5th International Conference on Academic Research In
Science, Technology and Engineering

ICARSTE
03 - 05 November 2022
Vienna, Austria

Numerical Investigation of Heat Transfer Performance for Dimple-Shaped Fin-And-Tube Heat Exchanger

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Abstract

Fin-and-tube heat exchangers are used in refrigeration, heating, ventilation, and air-conditioning systems. In the heating and cooling system, because the heat exchangers are directly related to system performance, it is essential to investigate the performance improvement of the heat exchangers to cope with the strengthening of energy regulations. Recently, research on heat transfer enhancement has been focused on the enhancement of the secondary flow to improve air-side heat transfer performance. Generally, the methods of the improvement of air-side heat transfer are increasing the heat transfer coefficient and area. In the study, the air-side heat transfer performance of a fin-and-tube heat exchanger with dimple geometries is analyzed using numerical methods. As a result, the heat transfer coefficient of the heat exchanger applied to the dimple shapes is 4.2% higher than that of the baseline owing to the secondary flow around the dimple shapes. The Colburn j-factor of the heat exchanger with the dimple shapes is 4.2% higher than that of the baseline. The pressure drop of the heat exchanger with the dimple shapes increases by 9.2% to that of the baseline. Additionally, the thermal-hydraulic performance of the heat exchanger applied to the dimple shapes is higher than that of the baseline despite the high f-factor. Therefore, the heat exchanger with the dimple-shaped fins shows better heat exchange performance by having a high heat transfer coefficient despite the higher pressure drop than the heat exchanger with the flat fins.

Keywords: Air-side heat transfer, f-factor; Heat transfer coefficient, j-factor,Pressure drop