


*Abstract*

# Alkali-Activated Materials as Alternative Binders for Structural Concrete: Opportunities and Challenges <sup>†</sup>

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Alkali-activated materials (AAMs, also called geopolymers) are considered as excellent alternative binders to replace Portland cement in concrete because AAMs have cement clinker free binders made of industrial by-products or treated and cleaned wastes containing minerals via alkali-activation technology. AAMs have been extensively studied in the past few decades. However, industrial scale production and engineering structure applications of this type of material remain scarce. The main challenges concerning scientific and technical aspects are that: (1) qualities and chemical compositions of raw materials largely depend on the adopted processing technique and there are considerable regional differences even amongst the same kinds of materials, such as fly ash. These situations largely affect the chemical activity of raw materials and have significant influence on reaction conditions and kinetics, which consequently leads to considerable changes in the generated microstructure and entirely different behavior and performance of the material after hardening. (2) Some uncertainties regarding the long-term performances and degradation mechanisms of geopolymer systems are missing. This primary issue needs to be addressed in order to build the acceptance and confidence required for the use of AAMs in industrial applications. (3) Studies have shown that AAM concrete has different time-dependent properties (i.e., higher shrinkage and creep) compared to ordinary Portland cement concrete. This implies that when AAM concrete is used as a structural element in construction where it is restrained externally or internally, the shrinkage of geo-polymer concrete will develop a tensile stress, which might cause cracking beyond the tensile strength of the concrete.

This presentation will review recent research on these aspects and introduce some projects from materials studies to structural applications.

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