Effect of Acidizing on Permeability, Strength and Stiffness of Veined Greywacke

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Abstract

Acid stimulation is used as a permeability recovery technique in both injection and production geothermal wells to dissolve scale deposit at the well-rock interface. Different chemical blends are used depending on the minerals causing the scaling. Hydrochloric acid, and in some cases formic and nitric acid, is used for calcite while hydrofluoric acid is used for silica scaling. The reservoir rock at Kawerau geothermal field in New Zealand includes greywacke basement rock, a very fine-grained, lithic-rich metasandstone. The greywacke has very high intact compressive strength, but is typically highly fractured owing to the complex tectonic setting of the central North Island of New Zealand. In the Kawerau reservoir rocks many of the fractures are sealed by calcite.

We investigated the impact of acidizing on both permeability as well as strength of the greywacke by testing 20 mm diameter, 40 mm long cylindrical cores of Greywacke samples using the dosing protocol used during acid stimulation in active wells. When acidized with a 10% HCL solution for 65 minutes, the samples experienced, on average, a 30% relative reduction in strength, a 21% reduction in elastic stiffness, a 16% increase in porosity and a nearly 4000% increase in permeability, compared to as-cut control samples. When subsequently acidized with a 10% HCL + 5% HF solution for 98 minutes, the samples experienced, on average, a 38% relative reduction in strength, a 29% reduction in elastic stiffness, a 110% increase in porosity and a 14000% increase in permeability, compared to as-cut control samples.

This clearly demonstrates that, while acid treatment in these rocks will improve permeability at the sample scale, it will also decrease strength and stiffness. It is not clear from this small study if the changes in strength and permeability after the second acid treatment are due to additional dissolution of the calcite infilling by the HCL or if the HF also contributes to the changes. We propose that additional research be undertaken to fully explore the impacts of acidizing on fractured Greywacke. We also propose that research on the acidizing effect on strength and stiffness be investigated in European reservoir rocks to determine if this type of soft stimulation technique has the potential to affect wellbore stability.

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