Assisted Extra Heavy Oil Sampling by Electromagnetic Heating

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Abstract

Sampling extra heavy oil becomes a challenging operation when viscosities overcome 3000 cp at reservoir temperature. The acquisition of quality samples that allow obtaining accurate viscosity measurements and initial solution gas, among other fluid characterization measurements, is crucial, since they are key parameters to identify and select reservoir strategies. Samples that are commonly gathered from such reservoirs come from mud tanks during drilling, which bring uncertainty due to chemical contamination, and from preserved cores, which usually cannot provide sufficient volume for the required analysis.

A new sampling technique presented in this paper, involves an operation assisted by electromagnetic heating. This technology has been studied since the 70s, with some field trials in the 90s, and is currently subject of renewed interest due to better design and prediction methods. It consists of applying radiofrequency heating through use of an antenna positioned in front of the zone of interest. The target zone heats up due to the water molecules oscillation induced by the electromagnetic waves. The increment of reservoir temperature reduces the extra heavy oil (EHO) viscosity and allows such viscous fluid to flow. After heating a substantial fluid volume, the downhole sampling operation with a wireline tool can be started. Heated volume and temperature increment become key parameters to have a successful operation.

The heating process is simulated using a coupled reservoir and electromagnetic (EM) simulator. The thermal and electromagnetic models are created for a reservoir with standard conditions found in Colombian Llanos basin, which is the type of reservoir where this heating technology will be applied. Multiple simulations of the heating process using different radio frequencies (RF) power levels, frequencies and antenna lengths were performed to identify the optimum combination which would allow fastest heating process.