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Flow Instability and Secondary Vortex Evolution in 90 Degree Bend LIN NIU[1], HUA-SHU DOU[2], Zhejiang Sci-Tech University, FLUID MECHANICS RESEARCH TEAM — Three-dimensional incompressible Navier-Stokes equations are employed to simulate the laminar flow in a 90 degree bend with square cross-section. Then, the energy gradient theory is used to analyze the stability of the flow. The Reynolds number based on the channel width and the averaged velocity is 158, 394 and 790, respectively. It is found that at Re=790, the value of the energy gradient function K increases as the fluid entering the curved section, causing flow instability and forming a pair of secondary vortices; then the secondary vortices gradually stabilizes and the value of K decreases. At the exit of the bend, the total pressure distribution in the cross-section presents serious distortion, which leads to a peak of K. As such, it promotes instability of the flow and causes a transition of two vortices to four vortices. With the flow ahead, the maximum of K in the cross section rises again, resulting in the transition of four vortices to eight vortices. While at low Re (Re = 158 and Re = 394), there is only one pair of vortices in the bend, which are stable, due to low value of K. This study shows that the occurrence of instability is closely related to the evolution of energy gradient function K.

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