Optimization of Architectured Structures in Building for Harness, Storage, and Release of Energy

C. Thoumyre[1], P. Lhuissier[1], L. Salvo[1], G. Bienvenu[2], M. Kermarrec[2]

[1]University Grenoble Alpes, SIMaP, Grenoble, France
[2]Hevatech, Ville-la-Grand, France

Abstract

The problem of storage, and release of thermal energy is an important challenge in various industrial fields. Several systems for thermal energy storage exist like phase change materials (PCM) and thermochemical storage [1]. The first system usually addresses short term storage (day duration) while thermochemical storage are very interesting for longer duration (seasonal storage).

However, thermal properties (conductivity, diffusivity) of most of these PCM and chemical compounds are poor limiting thus the amount of material that can be used. Adding a conductive structure within the PCM or the chemical compounds is a good way to enhance the efficiency of these systems. Among the possible structure, architecture materials are able to meet the requirements [2] : high porosity and good thermal conductivity.

In this study, which is done in the framework of the labex CEMAM, an open cell metal foam [3] is used for the structure to enhance supplying heat through the PCM (or chemicals compounds) and to accelerate and optimize the phase change (or the thermochemical reaction). Moreover, metallic foam must be adapted to obtain the best thermal exchange by coupling conduction and convection phenomenon [4-5]. We will present 3D simulation performed with COMSOL Multiphysics® software of the PCM phase change with and without the foam showing the great interest of such structure [figure 1]. We will also present the optimized foam to couple thermal conduction and convection.

Reference

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Figures used in the abstract

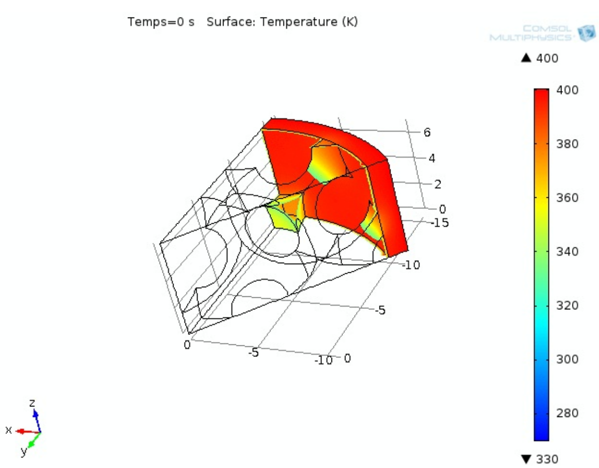

Figure 1: Thermal transfer in a metal foam filled with PCM.

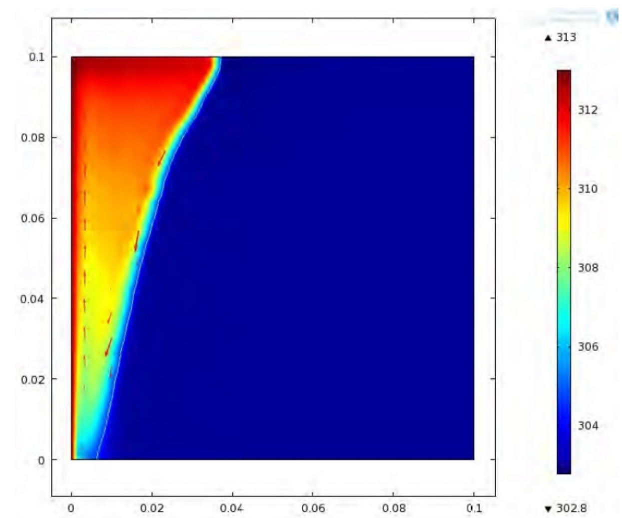

Figure 2: 2D Natural convection of 100% PCM.