

## Light-Weight Geopolymer Concrete- A Review

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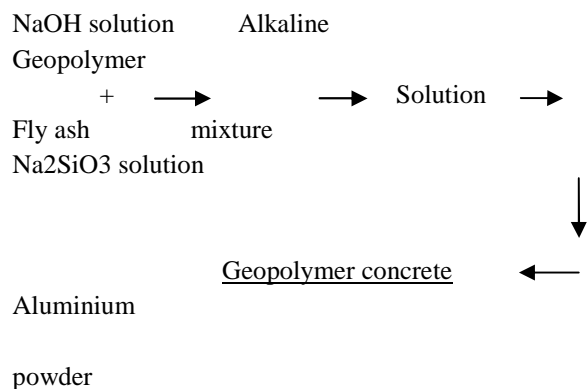
**Abstract** – An environmental point of view, cementitious material has got more CO<sub>2</sub> emission in an atmosphere. A utilization of alternative materials such as fly ash, rice husk, furnace slag, red mud etc. to cement in concrete can prove a sustainable solution. Geopolymer is nothing but the synthetically resin binder which binds an ingredients like fly ash which reacts with Kaolinite solution i.e. (sodium hydroxide and sodium silicate) to make a Geopolymer mixture. Geopolymer concrete is an innovative construction material which shall be produced by the chemical action of inorganic molecules. Fly ash is rich in silica and alumina reacted with alkaline solution produced alumina-silicate gel and then added an aluminum powder into slurry form concrete that acted as the binding material for the concrete and make the micro size pores in concrete making it lighter in density.

**Keywords:** Geopolymer concrete, fly ash, aluminium powder, Kaolinite solution etc.

### 1. INTRODUCTION

Due to growth of an environmental concern of cement factory alternative cement technologies have become an area of an increasing interest. The term “Geopolymer” to represent these binders and ingredients. Geopolymer concrete is concrete which does not utilize any Portland cement in its production. Geopolymer concrete is being studied extensively and shows promise as a substitute to Portland cement concrete. Research is shifting from the chemistry domain to engineering applications and commercial production of geopolymer concrete. The major problem that the world is facing today is the environmental pollution. In the construction industry mainly the production of ordinary Portland cement (OPC) will cause the emission of pollutants which results in environmental pollution.<sup>[1]</sup> The emission of carbon dioxide during the production of ordinary Portland cement is tremendous because the production of one ton of Portland cement emits approximately one ton of CO<sub>2</sub> into the atmosphere.<sup>[5]</sup> Concrete is a durable construction material produced by mixing Portland cement, water, aggregates and additives with special proportion. Revising the ingredients and production method of conventional concrete is important with respect to high consumption of concrete as a construction material. High consumption of concrete causes vast requirements of cement production .

Cement concrete research is shifting from the chemistry domain to engineering applications and Commercial production of Geopolymer. It has been found that Geopolymer concrete has good engineering properties.



**Fig 1.**Preparation process of Geopolymer concrete

### 2. CONSTITUENTS OF LIGHT WEIGHT GEOPOLYMER CONCRETE

The following are the constituents of Geopolymer concrete,<sup>[2]</sup>

- ✓ Fly Ash- rich in Silica and Alumina.
- ✓ Sodium Hydroxide & Sodium silicate
- ✓ Aluminium powder- (Reactive agent)

### **3. PROPERTIES OF LIGHT WEIGHT GEOPOLYMER CONCRETE:**

The properties of Geopolymer concrete are -<sup>[2]</sup>

- Sets at room temperature.
- Non-toxic, bleed free.
- Long working life before stiffening.
- Impermeable.
- Higher resistance to heat and resist all inorganic solvents.
- Higher compressive strength.
- Resistance to corrosion.
- Durability and thermal stability.

### **4. STUDY OF LIGHT WEIGHT GEOPOLYMER CONCRETE AND ITS PROPERTIES:**

#### **A. Effect of concentration of sodium hydroxide:**

According to the study of Subhash V. Patankar the temperature, and duration of oven heating on compressive strength of fly ash-based geopolymer mortar increases the workability and compressive strength both increase in concentration of sodium hydroxide solution for all solution-to-fly ash ratio. Degree of heating also plays vital role in accelerating the strength.<sup>[5]</sup>

#### **B. Geo-polymer binder with class c fly ash and alkali activators:**

The study of P. Kamhangritirong states that the compressive strength and microstructure of geo-polymer binder prepared with class c fly ash and alkali activators at room temperature can be successfully used as geo-polymer binder for concrete products. Also, Frantisek skvara at all suggested Geo-polymer prepared by addition of gas forming aluminum powder or silica fume are characterized by similar pore sizes, the pore size is comparable with that observed in lime silicate materials produced in autoclave. The strength of geo-polymer foams is dependent on their volume weight.<sup>[10]</sup>

L. Krishnan at all reported the alkaline liquids used in this study for the polymerization process are the solutions of sodium hydroxide (NaOH) and sodium silicate (Na<sub>2</sub>SiO<sub>3</sub>).<sup>[1]</sup>

**C. Carbon footprint & Environmental Effect:** The study of Dali Bondar states that using lesser amounts of calcium-based raw materials lower manufacturing temperature and lower amounts of fuel result in reduced carbon emissions for geopolymer cement manufacture up to 22%-72% in comparison with Portland cement. Geopolymer concretes, its specifications, benefits, applications and evaluation of carbon footprint and cost have been studied in this paper.<sup>[4]</sup>

Geopolymer concrete has excellent resistance to chemical attack and shows promise in the use of aggressive environments where the durability of Portland cement concrete may be of concern. This is particularly applicable in aggressive marine environments, environments with high carbon dioxide or sulphate rich soils. Similarly in highly acidic conditions, geopolymer concrete has shown to have superior acid resistance and may be suitable for applications such as mining, some manufacturing industries and sewer systems.<sup>[4]</sup>

Dr. S. G. Patil elaborated the chemical composition of Geopolymer is similar to that of zeolite, but amorphous in microstructure. Fly ash-based Geopolymer binders show excellent short and long-term mechanical characteristics and similar or even better to conventional concrete and Geopolymer are much superior to aggressive environment and fire than conventional concrete.<sup>[3]</sup>

M.I.Abdul Aleem determined Geo-polymer concrete is an innovative construction material which shall be produced by the chemical action of inorganic molecules. Fly Ash, a by-product of coal obtained from the thermal power plant is plenty available worldwide & it briefly reviews the constituents of Geopolymer concrete, its strength and potential applications.<sup>[2]</sup>

**D. Compressive strength** of Geopolymer concrete is very high compared to the ordinary Portland cement concrete. Geopolymer concrete also showed very high early strength. The compressive strength of Geopolymer concrete is about 1.5 times more than that of the compressive strength with the ordinary Portland cement concrete, for the same mix. Similarly the Geopolymer Concrete showed good workability as of the ordinary Portland Cement Concrete.<sup>[2]</sup>

## 5. APPLICATIONS

This light weight Geopolymer concrete used for the partition walls. In the short term, there is large potential for Geopolymer concrete application for ceramic mould, potential utilization in art and decoration as well as carving. Geopolymer technology is most advanced in precast applications due to the relative ease in handling sensitive materials (e.g. high-alkali activating solutions) and the need for a controlled high-temperature curing environment required for many current geopolymer.

## 6. CONCLUSIONS

Based on the results obtained in the experimental investigation, the following conclusions are drawn.

- 1) The geopolymer concrete gained the compressive strength within 24 hours without water heating.
- 2) The necessity of heat curing of concrete has required for gaining compression strength.
- 3) After heat curing, the geopolymerisation rate increases by producing denser matrix in mix which increases the compressive strength.
- 4) The 65% of fly ash can be replacing to cement in Geopolymer concrete.
- 5) The temperature and duration of oven heating on compressive strength of fly ash based geopolymer concrete increases the workability.

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