Improving the thermal behaviour of bricks by incorporating shape-stabilized phase change materials

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Abstract: The addition of a new shape-stabilized phase change material (ssPCM) in ceramic elements having large porosity has been carried out. In that way, a novel form-stable PCM based on bricks was developed. In order to study the incorporation of the thermoregulatory material in the composites, bricks with different porosities have been manufactured. In this work the ssPCM was synthesized using polyethylene glycol (PEG) as PCM and tetraethyl orthosilicate (TEOS) as supporter precursor by sol-gel method. The initial liquid product can be further turned into solid by neutralization procedures. ssPCM in its liquid form is adsorbed inside the porous brick by capillary action and it is further stabilized by controlling its gelation time, obtaining the new form-stable PCM. The adsorption curves, the long-term stability after 100 cycles of heating and cooling processes and the improved thermal energy storage capacities for the obtained samples have been studied. Different composites containing between 15 to 110 wt% of ssPCM respect to the initial dried mass of brick have been obtained, with thermal capacities within 8.94 to 28.80 kWh/m3 . The Fick´s law was used to predict the adsorption curves and only one diffusion coefficient was required to predict the content of the ssPCM into the bricks, independently of their porosity. Besides, all the samples exhibited a high long-term thermal stability influenced by the additional stabilizer effect of the ceramic matrix.

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