

Corrosion-Resistant Cement and Tailored Casing Equipment Solution Enable Operator to Apply for Class VI Permit for CCUS Wells

CORROSACEM™ CEMENT SYSTEM AND FIDELIS™ STAGE CEMENTER COMBINED TO ACHIEVE ZONAL ISOLATION

UNITED STATES - GULF OF MEXICO

CHALLENGE

- » An operator required a corrosion-resistant cement solution across injection zones and full isolation of the casing string for future planned CCUS wells.

SOLUTION

- » Place CorrosaCem™ cement system across the injection zone
- » Deploy Fidelis™ stage cementer for multi-stage cementing

RESULT

- » Successfully cemented 7-in. production string in two stages using the Fidelis™ stage cementer, isolating the ZOI, bringing cement to surface
- » CBL confirmed isolation of the injection zone
- » Operator pending approval to upgrade from Class V to Class VI permit

OVERVIEW

With increased regulatory pressure to reduce carbon dioxide (CO₂) emissions, operators continue to focus on carbon capture, utilization and storage (CCUS). Wells used for permanent CO₂ storage are designated Class VI and require an intensive and lengthy permit process. One of the key requirements to obtain a Class VI permit is isolation of the full production casing to surface using a corrosion-resistant solution. Advanced planning and operator collaboration are necessary to meet the specific permit requirements to obtain Class VI status.

CHALLENGE

An operator in the Gulf of Mexico required a corrosion-resistant solution across the zone of interest (ZOI) and full isolation of the casing string to surface to obtain a Class VI permit for CO₂ injection in two vertical CCUS wells. These wells are located in an area with restrictive geological margins (close tolerance pore pressure and fracture gradient), which poses challenges to effectively lift cement to surface while working within the equivalent circulating density (ECD) limitations. A multi-stage tool that can provide quality isolation across the cementing port seals is necessary to overcome these challenges.

The deeper sections of the well pose additional challenges related to high-formation temperature. Because the expected static temperature at total depth (TD) was 316°F, the solution required additional cement design modifications and laboratory confirmation to ensure optimal cement properties.

A FIT/LOT test was also necessary after drilling out the shoe in addition to a cement bond log (CBL) on each cemented section to confirm cement isolation.

SOLUTION

Halliburton used the CorrosaCem™ cement system to provide isolation across the injection zones. We tailored this reduced Portland cement blend with additives to help lower permeability, reduce corrosion alteration, and address the elevated temperatures for the deeper casing strings.

To adequately design each string, we ran multiple iterations using iCem® cementing service using information provided by the operator.

iCem cementing service is an engineering design tool used to assess specific downhole well variables of a cement application. The results of these pre-execution models revealed that ECDs would hinder a traditional cement application. Instead, we implemented a multi-stage tool as a mechanical solution to effectively pump the operation and provide full isolation of the casing string to maintain wellbore integrity.

The combination of the CorrosaCem™ cement system and the Fidelis™ stage cementer delivered effective production string and future injection zone isolation.



Class VI Permit

Wells used for permanent CO₂ storage are designated Class VI and require an intensive and lengthy permit process.

Following Halliburton recommendation, the operator selected Fidelis™ stage cementer to perform the critical two-stage cement operation. Its internal sleeve design provides increased stability compared to external sleeve options during well completions and does not interfere with fiber or monitoring cable. A multi-stage tool is ideal in an ECD-limited application because all components are internal, decreasing the impact of ECDs, with no additional annular restriction upon casing OD increase.

After cementing the second stage, an internal closing sleeve and two sets of CO₂-resistant, high-pressure seals on either side of the cementer ports helped restore casing integrity.

Double-lock rings on the closing sleeve latch into the outer case, locking the tool closed after completion of the second cementing stage. These features create a seal that retains structural integrity after cementing operations and can withstand cumulative stresses and well events, such as injection and pressure monitoring, across the internal sleeve throughout the life of the well.

One additional benefit: the 7-in. Fidelis stage cementer has been tested to the V0 rating per the API 19 AC V0 industry specification, providing zero bubble gas-tight mechanical isolation.

RESULT

The combination of the CorrosaCem cement system and the Fidelis stage cementer delivered effective production string and future injection zone isolation.

For each casing string, visual observation of cement returns to surface and density measurement confirmed full isolation on location. The operator ran, evaluated, and approved a CBL. This successful CBL was the final evaluation criteria necessary to meet the required Class VI permit parameters.

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