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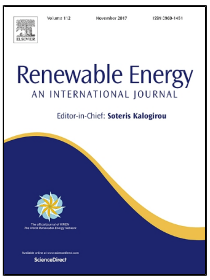

Performance evaluation of a novel solar air heater with arched absorber plate

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Performance evaluation of a novel solar air heater with arched absorber plate

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Abstract

The study presents a performance evaluation of a novel solar air heating system with arched absorber plate using turbulators. Simulation work is carried out in *ANSYS FLUENT (v16.2)* platform with *RNG k-ε* turbulence model at constant heat flux (500 W m^{-2}), in order to compare the thermal-hydraulic performance of the proposed design for a range of Reynolds number (3800 to 14000). Performance of the solar air heater is projected in the terms of Nusselt number (*Nu*), frictional factor (*Fr*) and thermal-hydraulic performance parameter (*THPP*). It is observed that the arched absorber plate design increases the air turbulence and vortex generation, which results in reducing laminar sub-layer generation near the surface of the absorber plate. A significant improvement is observed in Nusselt number at high Reynolds Number (above 10000). However, a marginal enhancement is also observed in frictional factor due to providing an extra obstacle along the duct length with arched shaped design in the flow field. It is observed that arched shape design of absorber plate can significantly improve overall performance of the solar air heating system using various turbulators. This study will likewise provide a new direction to the work trend in this area.

Keywords: Solar air heater, turbulator, THPP, dimply, equilateral triangle.

1. Introduction

Prior to 1970, solar energy was viewed as a prominent alternative to fulfill the continuous increasing demand of energy. An extensive research work was carried out to extract the maximum benefit of this renewable source of energy, due to the high rise in oil prices in 1970s (Yadav and Bhagoria, 2014). Among various alternatives, solar energy stands out as the best resource option to fulfill the increasing energy demand. Instead of direct use of solar energy it is more useful when converted into thermal energy (Bhushan and Singh, 2010). From literature, it has been revealed that