Effects of a Nanofluid and Magnetic Field on the Thermal Efficiency of a Two-Phase Closed Thermosyphon

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Heat transfer of a CuO/water nanofluid in a two-phase closed thermosyphon (TPCT) that is thermally enhanced by a magnetic field has been predicted by an optimized artificial neural network (ANN). The magnetic field strength, volume fraction of nanoparticles in water, and inlet power were used as input parameters and the thermal efficiency was used as the output parameters. The correlation coefficient (R^2 = 0.924), mean square error (MSE = 0.000340231), mean absolute error (MAE = 0.012410941), and normalized mean-squared error (NMSE = 0.112417498) between the measured and predicted thermal efficiency by the ANN model were developed. The results were compared with experimental data and it was found that the thermal efficiency estimated by the multi-layer perception neural network is accurate. In this study, a new approach for the auto-design of neural networks, based on a genetic algorithm, has been used to predict collection output of a TPCT. Heat Trans Asian Res, 42(7): 630–650, 2013; Published online 11 August 2013 in Wiley Online Library (wileyonlinelibrary.com/journal/htj). DOI 10.1002/htj.21043

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1. Introduction

A nanofluid is an emerging type of fluid in which nano-sized particles (typically less than 100 nm) are suspended in liquid. Researchers have observed that the thermal conductivity of nanofluid is much higher than the base fluids even for low volume fraction of nanoparticles in the mixture [1, 2]. The nanofluid is stable, introduces very little pressure drop, and it can pass through nanochannels [3]. Das et al. [4] observed that the thermal conductivity for a nanofluid increases with increasing temperature. Theofanous et al. [5, 6] studied the thermal patterns on nanoscopically smooth surfaces and found nano-scale imperfections and defects present on the heater are sufficient to initiate heterogeneous nucleation. Vemuri and Kim [7] investigated the advantages of a nano-sized surface structure in pool boiling of the working fluid FC-72, while Kang [8] studied effects of surface roughness on pool boiling heat transfer.

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