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Full Length Research Paper

The effect of magnetic field and nanofluid on thermal performance of two-phase closed thermosyphon (TPCT)

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The efficiency of two-phase closed thermosyphon (TPCT) with nanofluid as working fluid under magnetic field effect was investigated experimentally. In this study, silver/water nanofluid with different concentration (20 to 80ppm) is tested. Also, magnetic field with various strength (0.12, 0.35 and 1.2 T) exerted to TPCT by permanent magnet. It was seen that the TPCT heat transfer performance and the thermophysical properties of the base fluid are considerably affected by the nanoparticles addition and magnetic field. According to the experimental result, the thermal efficiency of thermosyphon significantly increased with the nanoparticles concentration increasing as well as magnetic field strength, and the TPCT shows better performance in the highest value of concentration (80 ppm) and magnetic field (1.2 T). Moreover, the experimental results represent that thermal efficiency in the presence of magnetic field somewhat increases.

Key words: Silver/water nanofluid, permanent magnet, two phase closed thermosyphon, thermal efficiency, heat transfer enhancement, magnetic field.

INTRODUCTION

The new technological developments as well as the industrial process intensification have made the need for more efficient heat exchanging systems a contemporary demand. Therefore, the scientific interest is focused both on improving the equipment design and on enhancing the thermal capability of the working fluids. Most commonly used working fluids in heat exchangers are water, methanol, ethylene glycol and oil which are originally poor heat transferring fluids. Numerous techniques have been introduced to improve the thermal performance of these fluids. Consequently, fluids with nanosized particles suspended in them which are later called nanofluids have been proposed by Choi (1995). Nanofluids are also well known in production of nanostructured materials (Tseng and Wu, 2002), engineering of complex fluids (Tohver et al., 2001) as well as enhancement of wetting and spreading behavior (Wasan and Nicolov, 2003).

Kim et al. (2006) investigated the effects of thermo-diffusion and nanoparticles on convective instabilities in binary nanofluids, and indicated that the Soret effect of solute that dissolved in binary nanofluids makes binary nanofluids unstable. Also, from their results, it can be found that the heat transfer enhancement by the Soret effect in binary nanofluids is more significant than that in normal nanofluids. Kang et al. (2006) investigated the thermal conductivities of silica, silver and ultra-dispersed diamond (UDD) nanoparticles suspension. The experimental results show that thermal conductivity enhancement was up to 70% for the best case of 1% UDD in ethylene glycol. In order to estimate the exact thermal conductivity, they used the effective particle volume fraction which was estimated by the measurement of viscosity. Their results show that heat transfer mechanisms, such as phonon transport in the solid/liquid interface and electron transport, must be considered to estimate the exact thermal conductivity of nanofluid. The mechanism of heat transfer intensification, recently brought about by

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