Premium treatment system for granite and sandstone formations - Fluid development and field trial in a geothermal well

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The primary objective of acidizing geothermal wells in fractured sandstones and granites is to remove scales blocking the pathway of water, thus increasing the productivity or injectivity of the formation. For this purpose, hydrochloric acid (HCl) - based fluids are commonly applied. At high temperature, however, the fierce reactivity of HCl often hinders deep penetration of the formation making stimulation of removed damaged zones difficult to attain. Selection of chemicals to reduce reactivity adds to the difficulties encountered in the acceptance by mining and water authorities.

Furthermore, the extreme corrosion tendency of hydrochloric acid requires high concentrations of corrosion inhibitors and intensifiers. Another problem often encountered during acidizing sandstones with HCl-based formulations is their incompatibility with clay minerals. Core flood experiments and field results indicate that high temperature illitic sandstone is sensitive to conventional mud acid treatments. Here, the commonly employed HCl pre-flush degrades illite and chlorite leading to fines migration and formation damage.

This paper introduces an innovative fluid system, which is based upon a naturally retarded, biodegradable acid and highlights its first field trial in a granite formation. Here, demanding borehole conditions (195°C BHT, vast openhole section, and a high concentration of illite) were encountered. Extensive laboratory tests regarding reactivity, acid corrosion tendency, and compatibility were conducted preparing the first field trial. In this context, core flood experiments with actual granite and sandstone samples, as well as solubility tests with cuttings from the target zones were performed. In contrast to HCl-based fluids, this state of the art acid system has supreme dissolving capacity against carbonates and silicates. Furthermore, it shows a low corrosion tendency and an excellent compatibility profile with illite, even at high temperature.

For the first field trial, three target zones in the openhole section were selected for chemical injection via tubing. The superior chemical properties of this treatment system lead to a greatly enhanced injectivity of the well. Due to its naturally retarded reactivity, this fluid can be pumped at much lower rates, compared to most HCl-based formulations. Laboratory and field results impressively proved that this new treatment fluid is an excellent alternative to commonly used HCl-based systems.