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Title: Lauric Acid for Use as a Latent Heat Storage Material

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Latent heat storage for solar heating greatly reduces the required quantity of heat storage materials because thermal energy is primarily stored in the phase change process (most commonly solid-liquid), not just the energy storage due to heat capacity (sensible heat storage). However, some latent heat storage materials (or phase change materials, 'PCMs') have reported shortcomings: corrosion with common encapsulation materials, toxicity, poor lifetime chemical stability, excessive volume change between phases, large phase hysteresis, high cost, and most commonly low thermal conductivity.

This study undertook a detailed examination of the thermo-physical properties of a candidate PCM aimed at scavenging heat from solar thermal collectors. The material is lauric acid (also known as dodecanoic acid, $CH_3(CH_2)_{10}COOH$). The study focussed on the required physical properties: heat capacity, volume change on melting, thermal conductivity, long-term stability, and thermal cycling. Our industry partner, Scotian WindFields, required these parameters for the PCM to pilot their first latent heat storage system for solar hot water in Halifax, NS.

In all measures, lauric acid was found to be a suitable solar heat storage medium for domestic hot water, given its melting point (44˚C), low volume change between phases (6.5%), high latent heat (184 kJ/kg), non-toxic nature, and low cost (nominally $14/kg bulk). The low thermal conductivity of lauric acid, 0.15 W m^{-1} K^{-1} at 30˚C in the solid phase, is typical of organic PCMs. These will always require heat transfer enhancements for use in heat storage systems. Reports in the literature by Sari (2003) and Sari and Kaygusuz (2003) regarding poor thermal cycling stability of lauric acid were deemed unsubstantiated by our own testing; our results showed that lauric acid is a very suitable and stable PCM.