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On the increased decay of swirl after vortex breakdown BALKAN GENC, OZGUR ERTUNC, HARESH VAIDYA, CAGATAY KOEKSOY, ANTONIO DELGADO, Institute of Fluid Mechanics (LSTM), University of Erlangen —
In this study, vortex breakdown in swirling flows and critical swirl rate for its occurrence was experimentally and numerically investigated. In order to understand and control this interesting phenomenon, a special pipe flow test facility with a rotating honeycomb type swirl generator was constructed. Measurements of all velocity components were carried out by using LDV combined with refractive index matching technique. The maximum Reynolds number and swirl intensity (ratio of angular momentum flux to axial momentum flux) of the flow were $\mathrm{Re}_D = 30{,}000$ and $S_o = 11$, respectively. Measurements at a few diameters downstream of the honeycomb revealed that, beyond a critical swirl intensity setting, the swirl component decayed faster as the swirl intensity was further increased. It is also measured that the axial flow attained reduced or even negative velocities around the centreline after this critical swirl intensity was exceeded. It is argued that rapid decay of swirl component due to vortex breakdown causes the change of tendencies in the flow. Critical swirl intensity was hereby proposed to be $S_o \approx 0.95$, which is important for design and prediction of swirling flows. In order to complement these experimental results CFD analyses were carried out.

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