



A Single-Shot Measurement of Capillary Pressure Curves Using a Single-Speed Centrifuge and Magnetic Resonance Imaging

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Abstract

Capillary pressure is the most fundamental rock-fluid property in multi-phase flow in petroleum reservoirs. The traditional centrifugal capillary pressure curve measurement involves rotating fluid bearing rock core plugs at variable angular velocities in a specially designed centrifuge. Collecting the expelled fluid from the rock cores as a function of increasing the rotational speeds and calculating a corresponding fluid saturation at the inlet with an approximate solution permit a quantification of the capillary pressure curve. A full capillary pressure curve determined with this method requires approximately 10 different rotational speeds.

We have developed a single-shot method to determine the capillary pressure curve with a single-speed centrifugation experiment to generate a capillary pressure distribution along the core and a quantitative magnetic resonance imaging (MRI) technique to measure the fluid saturation distribution along the length of the sample. The single-shot method for measuring drainage and imbibition capillary pressure curves is precise, rapid, and adaptable. Since only a single moderate speed is employed, the outflow boundary condition can be maintained, and the effect of gravity can be ignored. The single-shot experiment is approximately 10 times faster than the traditional experiment. The speed advantage permits routine drainage and imbibition capillary pressure curve determination in core plugs, as will be demonstrated.