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Evaporation versus imbibition in a porous medium[1] CHARLOTTE VAN ENGELAND, TIPs Lab - Universite libre de Bruxelles Chemical Engineering Department, Polytechnique Montreal, BENOIT HAUT, TIPs Lab - Universite libre de Bruxelles, LAURENT SPREUTELS, Chemical Engineering Department, Polytechnique Montreal, BENJAMIN SOBAC, TIPs Lab - Universite libre de Bruxelles
— Predicting and controlling the liquid dynamics in a porous medium is of large importance in numerous technological and industrial situations. We derive a general analytical solution for the dynamics of a liquid front in a porous medium, considering the combined effects of capillary imbibition, gravity and evaporation. We highlight that the dynamics of the liquid front in the porous medium is controlled by two dimensionless numbers: a gravity-capillary number G and an evaporation-capillary number E. We analyze comprehensively the dynamics of the liquid front as functions of G and E, and show that the liquid front can exhibit seven kinds of dynamics classified in three types of behaviors. For each limiting case, a simplified expression of the general solution is also derived. Finally, estimations of G and E are computed to evidence the most common regimes and corresponding liquid front dynamics encountered in usual applied conditions. This is realized by investigating the influence of the liquid and porous medium properties, as well as of the atmospheric conditions, on the values of the dimensionless numbers.

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