A Study on Effect of Alkaline Activator on Strength Properties of Geopolymer Concrete

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Abstract— **Geopolymer concrete is an alternative of ordinary Portland cement concrete made up of eco-friendly materials. This type of concrete assists in minimizing the greenhouse effects on the environment. Alkaline activator in geopolymer concrete plays an important role in the developing strength of concrete. This activator is made of sodium hydroxide and sodium silicate solution to different ratios with respect to molarity. The molarity of sodium hydroxide is crucial during the preparation of an alkaline activator. As the molarity of sodium hydroxide increase, the amount of sodium hydroxide increase which affect SS/ SH ratio. Fly ash plays a key role as the main source material in geopolymer concrete. GGBS is partially replaced with flyash to identify strength development of concrete. From the available studies, it is clear that the use of GGBS in fly ash always increases in strength of geopolymer concrete. However, the amount of GGBS should be restricted to the use of a huge extent to avoid the early setting of concrete. Moreover, it is understood that alkaline activators play a major role to develop bond between binders and aggregates. In this paper, few studies on the effect of alkaline activator with sodium hydroxide and sodium silicate under different curing with different molarities are discussed.**

Index Terms— **Geopolymer, Alkaline Activator, Eco friendly, GGBS, Fly ash**

I. INTRODUCTION

Concrete is the most usable material on the planet for most types of construction. One of the important type of cement to develop concrete is ordinary Portland cement. Nevertheless, the creation of concrete is answerable for around 5% of the world's carbon dioxide discharges. To make a progressively maintainable world, specialists and researchers must form and put into utilization a greener structure material. This paper will talk about the utilization of geopolymer concrete with ecofriendly materials to minimise the environmental pollution Furthermore, this paper will investigate the strength with different replacement of GGBS in fly ash concrete. A French Professor **Davidovits** coined the name geopolymer in 1978 to speak to a wide scope of materials portrayed by systems of inorganic particles. Geopolymers rely upon thermally enacted regular materials like Meta kaolinite or mechanical results like fly ash or slag to give a wellspring of silicon (Si) and aluminium (Al). The essential difference between geopolymer and ordinary Portland concrete is the binding material. The fastener might be fly ash, GGBS, silica fume, rice husk, metakaolin, etc. and alkaline arrangements are involved for polymerization. **Shakthiswaran. M (2014)**, huge amount of sodium hydroxide with adequate amount of sodium silicate leads to higher compressive strength of geo-polymer concrete. Superplasticizers may help with improving functionality. Geopolymer concrete uses fly ash as main source material, which is an industry by product. At present, most of fly ash in many developing countries are dumped into landfills, causing ecological issues. The creation of geopolymer concrete permits fly ash to be reused and disposed of from landfills. Geopolymer concrete is likewise impervious to harm than standard cement. It is likewise progressively impervious to salts, acids, seawater consumption, and fire. By and by, it is hard to make geopolymer concrete outside of a lab setting as designers and researchers are yet investigating it. Developing a geopolymer concrete is one of the best solution to reduce and save lot of natural resources that are used during manufacturing process of OPC like calcareous rocks, siliceous rocks and argillaceous rocks. Besides, huge amount of coal and other energy related fuels will be saved. Eventually, the effect of global warming might be reduced. Investigations on Geo Polymer Concrete has done by **(Balaraman R, 2016)** and explained the changing of molarity of Sodium hydroxide arrangement in Geo Polymer Concrete effect the strength of strength properties of geopolymer concrete and stated that the increase of molarity increase of workability of concrete. **(Posi, P 2013)** investigated the mechanical properties of geopolymer concrete containing reused lightweight aggregate and detailed that like typical weight reused coarse aggregate the compressive strength of geopolymer concrete decrease with an expansion in reused lightweight total aggregate. One of the potential utilization of geopolymer concrete is in the development and fix of roadways, streets, and air terminal runways. It is being used by developing countries because of its capacity to withstand heat. Since geopolymer concrete likewise has a high protection from chloride, it will endure less harm in the winter than streets and parkways produced using standard solid when calcium chloride street salts are utilized to bring down the point of solidification of water and keep streets operational. **Wazien, W et al (2016)** conducted a study to determine the effect of sand ratio on the density of geopolymer concrete. The materials used in this study, include fly ash, combination of sodium silicate (Na2SiO3), sodium hydroxide (NaOH), and river sand. From the results, it concluded that by increasing the sand content, the density of mortar increase, this is because sand contains a large percentage of quartz, which has high value of density equal to 2.65 g /cm3. **Al Bakri (2011) discussed t**he effect of curing on compressive strength is always considerable. The strength of geopolymer concrete depends on the materials used as well as curing. **Jamdade (2017)** has done similar research on the importance of oven curing with different temperature of 60, 90, and 120℃ with time intervals at 6, 12, 18 and 24 hours. The result shown the process of polymerization was not completed by the used curing time. However there slightly more compressive strength in 120℃ at curing temperature at 18 hours. **Krishnan (2018)** demonstrates this by directing investigations on this kind of concrete where they just change

a certain something, the proportion between fly ash and GGBS. The investigations of some research analysis on GGBS with flyash (Low calcium), affect setting time and early strength improvement of GPC at room temperature. Generally alkaline activator plays vital role in developing strength of geopolymer concrete, as it is provided by few researchers that the increase in SS/SH decrease the strength of concrete. Generally, calcium and alumni in GGBS assist concrete to increase in strength when mixed with fly ash whereas fly ash has good amount of silica. Irrespective of main source, materials like fly ash and GGBS (E. Chidambaram 2019) used baggage ash and GGBS with alkaline activator to determine strength properties under elevated temperature. The molarity of sodium hydroxide assist the strength development and shown that concrete can resist up to 600°c against surface cracking

II. METHODOLOGY

The materials used to develop geopolymer concrete are fly ash, GGBS; fine aggregate, coarse aggregate, sodium silicate and sodium hydroxide.

Different type of molarities of sodium hydroxide has different effects on strength of concrete. As molarity increase the amount of sodium hydroxide, increase which leads to decrease in sodium silicate content. When 8Molarity is used to prepare for alkaline solution with sodium hydroxide and sodium silicate. However, the amount of sodium silicate used is based on amount of sodium hydroxide solution. Firstly, 320 grams of NaOH (for 8M) pellets are taken into 1 litre of jar and mixed with water and stir completely to prepare NaOH solution and then weigh the mixture. Later, sodium silicate solution of adequate quantity (2.5 times of weight of sodium hydroxide solution) is added with NaOH mixture to prepare alkaline activator. During the mix, GGBS of required quantity is mixed thoroughly with fly ash to make into uniform colour and mix quantities of aggregates as per mix proportion and add alkaline solution. All the ingredients are mixed for 3-5 minutes. Specified size of mould (15 x 15 x 15 cm) used to cast specimens and cured under ambient temperature to determine compressive strength. From the available research studies, it is stated that geopolymer concrete is developed with any source of materials having silica, alumina and calcium as main source materials to undergo polymerisation with alkaline activator

III. DISCUSSION

From the studies, it is noticed that use of geopolymer concrete has better impact on environmental issues and save the natural resources with less emissions of CO_2 into atmosphere. As suggested by Chandrakar K, (2017), the utilization of advantageous cementitious materials is very much acknowledged because of the few enhancements conceivable in the concrete, for the general economy. GGBS when supplanted with fly ash in concrete has risen as a significant option in contrast to regular cement and ecological advantages. The ideal GGBS and fly ash substitution as the cementitious material is portrayed by high compressive strength, low heat of hydration, and protection from corrosion and cost-effective. This is very important to consider the effect of source materials on strength of concrete **(Anuar, K.A 2011)** where the source material for geopolymer was bottom ash rather than prevalently utilized fly ash and GGBS. The results show that the compressive strength is increased to 10% from 7 days to 28 days and high molarity of sodium hydroxide shows higher compressive strength in geopolymer concrete. From the many research results it is noticed that, there is steep increase in compressive strength with 30% GGBS and alkaline ratio of 1.5

IV. CONCLUSION

This study provides information of importance of alkaline activator on strength properties of concrete. The impact of molarity of NaOH on workability and SS/SH ratio which directly affect strength of concrete is discussed. The slump value and strength of geo polymer concrete increase with increasing molarity of sodium hydroxide solution. The increase of GGBS and decrease of SS/SH ration effect strength properties of geo polymer concrete and molarity of NaOH does not effect on strength of concrete when adequate amount of GGBS is used.

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