

Brazil

First gravel pack with fluidic-diode AICD in operator's ultra-deepwater field reduces water production and improves oil recovery

Breakthrough in productivity improvement from the combination of gravel packing and EquiFlow® AICD technology

CHALLENGE

- Sand-production in field with significant underlying aquifer
- Facilities not designed for high-water-content processing

SOLUTION

- OHGP with EquiFlow® AICDs and oil/water tracers
- Modified gravel pack placement to reduce treatment pressure

RESULT

- Hydrocarbon production and deferred water production exceeded expectations
- Tracer data demonstrated completion effectiveness in terms of reduced water
- and an enhanced, even inflow profile

Overview

Located in ultra-deepwater offshore Brazil, a post-salt heavy oil field development presented sand control and potential water production challenges. As part of the initial development plan, the project operator completed the first two wells with openhole gravel packs (OHGPs), but produced water remained a concern.

After discussing the available options, Halliburton and the operator agreed to complete the third well with OHGP and EquiFlow® autonomous inflow control device (AICD) technology to defer and reduce water risk, as well as equalize the inflow of hydrocarbon recovery along the completion. Oil and water tracers installed in the lower completion provided data over a 2 1/2-year period, which proved the AICD effectively balanced hydrocarbon inflow across all zones and significantly offset and reduced water production from the middle and heel sections of the well.



"Both productivity and production rates are above expectations."

"...this is the most prolific well among the three wells planned for the EPS..."

SPE-199325-MS

Challenge

The reservoir is situated above a significant aquifer and is heterogeneous, particularly in the middle and heel sections. Water breakthrough and increased water cut led to uneven oil recovery and impaired production from the first two OHGP wells. To minimize water production issues in the third well, the operator decided to incorporate AICD technology, which necessitated a new gravel pack strategy to ensure effective placement and efficiency.

Solution

Halliburton and the operator evaluated the available options and, after due diligence and consideration, decided AICDs would yield the greatest benefit. Single and multiphase testing conducted at field conditions verified operational efficiency. Halliburton also performed

CASE STUDY

several reservoir and gravel pump simulations and determined that a modified gravel placement technique with an optimized AICD completion and sacrificial screen assembly provided a reliable solution to overcome the excessive increase in equivalent circulating densities (ECDs). Low-density proppant placement using a multi-wave alpha technique induced returns through the sacrificial screen assembly to provide successful sand control. Tracers included in the assembly provided data to evaluate AICD performance and viability.

Result

Collaboration throughout the planning and execution phases led to this first global application of AICD technology in the ultra-deepwater environment. The OHGP completion with AICDs helped improve oil recovery and reduce water production to maximize asset value.

Tracer analysis results clearly demonstrated balanced oil recovery with contribution from all zones. In addition, incorporation of AICDs helped offset and curtail water production from the heel and middle section compared to previous OHGP completions without AICDs.

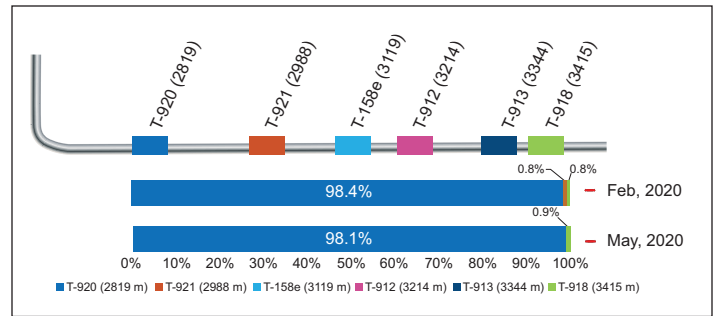


Figure 1

» **FIGURE 1** - Predominant water production toward the heel in the first two OHGP wells without AICDs.

» **FIGURE 2** - Sequential results from more than 2 years of tracer monitoring shows balanced oil flow and reduced water from the heel section in the OHGP well with AICDs.

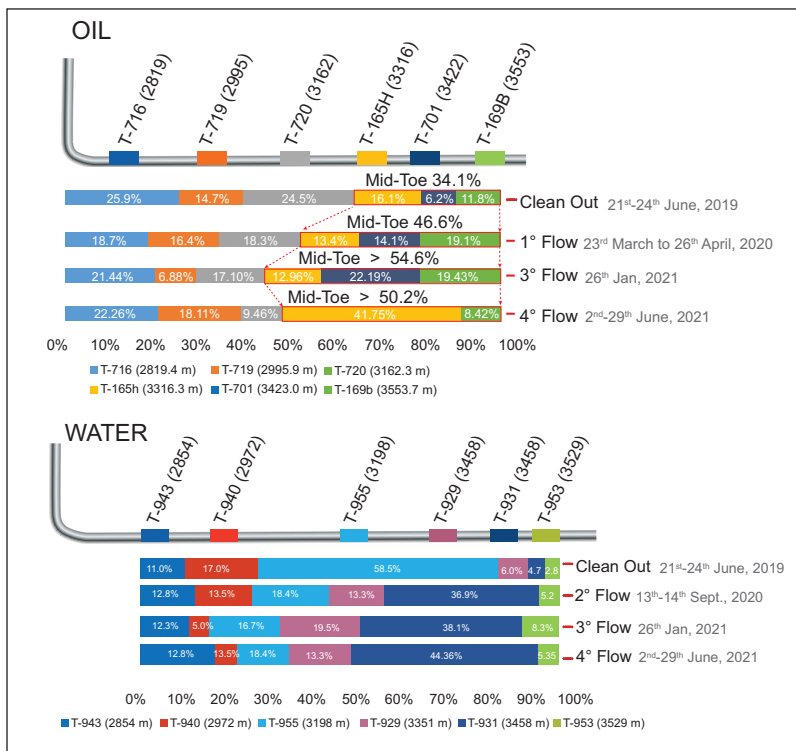


Figure 2

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