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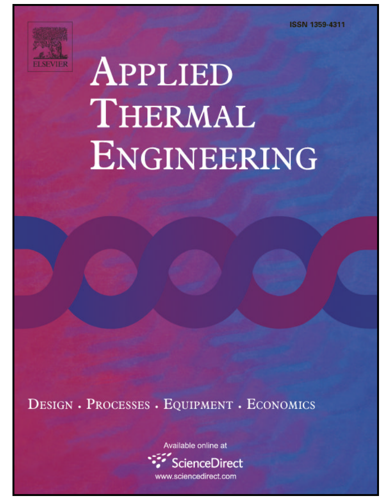

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Appasaheb Raul, Mohit Jain, Swapnil Gaikwad, Sandip K. Saha

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Modelling and Experimental Study of Latent Heat Thermal Energy Storage with Encapsulated PCMs for Solar Thermal Applications

Appasaheb Raul, Mohit Jain, Swapnil Gaikwad, Sandip K. Saha†

Department of Mechanical engineering, Indian Institute of Technology Bombay, Mumbai-400076, India.

Abstract

The variability in solar radiation creates a gap between energy demand and supply, which necessitates the use of efficient thermal energy storage for bridging the gap to make the solar thermal power plant a viable solution for continuous power generation. In this work, a mathematical model of encapsulated phase change materials (PCMs) based latent heat thermal energy storage (LHTES) is developed considering simplified non-equilibrium two energy equations coupled with enthalpy technique to analyse the transient variation in heat transfer fluid (HTF) temperature at the outlet of LHTES and PCM temperature. Experiments on a spherical capsule reveal melting and solidification behaviour of PCM from the measured temperature field. A lab-scale LHTES is designed and fabricated to evaluate the effects of charging temperature, discharging temperature and flow rate on thermal performance of the LHTES during charging and discharging operations. Detailed parametric study on capsule diameter and porosity shows that the energy stored and extraction are faster for smaller capsule diameter and higher porosity. The maximum efficiency of the storage in this work is found to be 75.69% for charging and discharging inlet HTF temperatures of 180 and 120 °C, respectively and flow rate of 8.2 lpm.

Keywords: Encapsulation, Phase change materials, thermal energy storage, charging, discharging

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†Corresponding author: Email: sandip.saha@iitb.ac.in
Tel.: +91 22 2576 7392; fax: +91 22 2572 6875.