

## Low-temperature cementing solution

### Cementing in deep water

Near-freezing temperatures, gas hydrates, flowing sands, and lost circulation constitute key challenges in deepwater wells during surface pipe running and cementing operations. Low temperatures during cementing slow the hydration process, compromising gel and compressive strength development, which are essential to preventing fluid migration and providing well structural support.

Several slurry and set-cement properties address deepwater challenges:

- strict slurry density control at surface and downhole conditions

- adequate rheology for optimal mud displacement
- early gel and compressive strength development
- minimal shrinkage and low permeability
- engineered set-cement mechanical properties to ensure long-term hydraulic isolation.

### The Schlumberger solution

The DeepCRETE\* deepwater cementing system, based on multicomponent, engineered blends, is simple to design and is mixed the same way as standard cementing systems.

### Applications

- Low-temperature environments, including deep water
- Lost circulation zones
- Shallow hazards (water, gas and hydrates)
- Wells with marginal differences between pore and fracturing pressures

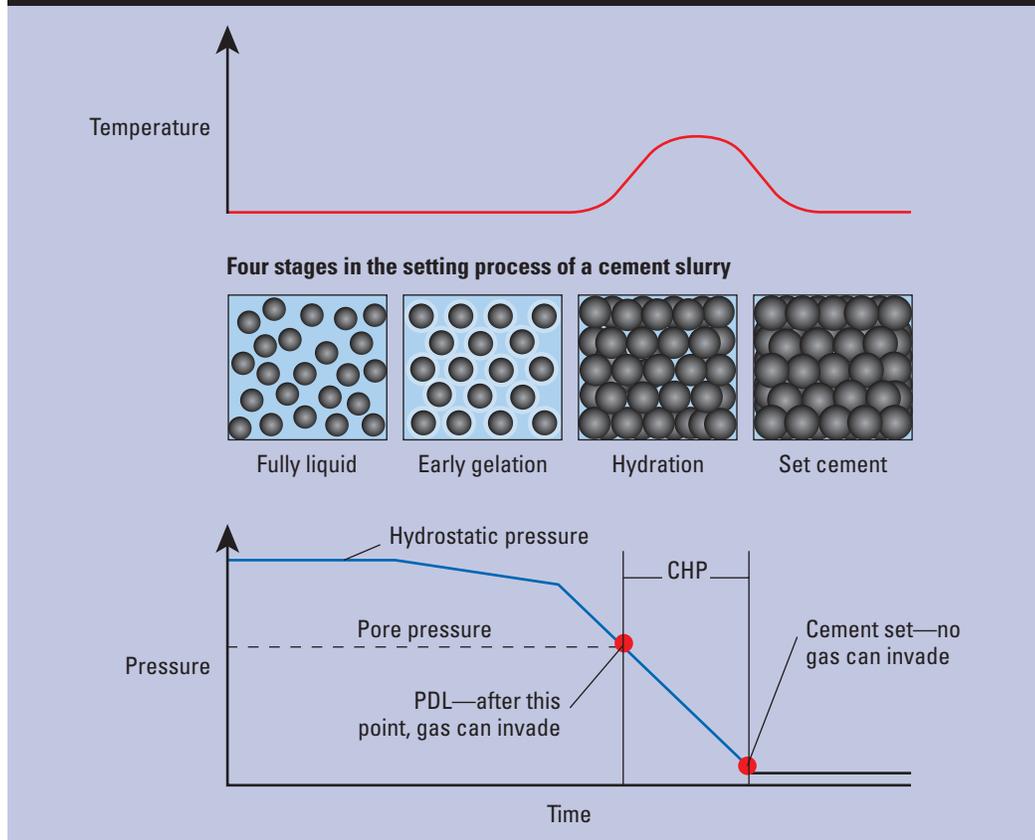
### Benefits

- Cost savings because of reduced waiting on cement (WOC) time
- Casing protection from corrosive fluids
- Risk mitigation of shallow flows

### Features

- Retains slurry and set cement properties independent of density
- Provides a wide range of densities with minor changes in the dry blend composition
- Reduces concentrations of fluid loss additives
- Improves resistance to shallow water or gas influx
- Permits designing set-cement mechanical properties to match casing and formation requirements
- Allows slurry stability at variable densities

*Fluid invasion in setting cement. When slurry static gel strength (SGS) exceeds the pressure decay limit (PDL), formation gas or water can enter the slurry because the pressure transmitted by the slurry falls below the pore pressure. When SGS is equivalent to the PDL, the critical hydration period (CHP) begins. A short CHP limits gas or fluid migration into the slurry.*



DeepCRETE formulations are optimized for deepwater applications, where very low seabed temperatures are common. The low water content of this system enhances the early gel and compressive strength development, while low densities minimize the risk of losses associated with the low fracture gradient encountered in many deepwater wells. These properties, combined with the DeepCRETE lower heat of hydration, help reduce WOC time, which is particularly important in areas where gas hydrates are a concern. The resulting set cement displays an extremely low permeability that ensures superior zonal isolation throughout the productive life of the well and after its eventual abandonment.

### The right design for deepwater cementing

The gel-strength development of the slurry affects the hydrostatic pressure distribution and the potential flow of either gas or water into the cement-filled annulus, a phenomenon known as fluid or gas migration. The risk of invasion or inflows into the cement matrix is greatest during the CHP, which begins when the hydrostatic column pressure falls below the formation pore pressure.

DeepCRETE systems display a much more aggressive gel strength development in low-temperature environments than the industry-recognized gel strength values of 100 lbf/100 ft<sup>3</sup> to 500 lbf/100 ft<sup>3</sup>.

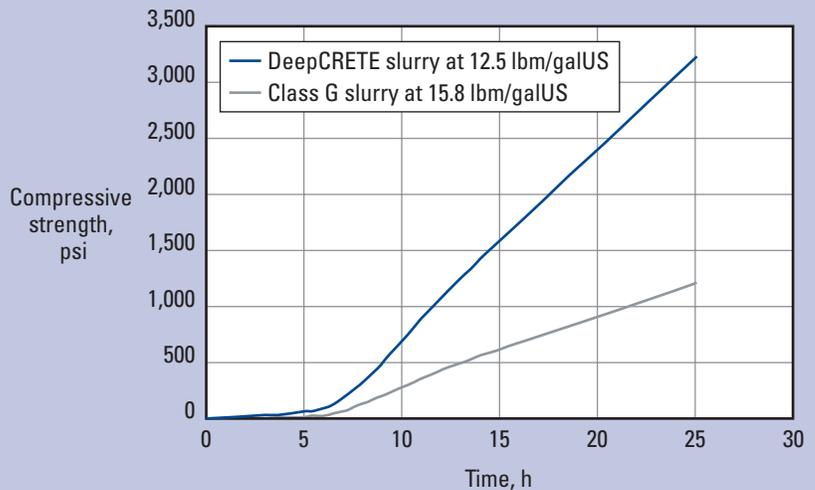
### Case history—Gulf of Mexico

The DeepCRETE system has been used to mitigate the risks associated with loss of isolation across surface casings in deep water. This system allows fast compressive strength development and annular flow prevention during and after cementing in extremely low-temperature environments. In a Gulf of Mexico example in water depths greater than 6,000 ft, the DeepCRETE system was used for two 20-in surface casing jobs in openhole diameters between 24 and 40 in. In both jobs, more than 2,000 bbl of slurry were pumped to ensure cement returns at the mudline. DeepCRETE cementing

*Deepwater spread costs are extremely high, so saving time with efficient cementing systems can provide substantial savings.*



*DeepCRETE slurry develops compressive strength faster than conventional Class G cement at 10 degC [50 degF].*



systems achieved the objectives for these casings while minimizing the amount of cementing equipment and personnel at the location.