DTS for Gas Lift Optimization

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Schlumberger
Introduction

A standard mobile slick line unit and drum with the fiber-optic installed inside a 1/8 inch diameter cable was utilized for these surveys.

The main objective of these slickline deployed DTS surveys was to verify gas lift valve operation and performance in order to detect any possible anomalies.
Fiber Optic Slickline

- Fiber inside slickline is the measuring device
- Wire remains stationary
- 10 nanosecond bursts of laser light sent down the optical fiber
- Back-scatter to surface contains temperature related information
- Distributed temperature from the top of the well to the deployment depth of the line

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accuracy</td>
<td>&gt; 0.1 deg C [0.18 deg F]</td>
</tr>
<tr>
<td>Resolution</td>
<td>~ 0.1 deg C [0.18 deg F]</td>
</tr>
<tr>
<td>Spatial resolution</td>
<td>1 m [3.28 ft]</td>
</tr>
<tr>
<td>Outer Diameter</td>
<td>3.18 mm [0.125 in]</td>
</tr>
<tr>
<td>Working pressure rating</td>
<td>103 MPa [15 kpsi]</td>
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<tr>
<td>Max. temperature rating</td>
<td>125 C [257F]</td>
</tr>
<tr>
<td>Anticorrosive material</td>
<td>Incoloy® alloy; H2S-corrosion resistant, 15%HCL</td>
</tr>
</tbody>
</table>
Data Display

Distributed Temperature Example

• Warm colors (yellow/red) represent higher temperature
• Cooling or cold temperatures shown as blue or blue-green curves
DTS Example: Case Study #1

2 Dimensional Temperature Data from DTS Data

- Traditional survey unable to accurately resolve lift/leak point(s)
- Production is unstable and “slugging” fluid to surface
- High fluctuations in injection pressure
DTS Example: Case Study #1

3 Dimensional DTS Data Plot

- **Final Diagnostic:** Multipoint Injection @ mandrel 5/7 (stable injection) & 7/7 (intermittent activity every 5 ms) combined with unstable flow conditions
- **Remedial Action:** GLV #5 & #7 changed out; Oil rate increased 600%; injection pressure stabilized/optimized
DTS Example: Case Study #2

Conventional Survey w/ Gauges

- Conventional survey indicated potential tubing leak uphole; client was going to pull tubing
- DTS survey concluded intermittent lifting from the lowest most valve
DTS Example: Case Study #2

• No leaks detected with DTS; temperature change associated with fluid level
• **Remediation:** Change out lowest most gas lift valve to a continuous injection valve

3 Dimensional DTS Data
DTS for Gas Lift Optimization

- DTS surveys can identify the operating valves if the well is operating in either a stable or unstable condition.
- Modelling can be used to see the magnitude of the expected steady state GLV effect at the operating valve and compare with the actual test results. Also, a pressure profile can be generated based on thermal simulation.
- A memory pressure gauge at the end of DTS string will aid in the gas lift design and optimization. It will assist with understanding the well performance with the current gas lift system and adjust or improve futures designs.
- An additional use for DTS is measuring the natural flowing temperature profiling using this information to predict gas-lift casing operating pressures for better lift design (source: SPE 181215)
Papers:

- SPE 154442: Slickline DTS Measurements Provide Useful Information for Well Integrity Diagnostics, Stimulation Treatments, and Water Injector Wells Performance: North America Land Case Studies
- SPE 181215: Identifying a Flowing Temperature Model for Gas Lift Designs in the Permian Basin
- SPE 114911: Real Time Well Diagnostic Using Slickline Fiber-Optic Distributed Temperature Sensors: West Venezuela Applications
- SPE 115816: Monitoring Inflow Distribution in Multi-zone, Velocity String Gas Wells Using Slickline Deployed Fiber Optic Distributed Temperature Measurements
- SPE 173640: Monitoring Acid Stimulation Treatments in Naturally Fractured Reservoirs with Slickline Distributed Temperature Sensing
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