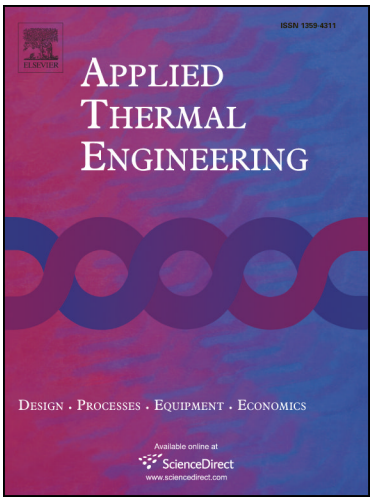

Research Paper

Comparative study based on energy and exergy analyses of a baffled Solar Air Heater with Latent Storage Collector

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PII: S1359-4311(16)32228-1
DOI: https://doi.org/10.1016/j.applthermaleng.2017.11.111
Reference: ATE 11481

To appear in: *Applied Thermal Engineering*

Received Date: 7 October 2016
Revised Date: 11 August 2017
Accepted Date: 21 November 2017

Please cite this article as: S. Ghiami, A. Ghiami, Comparative study based on energy and exergy analyses of a baffled Solar Air Heater with Latent Storage Collector, *Applied Thermal Engineering* (2017), doi: https://doi.org/10.1016/j.applthermaleng.2017.11.111

Comparative study based on energy and exergy analyses of a baffled Solar Air Heater with Latent Storage Collector

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Abstract:

In this empirical study, exergy and energy investigation of a novel solar air heater (SAH) was undertaken in presence of the paraffin wax slab as the Phase-Change-Material (PCM). Characteristics of the system was scrutinized in presence and absence of baffle on the absorber plate. In the experimental study, two types of baffle-equipped and an unequipped absorber plate were inspected in presence of PCM unit and their exergy and efficiency were compared. For the baffled absorber plates, the baffles are made of galvanized plates and are arranged in sequential or staggered manner. At three different air mass flow rates of $0.017\ Kg/s$, $0.014\ Kg/s$ and $0.009\ Kg/s$, inlet, PCM and outlet temperature were measured and compared. Exploiting the 1st and 2nd thermodynamics laws, the exergy and energy efficiencies were calculated. This study's outcome approved that, at different air mass flow rates, the baffle-equipped SAH obtained the highest efficiencies while the unequipped one has the lowest. It has been found out that, at the mass flow rate of $0.017\ Kg/s$, the maximum energy efficiency was attained for sequence-arranged baffle-equipped SAH (26.78%), while unequipped SAH had the least energy efficiency (14.30%) at the same mass flow rate. The exergy efficiencies varied between $4.86 - 20.47\%$ for all cases of study.

Key words:

Energy Efficiency, Exergy Efficiency, Phase Change Material (PCM), Solar Air Heater (SAH), Baffles

1. Introduction

The global energy utilization has been grown significantly as the demand for energy is exponentially growing. Since the industrial revolution, the worldwide energy consumption is highly reliant to the conventional fossil fuels and it became an indispensable part of the modern life. A small fraction of the energy requirement is being harvested from the nuclear power plants and hydropower systems, while a negligible proportion is being generated from renewable sources of energy, including solar, wind, geothermal, tidal and wave [1]. Although the renewable energy systems are being underestimated, they have the capability of providing the world with their energy demand. According to the investigations, exploitation of 5% of the solar energy will provide 50 times more energy than the world's requirement. Solar energy system has several privileges over other systems, including its availability and

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