# 3D imaging of moisture distribution and transport in early-age cementitious materials

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**Abstract**

The presence of water and its temporal and spatial distributions influence several processes that are critical to cementitious materials in the first hours to days after casting, including microstructure development during hydration, drying and autogenous shrinkage (which may lead to early-age cracking) and water-curing of concrete. In all these processes, microstructural changes and fluid transport are coupled phenomena, meaning that the fluid transport will influence the microstructure and at the same time changes in the microstructure (cracking, porosity changes) will affect the transport properties of the cementitious material, thus the water distribution. Novel non-destructive / non-invasive imaging techniques for probing simultaneously the microstructure and the moisture distribution provide data for validating coupled numerical models that consider the mutual interactions of cement hydration and transport.

The first part of this presentation shows examples in which neutron tomography (performed at the Paul Scherrer Institute, Switzerland), alone or in combination with X-ray tomography, was used to investigate moisture transport and distribution during drying of fresh concrete, self-desiccation and curing.

In the second part, first results from Talbot-Lau interferometry-based multi-contrast X-ray micro-tomography are shown. With this method, which has recently been implemented at Empa, it is possible to follow both microstructure changes during hydration (with attenuation-based contrast) and simultaneously also moisture transport (with phase- and small-angle scattering – contrast). Compared to neutron tomography, this laboratory-based setup offers the advantages of being continuously accessible and of providing different types of contrast obtained simultaneously on the same samples.

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