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Nanofluidity mitigates problems

Nanophysics can be harnessed to reduce downhole deposition of paraffin, asphaltene and scale while improving fluid viscosity at the surface.

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Nanofluidity increases average production, reduces operating expenses and protects the environment. Unlike traditional thermal, chemical and mechanical methods, which are remedial, Revelant's nanofluidity technology is preventative and uses nanophysics to drive better oil chemistry during production and transport.

This technology has seen use in diverse geological settings in 23 countries but has only recently launched in the U.S. Its production optimization technology, known as the Enercat, minimizes and often prevents paraffin crystallization, asphaltene flocculation and scale precipitation, all the while minimizing or preventing the usual increase in viscosity of crude oil as it rises in the well. First used in 1991, the technology lowered the pour point of paraffin-rich oils in northwestern Canada. With patents pending, Revelant is pioneering a new area of nanophysics called nanofluidity through an R&D partnership with Colorado State University (CSU). This partnership is advancing the measurement, tuning and focus of the Enercat to respond to various oil types and address perennial problems such as barium sulfate.

Description

The Enercat is a material composite that is not magnetic or radioactive and requires no external power source, maintenance or servicing. It has no internal restrictions and is installed below the depth of paraffin and/or asphaltene deposition and below the depth at which viscosity begins to increase up the wellbore. For scale problems only, depth is not an issue. It also can be installed in a series to handle high oil production rates.

The Enercat TubingTool is designed for downhole installation in the production tubing string of a well. It is installed during a completion operation or workover as an industry-standard 1.2-m (4-ft) pup joint that meets required installation specifications. Handling capacities vary by tubing size: 2⅜ in. at 30 bbl/d, 2⅞ in. at 35 bbl/d and 3.5 in. at 70 bbl/d.

The Enercat TrimTool is installed without pulling the tubing string by attaching the tool to the bottom of the pumping assembly on a producing well. This allows tool installation independent of workovers, making it ideal for low-producing wells. The 12-in. version handles up to 10 bbl/d, and the 28-in. version handles 15 bbl/d to 20 bbl/d (Figure 1). In addition, Revelant has completed the initial design specifications for an Enercat Slickline Through-TubingTool designed for offshore wells with 1,000 bbl/d or less production. Each tool has a handling capacity of 40 to 50 bbl/d.

Installation configurations

Each tool works in virtually any well that experiences deposition, including dual completions and directional, horizontal, steam-assisted gravity drainage, water source and water injection wells. Each also works with any pumping system with the exception of electric submersible pumps. Each application is customized for specific wells depending on tubing size and fluid volume. The tools typically run below the pump intake or above the pump discharge or, in the case of a flowing well, as a tail joint at the end of the tubing string.

FIGURE 1. The Enercat TubingTool is designed for downhole installation in the production tubing string of a well during a completion operation or workover. The Enercat TrimTool is designed for installation at the bottom of a pumping unit on a producing well during well servicing. (Source: Revelant)

Virtually all of the 4,500-plus Enercat installations world-wide have successfully solved paraffin, asphaltene, scale and heavy oil production problems if the tools were properly installed, and the wells did not have high fluid speeds, high GOR or extremely high salinity. A paraffin case history from Venezuela and an asphaltene

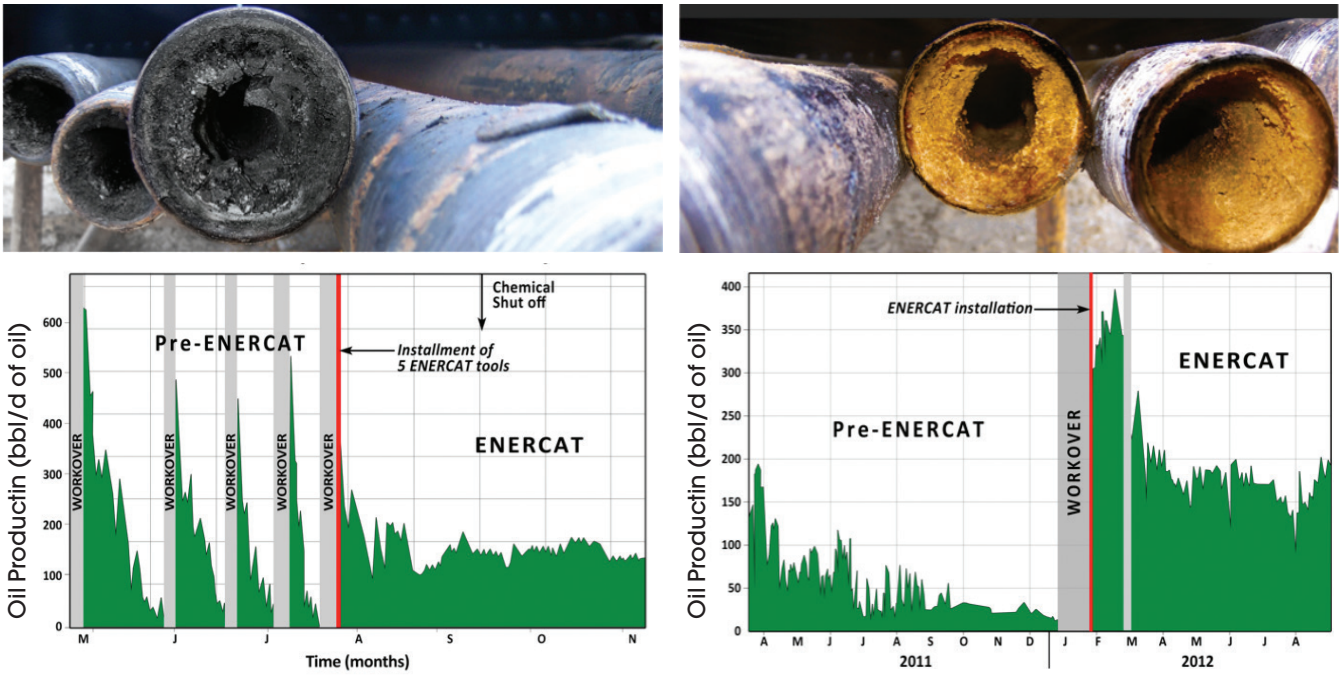

FIGURE 2. Stabilization and increased production result from the installation of the Enercat at the end of standard workovers. (Source: Revelant)

case history from the Eagle Ford in Texas are shown in Figure 2.

Revelant's nanofluidity technology saves time and production costs, improves safety, protects the environment and increases revenues by stabilizing and enhancing oil production. As oil prices decline and profit margins tighten, these inverted relationships become more critical (Figure 3).

Science CSU partnership

Revelant partnered with faculty at CSU to work out the details of the physics and chemistry underpinning the Enercat. A refined understanding of the tool will allow further tuning and addressing of specific problems with fluid stability in the oil and gas industry. The tool acts as a paraffin crystal modifier delaying the onset of crystallization by increasing paraffin solubility, which minimizes or prevents paraffin from crystallizing inside the wellbore. It also acts as a resin proxy by increasing the stability of asphaltene molecular dispersions, thus minimizing or preventing asphaltene flocculation and deposition and increasing viscosity as crude oil rises up the wellbore. The tool drives the crystallization of nonscale-forming aragonite over calcite in the crude oil bulk fluids, thus minimizing or preventing calcite from depositing inside the wellbore.

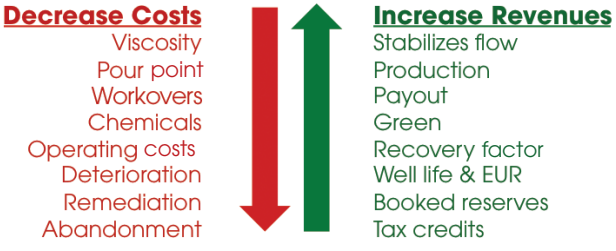

FIGURE 3. Reduced costs, increased revenue and environmental benefits result from the use of Revelant's nanofluidity technology. (Source: Revelant)

The Enercat's international track record, documented by case histories and testimonials from 23 countries, provides valuable insight into the mechanisms of Enercat technology. The empirical results from the case histories point toward physics driving chemistry at the nanoscale influencing the nanofluidity of the reservoir fluids. This changes the distribution of seed nucleates for crystal growth in the fluid, meaning the low-frequency molecular vibrations of the crude oil are affected by the generation and transmission of fields through the Enercat. Ambient conditions (energy) surrounding the tool downhole are the "hammer" that drives the fields. The generated frequencies influence fluids at the nanoscale, moving molecules in a constructive direction through quantum affects and classical mechanics. E&P