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MECHANICAL BEHAVIOUR OF GEOPOLYMER CONCRETE BASED ON OPTIMUM DOSAGE OF FLY ASH AND GGBS

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ABSTRACT

In the present study, an attempt has been made to find out an optimum mix for the geo-polymer concrete (GPC). fly ash, ground granulated blast furnace slag (GGBS) and Alkaline liquids have been used to prepare GPC mixes. prepared Cubes, cylinders were cured under hot oven. Cubes of size 150mm×150mm×150mm have tested for their residual compressive strengths. Cylinders of size 150mm×300mm are tested for their tensile strength. GPC cubes, cylinders of different proportions of fly ash and GGBS were prepared and their results were drawn. The GPC with 50-50 ratio gives comparatively higher strength but optimum strength for M30 grade concrete is 60-40 ratio.

KEYWORDS: *Thermal Power Plants, Optimum Strength, Strength of Geopolymer Cubes*

Article History

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INTRODUCTION

Cement and concrete are key components of both commercial and residential construction. In cement and concrete production cement is the key ingredient in concrete products. Cement production requires a source of calcium (usually limestone) and a source of silicon (such as clay or sand). The cement industry does not fit the contemporary picture of a sustainable industry because it uses raw materials and energy that are non-renewable fully. Thorough waste management, by utilizing the waste by-products from thermal power plants, fertilizer units and steel factories, energy used in the production can be considerably reduced.

Materials

GPC contains Natural River Sand and Locally available coarse aggregate with a specific gravity of 2.57 and 2.8. The C-S-H gel was achieved by the process of polymerization and hydration. A combination of Sodium silicate and Sodium hydroxide solution were chosen as the activator liquids. Sodium silicate and sodium hydroxide pellets and the s ilicate solution for both these elements purchased from a local supplier. The activator solution contains Sodium hydroxide in flake form NaOH with 98% purity, Sodiumsilicate solution Na2O 14.7%, Silicon oxide SiO2 29.4%, Water 55.9%. This fly ash and GGBS reacts with an alkaline solution (e.g., NaOH) and Sodium Silicate (Na2S iO3) to form a gel which binds the fine and coarse aggregates. GPC cubes, cylinders were placed oven for 24 hours of hot curing to complete the polymerization reaction at 60oC.

Mix Design

Geopolymerconcretemixis based on the conventional concrete proportions 1:1.45:2.57. GPC mix design with Solution -F lyash Ratio 0.35, Sodium hydroxide and Sodium Silicate ratio fixed 2.5, 8 Molarity were used for M30 grade.

Geopolymer Concrete

Fly ash, GGBS, fine aggregates are mix together and then coarse aggregate is added, finally, the alkaline solution mixed along with conplast super plasticizer. Different quantities of fly ash, GGBS (Shown in Table) were taken for each proportion 6 cubes (150×150×150 mm), 3 cylinders (150×300 mm)

C after 24 hours. Compressive strength of cubes at 7 and 28 days was tested and tensile strength of cylinders at 28 days were tested. the mix proportions were shown in table 1.

Table 1 Material Proportion for Mix

Sl. No.	Material	QTY (50-50) kg/m^3	QTY (60-40) kg/m^3	QTY (40-60) kg/m^3
1.	Fly ash	8.02	9.639	6.426
2.	GGBS	8.02	6.426	9.639
3.	FA	20.81	20.81	20.81
5.	CA	35.154	35.154	35.154
6.	NaOH	0.520	0.520	0.520
7.	Na_2SiO_3	4.076	4.076	4.076

Preparation of Test Specimens

The test specimens were prepared by Machine Mix, fresh concrete test was carried and placed in the specimen molds and used table vibrator for compaction. Specimens were kept for 24 hr for demolding. After that, the specimens were placed in the oven with 60oC temperature for 24 hr to complete the polymerization reaction.

RESULT AND DISCUSSIONS

Compressive Strength of Cubes

The average compressive strength for M30 grade concrete cubes for at the age 28 days obtained as 40.29

N/mm2. The average compressive

strength of geopolymer cubes at 28 days is for 50-50, 60-40, 40-60 are

57.67N/mm2,44.22N/mm2,47.33N/m

m2 Respectively. the Comparative bar chart is shown in Fig.1

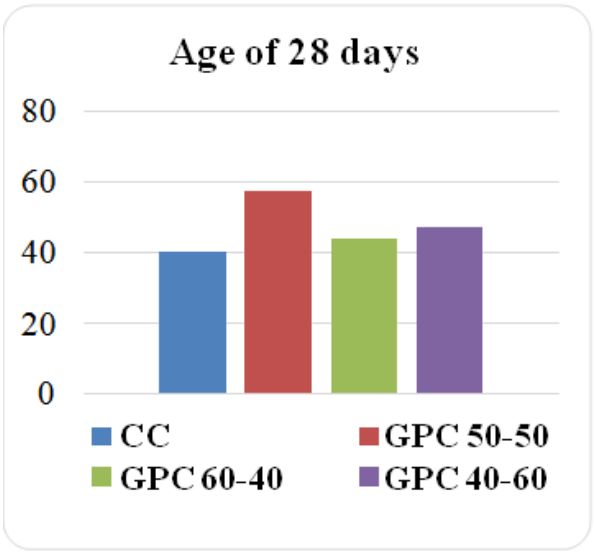

Figure 1: Compressive Strength Comparative Chart

Split Tensile Strength of Cylinders

The average split tensile strength for M30 grade concrete cylinders for the age of 28 days is obtained as 2.42 N/mm2. The average split tensile strength of geopolymer concrete cylinders after 28 days curing is for 50-50, 60-40, 40-60 are 2.22N/mm2, 1.94N/mm2,2.46N/mm2.respectively. the Comparative bar chart is shown in Fig.2

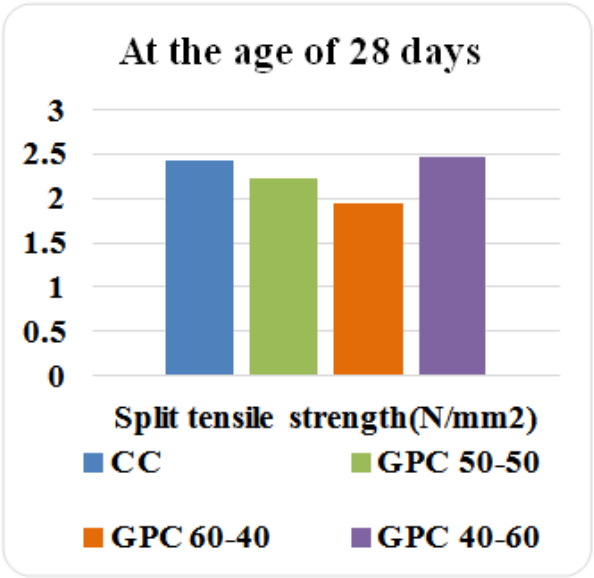

Figure 2: Split Tensile Strength Comparative Chart

CONCLUSIONS

- Based on this project the following conclusions were drawn Compressive strength of the Geopolymer concrete was made with different ratio of replacement of GGBS and Fly ash, it seems that increase in GGBS content up to 50 % replacement gives better results more than that the strength will get affect.
- GPC with 50-50%giveshigher strength but 60-40% gives the nearest value of required design strength so with that for M30 grade of GPC (60-40)% is with8M and 0.35 Solution to binder ratio is optimum mix ratio.

Feature Scope of Project

- In this project only 8M used to compare the results so the researcher can use different molar ratios with respect to replacement of 40-60 %.
- This project limited to M30
- Grade only so researcher can find the optimum mix for the different grades of GPC.
- This project deals only with Oven curing so not compared with ambient curing conditions.

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