OIL WELL INEGRITY ISSUES AND ZONAL ISOLATION CHALLENGES.

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Abstract: Well integrity as defined by the Norwegian standard NOROSK D-010 (2013) is the "application of technical, operational and organizational solutions to reduce risk of uncontrolled release of formation fluids throughout the life cycle of a well." The integrity of cement sheath as a primary hydrocarbon fluids containment barrier is of growing interest in the oil and gas industry. The primary cement barrier is increasingly being challenged in reservoirs with hydraulic fracturing operations and with high-pressure and high-temperature (HPHT) conditions. Unanticipated gas leak and annulus pressure build up may have severe health, safety and environmental consequences (HSE). Hence, real-time and long-term monitoring of primary cement performances are active areas of research and study in the industry. This presentation will provide a review of the challenges in well cement integrity and current technologies used by operators for monitoring well-cementing operations from the time of placement and throughout the well service life. The limitations of these methods stem from the fact that they are localized and intrusive jeopardizing by that the well cement integrity without addressing the main issues such as tensile failure, locating the top of cement and wait on cement time. Most of these evaluation tools are usually run after the cement is placed whereas the most critical period is during cement placement at which most issues could be avoided if monitored accurately. Meanwhile, operators currently perform testing of cement formulations in the lab under simulated downhole conditions. However, these are idealized conditions and do not account for the complex conditions encountered downhole. Therefore, there is a need for a solution to bridge the gap between lab results and field operations and the only promising technology that may provide real-time monitoring solution for cement operations is Smart Cement. This cement exhibits sensing capabilities by means of measuring the change in electrical resistivity due to induced chemical, thermal and mechanical stresses known as chemo-thermo-piezoresistive effects. The novelty of the smart cement system is in its ability to continuously monitor the performance of well cement providing the option to visualize cement operational issues in real-time in order to provide immediate solutions. Hence, preventing avoidable design and placement issues as well as future catastrophic issues leading to blowouts. The issues that may compromise well cement integrity begin from the time of mixing to placement which may extend throughout the service life of the well. Research suggests that smart cement has the potential to address these challenges due to it being a non-destructive, reliable and an economic solution for continuous downhole long-term monitoring of well cement operations.