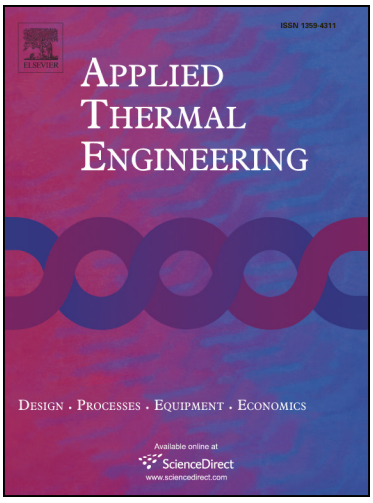

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Experimental analysis of heat transfer in spiral coils using nanofluids and coil geometry change in a solar system

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Abstract

Thermal coils have been extensively used as heat exchanger in many industrial and air-conditioning systems. The present study experimentally investigated three different geometries of thermal coils, including cylindrical spiral, conical spiral and conical-cylindrical spiral coils as well as working fluids water and MWCNT, CuO and TiO_2 nanoparticles. The effects of coil geometry and working fluid on the coil performance were evaluated. The working fluid in nanoparticles was 70:30 volumetric mixture of water and propylene glycol. Surfactant was used for more dispersion of nanoparticles in solution, and concentration of nanoparticles in all states was stable and equal to 0.1% of volume and that of surfactant was 0.1% of mass. To evaluate the performance of thermal coils, an evacuated heat pipe solar cycle was used, and the effect of thermal coil on the performance of collector was investigated. Validation of the obtained results showed a good match between experimental findings and empirical relations of other researchers. Results showed a better performance for the working fluids with higher thermal conductivity during the day; and use of CuO, TiO2 and MWCNT nanofluids in the base fluid, compared to water, increased the coil heat transfer by 39%, 25% and 53%, respectively. Considering the Nusselt number, conical-cylindrical spiral coil was thermally superior to the other two geometries, and use of conical-cylindrical spiral coil and conical spiral coil enhanced the efficiency of system by 17.1 % and 5.7 %, respectively in comparison with cylindrical spiral coil.

Keywords: Spiral thermal coil, solar collector, nanofluid, surfactant, nusselt number

1. Introduction

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