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EXPERIMENTAL INVESTIGATION OF FLEXURAL BEAM MADE OF GEO-POLYMER CONCRETE

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Abstract

Concrete is the most abundant manmade material in the world. One of the main ingredients in a normal concrete mixture is Portland cement. However, the production of cement is responsible for approximately 5% of the world's carbon dioxide emissions. In order to create a more sustainable world, engineers and scientists must develop and put into use a green building material. Geopolymer concrete is also much more durable that ordinary concrete due to its resistance to corrosion. It is also much stronger than ordinary concrete. Geopolymer concrete is a revolutionary sustainable building material that will pave the way for green building. In this paper an attempt is made to study strength properties of geopolymer concrete using low calcium fly ash replacing with slag in 5 different percentages. Sodium silicate (103 kg/m3) and sodium hydroxide of 8 molarity (41kg/m3) solutions were used as alkaline solution in all 5 different mixes. The investigations are to be carried for the Compressive strength, Split tensile strength, Flexural strength test on the concrete specimens. Hopefully one day in the near future geopolymer concrete will replace ordinary Portland cement as the most abundant man-made material on earth.

Keywords: Origin of term Geopolymer, fly ash, ggbs, alkaline liquid, design mix proportion, preparation of alkaline solutions, ambient curing, strength parameters, geopolmer concrete.

1. INTRODUCTION

Concrete is one of the most widely used construction material. Portland cement production is a major contributor to carbon-di-oxide emissions. The global warming is caused by the emission of greenhouse gases, such as carbon-di-oxide, to the atmosphere by human activities.Among the greenhouse gases, carbon-di-oxide contributes about 65% of global warming. Many efforts are being made in order to reduce the use of Portland cement supplementary cementing materials such as fly ash, silica fume, granulated blast furnace slag, rice-husk ash and metakaolin, and finding alternative binders to Portland cement. In terms of reducing the global warming, the geo- polymer technology could reduce the carbon-di-oxide emission to the atmosphere caused by Cement about 80%. In this project ,the effort was made to study the strength parameters of geo-polymer concrete. The term ''Geopolymer'' was first introduced to the world by Davidovits of France resulting in a new field of research and technology. Geopolymer also known as 'inorganic polymer', has emerged as a 'green' binder with wide potentials for manufacturing sustainable materials for environmental, refractory and construction applications.

2. LITERATURE REVIEW

In this chapter study of geo-polymer concrete and the application of are discussed using following research articles are presented. Supraja .V, M. KantaRao presented a study of geopolymer concrete, the portland cement is fully replaced with GGBS and alkaline liquids (sodium hydroxide and sodium silicate) are used for the binding of materials. Different molarities of sodium hydroxide solutions i.e. 3M, 5M, 7M and 9M are considered. The strength of geopolymer increases with increase of molarity of sodium hydroxide.

Parthiban.K, K.Saravanarajamohan presented the influence of the various proportions of GGBS (0-100%) on Fly Ash based GPC; the effect of the amount of Alkaline Activated Solution (AAS) in the mixture of GPC on their compressive strength is studied under ambient temperature conditions.

Palaniappan. A,S.Vasantha discussed the results of an experimental investigation and compare on the mechanical properties of different binder composition (17 TO 20 % replacement of cement by ground granulated blast furnace slag (GGBS)) of Geopolymer Concrete Composites (GPCC). The test results show that GGBS concrete shown increase in compressive strength of 13.82% as compared with conventional concrete.

Prof.Pratap,Krishnan concluded the experimental investigation FLY ASH and BLAST FURNACE SLAG are used in equal proportion (50% each).The geopolymer concrete gains about 60-70% of the total compressive strength within 7days.

3. RELATED WORK

Fly ash is one of the most abundant materials on the Earth. It is also a crucial ingredient in the creation of geopolymer concrete due to its role in the geopolymerization process. A pozzolan is a material that exhibits cementitious properties when combined with calcium hydroxide. Fly ash is the main by product created from the combustion of coal in coal-fired power plants. There are two "classes" of fly ash, Class F and Class C. Each class of fly ash has its own unique properties.

S.No	Characteristics	Values
1.	Type	Crushed
2.	Specific gravity	2.6
3.	Bulk Density	1765 kg/m^3
4.	Fineness modulus	6.45
5.	Maximum size	20mm

Fig.1. Properties of Aggregates

The sodium hydroxide solids were of a laboratory grade in pellets form with 99% purity, obtained from local suppliers. The sodium hydroxide (NaOH) solution was prepared by dissolving the pellets

(a small, rounded, compressed mass of a substance of sodium hydroxide)in water. The mass of sodium hydroxide solids in a solution varied depending on the concentration of the solution expressed in terms of molar, M. For instance, sodium hydroxide solution with a concentration of 8M consisted of 8x40 = 320 grams of sodium hydroxide solids (in pellet form) per liter of the solution, where 40 is the molecular weight of sodium hydroxide. Sodium silicate solution (water glass) obtained from local suppliers was used. The chemical composition of the sodium silicate solution was Na2O=8%, SiO2=28%, and water 64% by mass. The mixture of sodium silicate solution and sodium hydroxide solution forms the alkaline liquid.

4. METHODOLOGY

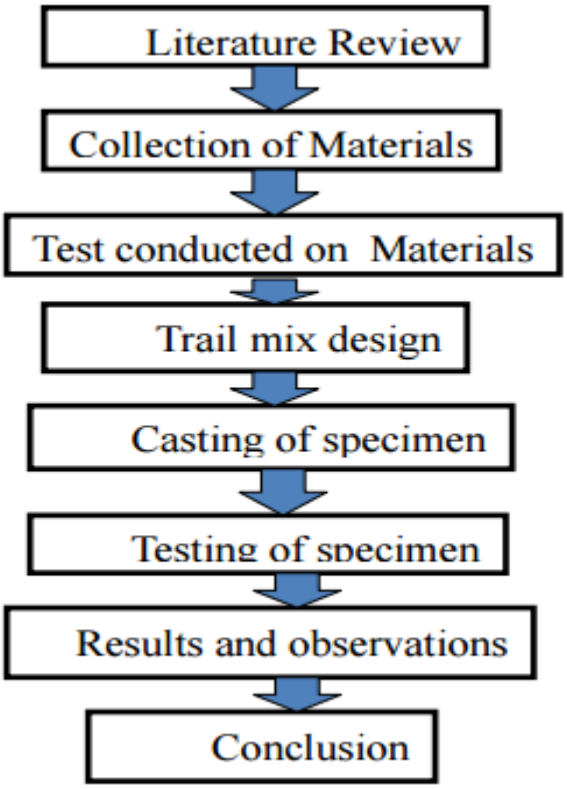

Fig.2. Methodology

In this chapter mix design of Geo-polymer concrete and the experimental investigation carried out on the test specimen to study the strength related properties of geo- polymer concrete was discussed in detail.The experimental test for strength properties of concrete are compressive strength, split tensile strength, Flexural strength test of concrete. Based on the test procedure given in IS 516-1959 code tests were conducted on specimens. The mixture of sodium silicate solution and sodium hydroxide solution forms the alkaline liquid.A combination of alkaline silicate solution and alkaline hydroxide solution was chosen as the alkaline liquid. sodium-based solutions were chosen because they were cheaper than potassium- based solutions. The Alkali activator solution has to be prepared 24 hours advance before use. The Sodium hydroxide is available in small flakes and Sodium Silicate in crystal forms depending on the required solution of different morality has to be prepared.

5. RESULT ANALYSIS

The test specimens for compressive strength test were made of cubes having a size of 150mm x 150mm x 150mm cast iron steel moulds were used. For each mix proportion three numbers of cubes were cast and tested at the age of 7 days and 28 days. The test specimens for split tensile strength test were made of cylinders having a size of The variation of compressive strength at the age of 7th and 28th days with optimum percentage of GGBS and flyash

S.No	Characteristics	Values
1.	Type	Uncrushed (natural)
2.	Specific gravity	2.54
3.	Bulk Density	1668 kg/m^3
4.	Fineness modulus	2.76
5.	Grading zone	Zone II

Table.2

From the test results, it was observed that the maximum compressive strength was obtained for mix M2 with 30% GGBS and 70% flyash. The results of flexural strength of concrete at the age of 28 days are presented in Table6.3. The variations in flexural strength at the age of 28 days with different percentage of GGBS and Flyash were plotted .From the test results, it was observed that when the percentage of GGBS increases, the flexural strength of concrete also increases. On the contrary, the strength decreases when the percentage of flyash increases.

CONCLUSION

Based on the experimental investigation the following conclusions are listed belowThe optimum replacement level of fly ash by GGBS in GPC will be carried out. Water absorption property is lesser than the nominal concrete. Achieving strength in a short time i.e. 70% of the compressive strength in first 4 hours of setting. Determines the different strength properties of geo-polymer concrete with percentage replacement of GGBS.

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