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Lamellae Generation and Dynamics During Gas Invasion of a Porous Medium Occupied by a Surfactant Solution

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Foam is widely used in oil recovery operations to improve sweep efficiency, in gas storage and acidization operations, and to solve problems caused by either a thief zone or gravity override. Foam, which can be preformed and injected in the reservoir or produced in-situ through the pore space, fills the high permeability areas known as thief zones and divert the displacing fluid into the direction of trapped oil, reducing the relative permeability of gas and leading to a more stable displacement front. The efficiency of these processes largely depends on the generation and stability of the foam films (lamellae) residing in the pores.

The mobility of the injected gas is reduced when it's foamed; this reduction is attributed to the increase in the gas effective viscosity and the reduction in gas relative permeability. The lamellae formed create resistance against the gas flow, impeding its free motion inside the porous media. The lamellae population that composes the foam is direct related with surfactant concentration, and their flow and mobility are functions of the pore geometry and foam properties. However, the dynamics of foam formation in porous media is not fully understood due to its complexity.

The goal of this research is to understand the dynamic process of gas invading a two-dimensional porous media glass model occupied by a surfactant solution and forming foam. A microfluidic setup composed of glass micromodel, syringe pump, pressure transducer and microscope, was used to visualize the pore-scale displacement and correlate the evolution of lamellae formation during the injection process with pressure difference for different flow conditions through image processing. The dynamics of lamellae formation and speed is reported and related to macroscopic flow behavior.

Time Block Preference

Time Block B (14:00-17:00 CET)

References

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