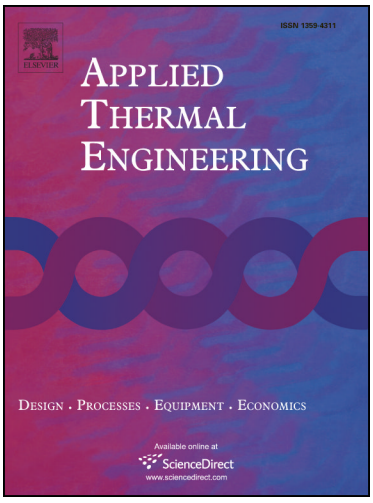

Novel scheme for a PCM-based cold energy storage system. Design, modelling, and simulation

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Novel scheme for a PCM-based cold energy storage system. Design, modelling, and simulation

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Abstract

This paper studies the design and dynamic modelling of a novel thermal energy storage (TES) system combined with a refrigeration system based on phase change materials (PCM). Cold-energy production supported by TES systems is a very appealing field of research, since it allows flexible cold-energy management, combining demand fulfilment with cost reduction strategies. The paper proposes and compares two different simulation models for a cold-energy storage system based on PCM. First, a continuous model is developed, the application of which is limited to decoupled charging/discharging operations. Given such conditions, it is a relatively precise model, useful for the tuning of the TES parameters. The second proposed model is a discrete one, which, despite implementing a discrete approximation of the system behaviour, allows to study more general conditions, such as series of partial charging/discharging operations. Simulation results of both models are compared regarding decoupled charging/discharging operations, and the ability of the discrete model to represent more realistic partial operations is analysed.

Keywords:
Refrigeration system, Thermal energy storage, Phase change materials, Dynamic modelling

1. Introduction

Nowadays, a great deal of energy is required by refrigeration systems, which impact global energy and economical balances. This demand is growing both in industrial or commercial sectors as well as for domestic use [1].