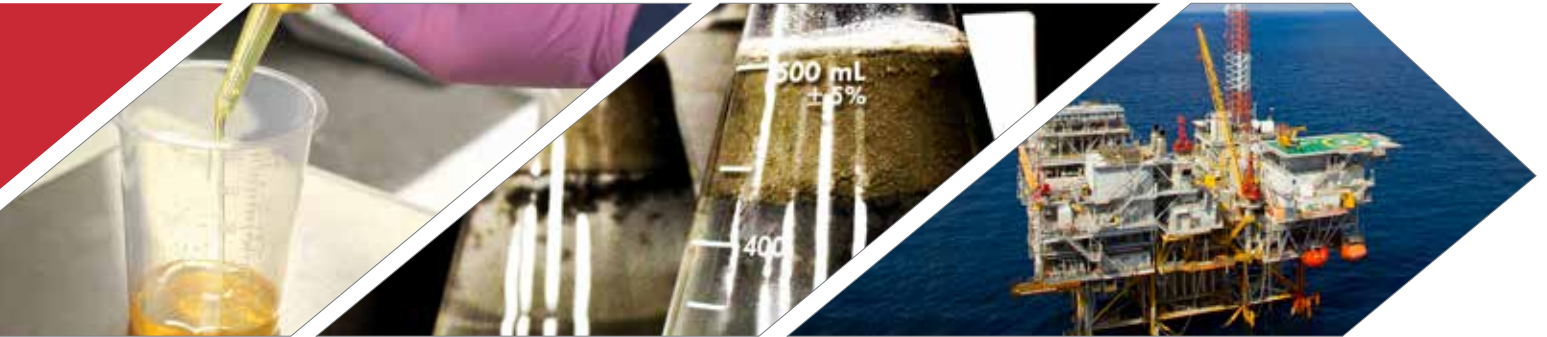


Deepwater Cementing Challenges

Tackle Deepwater Cementing Challenges with CSI Technologies, LLC



Deepwater well cementing requires highly advanced techniques, a strong engineering approach, and extra attention to every detail of the process. Combining engineering knowledge, field experience and a state of the art laboratory, CSI Technologies, LLC is able to apply the right technology and attention to any deepwater cementing operation. By using CSI's engineering and field expertise, deepwater oil and gas operators have successfully resolved serious cementing issues before they manifest as problems. Clients and government entities also look to CSI for expert engineering or R&D for novel solutions in deepwater cementing.

Specific advantages CSI provides operators drilling in deepwater include:

- > Experience: Over 150 combined years of offshore cementing experience
- > Deep knowledge: Fundamental understanding, engineering solutions, field application
- > Complete service: Design, engineering, laboratory, and on-site
- > Focus: A team of experts is dedicated to each cementing operation
- > Analysis of results: Focus on improving operations based on knowledge gained from each cementing operation.

The following specific examples illustrate the capabilities and services CSI has to offer.

BSEE-Sponsored Best Cementing Operational Practices

CSI Technologies has been contracted by the Bureau of Safety and Environmental Enforcement (BSEE) to perform a government funded research project to summarize the current state-of-the-art for cementing operations in the Gulf of Mexico and specify operational recommended best practices for offshore cementing. The results of this study will be integrated into a searchable database which presents appropriate design and operational guidelines to mitigate potential safety issues as well as specific design, testing, and operational procedures to ensure optimized cement seal effectiveness. As part of this research project, CSI formed a steering committee of operators currently drilling in the Gulf of Mexico to assist with general and case specific deep water cementing best practices.



RPSEA and NETL Sponsored Research

Supercement for Annular Seal and Long-term Integrity in Deep, Hot Wells

Deep Trek, a U.S. Department of Energy program, funded research to improve offshore well economics by investing in drilling and completion technology. CSI Technologies took on this challenge and through engineering analysis and laboratory evaluation, developed a supercement for use in harsh, offshore conditions. The issue identified in CSI's study was a lack of durability in cement sheaths, leading to compromised zonal isolation in a well. To remedy this situation, a sealing material needs to have adequate tensile strength to withstand the forces experienced in a wellbore. The supercement developed as a result of this project, has a large concentration of expansion additives. The expansion additives alter the crystalline matrix of the seal and pre-stresses the cement, increasing the apparent tensile strength and shear bond strength of the sealant.

Reverse Circulation Primary Cementing

In Reverse-Circulation Primary Cementing (RCPC) fluids are pumped downhole via the annulus and then up into the casing, in contrast to a conventional cement job where fluids are pumped down the casing then up into the annulus. The primary benefit of cementing through reverse circulation is that friction pressures and equivalent circulating densities (ECD) are reduced since it is no longer necessary to lift fluids all the way up the annulus as during conventional cementing placement. The objective of the RPSEA Deepwater Reverse-Circulation Primary Cementing (RCPC) project is to assess the viability of performing RCPC to reduce circulation pressure requirements for deepwater wells, to determine required technology to apply RCPC for deepwater wells, and to present development strategies for required technologies. For this project, CSI is conducting a laboratory study on the performance of cementing additives, spacers and the effect of RCPC on material performance. Based on these findings, design benefits as well as technical issues that need to

be addressed before RCPC can be used for deepwater applications will be identified. Further analysis will include RCPC simulations and laboratory analysis under real well conditions and scenarios.

High Profile, Deepwater Projects

CSI Technologies was contracted by an offshore deep water operator to perform post job engineering analysis on the cementing operations on their rig which led to poor initial cement sheath quality followed by several failed attempts at remediation. After extensive review of the operators drilling programs, cement designs, job execution logs, and subsequent formation integrity test results, CSI was able to recommend specific modifications to the operators cementing procedure. These modifications enhanced the operator's success rate for primary and remedial cementing operations within lost circulation and salt saturated formations, both very common occurrences in the Gulf of Mexico.

Confirmation Testing

CSI performs pre-job confirmation laboratory testing as well as on-site monitoring for several operators in the Gulf of Mexico. Duplicate rig samples are pulled by the service companies ahead of time and when a slurry formulation is finalized, CSI repeats the testing using weightouts and testing specifications outlined by the service company. This allows CSI's results to be compared directly to the service company with no difference in test set-up. Across operators, CSI has identified several slurry designs with a high-potential for failure before they were pumped. These include slurries with pump times which were less than job placement time, slurries which did not meet transition time requirements, free fluid requirements and other requirements outlines in API Standard 65-2. Based on rig cost and likely failures, CSI has saved clients tens of millions of dollars by insisting on redesigns. On-site, CSI ensures safe and successful cementing operations. Our level of involvement on location is on a case-by-case basis and ranges from auditing to advising.