

# Operator Mitigates Completion Concerns and Maximizes Well Life with Engineered Packer Fluid

## N-SOLATE® LV PACKER FLUID PROVIDES NEW LAB-TESTED SOLUTION FOR HIGH-TEMPERATURE DEEPWATER WELLS

GULF OF MEXICO

### CHALLENGE

- » Reduce undesired heat flow at temperatures above 270°F, for 20 years
- » Prevent corrosion of the completion tubulars
- » Ensure compatibility with elastomers used in completion equipment

### SOLUTION

- » Custom-engineered N-SOLATE LV packer fluid
- » Performed lab analysis to test:
  - » Maintenance of properties to last 20+ years
  - » Corrosion/pitting resistance under the stress of high pressure
  - » Compatibility with various elastomers (after 30-day exposure to high temperature)

### RESULTS

- » Placed low viscosity fluid downhole during the completion phase
- » Successfully transferred heat in the annulus
- » Led to operator requesting the same solution for additional completions in this field

### OVERVIEW

Reservoir fluids flowing up the production tubing at high temperatures can heat the sealed annulus, resulting in thermal expansion of the annular fluids. This expansion causes stress on the well and can lead to tubing or well failures. An operator in the Gulf of Mexico tasked Halliburton Baroid with developing a heat transfer fluid to mitigate adverse effects on completion tubulars for their high-temperature, deepwater wells. Due to various completion types, in addition to reservoir fluids, the packer fluid needed to be compatible with both Calcium Chloride and Calcium Bromide brines and sustain its properties in environments with bottomhole temperatures in excess of 270°F.

In less than 10 months, by following Baroid's Solution Creation processes in conjunction with support from both the regional and global labs, the N-SOLATE® LV packer fluid solution was developed to the customer's well-specific criteria and deemed fit for purpose.

### CHALLENGE

During the completion planning phase, high bottomhole temperatures and their effect on completion tubulars were identified as key risks to be mitigated to maximize the life of the well. Economic viability was based on continuing the desired productivity level for at least the next 20 years. With a static reservoir temperature of 245°F, thermal fluid flow modeling indicated that the produced hydrocarbons would remain above 270°F before reaching surface. An aqueous packer fluid that also acted as a heat-transfer fluid was required to address this challenge. In addition, the formulated system had to protect the completion tubulars against corrosion and be fully compatible with the elastomers used as part of the completion equipment.

### SOLUTION

The Halliburton Baroid technical team recommended a heat-transfer fluid to solve the operator's challenge—field-proven N-SOLATE® packer fluid technology, which is designed to insulate against undesired heat flow. In this scenario, however, a brand-new N-SOLATE LV packer fluid was engineered to facilitate, rather than prevent, heat transfer away from the tubing to the annulus.

An extensive laboratory testing program was conducted to validate the fluid's performance in a variety of scenarios before being used downhole:

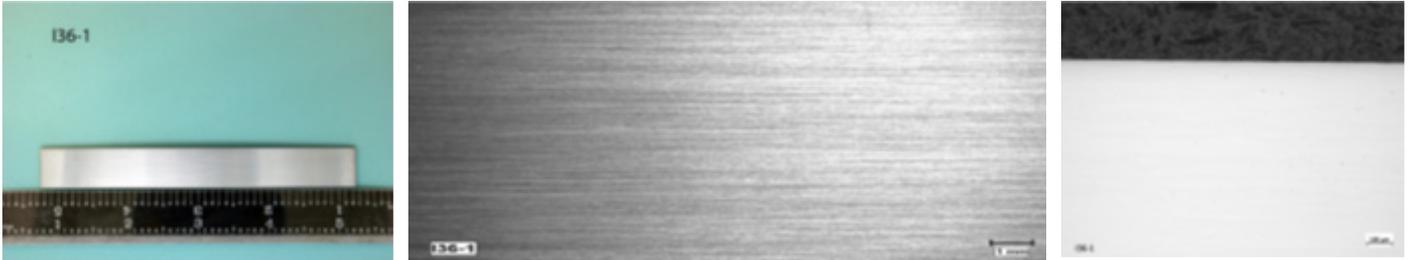
- Corrosion performance
- Elastomer compatibility
- Stress corrosion cracking (SCC)
- Long-term stability
- Fluid compatibility

**TESTING DETAILS**

Testing was performed after each batch was built to ensure the blend met exact specifications. So that the fluid was kept contaminant-free, the rig’s brine pits were completely cleaned, the sumps were pumped dry with the rig vacuum, and all mix and mud pump suction lines and flowline valves were double-isolated. Once the brine was on the rig, additional onsite QA/QC testing was performed to verify fluid cleanliness and specifications.

**SCC TESTING**

cracking or pitting was observed after SCC testing, as shown in the pictures below.



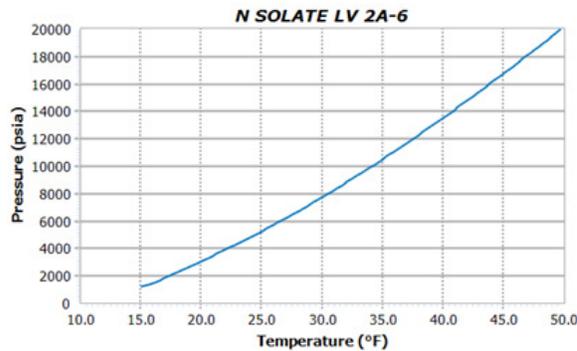
Photographs of 25Cr-125 bent beam sample after SCC testing: N-SOLATE LV / 2,000 psi N2 / 15 ppm O2 / 275°F environment. Left to right: a) photograph after testing and cleaning, b) close-up photograph, and c) optical micrograph at 100x.

**RESULT**

The customized N-SOLATE LV packer fluid, the newest addition to the N-SOLATE packer fluid family, was flawlessly spotted in the wellbore and kill line by Halliburton’s Cement Unit. Due to the ease of handling, there were no discrepancies with barrel-in/ barrel-out monitoring, pump speeds were able to be maintained, and pump pressures mirrored the modeled pressures.

After introducing N-SOLATE LV to this well, the operator was able to significantly reduce their costs and maximize asset value in the following ways:

- Reduced pressure on the subsurface wellhead
- Easy field deployment of a single, pre-mixed solution



Example of gas hydrate modeling for N-SOLATE LV packer fluid.

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