

Neutron imaging of transport in porous materials: rocks, gypsum, asphalt, clay brick, wood, and fruits

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We use neutron imaging to acquire the spatial distribution of water, or other fluids, in porous materials during wetting (in liquid or vapor phase), redistribution, drying, with or without the presence of temperature gradients. In addition, we impose different boundary conditions such as control air flow above the porous material, using a micro windtunnel, or controlled changes in relative humidity using an environmental chamber. We have documented sedimentary stones, gypsum, porous asphalt, clay brick, hard and soft wood, apples and pears.

Neutron imaging provides invaluable quantitative information, of very high resolution in moisture content, space and time. Such information is used for identifying the physics of the transport processes, material properties determination and for validation of computer models. In terms of modeling, we have developed a comprehensive framework using a fully coupled transport, chemical and poromechanical approach. Its multiscale implementation provides the capacity to take into account heat and mass transport, swelling and mechanical behavior at different material scales. The air, heat and moisture flow above the porous medium and the interaction with the porous medium is modeled by coupling the porous material model to a computational fluid dynamics code.

We will present the different types of experiments that we have run at Neutra and Icon, PSI, Villigen, some insights from the analysis of the data and examples of numerical simulations.

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