An Experimental Study of Gas-Liquid Two-Phase Flow in Glass Micromodels

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In the determination of one of the most important flow variables in reservoir engineering, the relative permeability-saturation curve (k_{ri}-S_i), it is necessary to know, with accuracy, variables like the saturation and the pressure differential of the phases, in addition to the intrinsic variables of the porous media, such as porosity and absolute permeability. In this study, the experimental tests were realized using a gas-liquid two-phase flow. The registered variables were, in the steady state, the liquid flow phase and pressure differential, and the flow patterns were visualized inside a transparent glass micromodel. These images were recorded at 500 fps, and were used in the calculations of the saturation of each phase and the gas velocity at three different points in the glass micromodel. Also, in this research, the effect of variables such as the superficial tension, the viscosity of the wetting phase, and the velocities of the gas and liquid phases, in the k_{ri}-S_i curves, and their effects on the flow patterns in the glass micromodel, were studied. The main conclusions reached were: 1) higher rate flows minimize the boundary effect; 2) the gas velocity profiles were related to the presence or the absence of the boundary effect; 3) variables, such as the superficial tension and the viscosity of the wetting phase, affect the flow pattern inside the glass micromodel; 4) the flow patterns are related to the relative permeability-saturation curves; and 5) visualization with high speed cameras is an efficient and exact methodology in the determination of the saturation of the phases and the study of the flow patterns in the glass micromodel.