Contribution ID: **244** Type: **Poster Presentation**

The influence of Wettability and flow rates on two-phase fluid displacement in porous media: Pore scale experimental visualization and numerical simulations

Wednesday, 1 June 2022 09:20 (1h 10m)

Multiphase flow in porous media widely exists in many natural and industrial processes, such as enhanced oil/gas recovery, geological CO2 sequestration,. Wettability is one of the key factors that affects multiphase flow in porous media. In this study, by means of high-resolution imaging in microfluidic flow cells patterned with random pore network, we performed displacement processes that occur during water flooding by using a microfluidic approach under controlled wettability conditions and recorded how wettability and flow rates influences the resulting displacement patterns. We further use the LBM method to numerically investigate the influence of wettability and flow rates on two-phase flow under various ranges of flowrates and wettability conditions. By using LBM simulation, the speed model adopts the D2Q9 model, and the collision item adopts the LBGK model. The pseudopotential model (Shan-Chen model) is used to describe the interaction force between particles. The boundary conditions are as consistent as possible with the experimental conditions. The entrance and exit adopt the Zou-He boundary, and the pore-solid interface adopts a half-step rebound impermeable boundary. Then numerical simulations by using Lattice Boltzmann Method (LBM) are firstly verified based on same experimental conditions and then extend to a wide range of flow rates and wettability conditions. Simulated results show LBM simulations are in good agreement with the experimental results. With the invading fluid being more wetting to the medium, fluid interface area is increased with slow displacement front velocity. Thus, the trapping of non-wetting and the breakthrough time of invading fluid are suppressed, resulting higher displacement efficiency. In addition, increased flow rate makes fluid invasion stable for all contact angles, indicating that the impact of wettability on the fluid invasion processes becomes negligible. Our work extends the classic phase diagram, explores the controls of wettability and flow rate on the displacement pattern at pore scale and provide a fundamental understanding on macroscopic multiphase flow behaviors.

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Time Block Preference

Time Block C (18:00-21:00 CET)

Participation

Online

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