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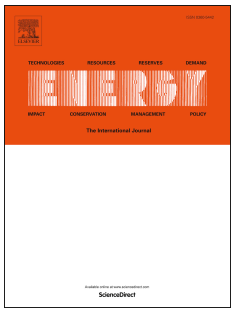

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Experimental study on the thermodynamic performance of cascaded latent heat storage in the heat charging process

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Abstract

Compared with single-stage latent heat storage, cascaded latent heat storage is considered as an effective way to store and utilize intermittent or fluctuant thermal energy due to an increased heat transfer rate, a uniform and lower HTF outlet temperature, faster charging/discharging processes and higher exergy efficiency. In this paper, an experimental three-stage latent heat storage system filled with three different phase change materials is established and its heat charging process is studied. Its temperature evolution in each stage during the heat charging process is measured and the corresponding thermodynamic performance is analyzed. Besides, the effects of stage number, HTF inlet temperature and HTF flow rates on the thermodynamic performance are discussed, respectively. The results show that the solid-liquid phase change in the three stages does not take place simultaneously due to the poor heat transfer and the large melting temperature difference. In addition, more stages could improve energy storage efficiency, exergy storage efficiency and entransy storage efficiency. Higher HTF inlet temperatures and larger HTF flow rates could increase transfer and storage rates of energy, exergy and entransy, but the storage efficiency of energy, exergy and entransy could only be obviously improved by higher HTF inlet temperatures.

Keywords: Cascaded latent heat storage; Heat charging process; Energy analysis; Exergy analysis; Entransy analysis