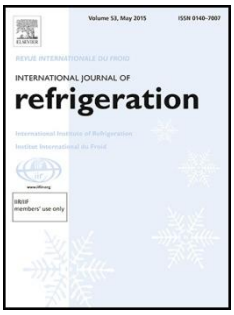
Accepted Manuscript



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PII: S0140-7007(17)30237-2
DOI: http://dx.doi.org/doi: 10.1016/j.ijrefrig.2017.06.003
Reference: JIJR 3668

To appear in: *International Journal of Refrigeration*

Received date: 5-4-2017
Revised date: 31-5-2017
Accepted date: 2-6-2017

Please cite this article as: Saman Nimali Gunasekara, Sofia Kumova, Justin Ningwei Chiu, Viktoria Martin, Experimental phase diagram of the dodecane-tridecane system as phase change material in cold storage, *International Journal of Refrigeration* (2017), http://dx.doi.org/doi: 10.1016/j.ijrefrig.2017.06.003.

Experimental Phase Diagram of the Dodecane-Tridecane System as Phase Change Material in Cold Storage

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Highlights:

- $C_{12}H_{26}$-$C_{13}H_{28}$ system has a congruent minimum-melting solid solution and polymorphs
- The minimum-freezing 17.7 mol% $C_{13}H_{28}$ blend (at -16 to -12 °C) is a potential PCM
- 17.7 mol% $C_{13}H_{28}$ blend freezes with an enthalpy of 165 kJ kg^{-1} and no supercooling
- The system has a minimum-melting trend, but has no eutectic as literature proposed
- Extensive physicochemical studies needed to explain melting/freezing discrepancies

Abstract

Integrating thermal storage with phase change materials (PCMs) in refrigeration and air conditioning processes enables energy performance improvements. Herein, the experimental phase diagram of the alkanes system dodecane-tridecane ($C_{12}H_{26}$-$C_{13}H_{28}$) is evaluated to find PCMs for freezing applications. For that, the Temperature-history method was coupled with a Tammann plot analysis. The obtained $C_{12}H_{26}$-$C_{13}H_{28}$ phase diagram indicated a congruent minimum-melting solid solution and polymorphs. The minimum-melting liquidus and the polymorphs identified here, agree with previous literature. However, the system does not represent a eutectic, as previously was proposed. The minimum-melting composition is here identified within 15-20 mol% $C_{13}H_{28}$ compositions. The 17.7 mol% $C_{13}H_{28}$ is the narrowest minimum-melting composition among those analyzed, melting and freezing between -16 to -12 °C and -17 to -15 °C, with: the enthalpies 185 kJ kg^{-1} and 165 kJ kg^{-1}; no supercooling; and only minor hysteresis. Hence, this blend has potential as a PCM in freezing refrigeration applications.

Keywords: *phase change material (PCM); $C_{12}H_{26}$-$C_{13}H_{28}$ system; phase diagram; Temperature-history method; Tammann plot; minimum-melting*

Nomenclature

Symbols

c_p	Specific heat at constant pressure (kJ kg^{-1}K^{-1})
Δh	enthalpy change (kJ kg^{-1} or kJ mol^{-1})
h	enthalpy (kJ kg^{-1} or kJ mol^{-1})
t	time (s)
T	Temperature (°C)