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CemSTRESS

Quantifying the risk of wellbore cement sheath failure by applying stress analysis and sensitization criteria

APPLICATIONS

- High-pressure, high-temperature wells
- Fracture stimulation
- Wells with large variations in mud weight while drilling
- Wells with potential micro-annulus development or planned postplacement pressure/temperature variations
- Postwell stress analysis for future well performance

BENEFITS

- Improved well performance and productivity
- Saved cost over time with long-term isolation and casing protection in corrosive areas

FEATURES

- Built-in cement properties database
- Less risk of cement failure, which causes loss of zonal isolation
- Tensile, compressive, and microannuli failure modes
- Sensitization and risk analysis
- Evaluation of robustness of cement systems against set well parameters
- Detailed report generation
- Modeling of pressure and temperature changes with respect to time
- Protection from annular gas pressure and fluid migration
- Repair of microannuli resulting from decreases in well-control-fluid weight during drilling and completion
- Optimized stress management with a predesigned cement system

A lack of understanding of the stresses a cement sheath experiences and when or why the sheath may fail can lead to zonal isolation loss, jeopardizing the future of the well. The lack of zonal isolation adversely affects all subsequent operations and degrades potential well performance and productivity.

THE KEY TO UNDERSTANDING STRESSES

CemSTRESS* software is the key to understanding stresses in the cement sheath. It can model up to 10 strings simultaneously, analyzing the stress imposed on each string by a well event, such as pressure testing. CemSTRESS analysis of radial and tangential stresses can determine cement sheath performance in compression, tension, or both, enabling the design of the set cement behind the casing to be optimized.

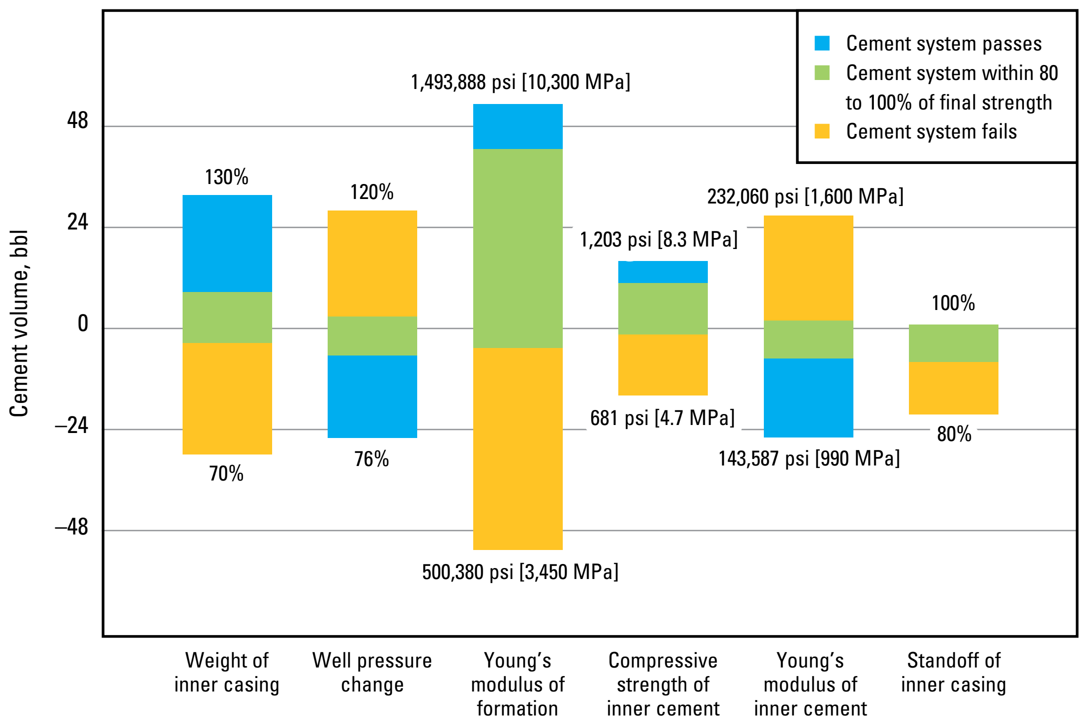
The system aids in selecting and designing a cement system that can extend well life and reduce the need for costly remediation—a system that can withstand stresses and maintain a 100% hydraulic seal for many years.

UNIQUE SENSITIZATION ABILITY

In addition, CemSTRESS software has the unique ability to “sensitize” many parameters, including formation flexibility support and standoff, so the decision about the best cement system to use can be based on the level of risk. Often, the best system is one with a low Young’s modulus, such as a flexible cement system using FlexSTONE* technology.

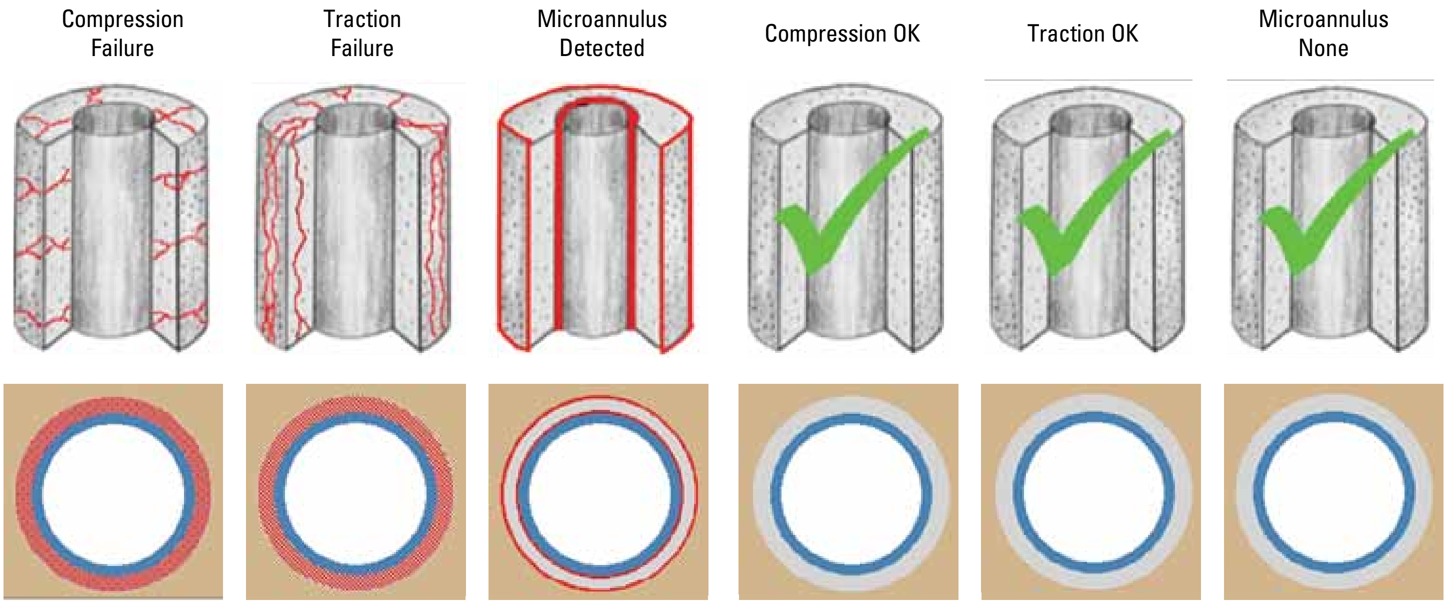
MICROANNULI IDENTIFICATION

CemSTRESS software can also be used to identify both inner and outer microannuli and to show their size and development over time. This ability makes it possible to optimize the level of expansion, if required.



CemSTRESS sensitivity analysis, which allows like-to-like comparison of FlexSTONE systems with conventional and foamed cement systems (against the variance of numerous wellbore parameters).

CemSTRESS



Nonoptimized 16-lbm/galUS [1,917.2-kg/m^3] cement system with Young's modulus of 1,160,301 psi [8,000 MPa]. The well cross sections (bottom) indicate various failure modes.

Optimized 16-lbm/galUS [1,917.2-kg/m^3] cement system with Young's modulus of 362,594 psi [2,500 MPa] and expansion properties. The well cross sections (bottom) indicate an optimized cement system.

PROCESS

Designing a cement system to extend well life uses a three-stage process called the FlexSTONE Isolation Suite:

1. System selection

In the first stage, the CemSTRESS software is used to determine whether the well requires a conventional cement system or a specialized system. This step provides direction for the next two stages.

2. Engineered design

In every well, there can be many different scenarios for cement sheath failure. The second stage uses CemSTRESS analyses of these scenarios to design a cement system—typically incorporating FlexSTONE technology—to keep the Young's modulus below the stress level predicted to induce failure.

3. Slurry optimization

In the third stage, Schlumberger cementing engineers use proprietary software to optimize the cement slurry design.

WORLDWIDE USE

The underlying mathematical engine in CemSTRESS software has been used in more than 20 countries worldwide since 2001 on more than 300 jobs involving placement of FlexSTONE and FlexSTONE HT* systems.

CASE STUDY—MIDDLE EAST

After applying a conventional 16.7-lbm/galUS [2,001.1-kg/m^3] class G slurry system, the first bond log was used to cement the 9⅝-in [24.44-cm] casing in a high-profile horizontal gas well. It indicated good hydraulic isolation behind the casing. A second bond log, following a 3,500-psi [24,131-kPa] pressure test, clearly indicated stress during the test had caused the hydraulic isolation to deteriorate.

CemSTRESS simulations determined that a cement system with a Young's modulus below 1,189,309 psi [8,200 MPa] would be required to withstand the applied stresses. A FlexSTONE system meeting that requirement was made the standard system for wells with similar conditions.

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