The effect of salt crystallization on the drying kinetics of building materials

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Drying, and imbibition-drying cycles are two important phenomena known to play a major role during the production and the lifetime of building materials. Herein we study the evaporation of a saline solution in porous media. The critical physical phenomena in work are the migration and redistribution of ions within the porous medium. Indeed the crystallization of solids induced by the evaporation of the liquid phase has major impact on the drying kinetics. These phenomena are encountered during the production of building materials such as cement or plaster based building materials during their drying. Also we found them in the form of imbibition-drying cycles in buildings as in the case of capillary rising damp. The impact of the saline solution on the drying kinetics of porous media is not yet fully understood, nor has this impact been well quantified.

Results obtained by MRI (Magnetic Resonance Imaging), SEM (scanning electron microscopy), binocular microscopy, microtomography and weight measurement instruments, have shown that, compared to the ones filled with pure water, drying kinetics of porous media filled with ionic solution is quite well slower. For this purpose, a plaster sample was submitted to imbibition-drying cycles. Drying is assessed through the evolution of the mass loss and the setup of saturation profiles by means of MRI (fig.1). The results of these experiments show that the drying kinetics decrease after each cycle. With the help of imaging technics, the crystallization properties at the surface and within the pores are assessed. A crystallization close to the surface, forming a dense layer of which the thickness can be approached, seems to explain the slowing down of the

drying kinetics. This enables the establishment a model for ion transport in porous media capable to predict the slowing down of the drying process of saline solution saturated building materials.

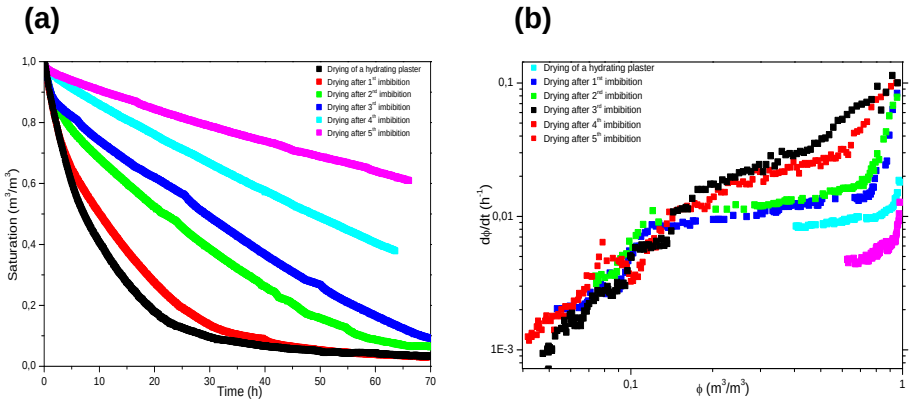

Figure 1: (a) Total water saturation as a function of time during the drying of a plaster sample. (b) Drying rate as a function of saturation during the drying of a plaster sample.
From pasty state (black), after a first (red), a second (green), a third (blue), a fourth (turquoise) and a fifth (purple) saturation with a saturated gypsum solution.

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