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Oscillatory Motion of Freely-Moving Light Bodies: from Cylinders to Disks

P. Cordeiro Fernandes, P. Ern, **F. Risso**, J. Magnaudet

Institut de Mécanique des Fluides, Toulouse, France

The oscillatory motion of flat cylinders rising freely in a slightly viscous fluid otherwise at rest was investigated experimentally. Original results concerning the translation and rotation of the body were obtained for a wide range of Archimedes numbers Ar (buoyancy vs. viscous effects) and diameter-to-height ratios d/h. Body inclination and velocity oscillate at the same frequency and have amplitudes that increase with Ar. However the dynamics are rather complex since the coupling between the body rotation and translation strongly depends on the body aspect ratio. When d/h increases, the amplitude of the oscillations of the body inclination reaches a constant value whereas that of horizontal velocity continues to increase. Moreover, the phase difference between the body velocity and inclination continuously evolves from about zero (bubble-like behavior) to a value close to 90 degrees (disk-like behavior). It also appears that the drag coefficient is strongly influenced by the oscillatory motion.

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