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Heat Transfer and Fluid Flow of TiO_2 Nanofluids in a Compact Heat Exchanger

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Extended Abstract

With the advancement of industries, higher energy efficiency becomes one of the most important targets for researchers, leading to the development of compact devices and working with new thermal fluids for better performance. However, the need to intensify the heat transfer process for cooling process in compact scales of heat exchangers led to use a new class of thermal fluid called nanofluids produced by dispersing nanoparticles into a conventional thermal fluid [1]. So far, numbers of investigations have been caried on the advanced thermophysical properties of nanofluids [2] as well as for the possible applications of nanofluids in cooling and heating systems for the wide usages in industry [3]. They show a good performance of using nanofluids in several heat transfer applications [4]. Nevertheless, using nanofluids may cause some problems such as corrosion, particles sedimentation and increase the pressure drop which needs more investigations for each nanofluid type [5-6]. Therefore, this study reports experimental investigations on the heat transfer performance and energy efficiency of TiO_2 nanofluids in a compact plate heat exchanger (CPHE). Several low concentrations (0.01-0.2 vol.%) of TiO_2 nanoparticles were selected to prepare the nanofluid samples using distilled water and ethylene glycol mixtures. The samples' stability and thermophysical properties, namely thermal conductivity and viscosity were measured. Maximum thermal conductivity enhancements of 4.4% and maximum viscosity enhancements around 8.0% were found for TiO_2 nanofluids. The heat transfer coefficient and pressure drop, and energy efficiency coefficient were determined for the nanofluids and base fluids employed in CPHE. Measurements were performed at different flowrates for the nanofluids flowing in the hot loop of the heat exchanger and their performance was evaluated in comparison with the base fluid. The results indicated a heat transfer enhancement for all particle concentrations. The maximum enhancement of EG/DW (15/85)-based nanofluids was 13.7% at 0.2 vol.% concentration of TiO_2. The increase in pressure drop is noticed up to 6.2 % at the particles' concentration of 0.2 vol.% in comparison with the base fluids. A considerable increase in energy efficiency was observed for the investigated nanofluids.

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