Transient Liquid Crystal Measurement of Heat Transfer Coefficient in Corrugated Plate Channels with Sine Wave Cross Sect

張嘉宏、吳佩學

E-mail: 9419527@mail.dyu.edu.tw

ABSTRACT

Corrugated plate channels have many applications. The most typical application in heat transfer enhancement is in the form of a plate heat exchanger, which is nowadays widely applied in the dairy, foodstuff, biochemical, chemical and allied industries. In the past, almost all the experimental and analytical studies related to heat exchangers were focused on total pressure drop and overall heat transfer coefficient. Although very few authors numerically investigated fluid flow and heat transfer in corrugated plate channels, they only had overall performance data for comparison and quite often the numerical predictions disagree a lot with experiments. Detailed local heat transfer coefficient distribution measurement data for such channels is so far not available in the public literature. In this study, the distribution of local heat transfer coefficient and the pressure drops along a corrugated plate channel were experimentally investigated. In all the experimental runs, the cross sectional geometry and the inclination angle of the channel were fixed, while the Reynolds number of the air flow was varied. The whole wall-surface heat transfer coefficient distribution from the entrance to the exit of the channel was measured with the transient liquid crystal technique. Results show that the local Nusselt number reaches a fully developed status after 5 to 6 pitches from the entrance. The local Nusselt number distributions on the upper and the lower walls were not the same due to different inclination angles of the corrugation with respect to the flow direction. The Nusselt number near the exit tends to decrease, possibly due to outflow conditions.

Keywords : plate heat exchanger, corrugated angle, transient liquid crystal technique, local heat transfer coefficient

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