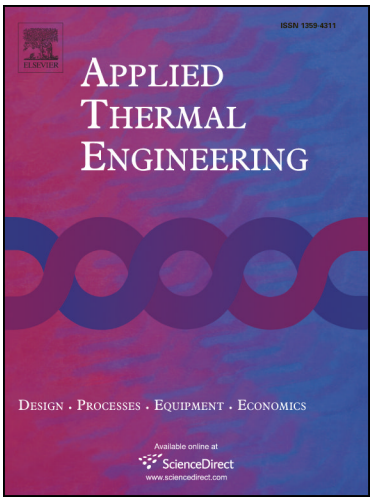

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Thermal and exergy performance of a nanofluid-based solar dish collector with spiral cavity receiver

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Abstract

The objective of this work is to investigate the use of nanofluids in a solar dish collector with spiral cavity absorber. The examined solar collector has total aperture 10.29 m^2 and the concentration ratio is 28.46. The analysis is conducted with a developed numerical thermal model which is validated with experimental results. Four different water-based nanofluids are investigated with the following nanoparticles: Cu, CuO, TiO_2 and Al_2O_3. The collector performance is examined for different nanoparticle concentration, flow rate and inlet temperature. The analysis is performed using the energy, exergy and entropy generation criteria. According to the final results, the use of Al_2O_3 is the best choice thermally, while the use of CuO is the choice exergetically. Generally, the exergetic efficiency of the collector is found to be close to 10%, while the thermal efficiency is close to the 35% due to the relatively high optical losses. Moreover, it is found that the pumping work of this collector is extremely low and the Bejan number is approximately close to 1. The results of this work can be exploited for selecting the proper water-based nanofluid for solar dish collectors with thermal and exergy criteria, as well as for determining the impact of various parameters in the system performance.

Keywords

Exergy analysis, Thermal analysis, Solar dish collector, Nanofluids, Spiral cavity receiver

1. Introduction

Solar energy utilization is one of the most promising ways for facing the huge worldwide problems in the domain of energy production and management. The climate change, the fossil fuel depletion, the increasing price of electricity and the increasing trends in energy consumption are the main problems [1-2] which can be partially faced by the exploitation of the renewable energy sources, as solar energy [3].