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Geopolymer Concrete for Low Cost Construction

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Abstract: The second most consumed product in the world is cement. It contributes nearly 7% of the global carbon dioxide emission. Geo-polymer concrete is a special type of concrete that is manufactured using industrial waste like fly ash and GGBS and red soil which are considered as a eco friendly and low cost construction material alternative to ordinary Portland cement (OPC) based concrete

This project mainly aims to reduce the cost of construction study of effect of fly ash (FY) ground granulated blast furnace slag (GGBS) and red soil on the mechanical properties of geo polymer concrete (GPC) thy replaced cement and sand (FA33-GGBS22, RS66) using Sodium silicate(Na2SiO3), Sodium hydroxide (NaOH), Aluminium oxide(Al_2O_3) and Calcium sulphate ($CaSO_4$) solutions as alkaline activators

Specimens were casted and curing in autoclave maximum temperature of 50-82*C period of 18 hours determined the mechanical properties of geo-polymer concrete. Test result shows the material percentage in GPC and mechanical properties of compressive strength and split tensile strength were increasing.

Keywords: Geopolymer concrete, GGBS, Fly ash, Sodium silicate, Sodium hydroxide,

I. INTRODUCTION

Concrete is the most widely used construction material in the world and ordinary Portland cement (OPC) is the major ingredient used in concrete. The production of cement releases large amount of carbon dioxide (CO_2) to the atmosphere that significantly to the greenhouse gas emissions. It is estimated that one ton of (CO_2) is released into the atmosphere for every ton of OPC production. In view of this there is a need to develop sustainable alternative to conventional cement utilizing the cementations properties of industrial by-products such as fly ash , ground granulated blast furnace slag and natural red soil . on the other side , abundance and availability of fly ash and GGBS worldwide cerate opportunity to utilize these by products , as partial replacement or as performance enhancer for OPC.

II. OBJECTIVES

- Alternative to OPC concrete.
- To develop a mixture proportioning process
- Durable infrastructures with design life of hundred of years (resistance against chemical attack).

III. METHODOLOGY

The work elements for the project are listed as below:

- Identification of source material, alkaline solutions, and other ingredients. The source material is flyash and the suitability of flyash from nearby power stations has been investigated.
- Material characterization of ingredients, such as particle size, and chemical composition.
- Development of Geopolymer concrete formulation with heat curing. In this geopolymer concrete of different strengths have been formulated. As curing quickens the polymerisation process, this has been resorted to.
- Studies on short-term and long-term mechanical properties. Strength tests such as cube compression test and cylinder split tensile strength have been conducted.
- Geopolymer concrete cubes of size 150X150X150mm subjected to compressive loading. And cylinder of size 150x300mm subjected to split tensile loading. Cubes and cylinder of geopolymer concrete are casted with different type material,

- Mix design M 35as for IS 10262(2009) guidelines, and cubes are drying in oven up to3-4 hours and curing in Autoclave up 18 hours after curing Comparison of Specimens are tested.

Table 1Mix proportions

	Mass (kg/m^3)	**Mass (kg/m^3)**	**Mass (kg/m^3)**	**Mass (kg/m^3)**	**Mass (kg/m^3)**	**Mass (kg/m^3)**
Materials	**Normal concrete**	**GPC Type 1**	**GPC Type 2**	**GPC Type 3**	**GPC Type 4**	**GPC Type 5**
Coarse aggregate	1082	1082	1082	1082	1082	1082
Fine aggregate	640	433	433	433	433	160
Fly ash	_	207	207	207	207	_
GGBS	_	105.82	105.82	105.82	105.82	105.82
CEMENT	481	158.73	158.73	158.73	141.89	158.73
Sodium silicate	_	158.73	158.73	158.73	158.73	158.73
Sodium hydroxide	_	57.72	57.72	57.72	57.72	57.72
Aluminium Oxide	_	_	8(extra)	8(extra) oven dried	12	_
Calcium Sulfate	_	_	_	_	4.81	_
Red soil	_	_	_	_	_	480
Water	197	197	197	197	197	197

IV. RESULTS

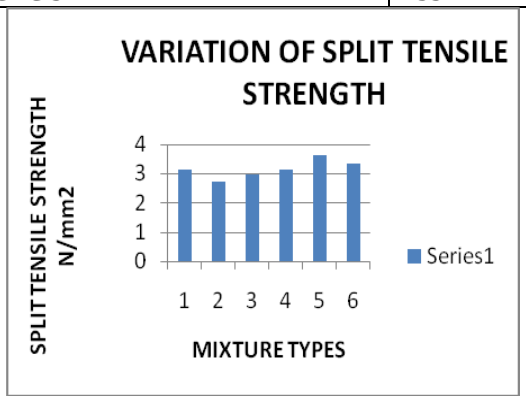
Table 2: Compressive strength of GPC cubes

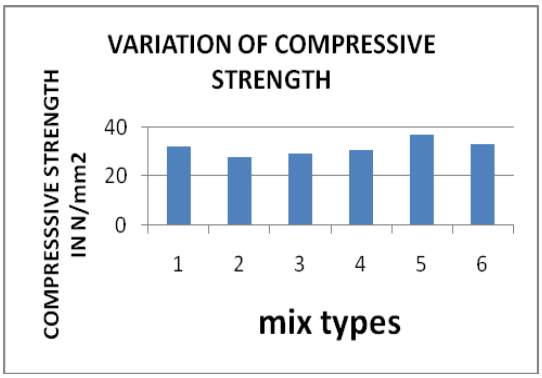
Mixture type	**Load (kn)**	**Compressive strength n/mm^2**
Normal concrete	728	32.36
GPC 1	628	27.92
GPC 2	661	29.4
GPC 3	688	30.59
GPC 4	830	36.88
GPC 5	741	32.95

Table 3: Split tensise strength of GPC cylinder

Mixture type	**Load (kn)**	**Split tensile strength n/mm^2**
Normal concrete	225	3.18
GPC 1	197	2.75

GPC 2	211	2.98
GPC 3	215	3.04
GPC 4	240	3.4
GPC 5	235	3.32





Graph 1: Variation of split tensile strength and compressive strength

V. CONCLUSION

- Geo-polymer concrete cubes and cylinders are casted for different GPC mix type and tested.
- In geo-polymer concrete extra amount Al_2o_3 increase strength.
- In geo-polymer concrete $CaSo_4$ increase high strength.
- Red soil mixed Geo-polymer concrete cubes minimise the fly ash and strength is higher than normal geo-polymer concrete.
- Found that red soil mixed geo-polymer concrete shows low cost material and shows better for low cost construction.
- Red soil is easily available soil and very low cost material.
- Keeping in view of savings in natural resources, sustainability, environment, production cost, maintenance cost and all other GPC properties, it can be recommended as an innovative construction material at low cost for the use of constructions.

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