

Study of radiant floor systems with phase change materials for improved performance

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FIGURE 1
(a) 3D representation (without scale) of the setup; (b) temperature profiles of the sensors on the floor surface – heating strategy controlled by timer.

A promising pathway to contribute to the decarbonization of the building stock is through improving the thermal performance and energy efficiency of buildings. Combining materials with high energy density such as Phase Change Materials (PCMs), with indoor heating and cooling systems is a valuable strategy to achieve this goal. PCMs are able to store and release large amounts of thermal energy *per* unit volume during phase change process, within a narrow temperature range. Incorporating PCMs in radiant floors can improve the overall performance of these systems. However, when the heat transfer medium is a mortar, the incorporation of PCM often results in the reduction of thermal conductivity, posing a challenge to system performance. To evaluate the impact that the incorporation of a microencapsulated PCM (mPCM) in the mortar of a hydronic radiant floor system (RFS) has on its thermal and energy performances, an experimental setup was built and subjected to different heating scenarios. The apparatus

consists of two comparable hydronic RFS specimens: one reference (Ref.) and another incorporating the mPCM in the mortar medium embedding the water pipes. The specimens were tested under intermittent heating strategies controlled by timer and floor surface temperature setpoints. The methodological approach was divided into: (i) analysis of the thermal performance of the RFS specimens; and (ii) assessment of energy performance based on the operating time of each specimen. The operating control strategy of the RFS proved to be key for an adequate performance, promoting the PCM phase change to occur, reducing temperature fluctuations and maintaining surface floor temperatures within comfort values. As major drawback, the PCM-RFS required longer operating times when the heat source is controlled by surface floor temperature setpoint, influenced by the thermophysical properties of the PCMmortar composition. Research available at: <https://doi.org/10.1016/j.est.2024.114084>.

