Increasing Production 200% in Mature Field

Case study: Petrobras Colombia applies low-temperature organic clay acid treatment

Challenge
Remove and stabilize fines in mature field to reverse declining production.

Solution
Design acid treatment with OCA* LT organic clay acid system for low temperatures.

Results
Increased initial production 200%. Maintained 100%-higher production over the long term.

Remove high clay content from shaly sands
In a mature Colombian field producing oil and gas from more than 10 distinct shaly sands, the sandstones are composed mainly of quartz, feldspars, clays, and lithic fragments. The total clay and feldspar content varies between 20 and 40%. The volume of smectite clay is often sufficient for resistivity logs to respond more to the volume of clay than to the difference between oil and water.

In this field, Petrobras Colombia required effective damage removal and fines stabilization to combat declining production due to fines migration and inorganic scale. The low formation temperature (120 to 140 degF) complicated this objective. When the company used conventional acid treatments with hydrofluoric acid [HF] systems and clay stabilizers, the temperature slowed the reaction kinetics (clay dissolution rate) of acid, providing only a short-term production increase. In less than 3 months, production fell below pretreatment levels.

To effectively combine the benefits of stimulation and fines migration control in this low-temperature reservoir, it was necessary to increase the reactivity of the organic clay system without risking destabilizing the clays or creating precipitates in the formation.

Normalized production increase for wells treated with OCA LT compared with conventional acid treatment. Using the OCA LT service maintained consistently higher production in the long term.
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Apply organic clay acid system for low temperatures

Schlumberger used the novel approach of optimizing the free HF and total fluoroboric acid \([HBF_4^-]\) available in the acid system. A mixture of organic acids and \(HBF_4\) was selected to get deep, live-acid penetration away from the wellbore and clay/fines stabilization while minimizing secondary and tertiary precipitates associated with using hydrochloric acid \([HCl]\) in an HCl-sensitive formation. The organic acid acts to chelate aluminum-3+ \([Al^{3+}]\) ions, keeping the silica in the solution, thereby preventing the precipitation of silica gel. The acid also maintains a low pH to prevent the possible precipitation of aluminum hydroxide \([Al(OH)_3]\).

Based on core flow testing, Virtual Lab® geochemical modeling, and StimCADE® well stimulation software, Petrobras Colombia implemented the OCA LT organic clay acid system to remove and stabilize fines in the low-temperature reservoir. This service is specifically designed for temperatures between 100 and 140 degF, in which conventional acid systems have proved to be ineffective, and can be applied in any formation with high clay content.

Boost production by 200%

The initial production of wells treated with the OCA LT system increased by 200%. Six months after the treatments, the wells still produced 100% more than they did prior to the treatment. Using OCA LT acid system to remove and stabilize clay content, Petrobras Colombia was able to maintain production in the field without the need to re-treat wells.