An investigation to evaluate the influence of Al_2O_3 nanoparticles on thermal performance of oscillating heat pipe using Box–Behnken design method

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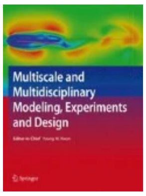

Multiscale and Multidisciplinary Modeling, Experiments and Design

Aims and scope

Submit manuscript

M. Prashanth, D. Madhu, K. Ramanarasimh & R. Suresh

Abstract

Heat pipes with conventional fluids have been effectively used in the last 3 decades for thermal management of a variety of engineering applications such as economizers, heat exchangers and electronics cooling. However, rapid growth of industrial automation and electric vehicle (EV), thermal management in electronics and battery system faces lot of challenges for cooling the devices due to more heat demand from condensed and compact electronic devices. The present investigation aims to analyze the effect of different wt% of Al_2O_3 nanofluids, fill ratio and heat input on thermal performance of Oscillating Heat Pipe (OHP) system were investigated using Response Surface methodology (RSM). The responses like Heat Transfer Coefficient (HTC) and thermal resistance were analyzed using ANOVA analysis, main effects plots and surface plots. Also, the experimental results were correlated with regression models. The obtained results indicated that the highest influence factors are heat input and fill ratio, while least is wt% of Al_2O_3 nanofluids. The lower thermal resistance of 1.1447 °C/W and higher heat transfer coefficient of 283.18 W/m^2 °C were obtained at fill ratio of 80% and heat input of 35W and 2% of Al_2O_3 nanoparticles. The predicted results represent the RSM model has realistic level of accuracy in its capability to define the thermal performance of the OHP system.

Abbreviations

Q: Heat input (W)

Tc: Condenser temperature (°C)

Te: Evaporator temperature (°C)

A: Area of condenser ($\pi \times d \times L_C$) (m^2)

Lc: Length of the condenser (m)

d: Tube diameter (m)

h: Heat transfer coefficient (W/m^2 °C)

R: Thermal resistance (°C/W)

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Contributions

MP is conducted the experimental part and manuscript preparation. DM is supported for conduction of experimentation and manuscript preperation. KR is advised to selection of process parameters and technical writing support. RS is develop the optimization and analysis of the results.

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Ethics declarations

Conflict of interest

The authors claim to be unaware of any financial or personal ties that may have affected their study.

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- Thermal resistance