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From catastrophic acceleration to deceleration of liquid plugs in prewetted capillary tubes.[1] JUAN MAGNIEZ, MICHAEL BAUDOIN, FARZAM ZOUESHTIAGH, IEMN, International Laboratory, UMR CNRS 8520, Universit de Lille, LEMAC/LICS TEAM — Liquid/gas flows in capillaries are involved in a multitude of systems including flow in porous media, petroleum extraction, imbibition of paper or flows in pulmonary airways in pathological conditions. Liquid plugs, witch compose the biphasic flows, can have a dramatic impact on patients with pulmonary obstructive diseases, since they considerably alter the circulation of air in the airways and thus can lead to severe breathing difficulties. Here, the dynamics of liquid plugs in prewetted capillary tube is investigated experimentally and theoretically, with a particular emphasis on the role of the prewetting films and of the driving condition (constant flow rate, constant pressure). For both driving conditions, the plugs can either experience a continuous increase or decrease of their size. While this phenomenon is regular in the case of imposed flow rate, a constant pressure head can lead to a catastrophic acceleration of the plug and eventually its rupture or a dramatic increase of the plug size. A theoretical model is proposed to explain the transition between theses two regimes. These results give a new insight on the critical pressure required for airways obstruction and reopening.

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