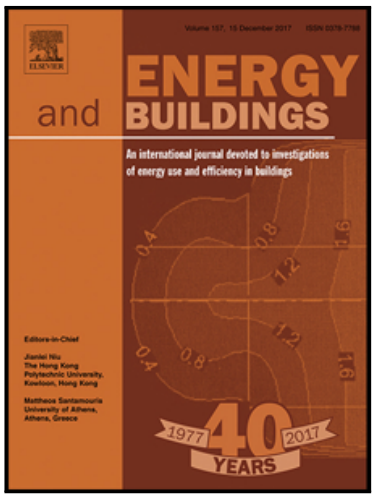

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PII: S0378-7788(17)32353-8
DOI: 10.1016/j.enbuild.2018.01.067
Reference: ENB 8347

To appear in: *Energy & Buildings*

Received date: 17 July 2017
Revised date: 21 December 2017
Accepted date: 26 January 2018

Please cite this article as: G. Promis, O. Douzane, A.D. Tran Le, T. Langlet, Moisture hysteresis influence on mass transfer through bio-based building materials in dynamic state, *Energy & Buildings* (2018), doi: 10.1016/j.enbuild.2018.01.067

Moisture hysteresis influence on mass transfer through bio-based building materials in dynamic state

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Abstract

Bio-based materials are increasingly present in the constitution of the building envelops thanks to their numerous advantages such as good thermo-hygric performances, weak environmental impact, efficient regulation of the perceived indoor air quality and human comfort... The analysis of moisture transfer is necessary to increase the efficiency of these materials and to ensure building sustainability. Actually, most of hygrothermal models neglect the moisture hysteresis effect, arguing the weak impact on the obtained results. Thus, a 3D numerical model was built on COMSOL Multiphysics, taking into account the hysteresis phenomenon to assess the impact of hysteresis effects. The model was validated thanks to experimental tests performed on hemp concrete and rape straw concrete. Tests were carried out under various dynamic hygric solicitations, with a regulated climatic chamber. The results have been compared in steady and transient states, with and without the effect of moisture hysteresis. Results have shown that hysteresis could be neglected in steady state, if the relative humidity range did not reach the capillary condensation. In this case, a model based on the main adsorption isotherm could lead to reasonable approximation, with weak calculation costs. For the analysis of a wall under real climatic solicitations, which corresponds to a non-steady state, neglecting the moisture hysteresis could lead to significant discrepancies, especially in terms of sample moist mass (and consequently moisture content or absolute humidity).

Keywords: Sorption isotherms, 3D numerical model, Experimental validation,

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