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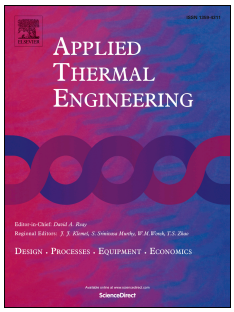

Correlation Studies of Hydrodynamics and Heat Transfer in Metal Foam Heat Exchangers

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Correlation Studies of Hydrodynamics and Heat Transfer in Metal Foam Heat Exchangers

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Abstract

This study presents the correlations of both hydrodynamics and heat transfer in a metal foam heat exchanger. The present work is focused on the application to dry cooling such as air-cooled condensers (ACCs). In particular empirical correlations for the permeability, form drag coefficient, friction factor, and the overall heat transfer coefficient for different samples of metallic foam have been validated and verified with available experimental data and numerical simulations. The modified correlations used in this study are established through the validation & verification studies of metal foam heat exchangers. In order to address the difference, finned tube heat exchangers are used to compare to the metal foam heat exchangers with the same geometry size and layout. For fully wrapped metal foam heat exchangers, the prediction using empirical correlation is consistent with computational fluid dynamics (CFD) simulations. However, the scenarios become complicated for partially wrapped metal foam heat exchangers. The numerical results show that there is an optimal choice of the porosity of metal foam in which the wall heat transfer coefficient and pressure drop reach the design goal. Overall, the heat transfer capability of metal foam heat exchangers can supersede conventional compact heat exchangers given optimal scenario.

Key words: metal foam, metallic foam, dry cooling, air-cooled condenser, porous medium, Darcy-Forchheimer model

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