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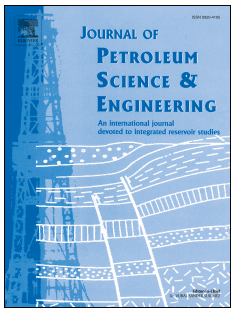

Phase wetting detection and water layer thickness characterization in two-phase oil-water flow using high frequency impedance measurements

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Phase wetting detection and water layer thickness characterization in two-phase oil-water flow using high frequency impedance measurements

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Abstract

Two-phase oil-water pipe flow is common in oil production. When transported water contacts pipeline walls, a phenomenon known as water wetting, severe internal corrosion can occur. Water wetting can be avoided by entrainment of the water phase into the oil phase. Consequently, it is of great interest to understand operating conditions where this happens. Various experimental works have been performed to study water wetting in oil-water pipe flow. In general, two-electrode DC conductance measurements have been used to detect water wetting. Despite its implementation, application of this analytical setup is not straightforward; it requires extensive calibration due to the effect of the electrochemical reactions occurring at electrode surfaces. Moreover, reliable conductance measurements of the water phase are unobtainable. Proper estimation of important geometric characteristics such as the thickness of water layers is not possible, either. In this work, high frequency impedance measurements on a flush mounted two-electrode concentric probe are used in order to detect phase wetting regimes in large-scale oil-water pipe flow, as well as to determine the water layer thickness associated with water wetting. Formulae that correlate the resistance of sensed water layers with their actual thickness are described and validated. Excellent results in terms of phase wetting detection are obtained and dynamic characterization of the water layer thickness is also enabled.

Keywords: Phase wetting, multiphase flow, high frequency impedance, conductance, water layer, corrosion.

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