A review of heat transfer enhancement techniques in plate heat exchangers

Plate heat exchangers have been widely applied in numerous industrial applications since their first commercial exploitation in the 1920s. Enhancing the thermal-hydraulic performance of plate heat exchangers is of crucial importance for the energy conversion as well as for the improvement of the system economy, through savings in the capital investment. The efficiency of a plate heat exchanger can be improved either by optimizing its geometry or using heat transfer enhancement techniques. This paper provides a comprehensive review of previous works regarding the effects of chevron corrugation geometrical parameters on the performance of plate heat exchangers, and the application of heat transfer enhancement techniques in plate heat exchangers, focusing on passive surface techniques and the use of nanofluids. The objective of the paper is not only to describe relevant studies, but also to provide an understanding of the heat transfer mechanisms governing the results, and to evaluate and compare the different heat transfer enhancement techniques. In addition, prospective directions for future research are provided. The review indicates that for the chevron-type plate heat exchanger, the chevron angle is the most influential geometrical parameter by changing the flow structures in the single-phase heat transfer; meanwhile the chevron angle has a significant influence on the heat transfer regions characterized by convection in the two-phase heat transfer. An analysis based on the performance evaluation criteria suggests that the thermal-hydraulic performances of the studies with different geometrical parameters and enhancement techniques are generally higher at low Reynolds numbers. Furthermore, the review and analysis indicate that the capsule-type embossing surface and the microstructured surface with a nano- and microporous layer are the enhancement techniques that present the highest performance in single-phase and two-phase heat transfer, respectively.

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