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Exploring the Potential of Phase Change Materials in Construction Environments

Authors : A. Ait Ahsene F., B. Boughrara S.

Abstract : The buildings sector accounts for a significant portion of global energy consumption, with much of this energy used to heat and cool indoor spaces. In this context, the integration of innovative technologies such as phase change materials (PCM) holds promising potential to improve the energy efficiency and thermal comfort of buildings. This research topic explores the benefits and challenges associated with the use of PCMs in buildings, focusing on their ability to store and release thermal energy to regulate indoor temperature. We investigated the different types of PCM available, their thermal properties, and their potential applications in various climate zones and building types. To evaluate and compare the performance of PCMs, our methodology includes a series of laboratory and field experiments. In the laboratory, we measure the thermal storage capacity, melting and solidification temperatures, latent heat, and thermal conductivity of various PCMs. These measurements make it possible to quantify the capacity of each PCM to store and release thermal energy, as well as its capacity to transfer this energy through the construction materials. Additionally, field studies are conducted to evaluate the performance of PCMs in real-world environments. We install PCM systems in real buildings and monitor their operation over time, measuring energy savings, occupant thermal comfort, and material durability. These empirical data allow us to compare the effectiveness of different types of PCMs under real-world use conditions. By combining the results of laboratory and field experiments, we provide a comprehensive analysis of the advantages and limitations of PCMs in buildings, as well as recommendations for their effective application in practice.

Keywords : energy saving, phase change materials, material sustainability, buildings sector
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