Contribution ID: **807**

Type: **Poster Presentation**

Discrete fluid model for drying of capillary porous media with evolving microstructure

Wednesday, 24 May 2023 16:10 (1h 30m)

The microstructure of capillary porous media partially saturated with liquid water often changes in the course of drying. This significantly affects the structural and transport properties of porous media. In this work, a discrete pore network model has been developed that allows to describe the microstructure dynamics and mass transport kinetics of a model capillary porous medium under slow drying conditions. In the pore network model, the space occupied by the fluid phases is approximated by a three-dimensional lattice of interconnected spherical pores and cylindrical throats. Assuming laminar axial flow through each pore and throat, equations based on Fick's law and Poiseuille's law are solved to obtain the local fluid pressures and flow rates. Since the solid matrix of the medium slightly moves during drying, due to stress induced by capillary forces, the complementary pore network is updated over time and the pore/throat saturations are mapped to the new pore network in a physical way. The evolution of the microstructure and phase distribution over time as well as drying rate and time are simulated using this adaptive pore network model and compared to those predicted by a pore network model where the solid phase remains stationary during drying (see Fig. 1).

Participation

In-Person

References

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Session Classification: Poster

Track Classification: (MS04) Swelling and shrinking porous media