Contribution ID: **807** Type: **Oral 20 Minutes**

Pore-scale modelling of multiphase flow in porous media: considering wettability and disordered microstructure

Monday, 14 May 2018 10:05 (15 minutes)

Multiphase flows in disordered porous media have a significant influence on many industrial applications, such as unsaturated soil mechanics, carbon geo-sequestration, and oil recovery. In this paper, we discuss two aspects of the problem, namely, (1) wettability at dynamic conditions and (2) disordered microstructures.

First, to simulate surface tension, wetting effects as well as dynamic contact angle at the pore-scale, a smoothed particle hydrodynamics (SPH) model with inter-particle force and modified solid-liquid interface formulation is applied. A newly introduced viscous force at solid-liquid interface is implemented to generate the rate dependent behaviour of contact angle with moving contact line, which can reflect the realistic interaction between different phases based on physical quantities. The dynamic contact angles are simulated under various moving contact line speeds and the correlation between corresponding capillary numbers are further analysed. The results are in good agreement with experimental observations under dynamic loading conditions and the effectiveness of the modified model is demonstrated.

Moreover, to study the effects of disordered pore networks on drainage characteristics, we used both numerical simulations (OpenFOAM) and physical experiments. The simulations covered a wide range of non-dimensional number, considering wettability, viscosity and surface tension. An improved Bond number equation for disordered porous media was proposed to capture the residual saturation as a function of gravity for different pore structures. Furthermore, we redefined the calculation procedure of the disorder parameter Iv, based on Voronoi tessellation, which is found to have a negative and linear correlation with the residual saturation for given gravity-driven drainage conditions. A qualitative agreement has been found between the simulation and experimental observations.

These preliminary results demonstrated the potential of using these proposed methods for accounting the pore-scale effects, including the hysteretic contact angle and disordered pore structures, and for simulating multiphase flows in porous media under various loading conditions.

References

Acceptance of Terms and Conditions

Click here to agree

Primary author: Dr GAN, Yixiang (The University of Sydney)

Presenter: Dr GAN, Yixiang (The University of Sydney)

Session Classification: Parallel 1-G

Track Classification: MS 1.02: Fractal Theory and its Applications to Flow and Transport Properties of Porous Media