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Simulation of Fluid-Fluid Interfacial Area in Two-Phase Systems under Static and Dynamic Conditions: Application of Pore-Network Modeling

V. Joekar Niasar and S. M. Hassanizadeh
Utrecht University, Earth Sciences Faculty, Utrecht, Netherlands (joekar@geo.uu.nl)

In physics of flow and transport in multiphase systems in porous media, interfaces play an important role. To gain a better insight into the role of interfaces in these processes, several theoretical, computational and experimental studies have been done during the past decades.

One of the issues in these studies is related to the measurement and calculation of interfacial area in porous media. Till now, in many studies interfacial area is calculated experimentally using techniques such as visualization, interfacial tracers, etc.. In this presentation, we show the application of pore–network models for calculating fluid-fluid interfacial area in hypothetical or real porous medium.

We have developed a quasi-static as well as a dynamic pore-network model to simulate relationships among capillary pressure, saturation and interfacial area for a two-phase system during drainage and imbibition.

For quasi-static conditions, simulation results have been compared with measurements implemented on a two-dimensional micro-model as well as a glass-bead sample. Measurements had been done using visualization techniques. There is a good agreement between the simulation results and measurements.

Dynamic pore-network model has been used to simulate creation of interface for different viscosity ratios. As expected, interfacial area trend is significantly dependent on the viscosity ratio, and consequently the invasion pattern.