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# A Lubrication Model for Wettablity Characterization

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Trapping of fluid in porous media by capillary forces is a key process in many subsurface processes. It can be favorable to store carbon dioxide in deep saline aquifers, or unfavorable for groundwater remediation and in petroleum production, where droplets of contaminants/oils are trapped in the pore-space by capillary forces. Wettability properties at the vicinity of three-phase contact region is a key parameter to describe trapping mechanisms as well as the long-term stability of trapped droplets. Although the concept of contact angle –i.e. the angle visually measured between the solid surface and the fluid-fluid interface –is widely used to model two-phase flow processes at the pore-scale, it does not accurately describe wettability alteration due to change in pH and salinity. The latter arises from inter-molecular interactions. Furthermore, the variation of contact angle with the velocity field at the three-phase contact region gives rise to more complications. This region is created by spreading of a thin film of one phase on the solid as oppose to the other fluid and is thin enough to be in the range of inter-molecular forces. We intend to model the wettability by investigating the evolution of this film.

To do so, we developed a lubrication model for the thin film evolution on the solid surface. The model is physically rooted and replaces the concept of contact angle. It accounts for inter-molecular forces by introducing the different components of the disjoining pressure, notably the van der Waals and electric double layer potentials. The developed framework relates molecular interactions to pore-scale simulations through the boundary conditions, paving the way to more realistic pore-scale simulations with wettability alterations. It also can be used as a tool to investigate other phenomena governed by inter-molecular forces, such as film stability and streaming potential.

For the particular case when the film contains electrolytes, the different ions will get adsorbed on the solid surface. Even though the fluid charge is neutral, a distribution of ions will form close to the solid surfaces. Movement of fluid in this region will create an electrical voltage called streaming potential. The effect of streaming potential can be noticeable, especially in the case of moving contact line. We would like to study the movement of the ions in this region in order to find out the range of the importance of streaming potential.

## Participation

In-Person

## References

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