

Oil saturation measurement from SWCTT

Single-well chemical tracer test (SWCTT) proves EOR effect

Challenge

The operator (ENI) of a West-African oil field wanted to measure oil saturation in the near-well region of one of the producers in the field before and after EOR pilot tests to qualify the EOR methodologies (IPTC 17951 and SPE 179788).

Solution

RESMAN's single well chemical tracer test was deployed and used to assess remaining oil saturation before and after the EOR operations. The SWCTT is a non-intrusive test based on injection of a partitioning tracer (ester) into the reservoir. Some of the ester hydrolyses during a shut-in period, and subsequent production of the well, yield tracer production curves of the ester and the alcohol produced during shut-in that can be used to determine remaining oil saturation (ROS) given by the expression

$$S = \frac{(t_2 - t_1)}{(t_2 + t_1(K - 1))} \quad (1)$$

where t_1 and t_2 are the retention times of the non-partitioning and partitioning tracer, respectively, S is the residual oil saturation, and K is the partition coefficient of the ester tracer.

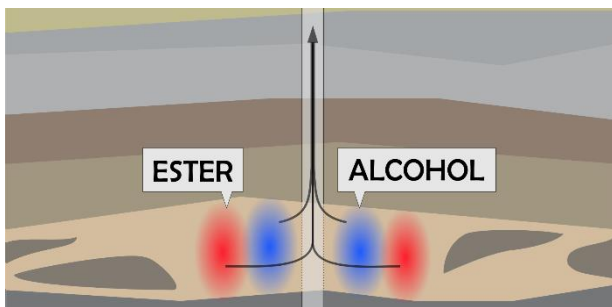


Fig. 2 - Illustration of the single-well chemical tracer test (SWCTT) principle. During a SWCTT, ester is injected into the formation. Parts of the ester react with water (hydrolyze) to form alcohol. During back-production (see illustration) the partitioning ester lags behind the alcohol and the time-difference is directly related to oil saturation in the formation.

Application

A crew was deployed to the well site and an on-site lab was established to provide concentration vs. time from the ester and in-situ generated tracer.

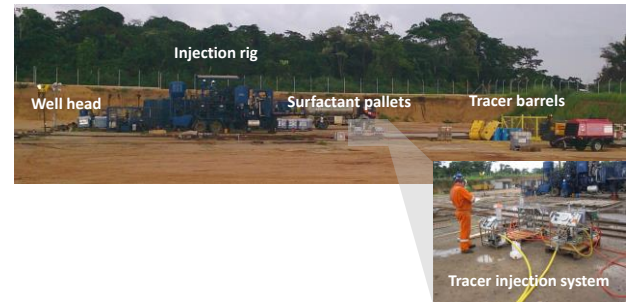


Fig. 2 - SWCTT injection rig-up at a West-African field site. Three SWCTTs were performed during a 1-month operation to verify surfactant and low salinity EOR operations.

Results

Tracer data recorded during the on-site operation was interpreted using a near-well model and used to find initial values for the ROS as well as ROS after low-salinity injection and after surfactant injection. The conclusion from the SWCTT was that low-salinity injection has little impact in the specific reservoir, whereas surfactant injection could decrease ROS.

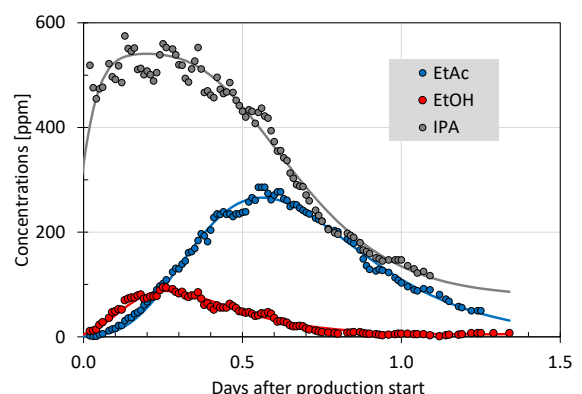


Fig. 2 - Tracer curves from one of the three tests that confirmed a large effect of surfactant in the field and verified that low salinity water flooding had a minor effect. The time-separation between the ester (EtAc) and ethanol (EtOH) gives the oil saturation.