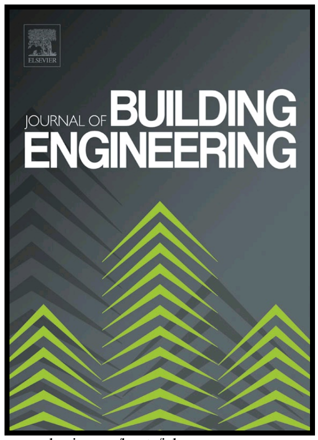
Author's Accepted Manuscript



www.elsevier.com/locate/jobe

Analysis of micro-dispersed PCM-composite boards behavior in a building's wall for different seasons

Kamal EL OMARI, Yves LE GUER, Pascal BRUEL

PII: S2352-7102(16)30111-5
DOI: http://dx.doi.org/10.1016/j.jobe.2016.07.013
Reference: JOBE161

To appear in: *Journal of Building Engineering*

Received date: 2 February 2016
Revised date: 11 May 2016
Accepted date: 31 July 2016

Cite this article as: Kamal EL OMARI, Yves LE GUER and Pascal BRUEL Analysis of micro-dispersed PCM-composite boards behavior in a building's wal for different seasons, *Journal of Building Engineering* http://dx.doi.org/10.1016/j.jobe.2016.07.013

Analysis of micro-dispersed PCM-composite boards behavior in a building's wall for different seasons

Kamal EL OMARI[a,*], Yves LE GUER[a], Pascal BRUEL[b]

[a] *Université de Pau et des Pays de l'Adour (UPPA), Laboratoire des Sciences de l'Ingénieur Appliquées à la Mécanique et au génie électrique (SIAME), 64000 Pau, France.*
[b] *CNRS - Laboratoire de Mathématiques et de leurs Applications, Inria Cagire Team, 64000 Pau, France.*

Abstract

The integration of phase change materials (PCMs) in buildings especially in their walls is the subject of more than a decade of growing interest due to their potentialities for energy saving and enhancement of thermal comfort. The present investigation concerns the applications related to thermal insulation. The idealized composite wall considered here numerically can be thought of as resulting from the incorporation of shape-stabilized PCM particles in a polymer matrix. A novel model is developed to study the thermal behavior of this PCM-composite when used as a planar insulating material submitted to variable thermal modulations on one of its faces. The numerical model couples the heat transfer in the wall with the heat transfer and the crystallization/melting process within PCM inclusions considered as spherical. Both processes are modeled by a finite volume approach combined with the enthalpy method to account for the phase change. Simulation results are used to monitor the temperatures in the wall and quantify the energy exchanges between its two sides. The thickness of the wall and the volume fraction of the incorporated PCM were varied in this study. This analysis permits to point out the configurations for which the negative effect of the higher thermal conductivity of the PCM outweighs the benefits related to its latent heat. The analysis is extended to different external temperature modulations representing different typical seasons/climates. The results show the impact of the choice of the PCM phase change temperature on the wall thermal efficiency over the year. For the case investigated, it was shown that a PCM composite board with increased performances during a summer day exhibits a degraded behavior during a winter day when compared to a pure (without PCM) insulation material.

*Corresponding author.
Email address: kamal.elomari@univ-pau.fr (Kamal EL OMARI)