Interface Estimation in a Three-Phase Separator using a Tomographic Profiler

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Abstract

Information on interface levels is an indispensable part of maintaining and improving the performance of various separation processes. Non-optimal levels or unawareness of the process state can result in several problems, such as issues in wastewater processing, poor product quality, or unnecessarily low throughput. Electrical tomography is a rapidly emerging technology for level measurements in separation processes. It is well-suited for measuring various interface levels in challenging operating conditions where good accuracy and decent time resolution are needed. Rocsole Ltd has been developing tomography-based level measurement technology, and this paper summarizes the results from different test cases carried out in a controlled test environment.

The test environment is created based on the conditions found in an enhanced oil recovery process. During the tests, different levels of liquids with various properties are used, and their electrical properties are examined using a tomographic probe sensor. The probe sensor sends an excitation voltage to an electrode ring, and the current response is measured on other electrode rings. The liquid interfaces and their properties can be characterized using the collected measurements.

The performance of the probe sensor is evaluated in a simulated separator process condition by installing it in a 300l test vessel and adding transmission oil, salt water, and 20%, 40%, and 60% water-cut emulsions. High salinities were used in both the water and emulsions since seawater injection is commonly used as part of an Enhance Oil Recovery (EOR) process. The error in estimated water-emulsion and oil-gas interfaces was within $\pm$ 1 cm (less than 1% deviation from actual values). Some mixing occurs as various fluids are inserted into the test vessel. The mixing of emulsion and water was relatively minor. However, oil and emulsion were mixed significantly, and no clear interface could not be identified. The estimated conductivity profile shows the conductivity gradient in the emulsion-oil interface correctly. The estimated conductivity values for

20% and 40% water cut emulsions show that the difference in the water cut can be clearly detected from the estimated conductivity values. The effect of contamination of the probe surface was also tested by applying Vaseline on the surface of the probe. The emulsion-oil and oil-gas interfaces are also accurately estimated with the contaminated probe. The estimation of the water-emulsion interface can be more difficult. However, it was correctly estimated after some minor changes in the estimation parameters.