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Propylene Glycol:Water-Based Nanofiber And Spherical Ag Nanofluids As Advanced Working Fluids

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Extended Abstract

Greenhouse gas emissions, especially those of carbon dioxide (CO_2), are considered one of the main causes of climate change and have become one of the most important environmental problems worldwide. Carbon dioxide has been the main source of extreme environmental pollution and has detrimental consequences on human life, regardless of whether the economy is developed [1]. In this regard, heat transfer plays a key role for both industrial and domestic processes. Improving the efficiency of heat exchangers can result in lower energy consumption and therefore a reduction in CO_2 emissions. An interesting way to improve the efficiency of heat exchangers is through the use of nano-enhanced thermal fluids, also termed nanofluids [2]. These materials are based on dispersions of nanoparticles in a base fluid and are characterized by exhibiting superior thermal properties such as the thermal conductivity [3].

This study presents the thermophysical properties of nanofluids based on a mixture of propylene glycol:water (PG:W) with a mass ratio 20:80. The selected nanoadditives were silver nanoparticles with two shapes: nanofibers of 30–50 nm wide (AgNF) and spherical nanoparticles (AgNP) with a diameter of 25–50 nm. There were designed two 0.10 wt.% mono nanofluids (with AgNF and AgNP) and a 0.10 wt.% hybrid nanofluid (with a AgNF:AgNP mixture at 1:1 mass ratio). In order to check the temporal stability of the dispersions, the hydrodynamic size of the colloids have been observed through dynamic light scattering under static conditions and also after shaking it for 30 s before taking measurements. The results showed good stability of the dispersions after 30 days. Isobaric heat capacity and density were determined through temperature modulated heat differential scanning calorimetry and vibrating U-tube, respectively. Thermal conductivity was studied by the transient hot wire technique in the temperature range from 283 to 333 K with average increases of 8% for the 0.10 wt.% AgNF nanofluid (the highest increase between those analyzed). The rheological behavior was analyzed by rotational rheometry between 283 and 323 K. The designed dispersions preserve the Newtonian behavior of the base fluid and the average viscosities show slight increases with respect to the base fluid. As an example, these increases reach 0.9% for the 0.10 wt.% AgNF:AgNP hybrid nanofluid.

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