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Abstract

Reservoir depletion makes it challenging for well cementing to achieve proper zonal isolation and long-term well integrity. Operators have experienced differential pressures of 2500psi to 3000psi between wellbore and the formation. Cement slurry exposed to such high differential pressures will be dehydrated, leading to improper setting and bulk shrinkage during the setting process. The consequence could be poor cement bond logs or even creation of channels for cross flows between water or gas zones. As a result, the operators must spend more time on remedial squeeze cementing or sidetrack the well, which is time-consuming and costly. Therefore, the effect of depleted reservoirs requires special attention in cementing design and execution to prevent such issues.

To overcome reservoir depletion challenges, the cementing design should follow API RP65-2 for isolating potential flow zones, but with more stringent criteria. Specifically, the cement blend should be designed using optimized particle sizes to minimize the cement matrix permeability. Also, an expanding agent is added for post-placement expansion to compensate bulk shrinkage. The cement matrix is augmented with latex technology to further reduce permeability, lower the fluid-loss value and improve cement bonding to the casing and formation. The resulting cement slurry should be also tested under differential pressure conditions to match those expected in downhole (reservoir-depleted) conditions to assess the fluid-loss tendency. To improve pre-flush fluid performance, a new method is used to evaluate the surfactant and solvent package and enhance spacer cleaning efficiency with an innovative fiber technology. Finally, cementing execution is critical to deliver the design successfully from blend handling, adherence to the pumping schedule to best practices such as centralization and casing movement.

This study compared the results of two cases: a conventional cement design used in the field a few years ago, and a new approach aimed at addressing the depleted reservoir challenges. Although the conventional design met the API RP65-2 for isolating potential flow zones and job execution, the cement logging result was very poor and resulted in sidetracking the new production section to obtain better zonal isolation. The new approach significantly improved the cement bond log compared to the conventional design, delivering zonal isolation of all water/sand interbeds to meet the requirements for completion and production.

This paper describes the challenges of depleted reservoirs for cementing and zonal isolation. The new approach in cement design, testing and execution is a good reference for operators who plan for drilling and cementing in depleted areas. It has the potential to save millions of US dollar in remedial cementing and related operations.