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# Effect of Various Alkaline Activator Solutions on Compressive Strength of Fly Ash-Based Geopolymer Concrete

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## ABSTRACT

In recent years, geopolymers, as a new class of green cement binders, have been considered as an environmental-friendly alternative to Ordinary Portland Cement (OPC) which can potentially reduce negative environmental impacts of OPC effectively. In this experimental research, effects of different alkaline activator solutions and variations of associated parameters, including KOH concentration and Na2SiO3/KOH weight ratio, on the compressive strength of fly ash-based geopolymer concrete were investigated. The obtained results showed that using NaOH provided greater 3- and 7- day compressive strengths as well as faster hardening. Conversely, using KOH resulted in higher 28-day compressive strength. Additionally, simultaneous inclusion of 50% NaOH and 50% KOH resulted in decline of the compressive strength. Furthermore, the obtained results indicated that increasing the KOH concentration up to 14 M resulted in the highest compressive strength, while weight ratio of 1.5 for Na2SiO3/KOH was the optimum value to achieve highest 7-and 28-day compressive strengths.

**Keywords:** **Geopolymer Concrete, Fly Ash, Alkaline Activator, Compressive Strength, NaOH**



## 1. INTRODUCTION

Concrete is the most consumed construction material after water, due to its special features including formability and availability of raw materials. As the demand for concrete rises, so does the consequent demand for Portland Cement (PC), as the main component of concrete [1]. But PC production has major environmental disadvantages, including high energy consumption and carbon dioxide (CO2) emissions [2]; for production of a ton of PC, approximately a ton of CO2 would be released [3]. On the other hand, environmental pollution and the global warming phenomenon have become major concerns in developed countries [4]. Global warming is caused by the emission of greenhouse gases and among the greenhouse gases, CO2 plays a major role in global warming with a 60% share [5]. The production process of PC is accounted for 7 to 10% of global CO2 emissions [6]. Therefore, developing an appropriate and workable substitution for PC is of great importance. In recent years, geopolymers have been introduced as environmentally friendly cementitious materials capable of reducing the negative environmental impacts associated with PC. Geopolymers were first developed by Davidovits, as a new family of binders of inorganic origin [7]. He utilized the name “poly(sialate)” to indicate the chemical composition of geopolymers, in which poly represented the polymeric nature and sialate was an abbreviation for the silicon-oxo-aluminate chain [8,9]. Geopolymers are inorganic alumino-silicate materials produced from raw materials, rich in silica (SiO2) and alumina (Al2O3), in combination with an alkaline activator solution [10]. The geopolymerization process involves a substantially fast chemical reaction under alkaline condition on Si-Al minerals, that results in a three-dimensional