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Unbranched, Saturated, Carboxylic Esters as Phase-Change Materials

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Abstract : This study evaluates unbranched, saturated carboxylic esters with respect to their suitability to be used as storage media for latent heat storage applications. Important thermophysical properties are gathered both by means of literature research as well as by experimental measurements. Additionally, esters are critically evaluated against other common phase-change materials in terms of their environmental impact and their economic potential. The experimental investigations are performed for eleven selected ester samples with a focus on the determination of their melting temperature and their enthalpy of fusion using differential scanning calorimetry. Transient Hot Bridge was used to determine the thermal conductivity of the liquid samples while thermogravimetric analysis was employed for the evaluation of the 5% weight loss temperature as well as of the decomposition temperature of the non-volatile samples. Both experimental results and literature data reveal the high potential of esters as phase-change materials. Their good thermal and environmental properties as well as the possibility for production from natural sources (e.g. vegetable oils) render esters as very promising for future storage applications. A particularly high short term application potential of esters could lie in low temperature storage applications where the main alternative is using salt hydrates as phase-change material.

Keywords : esters, phase-change materials, thermal properties, latent heat storage
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