IX Minsk International Seminar "Heat Pipes, Heat Pumps, Refrigerators, Power Sources",
Minsk, Belarus, 07-10 September, 2015

A SIMPLE MATHEMATICAL MODEL TO PREDICT HEAT PIPE MAXIMUM HEAT TRANSFER, EQUIVALENT THERMAL CONDUCTIVITY AND THERMAL RESISTANCE

Masataka Mochizuki*, Thang Nguyen, Yuji Saito, Tien Nguyen,and Mohammad ShahedAhamed
Fujikura Ltd.
1-5-1, Kiba, Koto-Ku,Tokyo 135, Japan
Tel. 81-3-5606-1174
Fax. 81-3-5606-1514
Email: mmotizuk@fujikura.co.jp

Abstract

The objective of this study is to provide a simple mathematical model to predict the performance of the heat pipe such as - the maximum heat transfer, the equivalent thermal conductivity and the thermal resistance based on the experiences of industrial products.The maximum heat transfer calculation is based on the maximum capillary force provided by the wick against the total pressure drop associated in the heat pipe.The calculation for the capillary force of the wick and pressure drop in heat pipe are based on traditional pressure drop formulae for vapor and liquid flow.For heat pipe thermal resistance calculation, a new proposal of an additional parameter function $f(L_{eff})$ which accounts for the vaporand fluid flow pressure drop dependent on the heat pipe length. This function dictates that the thermal resistance of heat pipe increases when heat pipe length increases. If without this additional function, the heat pipe thermal resistance would remain constant regardless of heat pipe length, and this assumption could be incorrect.

Analysis results showed that the maximum heat transfer and thermal conductance (inverse of thermal resistance) of heat pipe decreases with heat pipe length increases. The correspondence equivalent thermal conductivity increases with heat pipe length increases in the maximum heat transfer limit range. Theoretical calculation will be validated against experimental results and are discussed in this paper. Equivalent thermal conductivity of a heat pipe is very useful for CFD software input.