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Experimental thermal performance of a domestic latent heat medium temperature storage system during charging

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Thermal energy storage (TES) helps alleviate the mismatch between energy supply and demand by using the stored energy during peak demand periods when it is required. The two most appropriate types of TES systems for domestic applications are sensible heat and latent heat TES. Latent heat TES systems have larger thermal energy storage densities as compared to sensible heat TES systems thus reducing the space requirements for TES. An experimental investigation for a domestic latent TES system is presented in this paper. The latent heat TES system consists of a packed bed of encapsulated adipic acid in spherical aluminium spheres. The TES system is charged electrically using Sunflower Oil as the heat transfer fluid (HTF). Charging experiments are done with three different flow-rates (4 ml/s, 8 ml/s and 12 ml/s). Charging results are presented in terms of the HTF temperatures, phase change material (PCM) temperatures, charging energy rates and charging exergy rates. Results show that increasing the flow-rate reduces the temperature difference between the top and the bottom of the storage thus reducing the degree of thermal stratification. This reduction in thermal stratification results in the lowest peak charging energy and exergy rates with the highest flow-rate (12 ml/s). Energy and exergy rate profiles peak and drop for all flow-rates as the temperature difference between the top and bottom of the storage tank reduces as charging progresses. Charging with lowest flow-rate (4 ml/s) shows the best thermal performance and more pronounced phase change characteristics for adipic acid.

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