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# Durability of organic liquids encapsulated in geopolymer cement composites

The incorporation of organic liquids in cement-based materials is of interest for various applications, and in particular for the immobilization of radioactive industrial wastes. Immobilization of wastes into cementing materials by stabilization and solidification (S/S) is a common procedure, because it ensures chemical stabilization of many compounds and produces a mechanically stable waste form.
For the immobilization of organic liquid compounds, Portland cements have been widely studied, but issues are encountered in terms of cement setting and strength development, whenever more than a few percent of organic liquid are involved.
Comparatively, alkali-activated materials (AAM), and particularly geopolymers, display superior performances against organic contamination compared to Portland cements. Indeed, while the presence of organic compounds generally disturbs the hardening of hydraulic binders, the mechanisms of geopolymer formation involve water only as a dissolution medium, which is released in the pore system upon solid gel formation (polycondensation). This specific property of geopolymers eases significantly the synthesis of organic liquid/inorganic cement materials.

This research investigates the durability of two given geopolymer cement formulations, either based on alkali-activated metakaolin (MK) or on a mix of MK-blast furnace slag. The cement is mixed with different organic liquids (pump oil, TBP/dodecane) at 20%vol, and hardened for at least 28 days. Durability is determined as the water transport ability of the organic liquid/geopolymer composite (GEOIL), when it is flown through by a water typical of its expected in situ environment (i.e. in the vicinity of Portland-based concrete). An original experimental set-up is devised to avoid carbonation of the highly alkaline water, during tests lasting for up to 40 days. The potential water flow paths are determined by characterizing the geometry and the percolating part of the geopolymer pore structure (by mercury intrusion porosimetry coupled to nitrogen sorption-desorption isotherms), and of the organic liquid emulsion (by using X Ray micro-tomography). Coupled to 3D numerical simulations, the most probable flow paths are discussed, and the ability of the oil to migrate through the cement is determined depending on its amount in the geopolymer.

## Do you wish to participate as a Young Professional?

No

## Speaker's title

Ms

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## Do you wish to be considered for a Young Professional grant?

No

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