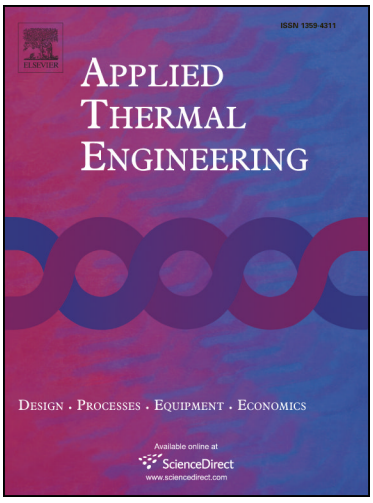

Multiple cylindrical inserts for parabolic trough solar collector

Evangelos Bellos, Ilias Daniil, Christos Tzivanidis

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Multiple cylindrical inserts for parabolic trough solar collector

Evangelos Bellos, Ilias Daniil, Christos Tzivanidis

Thermal Department, School of mechanical engineering, National Technical University of Athens, Heroon Polytechniou 9, Zografou, 15780 Athens, Greece.

Corresponding author: Evangelos Bellos (bellose@central.ntua.gr)

Abstract

The use of insert flow is a promising technique for increasing the performance of parabolic trough solar collectors. The objective of this work is to investigate the use of multiple cylindrical longitudinal inserts in the parabolic trough solar collector LS-2 module. Totally 15 cases are investigated with a computational dynamic model developed in SolidWorks Flow Simulation. More specifically, the reference empty tube, one case with a single insert, eight cases with two inserts flow, three cases with three insert flow and two cases with four insert flow. It is found that the use of more inserts leads to higher thermal, exergy and overall efficiency performance of the collector. Moreover, it is found that the exact location of the inserts plays a significant role in the results. The pumping work is found to be generally low in all the cases, the fact that proves that the increase in the pressure drop is not so important in the total system performance. The global maximum efficiency is found for the case with the four inserts and in this case, the thermal efficiency is enhanced 0.656%, the thermal losses are reduced about 5.63% and the heat transfer coefficient is increased 26.88%. The results of this work can be used for the proper design of multiple inserts design in solar systems.

Keywords

Parabolic trough solar collector, thermal enhancement, flow insert, multiple inserts, concentrating solar collector

1. Introduction

Solar energy utilization is a promising choice for facing numerous environmental problems as fossil fuel depletion, energy demand increase and global warming [1-3]. Concentrating solar collectors are able to produce useful heat in medium and high-temperature levels. So, they can be used in a great variety of applications such as solar cooling, refrigeration, desalination, industrial heating, chemical processes, methanol reforming and of course electricity production [4-5].

Parabolic trough collector (PTC) is one of the mature and widespread solar concentrating technologies [6-7]. A typical solar field with PTC has to be about 2000 m^2 in order to produce useful heat of 1 MW. A lot of research has been focused on its performance enhancement in order to produce higher amounts of useful heat and to create compact systems with lower land utilization. In this direction, a lot of research has been focused on thermal enhancement techniques which can increase the useful heat production. These techniques mainly aim to increase the heat transfer coefficient