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Drying of capillary porous media simulated by coupling of continuum model and pore network model

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Drying of porous media is traditionally described by macroscopic continuum models. In this frame, the partially-saturated porous medium is treated as homogeneous continuum and the fluid transport is driven by gradients of spatially-averaged quantities (such as moisture content) and controlled by non-linear (effective) parameters (such as moisture transport coefficient). The boundary conditions required to solve the continuum models are often specified either at the drying medium surface or at the drying front (i.e. the interface between the unsaturated and dry zones). The vapor pressure at the medium surface is often correlated to global or local moisture content using empirical expressions and the drying front velocity is determined from experimental observations. Such boundary conditions for coupling the internal and external transfer can be questionable. In this work, we recall an isothermal version of the broadly accepted macroscopic continuum model for drying porous media, and we impose flux boundary conditions at two interfaces, i.e., at the interface between the (gas-side) boundary layer and the (medium-side) dry region, as well as the interface between the dry and unsaturated regions which evolves freely during drying. Local relative humidity, local saturation as well as local transport parameters are computed from mesoscopic pore network simulations. This dataset is then employed to compute fluxes that couple the internal and external transfer in the continuum model. Decisive advantages of this approach over the classical method are that the continuity of the mass flux at the drying front and the porous medium surface is ensured and that the continuum model parameters are computed directly from pore network simulations –no need for any empirical correlation.

Time Block Preference

Time Block B (14:00-17:00 CET)

References

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