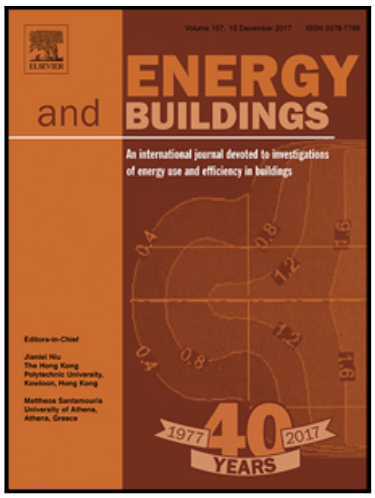

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Thermal enhancement of paraffin/hydrophobic expanded perlite granular phase change composite using graphene nanoplatelets

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Abstract

Thermal performance of latent heat thermal energy storage (LHTES) systems is often limited by low thermal conductivity of phase change materials (PCMs), which reduces the heat transfer rate and energy storage efficiency. This study investigates the development of a thermally enhanced paraffin/hydrophobic expanded perlite (EPOP) form-stable PCM seeded with graphene nanoplatelets (GNP) as a heat transfer promoter. Experimental research was carried out on fabrication, characterization and heat transfer performance analysis of EPOP-GNP composite. It was shown that the GNP particles partially immerse into paraffin occupied in the pores of EPO, which remarkably improved the thermal properties and heat transfer performance of composite PCM. In comparison with EPOP, the addition of 0.5wt% GNP increased the thermal conductivity by up to 49%. Heat transfer performance test also showed that the EPOP-GNP composite reduced the heat storage/release duration by up to 20%, compared to EPOP. Moreover, prototype test room experiment conducted on cement mortars containing EPOP-GNP revealed that the introduction GNP into form-stable PCM significantly enhanced the thermal energy storage performance of cement mortars. This is particularly demonstrated by the reduction in peak inner surface temperature of 0.8°C and the increase in inner surface convective heat gain energy by 78%, compared to cement mortars containing EPOP only. It can be said, therefore, the integration of GNP into form-stable PCMs is a promising way to achieve high energy storage efficiency in numerous LHTES applications such as solar energy storage and energy conversation in buildings.

Keywords: Phase change materials (PCMs); building energy efficiency; graphene nanoplatelets (GNP); heat transfer rate; energy storage