

Effect of Longitudinal Fins on Air-Flow Characteristics for Wing-Shaped Tubes in Cross Flow

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Abstract : A numerical study has been conducted to clarify fluid flow characteristics, pressure distributions, and skin friction coefficient over a wing-shaped tubes bundle in staggered arrangement with the placement of longitudinal fins (LF) at downstream position of the tube. The air-side Re_a were at 1.8×10^3 to 9.7×10^3 . The tubes bundle were employed with various fin height [hf] and fin thickness (δ) from ($2 \text{ mm} \leq hf \leq 12 \text{ mm}$) and ($1.5 \text{ mm} \leq \delta \leq 3.5 \text{ mm}$) respectively at the considered Re_a range. The flow pattern around the staggered wing-shaped tubes bundle was predicted using the commercial CFD FLUENT 6.3.26 software package. The distribution of average skin friction coefficient around wing-shaped tubes bundle is studied. Correlation of pressure drop coefficient P_{dc} and skin friction coefficient (Cf) in terms of Re_a , design parameters for the studied cases were presented. Results indicated that the values of P_{dc} for $hf = 6 \text{ mm}$ are lower than these of NOF and $hf = 2 \text{ mm}$ by about 11 % and 13 % respectively for considered Re_a range. Cf decreases as Re_a increases. LFTH with $hf = 6 \text{ mm}$ offers lower form drag than that with $hf = 12 \text{ mm}$ and that of NOF. The lowest values of the pumping power are achieved for arrangements of $hf = 6 \text{ mm}$ for the considered Re_a range. δ has negligible effect on skin friction coefficient, while has a slightly variation in ΔPa . The wing-shaped tubes bundle heat exchanger with $hf = 6 \text{ mm}$ has the lowest values of ΔPa , P_{dc} , Cf, and pumping power and hence the best performance comparing with the other bundles. Comparisons between the experimental and numerical results of the present study and those obtained by similar previous studies showed good agreements.

Keywords : longitudinal fins, skin friction, flow characteristics, FLUENT, wing-shaped tubes

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