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**To cite this version** : Moghaddam, Alireza and Kharaghani, Abdolreza and Tsotsas, Evangelos and Prat, Marc *Moisture transport coefficient in drying porous media*. (2015) In: 7th International Conference on Porous Media & Annual Meeting, 18 May 2015 - 21 May 2015 (Padoue, Italy). (Unpublished)

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# Moisture transport coefficient in drying porous media

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## ABSTRACT

Two main approaches have been used to derive mathematical models for the drying process: The first approach considers the partially saturated porous medium as a continuum and partial differential equations are used to describe the mass, momentum and energy balances of the fluid phases. The continuum-scale models obtained by this approach involve constitutive laws which require effective material properties, such as the diffusivity, permeability, and thermal conductivity which are often determined by experiments [1]. The second approach considers the material at the pore scale, where the void space is represented by a network of pores. Micro- or nanofluidics models used in each pore give rise to a large system of ordinary differential equations with degrees of freedom at each node of the pore network [2].

The characteristic length scale of the pore network models is several orders of magnitude smaller than the practically relevant length scale. A straightforward upscaling of the micro-scale models by using large pore networks is computationally costly, but it can be used to assess the quality of any chosen continuum-scale model as well as to estimate the effective parameters. When reliable estimates for these parameters have been obtained as functions of the pore size distribution and other material properties, the computationally much cheaper continuum-scale model may be used in future simulations without the need for further micro-scale simulations or experimental measurements.

In this work, the moisture transport coefficient ( $D$ ), the capillary pressure ( $p_c$ ), the effective liquid permeability ( $k_{eff,l}$ ) and the effective vapor diffusivity ( $D_{eff,v}$ ) are estimated from the post-processing of the three-dimensional pore network simulations for multiple realizations of the pore space geometry from a given probability distribution. These effective parameters are then applied to the moisture diffusion model at the continuum scale.

## REFERENCES

- [1] Whitaker, S.: Simultaneous heat, mass, and momentum transfer in porous media: a theory of drying. *Advances in Heat Transfer* 13, 119-203 (1977).
- [2] Metzger, T., Tsotsas, E., Prat, M.: Pore network models: a powerful tool to study drying at the pore level and understand the influence of structure on drying kinetics. In: Tsotsas E. and Mujumdar A.S. (eds.) *Modern Drying Technology*, pp. 57-102. WILEY-VCH, Weinheim (2007).

## GRAPHICS