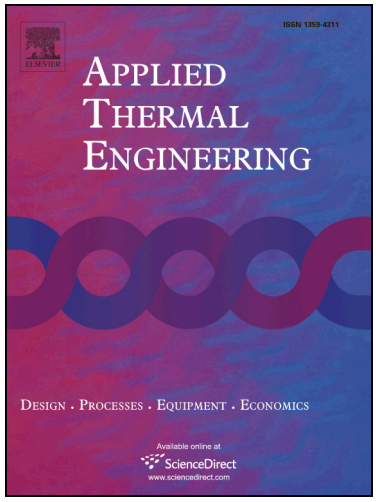

Thermal diffusivity measurement of Erythritol and numerical analysis of heat storage performance on a fin-type heat exchanger

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Thermal diffusivity measurement of Erythritol and numerical analysis of heat storage performance on a fin-type heat exchanger

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Abstract

Temperature dependency of thermal diffusivity of erythritol was measured by temperature wave analysis (TWA) method. This modulating technique allowed measuring thermal diffusivity continuously, even during the phase transition solid-liquid. Together with specific heat capacity and specific enthalpy measured by differential scanning calorimetry, the values of measured properties were utilized in a bi-dimensional numerical model for analysis of heat transfer and heat storage performance. The geometry of the model is representative of a cross section of a fin-type heat exchanger, in which erythritol is filling the interspaces between fins. Time-dependent temperature change and heat storage performance were analyzed by considering the variation of thermophysical properties as a function of temperature. The numerical method can be utilized for a fast parametric analysis of heat transfer and heat storage performance into heat storage systems of phase-change materials and composites.

Key Words: Phase change materials, Erythritol, Thermal diffusivity, Temperature wave method, Heat storage, Numerical analysis

Highlights

- Thermal diffusivity of Erythritol was measured by temperature wave method
- Thermal diffusivity was measured in function of temperature and during phase change
- Database of temperature-dependent thermal properties is used for numerical analysis
- Heat transfer and heat storage were analyzed in a fin-type heat exchanger
- Use of temperature-dependent properties in calculations lead to longer melting time

Introduction

Thermal energy storage using phase change materials (PCM) is a promising technology for recovery and reutilization of unutilized waste heat and for efficient utilization of primary energy. Depending on the phase change temperature of the materials, this technology can find application in many fields, such as storage of solar heat [1], thermal control of buildings by integration on construction materials [2], food processing or transportation [3], storage of waste heat from cars for improving the efficiency at start-up [4]. The measurement and analysis of heat storage/output performances is generally conducted on experimental apparatuses, by flowing a certain heat