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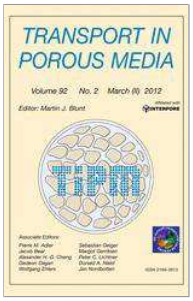
Drying Kinetics of Porous Stones in the Presence of NaCl and $NaNO_3$ NaNO 3 : Experimental Assessment of the Factors Affecting Liquid and Vapour Transport

Abstract

Salt decay is one of the most harmful and complex deterioration mechanisms of porous building materials in architectural heritage. Despite several decades of research, it is still insufficiently understood, which hampers the development of effective treatments and prediction models. One key aspect is the influence soluble salts have on the evaporative drying of porous materials. It is often observed, for example, that drying is slower for higher salt concentrations. However, there is still no consensus as to why it happens. In this article, we examine experimentally the drying kinetics of three natural stones impregnated with solutions of sodium chloride or sodium nitrate with different concentrations. The method consisted of the following sequence of determinations: capillary absorption, drying kinetics, vapour pressure and vapour conductivity. It also included a morphological analysis of the efflorescence formed during drying. We have concluded that the slower drying rate was mainly due to the reduced sorptivity that arises at higher salt concentrations. In the cases where compact salt crusts formed on the surface of the stone, there was an additional reduction in the drying rate because these crusts obstructed vapour transport. However, in most cases, efflorescence was porous and had negligible obstructive effects. Efflorescence morphology is conditioned by well-determined causal factors, such as porosity, pore size and mineralogical structure of the stone, or the type of salt and its concentration. Here, it also revealed that it incorporated a component of unpredictability. This suggests that it may be necessary to move beyond purely deterministic approaches to salt decay.



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