

Heavy Oil Reservoir Management in Colombia: Challenges and Opportunities

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Abstract

Significant quantities of heavy oil are trapped in the Colombian Reservoirs, especially those belonging to the Llanos, Caguan-Putumayo and Middle Magdalena Basin. The top 5 producers in the country, are heavy oil fields ranging from 7.5 to 13 API representing around 400,000 bopd. A similar situation can be considered for the reserves distribution, where heavy oil is placed in a key-player position in the short-term industry forecast. Production from these assets involves special challenges, nevertheless operators are finding strategic solutions to make it a sustainable business.

This presentation reviews some of the fluid and rock properties from literature examples for the county, and describes the main challenges and opportunities in reservoir management, drilling and completion, as well as production strategies to successfully develop these areas. The main subsurface challenges are discussed during the presentation, and can be summarized as follows:

- Low Recovery Factor under primary depletion, driven by: either high water oil ratio (WOR), low deliverability well wise or reservoir features away from traditional industry know-how.
- Adverse Mobility Ratio for any flooding process, resulting into poor volumetric and displacing efficiency.
- Difficulties for predicting reservoir connectivity and rock quality away from the wells, especially important for secondary recovery processes.
- Complex hydrocarbon migration histories that resulted in complex oil and water saturation distribution.
- Flow conformance issues in the wells.
- Validity of Darcy equation on porous media under high WOR / adverse mobility ratio.

Strategies to overcome these issues are driven by technology, discipline integration and cost effective approaches. Each reservoir has its proper solution. Nevertheless some worldwide or Colombian workflows are discussed as references:

- Horizontal Wells: Many heavy oil field examples show that horizontal wells can be used to efficiently drain larger reservoir sections. Basic physics is presented with key-factors to success.

- Completion Technology: increasing the well completion control is a corner stone for achieving high recovery factor in heavy oil. Tools such as inflow control devices (ICDs) are presented, as well as typical completion designs for different type of projects.
- Seismic as Reservoir Surveillance Tool: when injecting fluids that induce an important change in acoustic impedance such as steam, 4-D seismic becomes a key element to monitor the steam front and areal sweep efficiency. On the other hand, Micro seismic can be useful to estimate vertical flow conformance and process efficiency.
- Enhanced Oil Recovery (EOR): by far the most successful implementations for EOR in Heavy Oil are: Steam Injection, Water flooding and Polymer injection. General aspects for each of the last are presented and discussed. A recent and promising method of recovery called bilateral sink well is illustrated and discussed, as well as its applicability in the country.