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Heavy oil-water two-phase flow characteristics in a vertical pipe

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Oil-water two-phase flow widely exists in the oil industry with environment of high temperature and high pressure, such as oil exploitation, transportation and refining. Despite the great progress about oil-water two-phase flow, it seems clear that there is room for a great deal for more research on the effect of temperature and pressure on heavy oil-water two-phase vertical flow pattern. The goal of this study is to promote a better understanding of flow patterns of heavy oil-water two-phase pipe flow, particularly, flow patterns under high temperatures and high pressures. We conducted experimental measurements to examine the upward oil-water flow patterns in a small diameter vertical pipe (0.01 m ID) under high temperatures up to 130 °C and high pressures up to 20 mPa. The viscosity of the oil sample was 584.24 mPa-s and the density were 1.899 g/cm^3 at 30 °C. All the experiments were conducted with an in-house-built high pressure/temperature flow apparatus. This apparatus is equipped with a view window that allows us to visually observe the upward flow patterns of oil-water two-phase flow in a 0.01 m ID stainless steel pipe. The effects of pressure, temperature, Input Water Fraction (IWF) and mixture flow velocity on the flow patterns were systematically investigated. We plot the observed flow patterns on a flow pattern map in which input water fraction was used as the Y-axis and the mixture flow velocity was used as the X-axis. Based on the measurement results, we can observe the following flow patterns water-in-oil dispersed flow (D w/o), water-in-oil Bubbly flow (B w/o), water-in-oil Slug flow (S w/o), water-in-oil Creep Flow (CE w/o), churn flow (churn) and core Annual Flow (AF). Phase inversion was not observed in this work. With an increase in temperature at a given input water fraction, S w/o, CE w/o and churn flow with large water drops tended to transform into B w/o and D w/o with smaller water drops, the CE w/o disappears gradually, and the boundaries in the flow pattern maps tend to occur at lower input water fraction values. The effect of pressure on the flow patterns was found to be opposite to that of temperature. The possible causes leading to the changes in the flow patterns subjected to pressure/temperature variations were provided in terms of changes in density ratio, interfacial tension and viscosity ratio between oil and water.

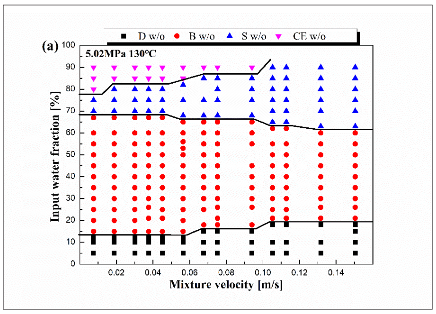

Figure-1: *Flow pattern map based on input water fraction and mixture velocity under 5.02 mPa at 130 °C.*

Biography

Jixiang Guo has completed her Doctor degree of Chemistry Engineering and Technology from China University of Petroleum, Beijing. She is a Professor and Doctoral Supervisor major in enhancing oil recovery. She has presided over several China's major scientific research projects. She has published more than 40 papers in reputed journals and has been serving as an Editorial Board Member.

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