SFM Solids Fraction Monitor

Schlumberger

Innovation for quality control

The SFM* Solids Fraction Monitor system, developed and patented by engineers at the Schlumberger Riboud Product Center, is a new method for real-time slurry quality control that accurately determines liquid-solid ratios independent of slurry density. The system was created in a tightly scheduled product-development process that lasted only 90 days, and was first used in Abu Dhabi.

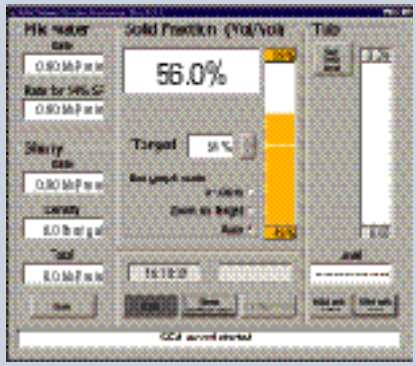
The system measures the rate of mix water and slurry flow and calculates the solid fraction from those measurements. The SFM service is a complementary technology, designed to provide quality control for Schlumberger low-density LiteCRETE* slurry systems. Although SFM technology was developed specifically for lightweight cementing operations, it is effective for slurries of any density.

An important element of successful low-density slurry placement and ideal set-cement properties is quality control. A key measure of quality in cement slurries is the solid fraction, which is the percent of dry blend in the slurry. The solid fraction can be calculated by dividing the volume of dry blend by the volume of slurry, and multiplying by 100. The solid fraction plus the porosity, or mix-water content, equals 100 percent.

In a conventional cementing operation, densitometers measure slurry density, and the solid fraction is calculated from density measurements. In ultralightweight slurries, however, the densities of the dry blend and the mix water are nearly the same, so densitometer measurements cannot discriminate between water and solid. The density would be the same even if the slurry consisted entirely of water.

Although small jobs can be batch-mixed and quality-controlled in a laboratory environment, this is impractical for jobs that require large volumes of slurry. The engineering team that developed low-density LiteCRETE systems recognized the importance of inventing a complementary quality-control technology.

SFM software instantly displays critical data in convenient readable formats



SFM technology allows cementing crews to maintain desired slurry properties while continuously mixing and pumping large slurry volumes. The system requires a slurry flowmeter, which can be the existing nonradioactive densitometer already available on cementing units, a residence tank sensor and a water flowmeter. These retrofits can be added easily to onshore or offshore mixing equipment.

Innovative and accurate control for cement slurry

Application

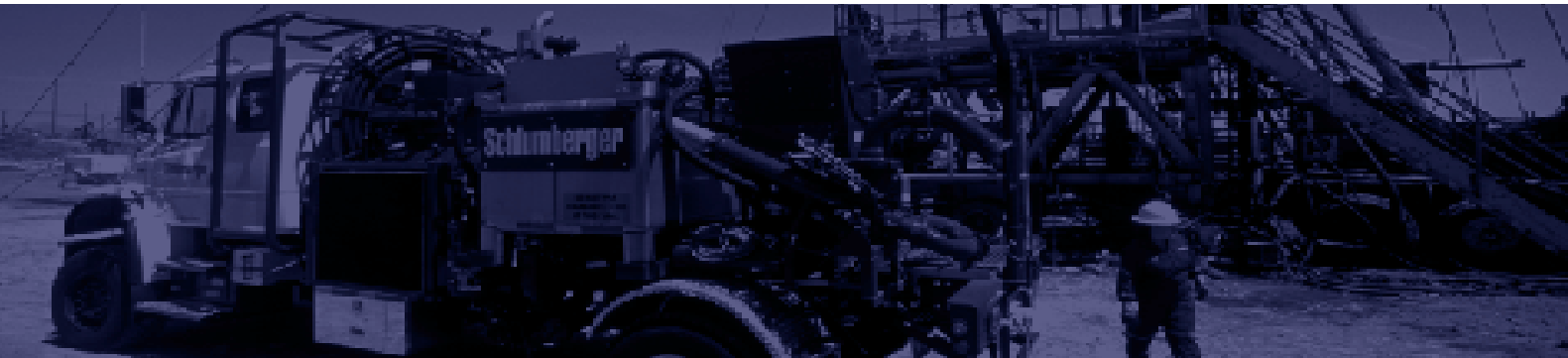
- Maintaining quality of cement slurry onsite

Benefits

- More sensitive than density control
- Less sensitive to blend density variation
- Accurate and precise real-time data

Features

- Continuous mixing control of all slurries, even at densities lower than water
- Real-time monitoring
- Complete compatibility with all acquisition systems
- Easy installation on any conventional mixing equipment



Case study

The Solids Fraction Monitor system was successfully used in the Middle East to mix and pump over 1200 bbl of 8.7 ppg slurry on a 13⅜-in. surface casing job. Due to very low formation fracture pressure it was decided to use the Schlumberger low density LiteCRETE* system to reduce the hydrostatic pressure and increase the chance to successfully place competent slurry all along the casing to surface.

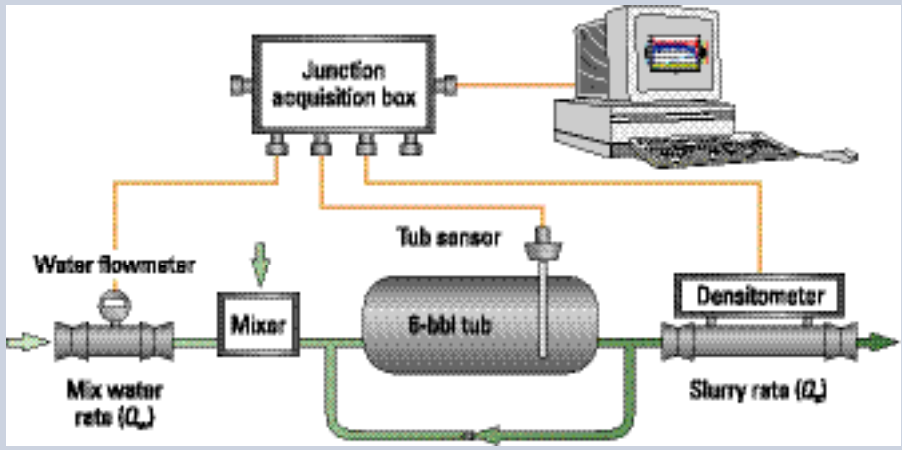
The slurry was designed with a high solids content exhibiting mechanical properties such as compressive strength and low permeability that far exceed conventional extended surface cements.

Monitoring such a large slurry volume using only a densitometer would have been impractical as the dry blend and mix water densities were very close, thus virtually any ratio of mix water and dry blend would result in quite reasonable densitometer readouts. Moreover, the small variation in density would have significantly impaired the solids content and set slurry properties.

This made the decision to use the SFM system to monitor the job an easy one. The blend density was 8.70 ppg, and the slurry volume to cover the entire zone of interest was 1200 bbl. During the job, the solids fraction was maintained within a range of 2 percent around the designed solid fraction (57 percent). Density remained effectively constant throughout the job. Cement evaluation logs run after the treatment confirmed the presence of ideal cement in front of the zones of interest.

Today, the operator has performed over 40 jobs using SFM technology to ensure better zonal isolation and has substantially reduced workover operations costs.

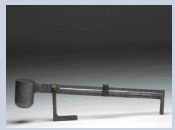
Cementing units can be retrofitted with the SFM equipment in a matter of hours.



Windows-based software helps cementing crews monitor and adjust the blend whenever necessary using exactly the same procedures as in conventional slurry mixing. In a field application of the SFM system, 98 percent of the slurry volume has been maintained within 2 percent of the solid-fraction target.

SFM technology has been used on well over 100 jobs successfully mixing/pumping over 50,000 bbls of slurry in the Middle East, U.S., Mexico, North Africa, Indonesia and Russia. The SFM system is available worldwide for use in conventional and LiteCRETE slurries.

Evolution of on-site slurry quality measurement


Mud balance


Pressurized mud balance


Nuclear densitometer


Nonradioactive densitometer


Solids Fraction Monitor

www.connect.slb.com

TSL-4262
December 2001

Schlumberger