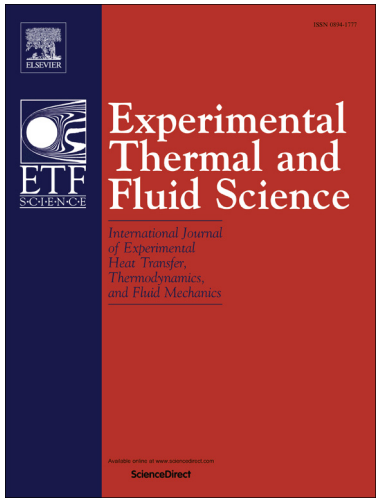

Experimental Investigation of Thermal Performance of Metal Foam Wicked Flat Heat Pipe

D. Somasundaram, A. Mani, M. Kamaraj

PII: S0894-1777(16)30362-4
DOI: http://dx.doi.org/10.1016/j.expthermflusci.2016.12.006
Reference: ETF 8968

To appear in: *Experimental Thermal and Fluid Science*

Received Date: 17 November 2015
Revised Date: 7 December 2016
Accepted Date: 8 December 2016

Please cite this article as: D. Somasundaram, A. Mani, M. Kamaraj, Experimental Investigation of Thermal Performance of Metal Foam Wicked Flat Heat Pipe, *Experimental Thermal and Fluid Science* (2016), doi: http://dx.doi.org/10.1016/j.expthermflusci.2016.12.006

Experimental Investigation of Thermal Performance of Metal Foam Wicked Flat Heat Pipe

D. Somasundaram [a,*], A. Mani [a], M. Kamaraj[b]

[a]Refrigeration and Air-conditioning Laboratory, Department of Mechanical Engineering,

[b] Department of Metallurgical and Materials Engineering,

Indian Institute of Technology Madras, Chennai 600036, India.

Abstract

Experimental investigations of thermal performance of a flat heat pipe (FHP) with and without wick columns were investigated. Copper metal foam fabricated by lost carbonate sintering process and characterized by Scanning Electron Microscope (SEM) was used as wick structure. The effect of heat input, cooling water flow rate, cooling water temperature and fill ratio on the thermal response of the FHP is presented. Results showed that the heat transfer coefficient increases with increased Reynolds number and cooling water temperature but decreases with increased heat input and amount of fill ratio. It was found that increasing the wick volume by inserting additional wick columns improves the FHP performance, due to the decreased thermal resistance with increased fluid movement in these additional wick columns. The experimental results were compared with that of analytical calculations at steady state and a good agreement was observed between them.

Key words: Flat heat pipe; Copper foam; Wick columns (WC); Evaporator; Condenser;

Nomenclature

A	area, m^2
C	specific heat, J/ (kg K)
h	convection heat transfer coefficient, W/ (m^2 K)
H	height of flat heat pipe, m
k	thermal conductivity, W/(m K)
L	length of flat heat pipe, m
Q_e	heat transfer rate, W
Re	Reynolds number ($R_e = \frac{\rho v L}{\mu}$)
R_t	total thermal resistance (^oC/W)
T	temperature, K
V	velocity of fluid, m/s
W	width of flat heat pipe, m
x	axial direction, m
y	height direction, m

Greek symbols

φ	Porosity
μ	Viscosity, Pa s
ρ	Density, kg/m^3
σ	Surface tension, N/m
θ	Wetting angle

Subscripts

a	adiabatic

*Corresponding author: Tel.: +91 44 2257 4666; fax: +91 44 2257 4652

E-mail addresses: soms.iitm@gmail.com, mania@iitm.ac.in, kamaraj@iitm.ac.in,