

Uncertainty analysis for the measurement of oil-water flow parameters, part I: Flow rate and water holdup

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Abstract

In this study, the reliability and quality of flow rate and water holdup measurements of oil-water flow in different pipe inclinations and diameters were investigated. The identified sources of errors in the measurement of flow rate were repeatability, accuracy of the flow meter, resolution of the measuring cylinder and instability of the regulating valves. The identified sources of errors in the measurement of water holdup were repeatability, resolution of the measuring cylinder and flow rate. The results showed that the relative uncertainty in the measurement of the oil-water flow rate was ± 1.71 % while the relative uncertainty in the measurement of the water holdups was ± 10.3 % at 0.5 m/s mixture velocity and 0.5 input water fraction in horizontal 30.6-mm ID pipe. It was also found that the flow meter accuracy made the largest contribution (about 50 %) while the resolution of the measuring cylinder made the least contribution (3 %) to the combined uncertainty in the flow rate measurement. In the case of the combined uncertainty in the water holdup measurement, the largest contribution came from the flow rate while the least contribution came from the resolution of the measuring cylinder in all the different pipe inclinations and diameters.

Keywords: Oil-water flow; Flow rates; Water holdups; Standard uncertainty, combined standard uncertainty; expanded uncertainty

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