

Confined steady flows, which display on-axis or off-axis vortex breakdown, have been numerically studied, with particular attention focused on means of controlling the vortex breakdown bubbles. Firstly, the model flow driven by one end disk of a cylindrical enclosure, which exhibits two distinct on-axis vortex bubbles, has been considered. The resulting computations revealed that, sloping slightly the stationary sidewall, beyond a threshold angle, provided an effective means of removing the secondary vortex structure, and the flow remains steady. Besides, this technique is shown to significantly modify the flow topology which displays off-axis bubbles, induced by the co-rotation of the end disks. Then, the effectiveness of adding a near-axis swirl, as suggested in recent experimental works, has been analysed numerically and found to substantially alter on-axis reverse flows