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Contribution ID: **653** Type: **Oral Presentation**

Experimental study of steady state flow paths during the immiscible flow of ganglia in stochastic porous media micromodels

Wednesday, 2 June 2021 14:45 (15 minutes)

Immiscible two-phase flow in porous media is a physical process encountered in a wide variety of applications, such as oil recovery, soil remediation, CO2 sequestration, as well as in several industrial systems. The models that describe two-phase flow in such porous media are traditionally based on Darcy's law and a typically valid when both phases are continuous over the entire flow domain. Under several flow conditions, however, one of the fluid phases is discontinuous (typically the non-wetting one) and moves under the effects of shear viscous stresses and pressure gradients imposed at its interface by the continuous (typically wetting) phase. The movement of the discontinuous phase in the form of ganglia has been the subject of various studies (1–4), with existing theories being formulated on the basis of data, which analyze the phenomenon based on the overall movement of the ganglia.
In this work, we study experimentally the flow of non-wetting phase ganglia during the co-injection of oil and water in a predominantly 2D PMMA micromodel. The micromodel is constructed using a CNC milling machine based on a stochastically reconstructed digital pattern that generates randomly shaped pillars of solid that follow a Gaussian size distribution. The flow is recorded using a high-resolution DSLR and the resulting images are post-processed to obtain both the ganglia size distributions and the temporally-averaged distribution of phases. We thus identify the effects of the flow rate (controlled by two rotary pumps) and the viscosity ratio of the fluids (by selecting oils of various viscosities) on the steady-state ganglia size distributions, the ratios of mobile over stranded ganglia phase saturation and the density of the flow paths, where the transport of the disconnected phase takes place. Our results demonstrate that the rates of ganglia fragmentation and coalescence intensify at higher Ca values, leading to size distributions that shift towards smaller average values. This effect can be directly correlated with the emergence of new flow paths that develop through narrower pores-throats as viscous forces progressively become dominant over capillary ones. The flow of ganglia through these narrower pores leads to their snap-off and fragmentation into smaller sizes.

Time Block Preference

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

References

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