Contribution ID: **59** Type: **Poster (+) Presentation**

Modeling rate-dependent relative permeability of three-dimensional heterogeneous structures with a one-dimensional semi-analytical approach

Wednesday, 2 June 2021 09:00 (1 hour)

Investigation of multi-phase flow in heterogeneous porous media is important for several fields, including enhanced oil recovery, CO2 storage in geological formations, and groundwater contaminant treatment. One of the key properties in characterizing such flows is phase permeability and its dependence on saturation, i.e. relative permeability curves. Such properties are usually determined via coreflooding experiments, where core samples are injected with several fluids at altering fractional flows. However, due to heterogeneity, the core's effective relative permeability curves change with the injection rate. Thus, full characterization requires conducting a significant number of coreflooding experiments with altering injection rates and fractional flows, which is a complex and time-consuming process.

The following work presents a novel framework for evaluating relative permeability curves at altering injection rates from a single injection-rate coreflooding experiment. A one-dimensional semi-analytical solution to two-phase flow at steady state is used to obtain profiles of the saturation, capillary pressure, and overall phase pressure gradient. The one-dimensional permeability profile is calibrated by matching the semi-analytical model to slice average saturation values, obtained from three-dimensional measurements, and the overall wetting phase pressure gradient. Once calibrated, the permeability profile is implemented in the semi-analytical model to estimate the effective phase relative permeability curves at varying injection rates. This method was tested and validated on three different scenarios: two synthetic cases with different permeability fields, and one case of realistic data based on coreflooding experiments conducted on a sandstone "Shezaf" rock sample.

Results have shown that the proposed approach is capable of capturing the effective relative permeability of both phases, for all of the tested scenarios, at all injection rates, by calibrating the one-dimensional permeability profile to a single total injection rate including four fractional flows. In addition, it was found that the harmonic mean of the one-dimensional permeability profile is in a good agreement with the core's effective permeability, thus setting an additional validation of the obtained one-dimensional permeability profile.

Time Block Preference

Time Block A (09:00-12:00 CET)

References

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