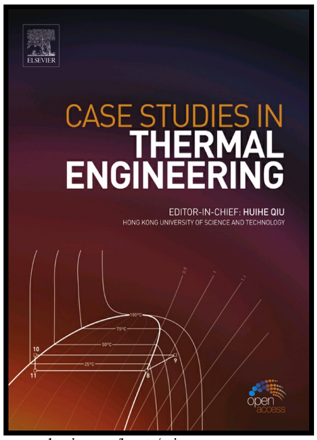

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Thermal and hydraulic characteristics of turbulent nanofluids flow in trapezoidal-corrugated channel: Symmetry and zigzag shaped

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Abstract

Thermal and hydraulic characteristics of turbulent nanofluids flow in a trapezoidal-corrugated channel are numerically investigated by implementing the finite volume method to solve the governing equations. The adiabatic condition for the straight walls, constant heat flux for the corrugated walls, and two configurations of trapezoidal channel symmetry and zigzag shape were examined. The performance of a trapezoidal-corrugated channel with four different kinds of nanofluids (ZnO, Al_2O_3, CuO, and SiO_2), with four various nanoparticle volume fractions of 2%, 4 %, 6% and 8% using water as base fluid is thoroughly analyzed and discussed. The nanoparticles diameter, another parameter is taken into consideration, varied from 20 to 80 nm. Results show that the symmetry profile of trapezoidal-corrugated channel has a great effect on the thermal performance compared with a straight profile and zigzag profile. The Nusselt number dropped as the nanoparticle diameter grew; however, it grew as the nanoparticle volume fraction and Reynolds number dropped. The best improvement in heat transfer among the nanofluids types was by SiO2-water. The present investigation uncovers that these trapezoidal symmetry-corrugated channels have favorable circumstances by utilizing nanofluids and in this manner fill in as a promising contender for incorporation in more compact heat exchanger devices.

Keywords: Heat transfer enhancement; Turbulent flow; Trapezoidal-corrugated channel; Nanofluids; Symmetry profile.

1. Introduction

In recent years, many industries have a strong need to achieve higher thermal performance in order to gain high efficiency, reduce the cost and weight, and minimize the size of heat exchangers. Use of corrugated channels can decrease the thermal resistance where its acts to reduce the thermal boundary layer thickness of the heat exchanger surface. Therefore, corrugated surface geometry is one of the numerous appropriate procedures to upgrade the heat transfer in these devices due to the appearance of the secondary flow regions in the trough of the corrugated channel which leads to improve the blending of the fluid and consequently maximize the heat transfer exchange.

On the coolant side, the poor thermal conductivity of the conventional fluid is the main impediment to improve the efficiency of heat exchangers. In order to cope with these limitations, the introduction of nanoparticles in a conventional fluid can be considered to jack up heat transfer abilities of these fluids. The component that produces (nanofluids) will have improved heat transfer capabilities, even with a small particle percentage. Many studies have detected that