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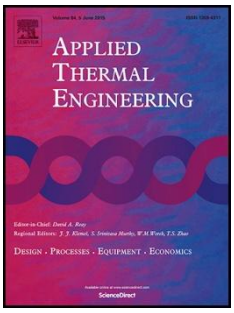

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Effects of Side Hole Position and Blowing Ratio on Sister Hole Film Cooling Performance in a Flat Plate

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Highlights

1. Sister hole film cooling performance is studied experimentally with TLC;
2. Side hole position can affect the sister hole film cooling effectiveness;
3. Flow structure and CRVP intensity are shown through numerical simulation;
4. CRVP intensity and coolant lift-off are reduced due to the presence of side hole

Abstract

Three kinds of sister hole and one single cylindrical hole were experimentally studied in order to analyze the effects of side hole position and blowing ratio on film cooling performance in a flat plate model by applying Thermochromic Liquid Crystal (TLC) technique. The blowing ratio varied from 0.3 to 2.5 and the density ratio of coolant to mainstream was 1.05. The Reynolds number based on the velocity of mainstream and the diameter of the main hole was fixed at 3400. Compared to the base hole, the film cooling performance of all sister holes showed obvious improvement at all blowing ratios. The middle stream sister hole and downstream sister hole each demonstrated good film cooling performance at all blowing ratios, while the upstream sister hole performs well only at a lower blowing ratio. A numerical calculation is also performed to better analyze the experimental results and determine the relationships among CRVP intensity, flow structure, and film cooling effectiveness at a low blowing ratio of M=0.5 and high blowing ratio of M=2.0. The presence of side holes can restrain the CRVP