

Abstract

Alkali-activated materials as alternative binder for structural concrete: opportunities and challenges[†]

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Alkali-activated materials (AAM, also called geopolymers) are considered as excellent alternative binder to replace Portland cement in concrete because AAM is cement clinker free binder made of industrial by-products or treated and cleaned wastes containing minerals via alkali-activation technology. AAMs have been studied intensively in the past decades. However, industrial-scale manufacture and engineering structures applications of this type of material remain rare. The main challenges concerning scientific and technical aspects are: 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, like 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 of 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 acceptance and confidence required for the use of AAMs in industrial scale applications. 3) Studies have shown that AAM concrete has different time depended properties (i.e., higher shrinkage and creep) compared to ordinary Portland cement concrete. This implies that when AAM concrete is used as structural elements in construction where it is restrained externally or internally, the shrinkage of geopolymer concrete will develop a tensile stress, which might cause cracking when beyond the tensile strength of the concrete.

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

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