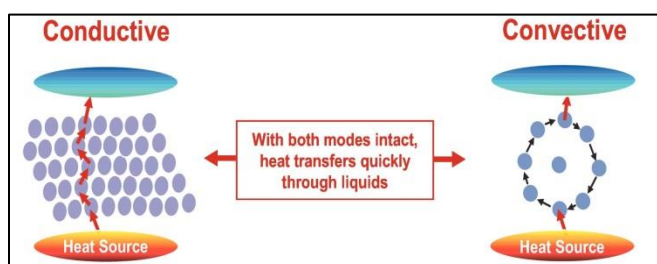


N-SOLATE® High-Performance Insulating Packer Fluids

Challenge

One of the challenges for production design is the potential for uncontrolled heat transfer to outer annuli and heat loss from the production tubing. This can damage outer annuli integrity, reduce productivity, and even lead to casing collapse. Under uncontrolled conditions, paraffin and asphaltene deposits and hydrate formations can occur.



Overview

Studies of effective methods to minimize heat transfer have identified four essential fluid characteristics for successful insulation:

- Tolerance for high temperatures
- Low thermal conductivity
- No suspended solids as weighing agents
- Long-term stability in the well



Compatibility results with crude oil, propylene glycol, methanol, and control line fluid, left to right. Contaminants were added at 20% by volume and allowed to equilibrate 24 hours at 70°F (21°C).

N-SOLATE® high-performance insulating packer fluids were created according to these criteria, and can effectively control unwanted heat loss by reducing both conduction and convection for the life of the well, providing the best overall performing thermally insulating packer fluid on the market today.

Benefits

N-SOLATE high-performance insulating packer fluids help prevent annular pressure buildup and maintain wellbore integrity, and ultimately providing an increase in production potential for the well. In addition, N-SOLATE packer fluids are a lower cost alternative to traditional methods such as vacuum-installed tubing (VIT), and help reduce costly risks associated with uncontrolled heat loss.

- Higher production potential
- Lower cost as opposed to traditional methods
- Prevents annular pressure buildup for the life of the well
- Control and prevent heat loss for the life of the well
- Maintains wellbore integrity
- Compatible with most wellbore fluids
- Easily removed from the wellbore
- Environmentally friendly, with low GOM toxicity and low oil and grease

Features

The N-SOLATE system is a new generation insulating packer fluid. Past systems utilizing biopolymers are simply not durable enough to provide long-term assurance. Baroid set out to develop a system which would remain durable for greater than six months at 300°F (149°C). This effort has yielded tremendous success and Halliburton now offers four systems:

- N-SOLATE 175 system: effective up to 175°F (79°C)
- N-SOLATE 275 system: effective up to 275°F (135°C)
- N-SOLATE 400 system: effective up to 400°F (204°C)
- N-SOLATE 600 system: effective up to 600°F (316°C)

These systems have taken insulating packer fluid technology to a new level and offer:

- Thermal conductivity (k) of 0.123 to 0.177 BTU/(hr*ft*°F)
- Thermal stability from 32°F to 600°F (0°C to 316°C)
- Density range from 8.5 lb/gal to 15.0 lb/gal
- Pumpable viscosity with heat-activated cross-link
- Covalently cross-linked (as opposed to ionically cross-linked)
- Hydrate-inhibitive to >8,500 psi at 40°F (>58.6 Mpa at 4°C) (can be engineered to higher pressure with density limitations)
- Environmentally friendly: oil and grease content <8 mg/L and LC-50 >100,000

The N-SOLATE 600 system is truly a unique fluid. The ability to withstand temperatures in excess of those that metallurgical components can is quite a feat by itself. But, N-SOLATE 600 fluid is also not subject to thermal thinning, guaranteeing enough viscosity is retained to eliminate or minimize convective heat loss. The N-SOLATE system uses nanotechnologies to achieve its performance objectives and becomes one of the first uses of nanotechnology in oilfield fluids applications.

Applications

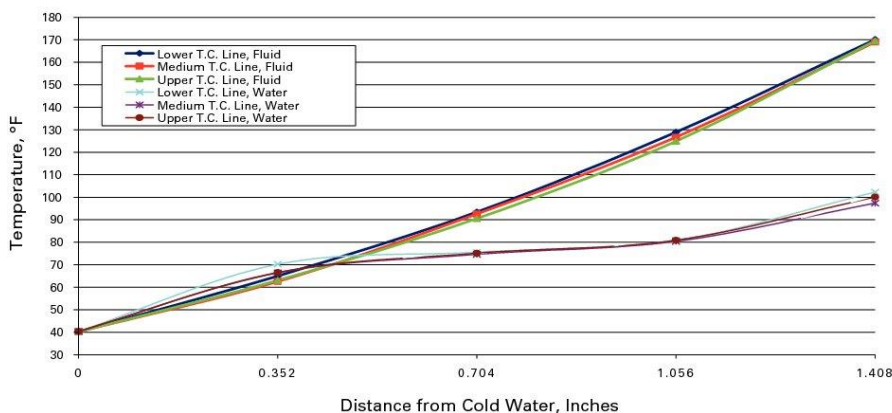
N-SOLATE insulating packer fluids are suitable for several applications, including deep water, HPHT, steam injection and permafrost. The N-SOLATE fluids are hydrate-inhibitive, pass oil and grease testing, and can be formulated to meet or exceed strict environmental criteria, including that of the Gulf of Mexico.

Extensive testing has shown that the N-SOLATE fluids are chemically compatible with propylene glycol, methanol, crude oil, control line fluids, and numerous mono- and divalent brines. In addition, N-SOLATE fluid exhibits excellent flow assurance capabilities; helps prevent annular pressure buildup; helps maintain lower ECD (equivalent circulating density), and can be used in environmentally sensitive areas. N-SOLATE fluid viscosity and gel strength can be customized for each individual application to help ensure that fluid density is supported over the long term.

Conclusion

N-SOLATE packer fluids can provide reliable, cost-effective protection when it comes to uncontrolled heat loss. They have been shown to outperform other options by meeting all the technical criteria as well as minimizing environmental impact. With outstanding thermal stability capabilities and density ranges, N-SOLATE fluids have been proven to help improve production rates while significantly lowering costs in deep water and steam injection operations.

Baroid Thermal Insulation Fluid Project
Temperature Profile of Wellbore Model with Water and Test Fluid



N-SOLATE 600 System

