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BIO-BASED MATERIALS FOR HYGRIC AND THERMAL CONTROL IN BUILDINGS

by

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Bio

Sylvie Lorente is the Associate Dean for Research & Innovation in the College of Engineering at Villanova University, PA, USA. She is the College of Engineering Chair Professor in Mechanical Engineering at Villanova, and Professor (Exceptional Class) at the National Institute of Applied Sciences (INSA), University of Toulouse, France.
She is also Hung Hing-Ying Distinguished Visiting Professorship in Science and Technology at Hong Kong University (Hong Kong), Extraordinary Professor at the University of Pretoria (South Africa), and Adjunct Professor at Duke University (USA). She is a member of the Academy of Europe.
Sylvie has a passion for flow architectures, and works on thermal design, energy storage, vascularized structures, porous media, biological flow networks, urban design and organizations, among other things. She is the author of 7 books, 10 book chapters and 200+ peer-reviewed international journal papers. She is listed among the 2% most cited scientists worldwide.

Abstract

In the context of the energy transition, new construction materials are being developed, with the concern of being more eco-friendly all along their life cycle. This includes bio-based materials like hemp concrete. Using such materials in the building envelope corresponds not only to the objective of leaving a lower carbon footprint, but also to the purpose of using less air-conditioning by taking advantage of the hygric and thermal properties that these material possess inherently.
Here, we review our recent work on a hemp-based hygroscopic material under various temperature and moisture dynamic conditions. The wall was made of precast hemp concrete (HC) blocks with air cavities. It was tested within a bi-climatic chamber and monitored thanks to hygrothermal sensors in the wall and in the chambers. A numerical model predicting heat and moisture transfer through hemp concrete was developed. Based on scale analysis, it allows to go further into the description by identifying the dominant driving forces both for moisture and heat transfer, for different classes of relative humidity. The results indicate how the heat and moisture transport phenomena within the wall are coupled, particularly how a temperature difference can be a sufficient driving force for the release of moisture. The work points out the impact of moisture adsorption on heat release and on the temperature changes within the wall.