World Academy of Science, Engineering and Technology
International Journal of Mechanical and Mechatronics Engineering
Vol:11, No:6, 2017

Two Dimensional Steady State Modeling of Temperature Profile and Heat Transfer of Electrohydrodynamically Enhanced Micro Heat Pipe

Authors : H. Shokouhmand, M. Tajerian

Abstract : A numerical investigation of laminar forced convection flows through a square cross section micro heat pipe by applying electrohydrodynamic (EHD) field has been studied. In the present study, pentane is selected as working fluid. Temperature and velocity profiles and heat transfer enhancement in the micro heat pipe by using EHD field at the two-dimensional and single phase fluid flow in steady state regime have been numerically calculated. At this model, only Coulomb force is considered. The study has been carried out for the Reynolds number 10 to 100 and EHD force field up to 8 KV. Coupled, non-linear equations governed on the model (continuity, momentum, and energy equations) have been solved simultaneously by CFD numerical methods. Steady state behavior of affecting parameters, e.g. friction factor, average temperature, Nusselt number and heat transfer enhancement criteria, have been evaluated. It has been observed that by increasing Reynolds number, the effect of EHD force became more significant and for smaller Reynolds numbers the rate of heat transfer enhancement criteria is increased. By obtaining and plotting the mentioned parameters, it has been shown that the EHD field enhances the heat transfer process. The numerical results show that by increasing EHD force field the absolute value of Nusselt number and friction factor increases and average temperature of fluid flow decreases. But the increasing rate of Nusselt number is greater than increasing value of friction factor, which makes applying EHD force field for heat transfer enhancement in micro heat pipes acceptable and applicable. The numerical results of model are in good agreement with the experimental results available in the literature.

Keywords : micro heat pipe, electrohydrodynamic force, Nusselt number, average temperature, friction factor
Conference Title : ICFMHTT 2017 : International Conference on Fluid Mechanics, Heat Transfer and Thermodynamics
Conference Location : London, United Kingdom
Conference Dates : June 28-29, 2017