Abstract

In the present research work, the flow of a dual jet consisting of a wall jet and an offset jet is numerically simulated using two-dimensional unsteady RANS equations. When the separation distance between the two jets (d) is varied in the range 0.7$\leq d/w \leq$2.1, w being the jet width, the near flow field demonstrates a periodic vortex shedding phenomenon similar to what would be expected in the wake of a bluff body. Large-scale vortices periodically shed from both sides of the nozzle plate, generating a well-organized von Kármán-like vortex street. On the contrary, for $d/w \leq$0.6 and $d/w \geq$2.2, a pair of steady counter-rotating stable vortices are formed close to the nozzle plate. The Strouhal number (St), a measure of vortex shedding frequency, decreases with increasing d. When the jet width (w) is varied in the range $0.6 \leq w/d < 1.6$, the periodic vortex shedding occurs in the flow field. Within this range, St decreases with increasing w. For $w/d \geq 1.6$, the shedding phenomenon is still evident, but St becomes insensitive to the variation of w. In contrast, for $w/d \leq 0.5$, the flow field remains always steady. When the width of the wall jet (g) is varied in the range $0.3 \leq g/d < 1$ keeping the width of the offset jet fixed at d, the periodic vortex shedding phenomenon is observed. Within this flow regime, St decreases with increasing g/d. For $g/d \geq 1$, the shedding phenomenon is still discernible, but St is uninfluenced by the bottom wall. On the contrary, for g/d=0.2, the flow field becomes steady. When the velocity ratio (V_r), the ratio of the inlet velocity of wall jet to offset jet, lies in the range $0.78 \leq V_r \leq 1.34$, the periodic vortex shedding occurs, and St increases with increasing V_r. On the contrary, the periodic phenomenon ceases if $V_r \leq 0.77$ or $V_r \geq 1.35$. The present work also considers the case of conjugate heat transfer, involving conduction through a solid slab and turbulent convection in the fluid, for the dual jet flow. The bottom surface of the solid slab is maintained at a constant temperature. The results indicate that the interface temperature and local heat flux along the solid-fluid interface depend on the flow (Reynolds number), fluid (Prandtl number and thermal conductivity) and solid (thermal conductivity) properties and also depend on the dimension of the solid slab (thickness). However, the local Nusselt number along the solid-fluid interface is a function of both flow and fluid properties and is independent of the solid property as well as the dimension of the solid slab.