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Dynamics of a capillary invasion in a closed-end capillary HOSUB LIM, Sungkyunkwan University, ANUBHAV TRIPATHI, Brown University, JINKEE LEE, Sungkyunkwan University — The position of fluid invasion in an open capillary increases as the square root of time and ceases when the capillary and hydrostatic forces are balanced, when viscous and inertia terms are negligible. Although this fluid invasion into open-end capillaries has been well described, detailed studies of fluid invasion in closed-end capillaries have not been explored thoroughly. Thus, we demonstrated, both theoretically and experimentally, a fluid invasion in closed-end capillaries, where the movement of the meniscus and the invasion velocity are accompanied by adiabatic gas compression inside the capillary. Theoretically, we found the fluid oscillations during invasion at short time scales by solving the one dimensional momentum balance. This oscillatory motion is evaluated in order to determine which physical forces dominate the different conditions, and is further described by a damped driven harmonic oscillator model. However, this oscillating motion is not observed in the experiments. This inconsistency is due to the following; first, a continuous decrease in the radius of the curvature caused by decreasing the invasion velocity and increasing pressure inside the close-ended capillary, and second, the shear stress increase in the short time scale by the plug like velocity profile within the entrance length. The viscous term of modified momentum equation can be written as $K\frac{8\mu\ell}{r_c^2}\frac{d\ell}{dt}$ by using the multiplying factor K, which represents the increase of shear stress. The K is 7.3, 5.1 and 4.8 while capillary aspect ratio χ_c is 740, 1008 and 1244, respectively.

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