EFFECTS OF RIB-CONFIGURATION ON THE THERMAL PERFORMANCE OF ONE-SIDED HEATED, RIB-ROUGHENED COOLING CHANNELS

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Detached-Eddy-Simulations (DES) were performed for investigating the thermal-hydraulics of a one-sided heated and rib-roughened cooling channel at Reynolds numbers ranging from $2.5 \cdot 10^4$ to $1.58 \cdot 10^5$. Heat transfer and flow characteristics for three different types of centrally positioned, transversally oriented rib-elements with a rib-height and rib-top-width of e and (a) 90 deg. edged, (b) 2 e radius round-edged or (c) 30 deg. inclined front- and rear-rib-surface haven been analyzed. The channel cross section was 15 e x 15 e with 2 e inside radiuses, the rib-pitch-to-rib-height-ratio was $p/e = 10$ and the rib-height-to-hydraulic-diameter-ratio was $e/D_h = 0.0638$. For all simulations, friction factors decrease and heat transfer coefficients increase for increasing Reynolds numbers. For varying rib-shapes, the averaged friction factor ratios differ up to 30 pct. and the Nusslet Numbers at the rib-roughened and the overall Nusselt Numbers differ up to 12 pct. and 8 pct., respectively. Maximum flow resistance and heat transfer occur for the 90 deg. edged rib-configuration. For all rib-shapes, the thermal performance factor (of increased heat conductance and equal pumping power) for cooling the rib-roughened wall decreases for increasing Reynolds numbers. Best thermal performance was obtained for the 90 deg. edged rib-configuration. Correlations for Nusselt number and average friction factor prediction were derived for the entire Reynolds number range.