Experimental Investigation of Heat Transfer Enhancement of Jet Impingement on a Plate Attached by a Porous Medium with a

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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 study, the jet impingement heat transfer on a target plate covered with porous medium with or without a center hole is experimentally investigated using the transient liquid crystal technique. Based on the results from jet impingement on a bare flat plate, the enhancement in heat transfer due to the addition of porous material is evaluated. The validity of the experimental system constructed for this research was confirmed first by comparing the experimental data of impingement on a flat plate at similar conditions in the literature. The system and the data reduction procedure were then applied to the experimental cases with the flat plate covered with a thick layer of porous medium. Experimental results show that the addition of the porous material with a center hole can effectively enhance the jet impingement heat transfer over a flat plate. The addition of the thick porous layer without a center hole, however, gave rise to adverse effect in jet impingement heat transfer. In addition, the geometry of the center hole of the porous layer has deterministic influence on heat transfer performance. An optimal center-hole geometry will allow fluid to effectively penetrate into the porous medium for heat exchange.

Keywords : jet impingement heat transfer, heat transfer enhancement, porous Material, center hole

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