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Foamed Cement Successfully Seals Underwater Well at 11,000 ft

Operationally versatile system enabled foamed cementing in the riserless well section, cutting time from 15 to 10 hours

When faced with transport restrictions due to the COVID-19 pandemic, an operator needed to cement a deepwater well but required a solution to avoid extra time and costs related to logistics. The operator used CemFOAM* foamed cementing equipment, data acquisition, and control system, which enables cementing wells at great depths without the need to blend. Using this system, the operator successfully cemented the well casing using foamed cement.

Find a cost-effective solution to cement a deepwater well

An operator sought a cost-effective solution to cement a deepwater well amid logistic limitations due to the COVID-19 pandemic. Only two wells in the world had been cemented at this water depth; one in Japan and another in Brazil. Neither well used foamed cement in the riserless section. The operator recognized this would be the first foamed cement effort at such depth, and this posed some risk.

The operator previously drilled a vertical well in Angola off the southwest coast of Africa. The well was drilled at a water depth of 11,000 ft [3,627 m]. The 36-in conductor was jetted at a 12,316 ft [3,754 m] true vertical depth rotary table (TVD-RT). An engineered trimodal cement slurry blend was evaluated that mirrored the system deployed by Schlumberger in Japan; however, it would cost USD 1 million more including airfreight for materials under COVID-19 pandemic transport restrictions when compared to the cost of foamed cement.

Use foamed cement in riserless well section

Following a thorough risk assessment and a track record of 23 foamed cement jobs already conducted in Angola, Schlumberger accepted the challenge to proceed with foamed cement in the riserless well section.

The CemFOAM foamed cementing equipment, data acquisition, and control system was selected and used. It automatically synchronized the total N_2 pumps and foamer pump rates with the base slurry rate from the cementing unit. All slurry testing was conducted in the district laboratory.

Through continuous mixing and nitrification of the 13.35 lbm/galUS [1.60 sg] base slurry, the foamed slurry volume was 1,387 bbl [220.5 m^3] with an average foam quality of 27.8% and average density of 10.5 lbm/galUS [1.26 sg]. A total of 119 metric tons of cement and 30,711 liters of N_2 were consumed. The final surface pressure was 594.6 psi [4.1 MPa]; the pumping operation took 10 hours. The lead cement slurry was reported at the seabed and the float shoe security check was positive. No casing subsidence was evident once the casing hanger was released. Subsequent 12¼-in openhole drilling was successful to 16,985 ft [5,177 m] TVD-RT and later plugged back.

Reduce job time from 15 to 10 hours

The selected foamed cement slurry provided the following time-saving benefits:

- The slurry density was adjustable by altering the nitrogen concentration.
- No blending was required. Only class G cement was needed, thus eliminating the logistical constraints linked to bulking, blending, storage, and potential bulk contamination.
- The liquid phase of the slurry recipe remained simple with only three slurry additives: a liquid extender, a retarder, and an ecologically sound foamer additive. All these products were locally sourced, making it easier to navigate logistical constraints induced by the COVID-19 pandemic.
- The proprietary CEMENTICS* zonal isolation software was used for all job simulations. It handles compressible fluids design and simulations and particularly accounts for nitrogen density change (due to in situ pressure change) during the placement and subsequently simulates foam quality versus depth during placement.
- On the equipment side, a full foamed cement package including a dedicated crew was mobilized for the operation, in addition to the existing cementing crew and equipment. A 3-in foam cross was coupled with two parallel 2-in lines from the foam cross to the rig floor. This rig up permitted high job flow rates and reduced the job time from 15 to 10 hours.

(Left) Side view of 3-in foam cross manifold coupled with two parallel 2-in lines, which permitted high job flow rates. (Right) An overhead view of a T junction that permits the use of two parallel lines. This method makes it possible to pump at higher flow rates.

*Mark of Schlumberger