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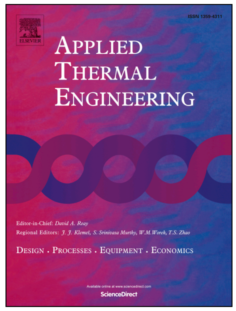

Microtomography-Based Numerical Simulation of Fluid Flow and Heat Transfer in Open Cell Metal Foams

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PII: S1359-4311(15)00059-9

DOI: 10.1016/j.applthermaleng.2015.01.045

Reference: ATE 6314

To appear in: *Applied Thermal Engineering*

Received Date: 30 October 2014

Revised Date: 13 January 2015

Accepted Date: 17 January 2015

Microtomography-Based Numerical Simulation of Fluid Flow and Heat Transfer in Open Cell Metal Foams

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Abstract

Engineering design of foams employed for specific applications such as heat exchangers entails adequate understanding of their behavior, regarding thermal and hydrodynamic characteristics, which proves to be a serious challenge for the researchers at present. The present paper intends to shed light on the complexity of realistically simulating heat transfer in a porous medium, by performing a 3-D simulation of heat transfer in open-cell metal foams having 85-95 percentage of porosity. A salient feature of the present simulation is the use of microtomography images as the solid model for mesh generation. Results show that the presence of an intense thermal gradient at the air inlet of the foam brings about density changes in the inlet region, causing airflow acceleration up to 1.7 times the inlet velocity. Moreover, this phenomenon establishes thermal equilibrium between air and the solid over a relatively short length of the porous medium. In all the simulated cases, the coefficients of linear (α) and non-linear (β) terms of the pressure drop equation, the effective thermal conductivity (k_{eff}) and the local convection heat transfer (h_l) are found to be heavily dependent on the percentage of the porosity and the geometric characteristics of the porous medium. Comparison of some of the numerical results with the available experimental data shows reasonably good agreement. Based on the numerical results, a correlation for the mean Nusselt number was obtained in terms of parameters such as the percentage of porosity and

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