Determination of Water Breakthrough Time in Noncommunicating Layered Reservoir

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The original Buckley-Leverett fractional flow formula has been extended and more detailed formulation of waterflooding behavior in a multilayered system is presented. In this paper, the layers are assumed to communicate only in the wellbores, and the reservoir may be represented as linear system. Most previous investigations of this nature were limited by assumptions. This study improves on previous work by applying Buckley-Leverett displacement theory to a noncommunicating layered reservoir where permeability, porosity and thickness vary from layer to layer except the oil-water relative permeability and oil viscosity are assumed the same for all layers. Gravity and capillary pressure effects are neglected. These particular considerations have been given to the evaluation of breakthrough time for each layer as a function of cumulative water injection into that layer at the breakthrough. To verify the modified method, calculations were performed a three layered reservoir at three different cases of mobility ratios and compared with Prats et al's method. It is shown that the breakthrough times in the layer with the lowest permeability-thickness product (kh) are in very good agreement with Prats et al's method. However, breakthrough times for the layer with the highest kh are slightly different from Prats et al's method.

Keywords: Buckley-Leverett Theory, Immiscible Displacement, Water Breakthrough, and Improved Oil Recovery.