DATA SHEET

HALLIBURTON

Cementing software

FEATURES

- Operational risk mitigation helps ensure optimal casing and cement placement
- 3D displacement simulator for CBL performance prediction
- Real-time data monitoring for instantaneous barrier validation
- Reverse flow path modeling for improved reverse cementing accuracy
- Risk mitigation to manage LCMs with downhole equipment
- Comprehensive post-job validation

BENEFITS

- Facilitates prompt decision-making and issue resolution
- Helps ensure accurate predictions for downhole hydraulics and TOC
- Enhances safety through identification of abnormal pressure trends
- Optimizes cement process, which reduces downtime and costs
- Maximizes probability of high-quality CBL and well integrity
- Provides valuable data-driven insights for post-job analysis
- Enhances remote collaboration and job oversight
- Enables instant validation of cementing applications
- Improves future job performance and design accuracy

iCem® cementing service

Barrier design and tailoring digital twin enables real-time job monitoring, evaluation, and instantaneous barrier validation

Overview

iCem® cementing service is a cutting-edge field digital twin that focuses on real-time validation of cement operations accompanied by advanced monitoring capabilities. The software harnesses an accurate and swift hydraulic model that operates concurrently with the execution of cement applications to deliver instant insight into fluid positions and cement annular coverage. This innovative solution empowers operators with predictive capabilities for well cement coverage, which facilitates compliance with regulatory standards. Furthermore, iCem service facilitates rapid "what if" scenario simulations, which enables well-informed decision-making and enhances operational predictability for optimal job execution and mitigation of remedial events. With remote access to critical execution variables in real-time, operators can seamlessly monitor operations.

Tailored design decisions deliver annular barriers that maximize wellbore performance

iCem service enables engineers to make well informed decisions to tailor the job design, get casing safely to bottom, place cement, and predict cement quality. To design and place effective barriers, iCem service evaluates safe casing placement, lost-circulation material (LCM) strategies with the Particle Wizard™ LCM software, and safe/optimum cement placement with 2D hydraulics and 3D displacement efficiency simulations to achieve the required top of cement (TOC).

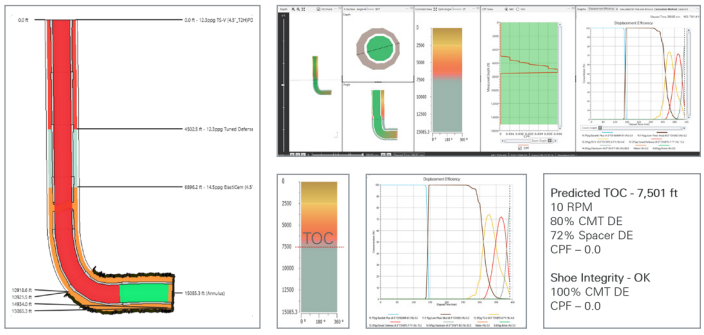
2D hydraulic key features

- **Torque and drag** determine the rotational and axial resistance experienced by the casing attributed to friction and other forces while running casing
- **Surge and swab** predict pressure changes in the wellbore caused by casing movement while RIH
- **2D fluid positions** for TOC assessment
- **Downhole equivalent circulating density** (ECD) and hydrostatic pressure vs. time or volume to determine risk of flow or fracturing of a formation
- **Rate in and rate out profiles** to assess free fall windows and potential lost-circulation events
- **Dynamic temperature simulator** improves ECD assessment accuracy by modeling the actual temperature profile at which cement fluids are placed and tested
- **OH size assessment** based on circulation pressure and rates for accurate estimation of open hole (OH) washouts and TOC
- **Balance plug hydraulics** for accurate prediction of cement plug placement
- **LCM risk assessment** with Particle Wizard™ software
- **Standoff profiles** optimize cement placement and impact of soft or stiff string centralization
- **Casing equipment hydraulics** to predict pressure drop across downhole equipment
- **Rheological hierarchy model** improves ECD simulation accuracy and its impact in 3D simulations
- **Erodibility profile** to account for the shear forces required to remove gelled or partially dehydrated mud
- **Hook load while cementing** to consider the weight of the casing string, cement slurry, and the impact of buoyancy forces
- **Lost-circulation hydraulics** predict the effect of lost circulation on cement placement and TOC
- **Foamed cementing hydraulics** enable design and placement of foam slurries with either constant density or flow rates

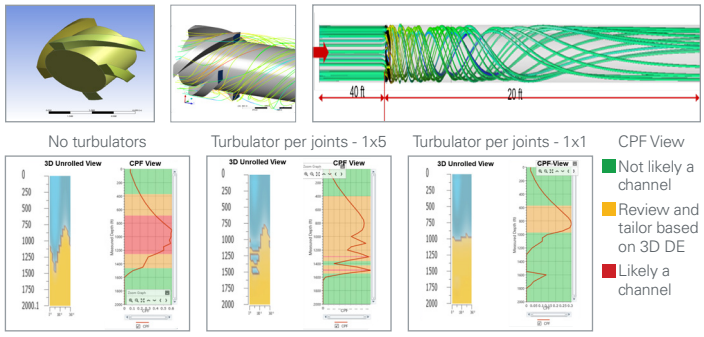
Computational fluid dynamics (CFD) 3D displacement efficiency

iCem software models the intermixing of wellbore fluids in annular geometry, considering factors like casing movement, mechanical separation, turbulator centralizers, fluid rheology, standoff, placement rates, and density hierarchy. It predicts fluid displacement efficiency, even in reverse circulation, to optimize shoe track length and cement integrity. The software models fluid concentration over time at all depths, including lost-circulation impacts, for optimum TOC prediction that results in a predictive CBL.

This solution provides predictive capabilities for well cement coverage, which can facilitate compliance with regulatory standards and TOC predictions. iCem service also enables rapid "what if" scenario simulations for informed decision-making and better operational predictability.



Predictive diagnostics indicate the results of 3D displacement efficiency and are used to predict fluid concentrations in the annulus, evaluate potential mud channels, TOC, and the predictive response of CBL measurements.



Predictive diagnostics with turbulator and Protech™ centralizers. This characterization demonstrates the impact of turbulator-like geometries on fluid intermixing profiles, which, in some cases, can eliminate the need for additional pipe movement aids.

Real-time monitoring with real-time viewer

Operators can remotely access and monitor up to 20 real-time variables from any location, enabling comprehensive job monitoring and data download in a CSV format. The streaming of calculated variables such as downhole ECD and surface pressure allow for the evaluation of design performance against execution. This comparison enables instant TOC assessment based on a real-time pressure match assessment.

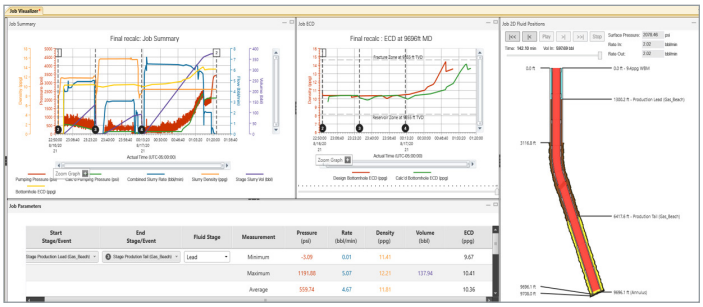
This feature is crucial for cement operations. It provides immediate insights into the cement process, enables prompt decision-making, and helps mitigate potential issues. Real-time monitoring can help identify abnormal pressure trends or unexpected changes in downhole conditions, which enhances safety and risk management. It also reduces downtime and costs by allowing instant TOC adjustments. Remote access improves team collaboration, oversight, and support, leading to better cement operations.

Instantaneous barrier validation with job visualizer

The iCem service 2D hydraulics simulator models wellbore hydraulic dynamics throughout the cement application. The simulator matches calculated and real-time surface pressures to ensure downhole hydraulic predictions accurately represent wellbore conditions. This capability makes the modeled TOC predictions highly reliable, which is crucial for effective zonal isolation and well integrity.

The main benefit is its ability to provide instantaneous job validation using real-time parameters like density and rate. The accuracy in modeled and real-time pressure matching allows operators to quickly make informed decisions and adjust operations. This leads to improved operational efficiency, well integrity, and reduced risks of wellbore instability and cement failures.

Real-time viewer provides remote access to real-time data and calculated variables. Real-time pressure match assessment between design and execution allows the viewer to instantly evaluate TOC compliance with requirements and enables real-time insights into the cement operation, which facilitates prompt decision-making and the capability to addresses potential issues before they escalate.

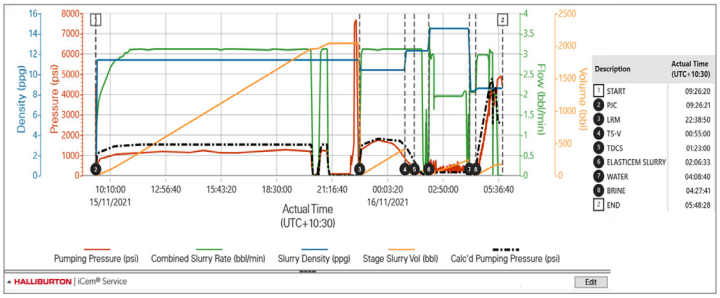


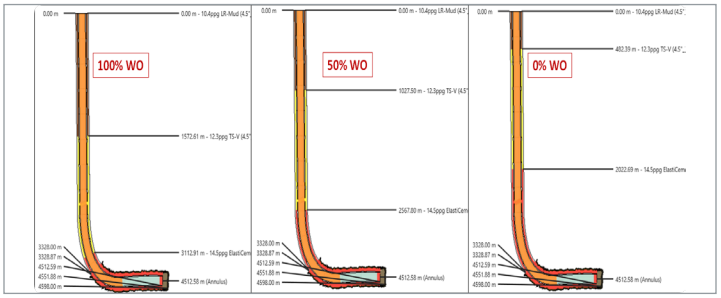
Job visualizer monitors downhole hydraulics and real-time fluid positions to assess TOC and provide instantaneous job validation based on optimum match of the modeled pressure (iCem service predicted well response) and the real-time measured pressure (well hydraulic response).

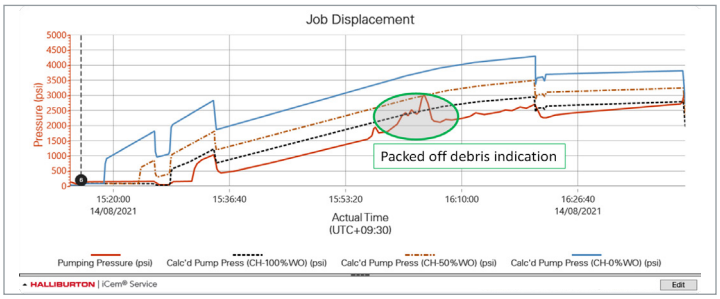
Post-job evaluation

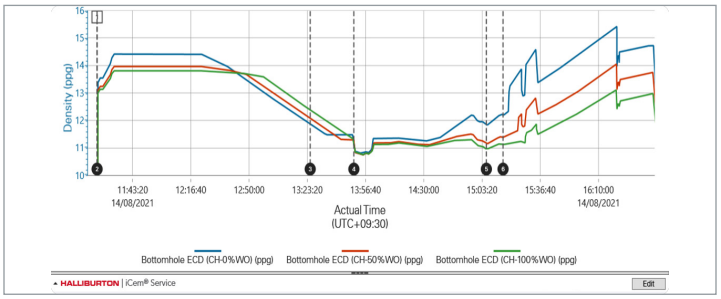
The comparison of real-time and design/planning phase job performance is crucial to evaluate cement operations. Through pressure matching assessments and 2D fluid position modeling post-execution, operators can accurately validate the cement operation. This involves a comparison of real-time data (rate, density, pressure) with preplanned design parameters (open hole size, well geometry, fluid properties, etc.). Alignment of calculated and real-time surface pressures confirms the operation was executed as planned, verifying the modeled TOC and ensuring desired zonal isolation and well integrity.

The main benefit is the ability to quickly investigate and address any irregularities. Assessing actual TOC depth and fluid positions immediately after execution allows operators to identify and correct deviations, applying lessons learned to future operations. This enables prompt decision-making and corrective actions, reducing the risk of wellbore instability and failures. Additionally, detailed post-job evaluations provide valuable insights for refining techniques, improving design accuracy, and enhancing overall job performance. Ultimately, this leads to more efficient, reliable, and safe cement operations, maximizing long-term well integrity and success.









The post-job evaluation process involves the comparison of real-time data with design parameters to validate cement operations. This includes pressure-matching assessments and 2D fluid position modeling. The process allows rapid investigation of irregularities and assessment of the actual TOC depth to enable prompt corrective actions and enhance future job performance with the ultimate goal to ensure well integrity, zonal isolation, and operational success.

For more information, contact your local Halliburton representative or visit us on the web at www.halliburton.com