**Two-phase flow experiments with PDMS micro-models; the quasi-static case**

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**Abstract**

Over the last 25 to 30 years, micro-models have been increasingly applied in various research areas to study the behavior of fluids inside micro-structures. Studies have included chemical, biological, and physical applications. Micro-models have been proven to be a valuable tool in the field of porous media by allowing the observation of flow and transport on the micro-meter scale. They have helped to increase our insight of flow and transport phenomena on both micro- and macro-scales.

A micro-model is an artificial representation of a porous medium, made of a transparent material. This fluidic device bears a flow-network, with features on the micro-scale, and an overall size of up to a few centimeters. It also has an inlet and outlet area for the introduction and removal of the phases involved. We have constructed a micro-model made of PDMS (Poly-Di-Methyl-Siloxane). This is a viscoelastic, silicon-based organic polymer. It is optically transparent, inert, non-toxic, and non-flammable. Given its mechanical and chemical properties, PDMS is a material suitable for manufacturing micro-models that can be used to study two-phase flow.

In order to investigate the significance of incorporating interfacial area as a separate variable in the governing equations of two-phase flow, an experimental setup was constructed to study and visualize two-phase flow in a PDMS micro-model under quasi-static conditions. A number of experiments were performed for drainage and imbibition. Data obtained for capillary pressure, saturation, and interfacial area were used to construct *Pc-S* graphs for main drainage and imbibition as well as scanning curves. Also, *Pc-S-awn* surfaces were obtained.

The results obtained from the experiments showed that the inclusion of interfacial area as a separate variable in the equations of two-phase flow can be an efficient way to model hysteresis.