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Modeling the force balance controlling spatial distribution of deposited polymeric substances in porous media

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Plant roots and bacteria alter the soil physical properties by releasing a polymeric blend of substances (e.g. extracellular polymeric substances and mucilage). Despite experimental evidence of the impact of such polymer solutions on water fluxes across the root zone, the physical mechanisms controlling the spatial distribution in complex porous media (soils) have not yet been addressed. In particular, it is not clear how the physical properties of polymer solutions (viscosity, surface tension and water adsorption, all depending on the polymer concentration) shape the configuration of the liquid phase in porous media. In this study, we present a new approach by modeling the (polymer concentration dependent) force balance between viscous flow and water adsorption, defining a threshold for the immobilization of the polymeric network. At this critical point, the polymers are deposited as two-dimensional surfaces, such as hollow cylinders or interconnected surfaces. We implement this force balance in three-dimensional simulations of drying in porous media to determine the polymer deposition at the critical point. Simulations are conducted for different drying rates, polymer concentrations and particle size distributions. Simulations are compared with results of scanning electron microscope and X-ray imaging to improve our understanding of the rules defining the polymer deposition.

Time Block Preference

Time Block A (09:00-12:00 CET)

References

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Primary authors: Dr LEHMANN, Peter (ETH Zurich); Dr BENARD, Pascal (ETH Zurich); Dr ZARE, Mohsen (University of Braunschweig); Prof. CARMINATI, Andrea (ETH Zurich)

Presenter: Dr LEHMANN, Peter (ETH Zurich)

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