“Durability Properties of Geo-polymer Concrete”

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Project Proposal Ref no: 46S_BE_1835

Introduction:

Geo-polymer concrete is a type of concrete that is made by reacting aluminate and silicate bearing materials with a caustic activator, such as bagasse ash or slag from iron and metal production. It can be a suitable substitute for ordinary Portland cement (OPC). Geo-polymer concrete (GPC) is one of the most attractive materials among researchers due to its strong potential in structural engineering and sustainable development. It is also environment friendly as it is based on industrial solid wastes and by products like Ground Granulated Blast Furnace Slag (GGBS) and Bagasse ash (BA) which are often disposed into landfill thereby providing a viable use for waste materials. These products contain cementitious material properties and can be used as alternate for cement to overcome environmental problems.

Objectives:

1. To study the strength parameters of geo-polymer concrete.
2. To make concrete eco-friendly without the use of cement (i.e., geo-polymer concrete).
3. To study the effects of different curing methods on geo-polymer concrete.
4. To identify the potential use of bagasse ash and GGBS.
5. To study the durability properties of geo-polymer concrete.

Literature Review:

Mugahed Amran, Amin Al-Fakih, S.H. Chu, Roman Fediuk, Sani Haruna, Afonso Azevedo, Nikolai Vatin carried out Long term durability properties of geo-polymer concrete. It is observed from the results that GPC is superior to OPC in terms of durability with better

resistance against fire, sulphuric acid and aggressive environment as it displays GPC has lower strength loss and slight erosion in acid, sulphate and chloride solution and minor surface trickling's occurred after exposure to high temperature, the compressive strength is increased with elevated sodium hydroxide concentration.

Prashant Sunagar , Sumalatha J ,Mahesh Kumar C L ,Shwetha K G , Sanjith J and Kiran B M carried out work on Strength and durability behaviour of fly ash based Geo Polymer Concrete in Structural Application. The test result showed that there is a considerable increase in compressive strength of GPC (around 30%), it has good resistance against acid , sulphate , sea water resistance and has exceptional characteristics and is suitable for structural applications.

Mariam Farouk Ghazy , Mohamed Helmy Taman , Sara Saad ELatfawy studied durability properties of Geo Polymer based materials and its utilization as a repair and strengthening materials. The compression strength is increased with elevated sodium hydroxide concentration, durability of GPC is better than OPC, however durability of fly ash based GPC is greatly governed by internal configuration of alumino silicate.

Methodology:

In the present study, firstly the basic tests are conducted on Ground Granulated Blast Furnace Slag (GGBS), Bagasse Ash (BA), Fine Aggregate (FA) - Manufactured Sand (M-sand), Coarse Aggregate (CA) - 10mm aggregates - 20mm aggregates and mix design for Geo-polymer concrete is done based on the literatures and final mix proportion is presented below

The below mix proportion is for $1m^3$:

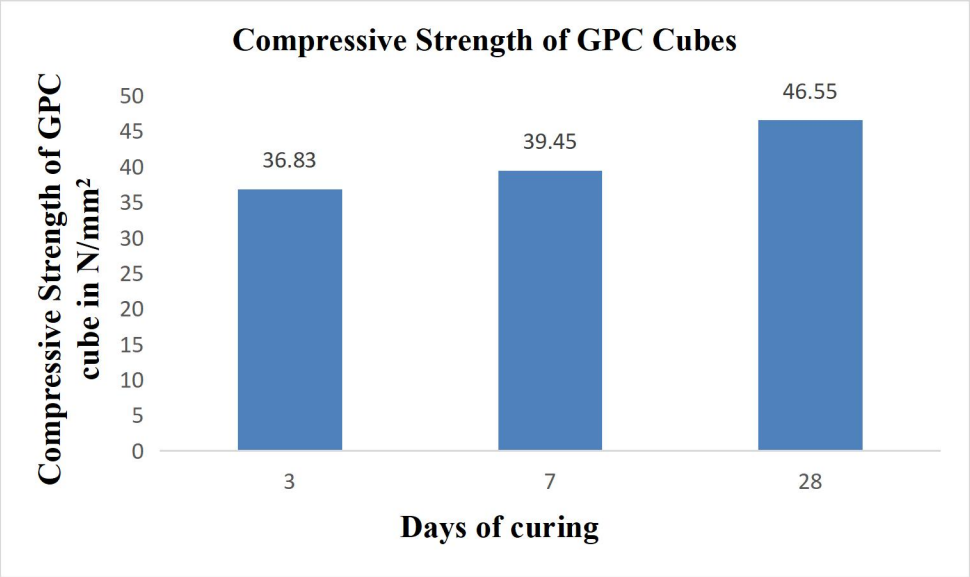
Materials	**Per m^3**
Ground Granulated Blast Furnace Slag (GGBS)	280 Kg
Bagasse Ash (BA)	120 Kg
Sodium Hydroxide (NaOH)	18.28 Kg
Sodium Silicate (Na_2Sio_3)	142.86 Kg
Fine Aggregate (FA)	680 Kg
Coarse Aggregate (CA)	1100 Kg
Distilled Water	38.86 Kg

Chemicals for Solution	Per m3	Percentage
NaOH	18.28 Kg	9.14%
NaSi2O3	142.86 Kg	71.43%
Distilled Water	38.86 Kg	19.43%

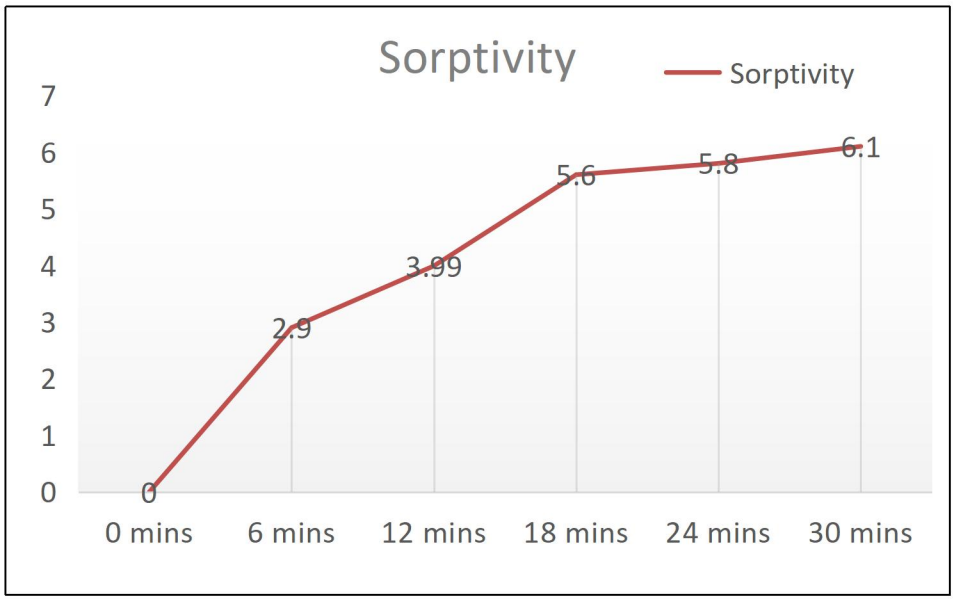
Admixtures	Per m3	Percentage
GGBS	280 Kg	70%
BA	120 Kg	30%

Materials	Per m3	Percentage
Admixtures (GGBS+BA)	400 Kg	18.35%
Fine Aggregate	680 Kg	31.19%
Coarse Aggregate	1100 Kg	50.46%

Results and discussions



The above graph indicates the compressive strength of geopolymer concrete after 3, 7 and 28 days of ambient curing.



The Sorptivity values for OPC cubes vary from **(10 to 20) X 10^{-5} mm/$min^{0.5}$**. The Sorptivity value obtained for GPC is **4 X 10^{-5} mm/$min^{0.5}$**. Hence, it can be concluded that sorptivity value of **GPC is lesser than OPC**.

Conclusions

1. Geopolymer concrete is a promising alternative to traditional cement-based concrete.
2. It has a lower carbon footprint and can be produced using industrial waste materials.
3. Geopolymer concrete has superior durability and high strength properties.
4. The use of geopolymer concrete can significantly reduce the environmental impact of the construction industry.
5. Geopolymer concrete has the potential to provide sustainable and durable infrastructure solutions.

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