SPWLA France

Webinar by Gilles Puyou

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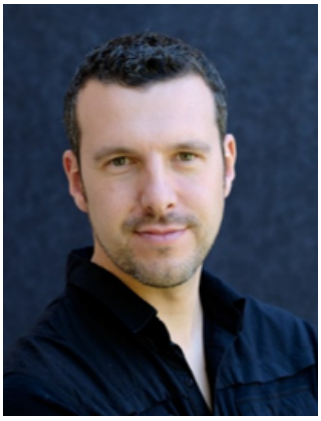
Topic: Gas-Oil interaction and Gravity impact on high permeability WAG experiments

Speaker



Gilles PUYOU is a Reservoir Laboratory Engineer at TotalEnergies, based at the CSTJF research center in Pau, France. He holds an engineering degree in Applied Physics and has built a career specializing in laboratory-based reservoir characterization and simulation workflows. He contributes to high-impact projects focused on core analysis, dynamic simulation, and enhanced oil recovery. His work spans both experimental and modeling domains, with a strong emphasis on automation and innovation in laboratory processes.

Gas-Oil interaction and Gravity impact on high permeability WAG experiments.

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Abstract:

This study evaluates the impact of the gas-oil interaction on miscible gas injection experiments, and also the gravity impact on these experiments. The program comprised 4 reservoir conditions WAG experiments, conducted in multi-contact miscible conditions, with live oil and reservoir rock, and different WAG slug sizes, starting either with water or with gas. More conventional 2-phase laboratory conditions experiments were also conducted and available for comparison. The field of interest is a high-pressure sandstone green field, in deep offshore environment, with low dip and high permeabilities.

Advanced monitoring allowed to visualize and quantify the thermodynamic phenomena of stripping and swelling for all experiments, as well as gas override and water underride for the horizontal experiments.
The results compare recovery factors, the evolution of trapped gas, water saturation, and productivity indices across various injection cycles. The experimental design allowed efficient monitoring of effluent production volumes with reservoir pressure and temperature respected, and at surface conditions with clear separation of flashed oil, oil produced via gas, and gas, complemented by compositional analysis of gases and liquids.

The history match in 1D and 2D allowed to quantify the 2-phase petrophysical parameters like relative permeabilities, and also the three-phase parameters specific to alternate injections of gas and water (GWGW and WGWG long slugs and GWGW short slugs).

A specific focus was set on the gravity impact on a scenario with maximum gas-oil interaction (GWGW): varying the orientation from horizontal to vertical showed a substantial change in behavior: the mixing zone was much reduced, changing the nature of the gas-oil interaction.

Flow analysis and understanding were enhanced using a real time 2D X-ray imaging system to visualize 3-phase fluid distribution within the rock sample. The study's findings clearly demonstrate that switching the injected phases allows to stabilize and better distribute the gas, which results in improved recovery thanks to the thermodynamic exchanges.

Overall, these WAG injections illustrate the benefit of 3-phase flow even in high permeability horizontal floods: the high recovery factors, which were expected for miscible conditions, were achieved much quicker when alternating gas and water as injected phases.