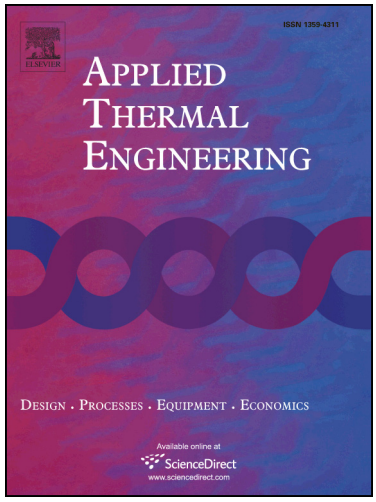

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The Effect of Open-Cell Metal Foams Strut Shape on Convection Heat Transfer and Pressure Drop

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Abstract

Metal foams are promising materials for applications where enhancement of heat transfer is needed. Their performance depends on morphological parameters, such as the diameters of cells, pores, and struts, the porosity, the shape of struts.

The effect of strut shape on convection heat transfer and pressure drop in open-cell metal foams has been investigated numerically in this paper by introducing the foam shape factor, a parameter that characterizes the shape of the strut. The analysis has been carried out both on real and ideal foams. The geometry of three 40 Pores Per Inch (PPI) real foams, with 0.87, 0.94 and 0.96 average measured porosities, was determined with X-ray Computed Microtomography (XCT) and a morphological analysis of the XCT data was carried out. The geometry of the ideal foams, based on the Lord Kelvin foam model, with the same PPI and porosities as those of the real foams, was generated with the free-to-use software Surface Evolver, building up foams with different strut shapes. Governing equations have been solved with a finite element scheme, assuming a uniform heat flux condition at the solid/fluid boundary of the foam.

Results are presented in terms of convection heat transfer coefficients and pressure distributions as a function of strut shape parameters. The comparison between predictions for ideal and real foams, for different strut shapes, confirms that, in all cases, the closer the form of the ideal strut to that of the real strut the better the agreement among predictions. It is also pointed out that the convection heat transfer coefficient is maximized when, at equal porosity, the ligament shape is convex, while a concave strut shape maximizes the pressure drop.

Keywords: Metal foams, Convection heat transfer, Pressure drop, Strut shape effect.

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