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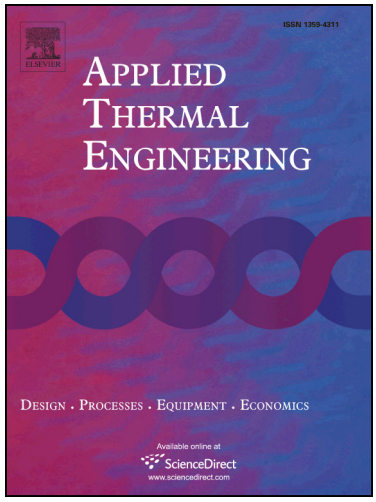

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Effect of Perforation Shape and Porosity on Effective Thermal Conductivity of Matrix Heat Exchanger Plates

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Abstract

The effective thermal conductivity of a matrix heat exchanger plate is used to determine the heat transfer characteristics of the matrix exchanger in transient testing methods. In this paper, the influence of two parameters namely porosity, which is an indication of the void space and perforation shape, which is the geometry of the void, on effective thermal conductivity is analysed numerically and experimentally. The perforated copper plates of square, rhomboidal, rectangular and circular shapes of different porosities are used. A new parameter called perforation coefficient which generalises the different perforation shapes is coined. Correlations are developed using regression analysis to understand the effect of these parameters on effective thermal conductivity.

Keywords: Effective thermal conductivity; Matrix heat exchanger plates; Correlations; Perforation coefficient; Porosity; Numerical analysis; Experimental Analysis; Design and Manufacturing.

1. Introduction

The matrix heat exchangers [1] are high effectiveness heat exchangers used in cryogenic applications. Its increased effectiveness is due to the increased surface area of perforations and decrease in axial conduction due to alternate stacking of low thermal conductivity stainless steel spacers. Heat transfer characteristics of matrix heat exchangers are obtained by conducting single blow transient test [2]. The result of the test along with the effective thermal conductivity is used to calculate the effectiveness of the heat exchanger. Thus determination of effective thermal conductivity of the perforated plates is important. The plates can be made with different shapes of perforation and with different porosities. Thus the perforation shape and porosity become important influencing parameters. Porosity is the ratio of volume of the void spaces to the total volume of the plate.

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