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Monitoring water flow by means of neutron and X-ray tomography

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Soils are often organized in structures, such as aggregates and fissures. Their influence on the water, air and solid movement is crucial because they cause non-uniform non–equilibrium flow. The understanding of these flow processes can be improved by the recent advances in imaging techniques. Neutron radiography and tomography are efficient tools for monitoring the water distribution in real time. By means of X-ray tomography the internal fabric of the soil matrix can be reconstructed at the resolution of a few microns.

We monitored the infiltration of water into an aggregate packing with time-series of neutron radiograms. We observed that the contacts between aggregates are the key factor under water- unsaturated conditions: the contacts are highly conductive when wet but strongly limit the water exchange after being drained. The transition between these two hydraulic states is abrupt. It is explained by the presence of fissures and niches within the contacts that are getting easily drained. After drainage the water flows through narrow and almost point-like contacts between aggregates. This phenomenon was verified by high resolution X-ray tomography of the contacts.

By means of neutron and X-ray investigations we understood that micro-heterogeneities in the contacts between aggregates, affect the global (effective) hydraulic properties of aggregated soils.