EnsurSet cement system

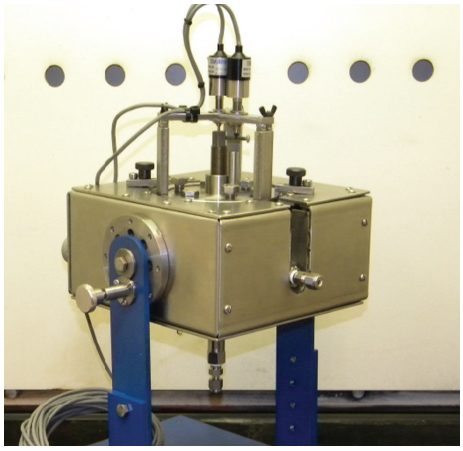
Maintain long-term well integrity with self-sealing cement system providing enhanced mechanical properties

The Baker Hughes **EnsurSet™ self-sealing cement system** provides a durable cement sheath to help ensure well integrity and zonal isolation for the life of the well. Because of changes in pressure and temperature to the cement sheath over the life of the well, the cement sheath may fail or crack and allow annular pressure to build up. This cracking and pressure build-up can result in

- Sustained casing pressure
- Cross flow
- Lost production
- Collapsed casing
- Contaminated water zones
- Increased workover costs

By sealing cracks up to 0.009 in. (0.2286 mm), the Baker Hughes EnsurSet self-sealing cement system helps address these problems. EnsureSet cement swells in the presence of hydrocarbons to shut off the flow through the cement matrix and micro-annulus.

The cement system improves the ductility of the cement and the tensile to compressive strength ratio, and it lowers Young's Modulus and provides a higher Poisson's ratio. It can self-seal multiple times and delivers a durable cement sheath in a wide variety of field conditions. The hydrophilic EnsurSet cement easily mixes in the field and its mechanical properties can be customized to meet specific well challenges.



Self-sealing test apparatus

Applications

- Cementing in fields with a history of sustained casing pressure
- High tectonic stress areas
- Hydraulic fracture areas
- Risk mitigation
  - Unable to follow all of best practices
  - Less than optimal centralization, no pipe movement
- Plug and abandonment

Benefits

- Self-sealing properties
  - Swells in the presence of liquid hydrocarbons and/or condensates
  - Shuts off liquid hydrocarbon flow through the cement matrix or micro-annulus
- Improved ductility of cement, lower Young's modulus, higher Poisson's ratio
  - Makes cement more resilient to stress
  - Enhances durability of cement
  - Improves tensile to compressive strength ratio
- Hydrophilic provides better and easier mixing than hydrophobic materials
- Sealing cracks in the matrix and the micro-annulus
  - Address and mitigate risks associated with sustained casing pressure
- Environmental Compliance
  - Member of SmartCare Family Products

The cement system is thoroughly tested with a custom-engineered and patented test device that quantifies the limits of the crack size and helps ensure that the cement system maintains long-term zonal isolation. This cement system can

- Be mixed and pumped using conventional cement equipment
- Work in slurry densities from 12.4 to 17.5-ppg at temperatures up to 325°F (163°C) without any negative impacts on the slurry
- Reduce flow within 24 hr and seal cracks in 48 hr
- Seal same crack multiple times
- Seal cracks up to 0.009 in (0.2286 mm)

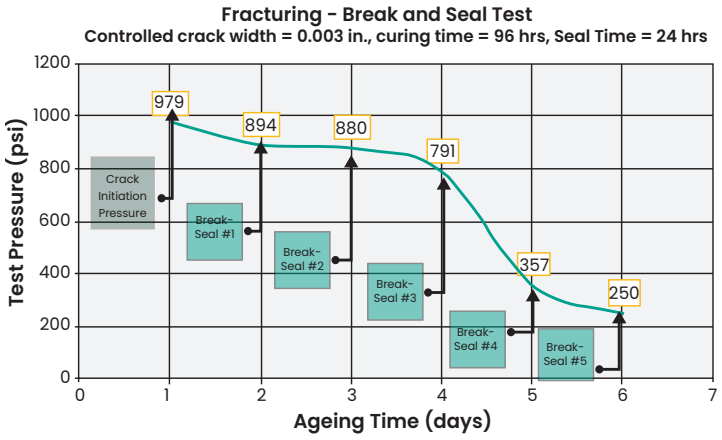
Wellbore isolation is becoming increasingly more important to both regulatory agencies and the public. No matter how good the cement design, external factors—tectonic stresses, changes to temperatures or pressures other than anticipated, unknown rock and reservoir properties, hole and placement issues—can result in failed cement and a buildup of sustained annular pressure, either through the cement matrix or a micro-annulus. Recent studies have found that more than 50% of the wells that are 15 years old or older have at least one casing string with sustained casing pressure.

Remedial operations in these cases are both difficult and expensive. Today, US federal regulation does not allow wells with sustained annular pressure to be plugged and abandoned. The Baker Hughes EnsurSet self-sealing cement system alleviates this problem with a cement system that reduces remediation costs and maximizes the integrity of the well over its entire life.

A self-sealing cement additive is blended with the cement and when it is pumped into the well. The additive remains inactive until hydrocarbon contacts the material. Upon contact, the self-sealing material absorbs the hydrocarbon and swells the material to plug the gap and shut off and seal the hydrocarbon flow.

Test apparatus capabilities

- Cures cement under temperature and pressure
- Adjustable desired crack or micro-annulus width
- Hydraulically cracks cement under temperature
- Controls, measures, and records developed crack size
- Tests flows through cracked cement matrix or induced micro-annulus
- Measures and records flow and pressure
- Tests with gas, oil, or other fluids



EnsurSet Cement system system capable of sealing same crack multiples times.

Enhanced mechanical properties

	Conventional Cement slurry	EnsurSet Cement slurry
Compressive strength	2300 psi	2350 psi
Tensile strength	235 psi	350 psi
Young's modulus	1.6 x 106	7 x 105
Poisson's ration	0.18	0.30

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