

Ternary Eutectic Chloride Salt BaCl₂-KCl-NaCl for High Temperature Thermal Energy Storage

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Abstract

In the current study a ternary eutectic chloride salt (BaCl₂-KCl-NaCl) has been investigated as a potential high temperature phase change material (PCM) for thermal energy storage. The composition was predicted using the software FactSage 6.4, while thermophysical properties such as melting/freezing point, latent heat, and specific heat capacity were determined using differential scanning calorimetry (DSC). The DSC results show that the melting point (542.8 °C) is comparable to predictions from FactSage 6.4 and other reported literature while the latent heat (183.2 kJ/kg) is comparable with previous literature but higher than predicted from FactSage 6.4. The solid and liquid density has been estimated to be 2,990 kg/m³ and 2,405 kg/m³, respectively, while the thermal conductivity has been estimated to be 0.41 W/mK. Thermal cycling of the PCM around its melting point showed no change in melting point and a decrease in latent heat (24.4 %), possibly due to the changes in sodium- and potassium- chloride crystalline phase ratios when analysed with x-ray powder diffraction (XRD).

Initial Results

Below is a selection of figures from the proposed study.

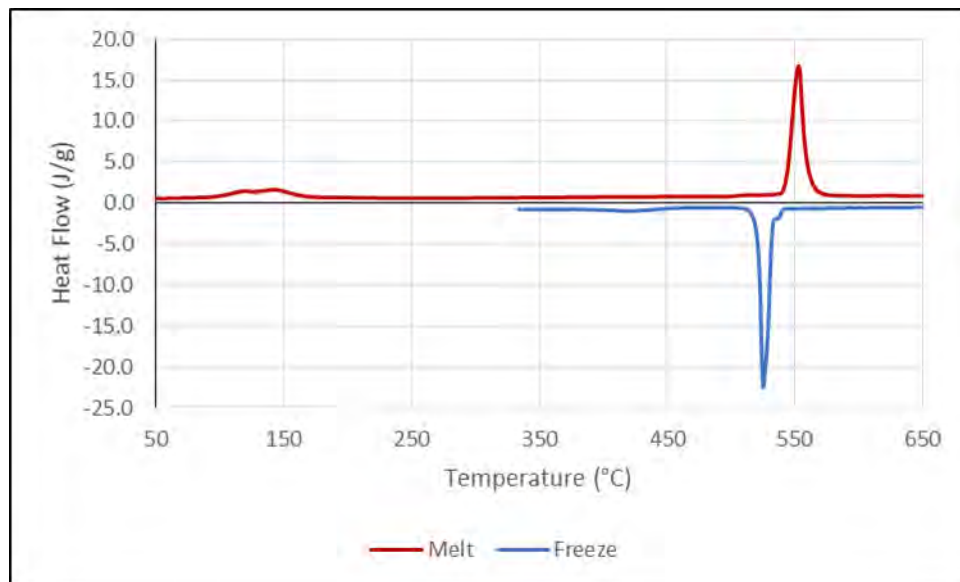


Figure 1- Melting Point and Latent Heat of uncycled CL540

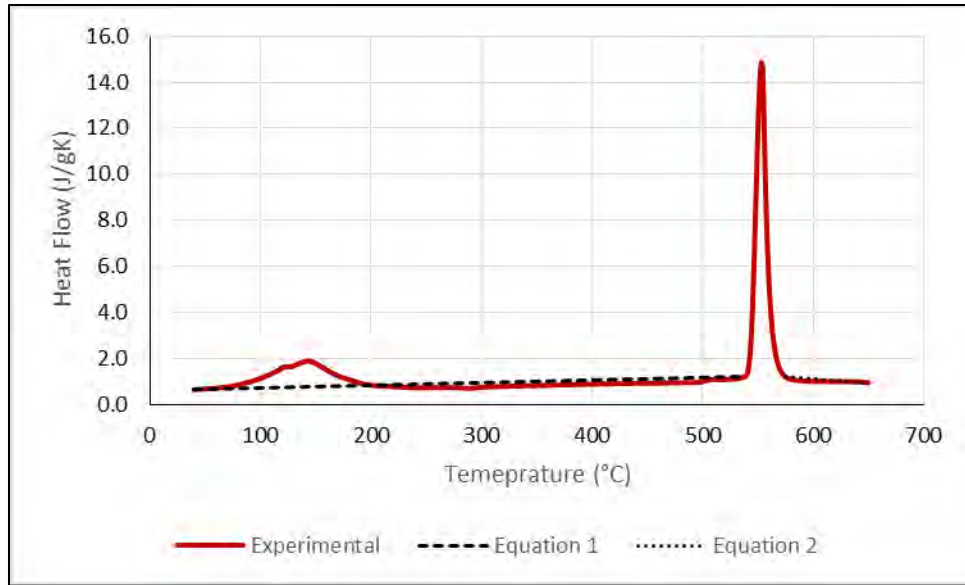


Figure 2- Experimental Heat Capacity of CL540

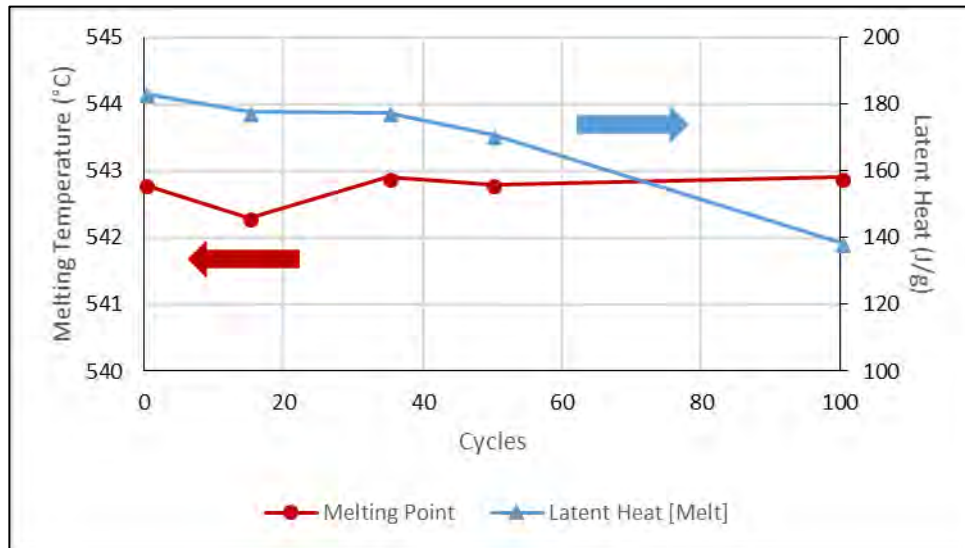


Figure 3- Cycling Effect on Melting Point and Latent Heat of CL540