Fiber-Optic Distributed Temperature Sensors Help Extend Well Life and Increase Recovery

WellWatcher BriteBlue HT high-temperature multimode DTS fiber enables continuous, accurate temperature profiles

**CHALLENGE**

Find a permanent, reliable means of continuously monitoring the steamflood operating temperature in an entire horizontal section of a heavy oil reservoir without difficult and costly well intervention methods.

**SOLUTION**

Install a WellWatcher BriteBlue HT* high-temperature multimode DTS fiber sensor using patented fiber-optic pumping installation technology.

**RESULTS**

Obtained the distributed temperature profiles of the injection and production wells, allowing the subcool temperature differences in the wells to be balanced and optimized, thereby helping extend the life of the wells and increase the overall hydrocarbon recovery.

**Accurate temperature measurements vital for extracting heavy oil**

Several operators with invested interests in heavy oil thermal recovery in Canada were committed to understanding how best to extract hydrocarbons using steamflood technology. They found that the key to the extraction was how the steam chamber was distributed within a reservoir and how the producer wells were positioned in relation to that distribution. They also found that accurately measuring temperatures at multiple points along the wellbore was a vital part of the extraction process.

**Temperature data captured in real time with new fiber-optic sensor**

In response to this need, Schlumberger—with more than a decade of experience in monitoring thermal recovery wells—developed the WellWatcher BriteBlue HT high-temperature multimode DTS fiber. The fiber was put through a rigorous development process that included accelerated laboratory testing in temperatures of up to 300 degC [572 degF] and in a pure pressurized hydrogen environment of 3.4 MPa [500 psi].

The new fiber technology allows downhole distributed temperature profiles to be monitored at the surface in real time. It helps build a detailed picture of what is happening across the entire length of a wellbore. Data can be transmitted to multiple remote locations with satellite, Internet, and cable communications, allowing operators to immediately identify the time, location, and reasons for changes in flow, all inferred from the temperature profile. The information obtained helps optimize the steam injection process and maximize production.

**CASE STUDY**

Completions

Distributed temperature profiles were obtained seven times over 9 months. The data reflect the consistency of the profiles over time. The absence of the characteristic hydrogen loss–induced bend indicates that hydrogen did not degrade the fiber.
CASE STUDY: WellWatcher BriteBlue HT multimode fiber enables continuous, accurate temperature profiles

**Loss rates minimized, extending well life and increasing production**

The first installation of the WellWatcher BriteBlue HT fiber sensor was in April 2007 in a typical steam-assisted gravity drainage well. The well measured 1,200 m (3,937 ft) and had a 600-m (1,969-ft) horizontal section. It was regularly operated at about 200 degC (392 degF). After 15 months, the sensor has operated normally, and the fiber has shown no visible temperature variations caused by hydrogen degradation. Accurately monitoring the distributed temperature profiles of the injection and production wells has allowed the subcool temperature differences to be balanced and optimized.

WellWatcher BriteBlue HT fiber sensors have since been installed in numerous newly drilled wells and in older installations in which the fiber had degraded and no longer provided accurate temperature profiles. To date, no WellWatcher BriteBlue HT fiber installations have shown loss rates of more than about 0.25 dB/km per year at elevated temperatures; the loss rates of previous best-available fibers were about 12 dB/km per year under comparable conditions. This 50-fold improvement has significantly increased the time between fiber replacements, allowing operators to use wellbore data for reservoir optimization for much longer periods than had previously been possible. The result has been both an improvement in reservoir recovery and improved efficiency of steam injection.

**Better understanding gained through accurate distributed temperature profiles**

In the Canadian reservoirs, the downhole data acquired with the permanently installed WellWatcher BriteBlue HT fiber have continued to show the steam chamber profiles continuously and in real time throughout the horizontal sections of the wells. Armed with these temperature profiles, the operators have gained a better understanding of the steam-injection process and the factors required for its optimization. This knowledge has helped them extend the life of the wells and increased overall hydrocarbon recovery.