

Fundamental parameters controlling geopolymer binders

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Geopolymers are inorganic aluminosilicate binders with potential applications as sustainable alternative materials to traditional cement. They are formed by alkaline activation of fine amorphous aluminosilicate materials under low temperature processing conditions.

In fact, contrary to CaO-based Portland cement production which is an energy- and carbon-intensive process largely contributing to CO₂ emissions, geopolymer manufacturing requires low-carbon raw materials (aluminosilicate minerals, or industrial by-products) and mild processing conditions.

Most of the scientific literature dealing with geopolymers concerns the study of properties, performance and applications of geopolymeric materials, but little fundamental research has been carried out to develop a more complete understanding of the chemistry of geopolymerization.

The Ph.D. project is focussed on investigating the fundamental physical-chemical parameters controlling geopolymer formation in order to get a deeper understanding of the mechanism involved in geopolymerization reaction.

This project will investigate the production of geopolymer materials from natural raw materials (kaolin and other clay minerals) and industrial by-products (fly ash). The starting raw materials, geopolymerization processes, structural and microstructural properties of final products will be characterized by means of XRD, XRF, SEM, x-ray micro-tomography and compressive strength tests.

Thermodynamic modelling (GEM software) will be used to assess the basic chemical parameters controlling geopolymerization formation.

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