Multiscale imagery of cement paste: relation with the confined transport of water

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Abstract

Most of natural or industrial geo-materials like sedimentary rocks, shale or cement pastes are made of an intricate clustering of polydisperse grains. For many of these materials, the particle organization on a length-scale ranging from nanometer to several micrometers is a cornerstone to properly understand transport properties (diffusion-permeation) and mechanical strength. In this context, micro and nano X ray microcopies, small angle X ray and neutron scattering (SAXS and SANS) and soft X-ray ptychography are attractive and no destructive tools for the investigation of the structural evolution of these strongly disordered systems. These experiments have the ability to probe a hierarchical organization on a large length scale ranging from nm to several hundred mm. This multimodal structural analysis offers the possibility to use 3D reconstructions and to build constrained models mimicking the geometrical features observed at different length scales. These models can then be used to compute mechanical and transport properties allowing comparison with the experimental determinations. In this conference, we first present some strategies to image at different length scales the structure and the time evolution (the setting) of the cement paste. Analysis and modeling using a colloidal and/or a "granular" approach is presented, allowing to test and to discard some microstructure hypothesizes. In the second part and in relation with the geometrical constraints generated by image analysis, we discuss the diffusive transport of water inside the cement paste which is known to be strongly hindered. An intermittent dynamics involving adsorption and relocation inside the pore space is especially emphasized.

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