Cementing for Long Term Integrity

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The main purpose of primary cement job is to provide long term zonal isolation for the life of the well. However, events in the life of the well can alter the integrity of the cement sheath, leading to undesirable and potentially dangerous effects. One of these effects, sustained casing pressure (SCP), continues to present a significant challenge to the oil and gas industry. Loss of pressure containment in localized areas of the well may also pose significant problems even if such loss does not lead to flow to surface as evidenced by SCP. This inter-zonal communication down hole can significantly impair production as well as limit the effectiveness of stimulation treatment, making it equally problematic. To help combat loss of cement sheath integrity, Halliburton has developed a three-level defense strategy that ensures long term cement sheath integrity for the life of the well. To achieve this objective, as a first step, the drilling fluid should be displaced efficiently and the cement slurry placed in the annulus. The set cement sheath should withstand the stresses induced by various well operations and maintain integrity during the life of the well. However, a majority of the cement design programs in the industry consider only the slurry properties and do not assess the effect of well operations on the cement sheath. This presentation discusses a three-step mechanism to help maintain long term cement sheath integrity during well operation. These mechanisms are (1) modelling and analysis to deliver a cementing system that has been engineered to withstand the forces exerted on it by various well construction, completion, stimulation and production operations, (2) display of intelligence by the in situ cement sheath through the incorporation of certain additives in the cement that will swell in the presence of flowing gas or crude oil, and (3) swelling-element tools run as integral parts of the casing. The pressure in the annulus side sometimes results in an inability to continue further operation. From the processes reviewed in this presentation, one can estimate the risk of failure of various cement systems and select a fit-for-purpose system that will help minimize the overall cost. This process should improve the economics of constructing and producing oil and gas wells (cost-effective life cycle design) and also help improve safety because zonal isolation failures may be reduced.