Numerical Modelling of Heat and Mass Transfer in Porous Materials During Drying and Shrinkage

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Abstract

Drying is an essential step in many manufacturing processes, for it will have an important impact on the product quality and energy consumption. This is why many numerical models have been realised over decades, in order to predict the hygrothermal behaviour of porous media during the drying process, depending on external parameters such as air temperature, convection, conduction or infrared radiation. In certain cases, the shrinkage must not be neglected.

Most of these models use three variables : moisture content, temperature and pressure. While complete enough to simulate the behaviour of a single-layer system, this kind of model shows its limits when applied to a multilayered wall composed of different materials, such as concrete and plaster ; the discontinuity of moisture content at the interface will cause numerical errors and insolvent equations.

In this paper, we present a model allowing to properly simulate the pressure, heat and mass transfer during the drying of moist plaster on dry concrete. We take advantage of the continuity of vapour pressure between two materials to use it as the main variable in the mass conservation equation, and calculate the moisture content separately through a partial differential equation. This model will also simulate the deformation of materials using a behaviour law depending on moisture content.