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ThermaSTONE

Thermally responsive cement

APPLICATIONS

- Heavy oil markets
- Geothermal wells

BENEFITS

- Sets at low temperatures
- Withstands high temperatures
- Has high compressive strength
- Allows for casing expansion without tensile failure
- Offers advanced long-term zonal isolation for wells under constant changes
- Reduces cement-sheath stress six times more than conventional systems.
- Offers economical solution for effective wellbore isolation under extreme dynamic thermal and pressure conditions

FEATURES

- High flexibility
- Thermal stability
- High coefficient of thermal expansion
- Low Young's modulus at steam conditions
- Expansion of up to 2%
- Ability to be mixed and placed with conventional equipment and practices

ThermaSTONE* thermally responsive cement is designed with optimal mechanical properties. This technology allows the cement to withstand the extreme pressures and temperatures experienced during steam injection operations for heavy oil wells. The ability of the set cement to expand and contract parallel to the well's fluctuating temperatures reduces stress on the cement sheath. This occurs because ThermaSTONE cement has nearly the same thermal expansion properties as the steel casing itself.

Cement must maintain long-term stability once placed. Pressure and temperature changes can cause failure within the set cement. The initial temperature change also causes a change in the set cement's chemistry and properties. If the primary cementing operation does not provide stability and good zonal isolation, the injected steam might not achieve maximum efficiency.

In the worst-case scenario, the steam might break through to surface. Unlike conventional cement, ThermaSTONE particles can expand and contract thermally. This reduces cement-sheath stress six times more than conventional systems.

ThermaSTONE cement is made of Portland cement, silica particles, and high-temperature-resistant particles. Its optimized cement-based blend sets at low temperatures, has a high coefficient of thermal expansion, has low Young's modulus at steam conditions, and uses standard cementing equipment.

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This cement is optimal for operations in the heavy oil market—operations located in Indonesia, the Middle East, South America, and particularly, Canada, which has about 70% of the heavy oil reserves in the world. The target formations are usually highly permeable sands, which are often drilled horizontally. Placement of the cement is on the casing string, which would experience the temperature and pressure fluctuations.

ThermaSTONE cement can help improve productivity and reduce overall operational costs by maintaining a steam-to-oil ratio that is similar to the conditions of the originally cemented well. The cement is able to maintain long-term wellbore integrity due to its ability to withstand the dynamic thermal and pressure changes that happen during the steam injection process.

In the lab, ThermaSTONE cement system was tested at 344 degC for 6 months, and compressive strength, tensile strength, and Young's modulus data were measured every month. Schlumberger CemSTRESS* cement sheath stress analysis software was used to determine a failure line for standard cement operating conditions. Results showed that ThermaSTONE cement retained its tensile strength beyond 6 months. Conventional systems did not, and their strength continued to decrease.

ThermaSTONE cement is a superior engineered cementing system for steam injection wells—combining mechanical properties and thermal expansion. This cost-effective solution offers advanced long-term zonal isolation for wells under constant dynamic changes. When paired with Schlumberger CemSTRESS software, the designed cement job provides a fit-for-purpose solution.

Specifications	
Density	11.7–14.2 lbm/galUS (1.4–1.7 kg/m^3)
Young's modulus	Less than 4,500 MPa
Expansion	Expands up to 2%
Steam injection temperature	482 degF–662 degF (250 degC–350 degC)

ThermaSTONE cement maintains a steam-to-oil ratio similar to conditions of the originally cemented well.

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