Contribution ID: **124** Type: **Oral Presentation**

Multiphase flow dynamics effect on microscale phase configuration

Wednesday, 24 May 2023 15:00 (15 minutes)

We study the dynamics of pore-scale gas and liquid flow through a horizontal quasi-two dimensional millifluidic device. The multiphase flow dynamics is controlled by the physical properties of the fluid phases and their initial spatial distribution; it govern their spatial distribution at subsequent times, through the interplay between capillary and viscous forces. In turn, this spatial configuration of fluid phases significantly affects the relative hydraulic properties of the domain, such as conductance and tortuosity. During flow in multiphase systems, the flow rates and the phases saturation are strongly coupled. Disentangling the decoupled effect of each of these mechanisms on the phases'configuration is a major step towards the prediction of complex multiphase flow and capillary non-equilibrium conditions.
Here, we use experimental data gathered from several multiphase flow experiments conducted in a millifluidic device and using different flow dynamics (flow rates, air/liquid injection duty cycles, initial saturation degree, etc.). This data is analyzed in terms of criteria such as the water-filled pore size distribution, coordination number distribution, and air mobility. This analysis draws from a newly developed image analysis method, using the distance map curvatures to locate the critical points of pore throats and bodies from binary 2D or 3D images. Moreover, direct numerical simulation of single-phase flow is used to evaluate the velocity distributions in the percolating (imbibing) liquid phase.
In this study, we show that the phases saturation is the major driver determining the spatial distribution of fluid phases. However, capillary non-equilibrium distribution prevails even at relatively low capillary number (low velocity) conditions. The divergence from capillary equilibrium phase distribution, in terms of water filled pore size distribution and coordination number, is related to the flow dynamics. In addition, we relate quantitatively the magnitudes of capillary and viscous forces to the air clusters'shape and size probability density functions, and how the liquid preferential flow evolves through the most conducting (larger pores) paths.

Participation

In-Person

References

MDPI Energies Student Poster Award

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

Country

Spain

Acceptance of the Terms & Conditions

Click here to agree

Energy Transition Focused Abstracts

Primary authors: Dr BEN-NOAH, Ilan (Institute of Environmental Assessment and Water Research (IDAEA), The Spanish National Research Council (CSIC), Barcelona, Spain.); HIDALGO, Juan J. (IDAEA-CSIC); Dr JIMENEZ--MARTINEZ, Joaquin (2 Department Water Resources and Drinking Water, Swiss Federal Institute of Aquatic Science and Technology, Eawag, Dübendorf, Switzerland. 3 Institute of Environmental Engineering, Department of Civil, Environmental and Geomatic Engineering, ETH Zurich, Zürich, Switzerland.); Prof. MÉHEUST, Yves (G´eosciences Rennes, Univ. Rennes, CNRS, Rennes, France); Prof. DENTZ, Marco (Institute of Environmental Assessment and Water Research (IDAEA), The Spanish National Research Council (CSIC), Barcelona, Spain.)

Presenter: Dr BEN-NOAH, Ilan (Institute of Environmental Assessment and Water Research (IDAEA), The Spanish National Research Council (CSIC), Barcelona, Spain.)

Session Classification: MS06-A

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