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Dynamic Regulation of Degree of Diversion During Matrix Acidizing Treatments Performed in Naturally Fractured Reservoir

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SUMMARY

Zonal coverage and fluid-loss control in naturally fractured carbonate reservoirs with high permeability contrast are the key challenges during matrix acidizing treatments.

A novel fiber-laden polymer-free self-diverting acid system was introduced in Saudi Arabia to improve zonal coverage across the entire interval of interest during stimulation treatments in HPHT environment. This diversion system combines a self-diverting acid, which utilizes a non-damaging viscoelastic surfactant that gels as the acid spends and degradable fiber. The combination of the self-diverting acid and fiber improves the diversion process by combining the aspects of both viscosity-based and particulate diversion techniques. The fluid system has a distinct benefit in that it does not contribute to reservoir damage as the fiber will dissolve with time and temperature plus viscoelastic surfactant will break down upon contact with hydrocarbons.

The fiber-laden self-diverting acid system has been applied in the Khuff reservoir with impressive results in numerous newly completed gas wells and those wells that needed work-over intervention. Unlike the conventional diverters the combination of the two different diversion techniques enabled dynamic tuning of degree of diversion throughout the treatment. This real-time delivery of fit-for-purpose diverter package adjusted upon reservoir response optimized matrix acidizing stimulation.

Zonal coverage and fluid-loss control in naturally fractured carbonate reservoirs with high permeability contrast are the key challenges during matrix acidizing treatments. Throughout such treatments fluid has the natural tendency to take the path of least resistance, penetrating layers with the highest porosity and permeability while little or no acid is injected into lower-quality zones. Excessive fluid loss to these high-quality thief zones results in a non-homogenous distribution of stimulation fluids across the targeted interval and thus less than optimum stimulation performance.

Non-reactive and reactive polymer based diverters were historically accepted as systems that could efficiently control fluid leak off. However, use of polymer based fluids and non-soluble particle diverters could be source of formation damage. Finding the right balance between induced formation damage and zonal coverage is a challenge and avoiding this damage by using non-damaging fluid with superior fluid leak-off control properties is the logical problem solution.

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