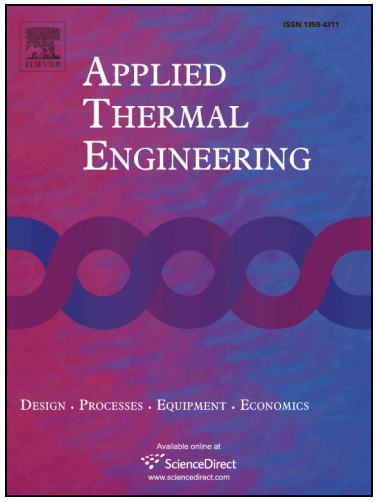

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Energy and Exergy Analyses of Medium Temperature Latent Heat Thermal Storage with High Porosity Metal Matrix

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ABSTRACT

Thermal energy storage system in a concentrating solar plant (CSP) reduces the gap between energy demand and supply caused by the intermittent behaviour of solar radiation. In this paper, detailed exergy and energy analyses of shell and tube type latent heat thermal storage system (LHTES) for medium temperature solar thermal power plant (~ 200 °C) are performed to estimate the net useful energy during the charging and discharging period in a cycle. A commercial-grade organic phase change material (PCM) is stored inside the annular space of the shell and the heat transfer fluid (HTF) flows through the tubes. Thermal conductivity enhancer (TCE) in the form of metal matrix is embedded in PCM to augment heat transfer. A numerical model is developed to investigate the fluid flow and heat transfer characteristics using the momentum equation and the two-temperature non-equilibrium energy equation coupled with the enthalpy method to account for phase change in PCM. The effects of storage material, porosity and pore-diameter on the net useful energy that can be stored and released during a cycle, are studied. It is found that the first law efficiency of sensible heat storage system is less compared to LHTES. With the decrease in porosity, the first law and second law efficiencies of LHTES increase for both the charging and discharging period. There is no significant variation in energy and exergy efficiencies with the change in pore-diameter of the metal matrix.

Keyword: Latent heat thermal storage, PCM, Metal matrix, Second law, First law, Efficiency

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