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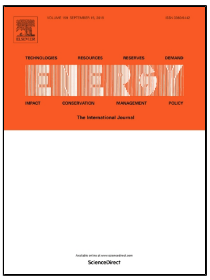

New salt hydrate composite for low-grade thermal energy storage

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New salt hydrate composite for low-grade thermal energy storage

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Abstract

This study aims to develop a new salt-based thermochemical composite for long-term storage of low-grade thermal energy which enables overcoming mismatch between energy demand and supply. The energy density and dehydration behavior of five different salts; $Al_2(SO_4)_3.18H_2O$ and $MgSO_4.7H_2O$, $CaCl_2.6H_2O$, $MgCl_2.6H_2O$, and $SrCl_2.6H_2O$ are examined. Subsequently, the performance of two low cost host porous structures; expanded clay and pumice, impregnated with the most suitable salt for storing low-grade thermal energy is studied over a few number of cycles using a lab-scale packed bed reactor. The results showed that $SrCl_2.6H_2O$ has the highest energy density and lowest dehydration temperature so that >80% of its energy density can be stored at <90°C. Thermal cycling the composite materials revealed that up to 87 kWh/m^3 and 22 kWh/m^3 energy can be stored using expanded clay-$SrCl_2$ (40 wt%) and pumice-$SrCl_2$ (14 wt%), respectively. However, the performance of expanded clay dropped sharply over four cycles while the generated power using pumice composite was sustained almost constant over ten cycles. Although pumice-$SrCl_2$ is a promising composite in terms of cyclability, further research is required to improve its energy storage capacity to make it attractive for large scale applications.

Keywords: Solar energy, Energy storage, Salt hydrate, $SrCl_2$, Pumice, Expanded clay