Contribution ID: **130** Type: **Poster Presentation**

Flow of Liquid Through a Stagnant Foam in a Model Fracture

Thursday, 25 May 2023 15:30 (1h 30m)

Foam is a promising means of increasing carbon storage in CO2 sequestration projects and waste isolation and removal in soil remediation, and a proven tool for enhanced oil recovery. Many of these applications involve fractured geological formations. Li et al. (2021a) studied inter-bubble diffusion and coarsening in foam in two glass model fractures. The bubbles were larger than the gap between fracture walls, so that only one sheet of bubbles occupied the model. As part of that study, they showed how one can determine water saturation and capillary pressure in the model fracture from analysis of visual images of the foam, specifically the location of wetting liquid along the uneven aperture in the model fracture (Li et al., 2021b). This approach would not be possible in a conventional microfluidic device with uniform depth of etching. Their approach depends on an assumption that capillary pressure is uniform within the region of an image, which was (0.8 cm)^2 and (2 cm)^2 for the two model fractures.
We describe a model for the flow of water through the Plateau borders of the foam in these experiments along the top and bottom fracture surfaces. The width of the Plateau borders is determined by capillary pressure, as determined by Li et al. Numerical solution for velocity and flow rate through the Plateau borders then allows flow rate along each to be determined as a function of capillary pressure and pressure gradient. A numerical model then solves for flow through the network of Plateau borders along the fracture wall. We allow for either no-slip or zero-shear-stress boundary conditions at the water-gas interface, reflecting the two extremes of foaming surfactant behavior.
Our results show that water redistributes itself to equalize capillary pressure across the image area in the order of tens of seconds. Thus the assumption of Li et al. (2021b) is justified. The relative permeability of water through the Plateau borders in a trapped foam in these model fractures lies between 1E-04 and 1E-07, depending on capillary pressure and bubble size. This method could also be applied to determine the relative permeability of water in trapped foam from images of the foam in conventional microfluidic devices, if one can measure or infer capillary pressure within the device.

Participation

In-Person

References

Li, K., Sharifnik, M. Wolf, K.H.A.A., and Rossen, W.R., "Coarsening of Foam in Two Model Fractures with Different Roughness," accepted for publication by Colloids Surfaces A: Physicohemical and Eng. Aspects 631: 127666 (2021a). https://doi.org/10.1016/j.colsurfa.2021.127666
Li, K., Wolf, K.H.A.A., and Rossen, W.R., "A Novel Technique to Estimate Water Saturation and Capillary Pressure of Foam in Model Fractures," accepted for publication by Colloids Surfaces A: Physicohemical and Eng. Aspects 632: 127800 (2021b). https://doi.org/10.1016/j.colsurfa.2021.127800
Obbens, E., "Analysis of Two Problems in Network Transport,"MSc thesis, Delft U. of Technology, 2022. Available at http://repository.tudelft.nl/

MDPI Energies Student Poster Award

No, do not submit my presenation for the student posters award.

Country

The Netherlands

Acceptance of the Terms & Conditions

Click here to agree

Energy Transition Focused Abstracts

Primary authors: Mr OBBENS, Ewald J. M. (Delft U. of Technology); Dr LI, Kai (Delft U. of Technology); Prof. ROSSEN, William (Delft University of Technology)

Presenter: Dr LI, Kai (Delft U. of Technology)

Session Classification: Poster

Track Classification: (MS06-A) Physics of multiphase flow in diverse porous media