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3D vortex breakdown in straight pipes M.A. HERRADA, University of Seville (Spain), R. FERNANDEZ-FERIA, University of Malaga (Spain) — Three-dimensional (3D) and axisymmetric numerical simulations of the incompressible Navier-Stokes equations have been conducted to study the occurance of vortex breakdown in a familly of columnar vortex flows in straight pipes. The numerical simulations show that the basic form of breakdown is axisymmetric, and a transition to helical breakdown modes is shown to be caused by a sufficiently large pocket of absolute instability in the wake of the bubble. Depending on the values of the Reynolds and swirl parameters, two distinct eigenfunctions corresponding to azimuthal wavenumbers m=+1 and m=+2 have been found to yield a helical or double-helical breakdown modes, respectively. By means of a simple linear, spatial stability analysis carried out in the sections of the pipe where the basic axisymmetric flow present reverse flow, we have identified the frequencies and the dominant azimuthal wave numbers observed in the 3D simulations.

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