Contribution ID: **519** Type: **Poster (+) Presentation**

Analysis of droplet mobilization confined in a micro pore-doublet system at low capillary number

Wednesday, 2 June 2021 16:00 (1 hour)

Immiscible two-phase flow in porous media has drawn great attention in various applications including soil remediation, enhanced oil recovery, and CO2 sequestration (Zarikos et al., 2018; Alamooti et al., 2020). One of the main effective processes on the performance of these applications is the trapped phase mobilization phenomenon. The balance of total drag forces (including pressure and viscose forces) and surface tension forces can determine the mobility of confined droplets (Yang et al., 2019). Several experimental and numerical works have been conducted to quantify and qualify the mobilization (Madani et al., 2014; Yang et al., 2019). However, the combination impacts of surface hydrophobicity, viscosity ratio, and recirculation on the mobilization of the trapped phase inside the confined droplet at low capillary numbers have less focused.
Here, we use filtered surface force formulation of the volume of fluid method (Raeini et al., 2012) to formulate two-phase flow at microscale at low capillary number. To assess the mobilization process, a 2D pore-doublet model is set and a liquid droplet was confined in one of two micro-channels. This special pore assembly provides an opportunity not only to fully confine a droplet inside one of two microchannels but also to evaluate the role of fluid flow in another microchannel on the mobilization of the confined droplet. We optimized the mesh size using a mesh sensitivity analysis. Then the model was validated against existing experimental data for a droplet partially confined in a microchannel. Furthermore, an analysis was conducted to ensure that the spurious currents are suppressed during the simulation.
We found that regardless of the wettability of the surface, the consideration of the individual critical value for capillary number or viscosity ratio for sepeartion of mobilized and trapped regimes is not efficient,. Therefore, a critical line should be considered for both parameters.
However, due to higher surface tension forces for hydrophilic surfaces, this critical line moves to higher values of capillary numbers and viscosity ratios. We performed a force balance analysis on the interface of confined droplet and flowing phase and also on the interface of confined droplet and solid surface for both mobilized and trapped cases. The results show that, regardless of the surface wettability the trapped cases, the total drag forces is equal to surface tension forces. It does not necessarily mean that viscose and pressure forces are in the same direction as the flow of invading phase in the adjacent microchannel can cause negative viscose force against the movement of the droplet. Depending on the viscosity of the confined droplet and the transversal element of viscose force, the recirculation phenomenon can be seen inside the confined droplet.
The results of this work can be used in many applications where the adhesion forces on the walls of pore spaces can play a pivotal role. As a basis, we expect that this model can be coupled with other processes such as heat and mass transfer in more complex porous media where the heterogeneity can influence the mobilization of trapped droplets.

Time Block Preference

Time Block A (09:00-12:00 CET)

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