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Oscillations of free cylinders at low Reynolds numbers inside a Hele-Shaw cell[1] J.-P. HULIN, Univ Paris Sud, CNRS, Lab FAST, Bt 502, Campus Univ. Orsay, F-91405 (France), V. D'ANGELO, L. GIANORIO, M. CACHILE, GMP-FIUBA, Paseo Colon 850, 1063, Buenos Aires (Argentina), CONICET (Argentina), H. AURADOU, Univ Paris Sud, CNRS, Lab FAST, Bt 502, Campus Univ. Orsay, F-91405 (France), B. SEMIN, LPS Laboratory, Dept. Physique ENS, 24. rue Lhomond, 75231 Paris Cedex 05 (France) — We study two instabilities of a horizontal free cylinder in a vertical viscous Hele-Shaw flow: they are shown experimentally to depend critically on the transverse and lateral confinement of the flow characterized respectively by the ratios D/H (resp. L/W) of the diameter (resp. the length) of the cylinder to the gap (resp. the width) of the cell. The onset of the instabilities depends essentially on D/H. For $0.4 \leq D/H \leq 0.6$, we observe transverse horizontal oscillations of the cylinder perpendicular to the walls: their frequency is constant with D/H and L/W at a given vertical cylinder velocity V_c. This instability is locally $2D$ along the length of the cylinder and controlled by the local relative velocity V_r^{loc} of the cylinder and the fluid: it occurs down to Reynolds numbers $Re^{loc} = V_r^{loc} H/\nu \simeq 15$, i.e. below the vortex shedding threshold $(150 - 250)$ for fixed cylinders between parallel planes. These results are compared to $2D$ numerical simulations. For $D/H \geq 0.55$, we observe a fluttering motion with periodic oscillations of the tilt angle of the cylinder from the horizontal and of its horizontal position: their frequency decreases as L/W increases and is independent of D/H and V_c.

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