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Sustained inertial-capillary oscillations and jet formation in displacement flow in a tube YI SUI, Department of Chemical Engineering, Imperial College London, UK, PETER D.M. SPELT, LMFA, CNRS and Universite Claude Bernard Lyon 1, France — We study inertial effects in the displacement of a fluid in a capillary by a more viscous fluid using a level-set method. Various flow regimes are identified with a Reynolds and a capillary number as the main parameters. At relatively low Reynolds number, the meniscus forms a steady shape, and the interfacial curvature at the tube centre could change from being concave to convex upon increasing the Reynolds number. Beyond a critical Reynolds number, a quasi-steady solution is no longer found for sufficiently small contact angle values (less than 80 degrees): instead, the interface undergoes non-dampened periodic oscillations and, at even larger values of the Reynolds number, quasi-periodically, and the interface evolves from simple wavy shapes to complex shapes with multiple wavy units. Beyond a second critical Reynolds number, the liquid forms a jet and the meniscus advances with a nearly constant speed which decreases with Re. This is also observed at large contact angle values. In a developing jet, however, the interface shape remains partially quasi-steady, near the contact line region and the tube centre. The flow behaviour is shown to be robust over a range of other governing parameters, including the capillary number and the slip length.

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