UNIVERSITY OF DELAWARE

CENTER FOR NEUTRON SCIENCE

UNIVERSITY OF DELAWARE
ENGINEERING

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ALKALI ACTIVATED MATERIALS SUCH AS GEOPOLYMERS FROM LIQUID TO SOLID STATE

BIO:

Arnaud Poulesquen is Researcher-Engineer at CEA, the French Atomic Energy Commission. His research interests concern the relation between rheological and structural properties in various materials such as alkali activated materials under various shape: bulk, emulsions and foams and soft gels. The characterization of porous materials and fluid transport properties combining calorimetry and neutrons or X-ray scattering experiments is also a part of his research. He graduated in 2001 with a PhD in materials science from the Ecole Nationale Supérieure des Mines de Paris and received his Habilitation degree from the University of Montpellier in 2013. He joined the international joint unit (UMI) Multiscale Science for Energy and Environments as a visiting scientist for a year (2018-2019) for working on aluminosilicate materials from atomistic modeling and experimental point of view.

ABSTRACT:

Alkali Activated Materials (AAM) such as geopolymers have recently gained some particular attention and can be seen as a potential alternative to Ordinary Portland Cements for specific applications. For example, in nuclear industry, the use of geopolymers prevents deleterious interactions with the waste to immobilize, allowing a good stability of the waste packages over time. Although such alternative binders are increasingly studied for the past twenty years, there remain outstanding questions regarding the gelation process, that are driven by the composition of the solution, their stabilities and their aging. It is therefore crucial to provide a clear and realistic description of such materials in order to tune and tailor macroscopic properties.

My talk aims to describe alkali activated materials such as geopolymers that are synthesized by the alkaline activation of aluminosilicate calcinated clay (mainly metakaolin). A multiscale porous network, constituted of mesopores and macropores, builds up over time due to polycondensation reactions between the dissolution products of the calcinated clay and the silicates of the activating solution. I will detail the different step of geopolymerization from liquid to solid state by using various techniques such as rheology, small angle scattering, conductimetry, isothermal calorimetry and NMR spectroscopy. We will see that combining both calorimetry and NMR, allow us to determine the enthalpy of dissolution of the metakaolin. I will show that this dissolution enthalpy is equivalent whatever the composition of the activating solution and the composition of the metakaolin. Then, I will briefly describe the main characteristics of the porous network. In a second part of my talk, I will detail the synthesis of alkali activated material foams for liquid waste decontamination application. The stability of the foam against aging, the influence of the foaming agent and the nature of the surfactants will be discussed with regard to the properties of the solid macroporous network expected for targeted specific applications (thermal insulation or filtration for instance)

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