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Assessment and Prediction of Heat Transfer Performance of Oscillating Heat Pipe using Acetone

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ABSTRACT

Heat pipe is a device to enhance the performance of heat transfer, in particular to transition phase change process. The present investigation is carried out to measure the thermal performance of a closed loop acetone filled oscillating heat pipe with four turns is fabricated and tested. The test was carried out for the inner diameter of 1.7 mm copper tube by varying the acetone of 50%, 60%, 70% and 80% filler ratio with a heat input of 15 W to 40 W in steps of 5 W has been considered. The results shows that 80% acetone filled OHP provides the better thermal performance with an average minimum temperature difference between condenser and evaporator by 6.03%, heat transfer coefficient increased by 77% and the thermal resistance decrease by 43% respectively. The mathematical modelling was developed to predict the performance of the heat transfer. The model clearly shows that the independent variables are statistically significant with a p-value of 0.05 and the uncertainty analysis between the experimental and predicted values are less than 10%.

1. Introduction

In heat pipes, pulsating heat pipe was the promising device for the heat transportation in heat transfer unit. Therefore, micro-grooved OHP is one of the effective modes to evaluate the performance heat transfer of the system. This device would enhance the allowable input heat flux by condensate the backflow to the evaporator when the filling ratio ranging from 30% to 60% [1]. Due to increase in filling ratio, heat added to the evaporator section leads to increase in temperature and pressure during the flow process. Therefore, filler ratio was the major part to increase the heat input for the oscillation motion of the working fluid [2]. To heat the oscillating pipe many methods was applied in the evaporator section. There was a pulsed supply with regulated current method was used to heat the system. This method generates a large amplitude oscillation to heat up for a short period of time [3]. To increase the heat transfer mechanisms of oscillating pipe a mathematical model

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