Numerical Analysis of Heat Transfer Performance of Jet Impingement on a plate with Attached Porous Medium

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ABSTRACT

Jet impinging is an important cooling/heat transfer technique in the industries, such as industrial drying, metal and glass annealing, secondary cooling in iron casting, laser cooling, plasma cutting cooling, gas turbine blade cooling, and cooling of microelectronics. Nowadays, enhancement techniques for jet impingement heat transfer are still under intense investigation by academic researchers. In this numerical study, jet impingement on a bare flate plate was used as a basic case, and the heat transfer enhancement of jet impingement on a flate plate with attached porous medium with or without a center hole was investigated. The effects of the porous medium geometry and properties on heat transfer were also examined. Appropriate numerical models were firstly determined by comparing the computational results with various models with existing numerical and experimental data in the literature. The appropriate models were then employed in the computation for the geometries used in this study. Computational results show that an attached porous medium with a center hole can effectively enhance jet impingement heat transfer. On the other hand, an attached porous medium without a center hole has detrimental effect. In addition, the center hole geometry and permeability have the most influential effects. The best center hole geometry should allow flow to effectively penetrate into porous medium for heat exchange. Permeability should be higher at low porosity and lower at high porosity for better heat transfer.

Keywords : jet impingement, heat transfer enhancement, porous medium, center hole, porosity, permeability

Table of Contents

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