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Role of the Silica source on the geopolymerization rate: relation with mechancial properties

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Geopolymers are materials synthesized by alkaline activation of alumino-silicate at room temperature. Alumino-silicates were obtained from industrial wastes, calcined clays, natural minerals or mixtures of two or more of these materials. Two solutions exist to activate the chemical reaction: (i) the first one based on the use of water glass solutions and (ii) the second one making in situ alkaline silicate solution by dissolution of silica in an alkaline medium. The use of current geomaterial like sand aims at reducing again the production costs of final materials.
The synthesis of geopolymer-silica composites was achieved at room temperature to determine the influence of the addition of quartz or amorphous silica on the polycondensation rate and the mechanical properties. Samples with a composition range from 100% quartz to 100% amorphous silica were formed, compared and characterized by XRD, infrared spectroscopy, thermal analysis, SEM, and compression tests. The results give evidence that the increase of amorphous silica in the mixture favors the polycondensation reaction (i.e. "geopolymerization") and then the mechanical properties. The replacement of the amorphous silica by quartz led to heterogeneous materials without cohesion. These facts are explained by the modification of the Si/Al ratio in the geopolymer matrix due to the increase of quartz in the mixture. Nevertheless, SEM observations demonstrated that grains of quartz played an important role in the mechanical reinforcement.

Keywords: geopolymers, sand, amorphous silica, FTIR, TGA-TDA, gel