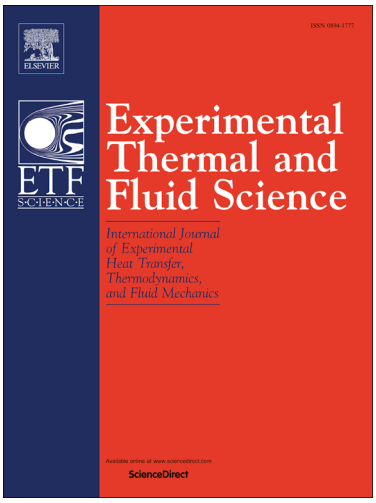

Optimization of a solar air heater with phase change materials: Experimental and numerical study

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Optimization of a solar air heater with phase change materials: Experimental and numerical study

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Abstract

In this paper, a solar air heater (SAH) with phase change material (PCM)-based energy storage is investigated. Paraffin was placed underneath the absorber plate as the PCM. A transient two-dimensional laminar model was used in the Ansys Fluent 17 software to study the effects of different parameters on the performance of the SAH, such as the air mass flow rate, the amount of paraffin, and the thermal conductivity of the paraffin. The performance of the SAH was optimized by considering two objectives simultaneously: thermal energy efficiency and maximum nocturnal temperature difference between the inlet and the outlet of the SAH. To validate the numerical model, a SAH with a 2-cm paraffin layer and the same dimensions as the numerical model was built and tested. The results of the simulation showed good agreement with the experimental results.

Keywords : Solar Energy; Solar Air Heater; Phase Change Material (PCM); Energy Storage

1. Introduction

Although solar energy is the most abundant and accessible form of renewable energy in nature, its time-dependent nature is a major disadvantage [1], and storing the solar energy as a reliable source is