Study on development of foundry sand based geopolymer concrete for temperature maintaining effect

[1]Rajesh Kumar Thakur, [2]Aman Bathla, [3]Dr. Gurcharan Singh

[1]M.tech Student, [2]Assistant Professor, [3]Head of Department
Department of Civil Engineering,
Geeta Engineering College, Panipat, Haryana, India

***Abstract*: As we know construction is very important in life. Concrete is most commonly used in construction. So the demand of concrete is growing day by day for satisfying the need of development of infrastructure facilities. It is a well-established fact that production of OPC not only consumes significant amount of natural resources and energy but also releases substantial quantity of CO2 into the environment. The amount of the carbon dioxide released during the manufacture of OPC due to calcinations of limestone and combustion of fossil fuel is in the order of one ton for every ton of OPC produced. Therefore, it is essential to find alternatives to make the concrete environment friendly. The geopolymer concrete is a useful invention in the world of concrete in which cement is totally replaced by pozzolanic material that is rich in silica as well as alumina and activated by alkaline liquid to act as binder in concrete by means of polymer chains. The fly ash is one of the source materials for geopolymer binders. Fly ash comes primarily from coal-fired electricity generating power plants. Fly ash is the mineral residue produced by burning coal. The fly ash consists primarily of silica, alumina and iron. Fly ash is a waste by-product material that must be disposed off or recycled. The foundry sand is also a waste by product of metal foundries. When the sand can no longer be reused in the foundry, it is removed and called as Foundry Waste Sand. Foundry waste sand is a high quality uniform silica sand that is used to make moulds and cores for ferrous and non-ferrous metal castings. The metal casting industry annually uses about 100 million tons of foundry sand for production. Over time, foundry sand physically degrades until they are no longer suitable for moulds. Consequently, 9 to 10 million tons of sand is discarded each year. So the fly ash and foundry sand is available abundantly, they are the waste materials that are not easily disposed and require more land to dispose. Hence it is essential to make the efforts to utilize these by product in concrete manufacturing in order to make the concrete more environments friendly.**
This research work has done to utilize waste by products and to see the effect of different temperature on various parameters of geopolymer concrete using foundry sand such as flexural strength, split tensile strength and compressive strength.

***Keywords*: foundry, concrete, geopolymer.**

INTRODUCTION

For all construction works, concrete is used normally as structural material. Supplementary materials may be added to concrete in order to increase the strengthening properties and for enhancing the serviceability. Examples of supplementary materials added are those which contains, silicon, aluminium such as blast furnace slag, fly ash, silica fume, steel fibres, glass fibres, rice husk, crushed stone dust etc. The 2nd most broadly used material in the world is concrete. Concrete is a combination of water, cement, coarse aggregate, fine aggregate, with or without adding admixture. The main component in concrete that attaches the component together and formed concrete is cement. The environmental issues produced with the production of OPC are well known. Due to the calcinations of limestone and combustion of fossil fuel, CO2 is produced in huge amount i.e. around 1tonne for every tonne of OPC. This has led to the development of geopolymer concrete in which the cement is totally substituted with pozzolanic material which is activated by the alkaline solution (basic) to act as a binder. In addition, it consumes natural resources like limestone, shale, sandstone and requires more energy during production. OPC is next most energy intensive material after production of aluminium and steel.

In contrast, the plentiful availability of fly ash worldwide creates prospect to utilise this by-product (coming by burning coal from thermal power plant) as a substitute for OPC to manufacture concrete. In 1978, Davidovits developed a binder formed by the polymeric reaction of alkaline solution with the silicon and the aluminium present in fly ash. Silicon and aluminium are available in source materials of geological basis or by-product materials such as fly ash, ground granulated blast furnace slag, rice husk ash, and waste paper sludge ash. OPC has been replaced by fly-ash in the last two spans. The cementations paste is prepared from fly ash and alkaline solutions. An alkaline liquid could be used to react with the Si and Al.

Objective of the study:

1) To reduce the carbon dioxide from atmosphere by replacing cement with fly ash because in making cement it emits lot of carbon dioxide which causes green house effect.
2)To gain more strength of GPC over OPC by maintaining temperature.
3) To make the concrete more economical by using waste by products like fly ash, foundry sand.

PROPERTIES OF GEOPOLYMER CONCRETE

1. Non-toxic, bleeding free.
2. Sets at room temperature.

3. Long working life before stiffening.
4. Impermeable.
5. Higher resistance to heat and resist all inorganic solvents.
6. Higher compressive strength

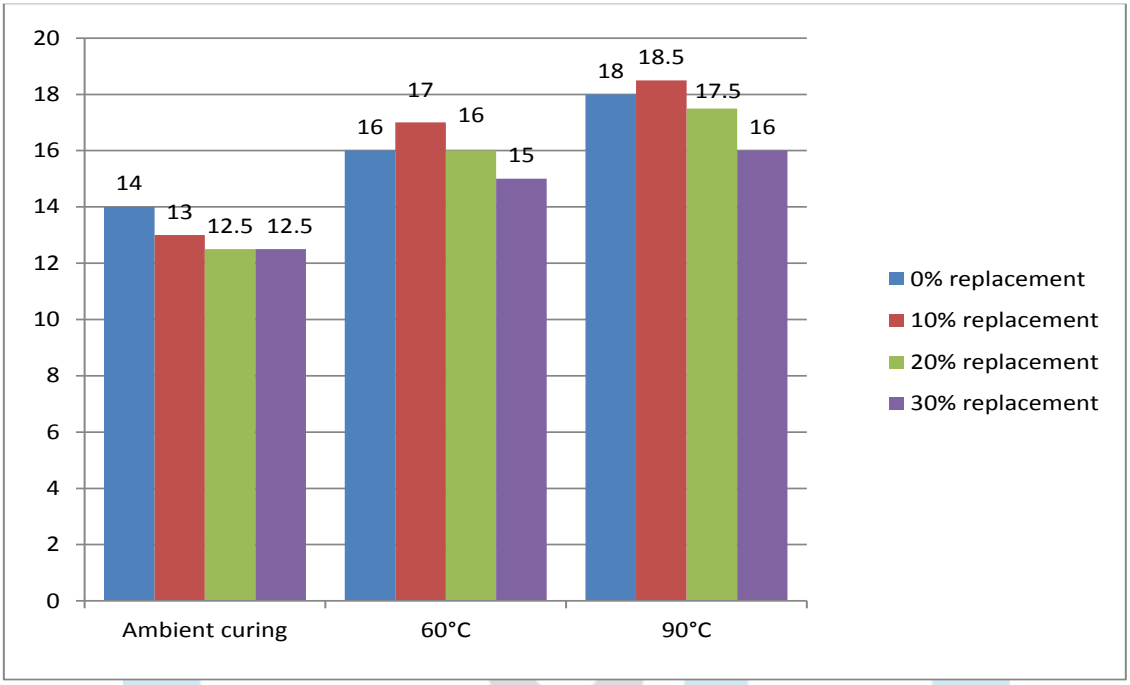

Figure : Compressive strength of GPC w.r.t. different curing condition and replacement of foundry sand at 7 days

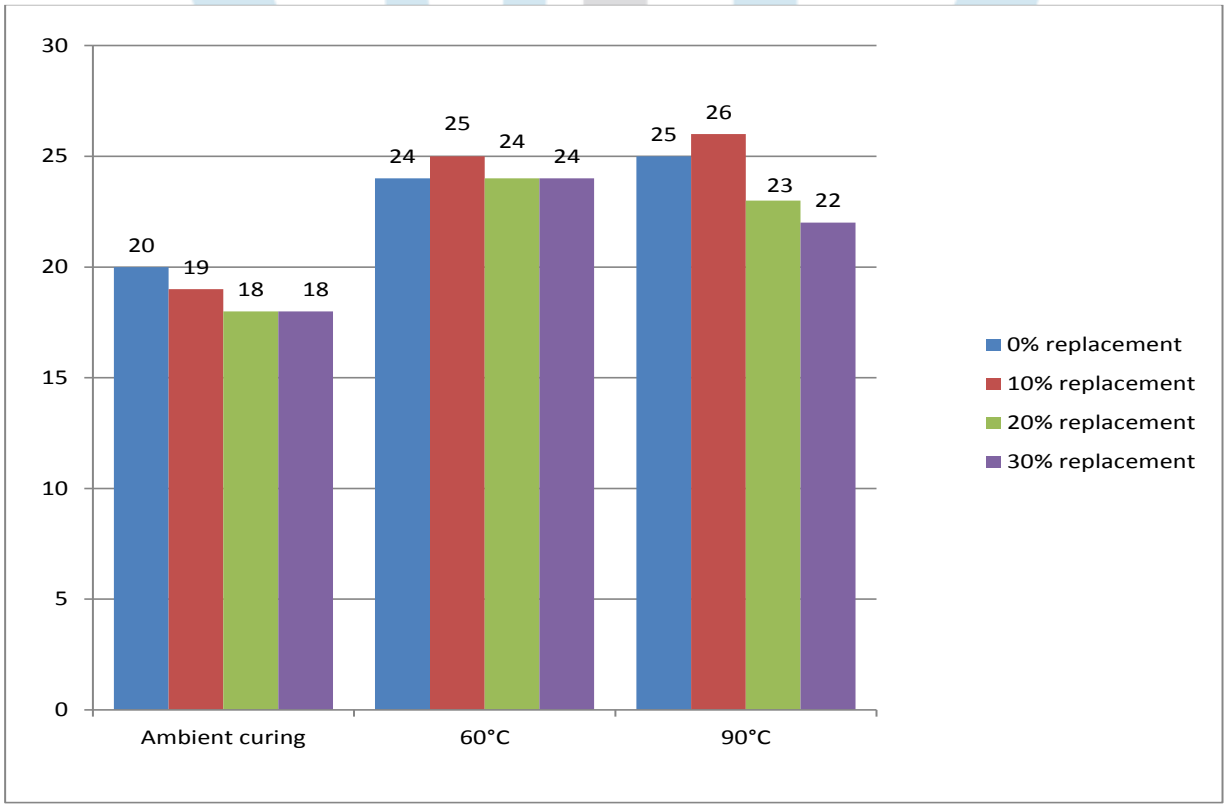

Figure : Compressive strength of GPC w.r.t. different curing condition and replacement of foundry sand at 28 days

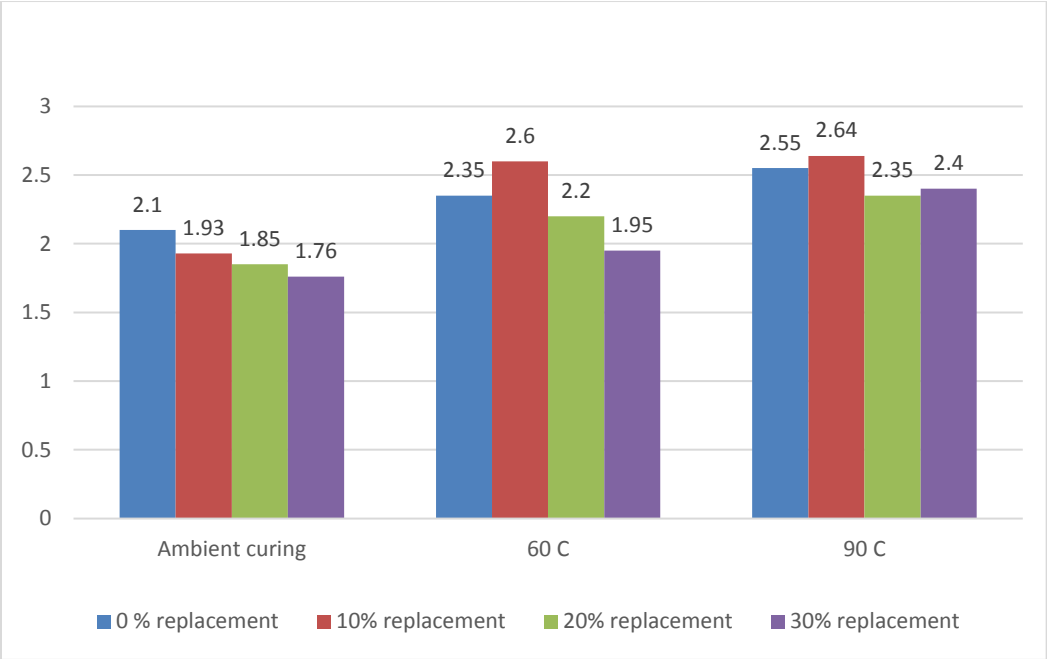

Figure : Flexural strength of GPC w.r.t. different curing temperate and replacement of foundry sand at 7 days

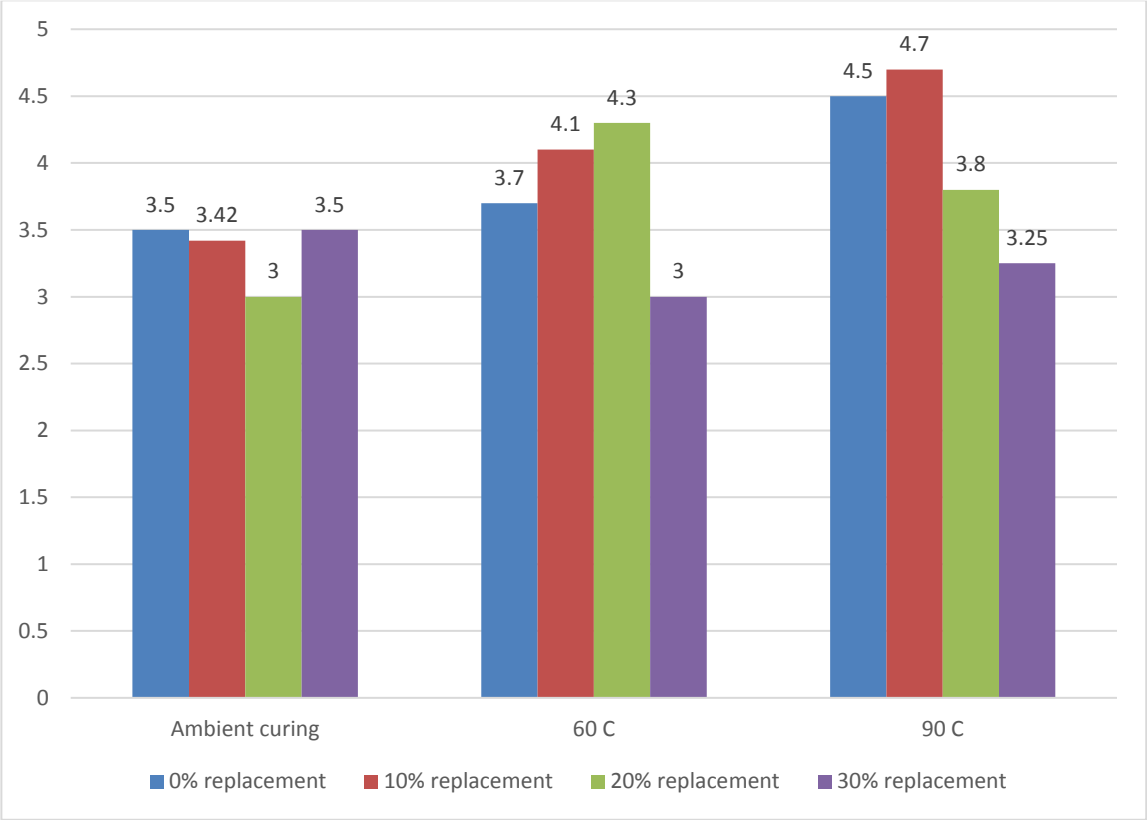

Figure :Flexural strength of GPC w.r.t. different curing condition and replacement of foundry sand at 28 days

CONCLUSIONS

Based on the results of the experimental investigation, following conclusions are drawn: -

1. The heat cured concrete achieved higher compressive strength, split tensile strength and flexural strength in comparison with ambient curing.

2. The Compressive strength of Geopolymer concrete was found to be increasing with replacement of foundry sand. It is found that replacement of 10% of foundry sand gives highest compressive strength, the strength increased by 20%.
3. The compressive strength increased upto 20% at heat curing as compare to ambient curing.
4. Maximum strength was found at 60°C heat cured concrete with 24hrs curing oven period.
5. The split tensile strength also increasing with 10% replacement of foundry sand further increase in foundry sand results degradation in strength in order form at 7 days curing.
6. For ambient curing condition, with 10% replacement of foundry sand by normal sand the flexural strength showed brilliant out comes when compared to compressive strength.

RECOMMENDATIONS

1. The compressive strength of geo-polymer concrete using foundry sand is more than OPC, so we can use GPC in construction.
2. The making of GPC can reduce carbon dioxide from atmosphere, so GPC is more eco-friendly than OPC.
3. The manufacturing cost of GPC is more economical then OPC.

FUTURE SCOPE

1. The properties of geopolymer concrete using foundry sand with varying sodium hydroxide to sodium silicate ratio can be studied.
2. In addition to foundry sand chemicals variations in GPC concrete due to sodium hydroxide or potassium hydroxide can study.
3. The effect on geopolymer concrete due to use of slag instead of fly ash along with replacement of slag by sand can be investigated.
4. The effect on shrinkage property of geopolymer concrete when foundry sand reacts with alkaline solution can be studied.

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