI No	Property	Value
1.	Specific gravity	2.61
2.	Fineness	202.7 g/m ²
3.	Fineness modulus	7
4.	Density	2068.50Kg/m ³

2.4. Sodium hydroxide

Generally the sodium hydroxides are available in solid state by means of pellets and flakes. The cost of the sodium hydroxide is mainly varied according to the purity of the substance. Since our geopolymer concrete is homogenous material and its main process to activate the sodium silicate, so it is recommended to use the lowest cost i.e. up to 94% to 96% purity. In this investigation the sodium hydroxide pellets were used.

2.5. Sodium silicate

Sodium silicate is also known as water glass or liquid glass, available in liquid (gel) form. In present investigation sodium silicate 2.0 (ratio between Na₂O to SiO₂) is used. As per the manufacture, silicates were supplied to the detergent company and textile industry as bonding agent. Same sodium silicate is used for the making of geopolymer concrete.

2.6. Coarse Aggregate

The fractions from 20 mm to 4.75 mm are used as coarse aggregate. The Coarse Aggregates from crushed Basalt rock, conforming to IS: 383 are being used. The Flakiness and Elongation Index were maintained well below 15%.

2.7. Fine aggregate

Those fractions from 4.75 mm to 150 microns are termed as fine aggregate. The river sand and crushed sand is used in combination as fine aggregate conforming to the requirements of IS: 383. The river sand is washed and screen, to eliminate deleterious materials and oversize particles.

3. EXPERIMENTAL METHODOLOGY

As there are no code provisions for the mix design of geopolymer concrete, the density of geopolymer concrete is assumed as 2400 Kg/m³. 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 70%. The alkaline liquid to fly ash and Marble dust ratio is kept as 0.4. The ratio of sodium hydroxide (NaOH) to sodium silicate (Na₂SiO₃) is kept as 2.5.

3.1. Mix Proportion

Table 3 Mix Proportion

Elements	Density kg/m ³	Per cube kg/m ³	Per cylinder kg/m ³
Coarse aggregate	1294	4.36	6.6
Fine aggregate	554	2.244	3.53
Cementitious materials	394	1.596	2.5
Fly ash (75%)	296	1.188	1.584
Marble dust (25%)	98	0.369	0.624
NaoH	45	0.181	0.288
Na ₂ SiO ₃	113	0.457	0.718
Super plasticizer (SP430)	98.5	34	52

4. TEST RESULTS

The results obtained from experimental investigations are tabulated in below tables. The results have been analyzed and graph showing the strength variations are plotted. The effect of variation in molarities of alkaline solution with cementitious materials is discussed here.

Figure 1 Variation of Compressive Strength with Molarities

Figure 2 Variation of Split Tensile Strength with Molarities

Figure 3 Variation of Flexural Strength with Molarities

5. CONCLUSION

1. With the inclusion of Marble powder the strength of concrete gradually increases up to a certain limit but the gradually decreases.
2. With the inclusion of Marble powder up to 25% the initial strength gain in concrete is high.
3. Higher concentration of NaOH solution results in higher strength.
4. 3days curing period produces higher compressive strength.

REFERENCES

- [1] Davidovits, J.,(2002), 30 years of successes and failures in geopolymer applications-Market trends and potential breakthroughs, Proceedings of the geopolymer 2002 conference Oct28-29, Melbourne,Australia,1-15.
- [2] Son Hoang Trinh, Dong Van Dao, Quynh Anh Thi Bui. A Study on Effect of Aggregate Grading on Compressive Strength and Workability of Fly Ash Based Geopolymer Concrete Totally Using Steel Slag Aggregate. International Journal of Civil Engineering and Technology, 8(5), 2017, pp. 1460–1467.
- [3] Prakul Thakur, Khushpreet Singh and Raju Sharma, An Experimental Study on Geopolymer Concrete with Bagasse Ash and Metakaolin: A Green Concrete, International Journal of Civil Engineering and Technology, 9(7), 2018, pp. 1066-1077
- [4] K. Chandra Padmakar and B. Sarath Chandra Kumar, An Experimental Study on Metakaolin and GGBS Based Geopolymer Concret. International Journal of Civil Engineering and Technology, 8(1), 2017, pp. 544–557.
- [5] Subhrajyoti Nath and N. Lokeshwaran, Behavior of Fiber Reinforced Geopolymer Concrete Beam Column Joint Under Cyclic Loading, International Journal of Civil Engineering and Technology, 9(4), 2018, pp. 355–364.