Case study: Colombia

AquaCUT RPM significantly reduced water cut in mature, high-permeability field creating $millions in extra value

An operator in Colombia had a mature field with sandstone formation, high water cut (above 90 percent in some wells), and depleted formations with reservoir pressure gradients close to 0.25 psi/ft. They wanted to find a solution to keep oil production and profitability even in long, perforated intervals with variable permeabilities (from 500 mD to 3,000 mD) and average temperatures of 180˚F. Lithological logs showed the reservoir had intercalations of sand and shale.

The operator reached out to Baker Hughes, who suggested AquaCUT™ relative permeability modifier (RPM). AquaCUT RPM is a subsurface water conformance product that decreases the water cut in mature sandstone wells, reducing associated processing and disposal costs while also extending the productive life of the well. By selectively targeting only the water phase of produced fluids, AquaCUT RPM products reduce the amount of produced water with no impact on hydrocarbon production. In the presence of oil, the AquaCUT RPM components deform and minimize the restriction of the formation pore throat, allowing oil or gas to flow unimpeded. Alternatively, in the presence of water, the water-wetting polymer expands, filling the pore throats which increases the resistivity of water flow.

For the qualification process, core flooding tests were performed on plugs in conjunction with the customer's technical representatives. Initially, permeability baselines were measured obtaining an absolute permeability (K) of 2,353 mD.

A total of 30 wells were treated with AquaCUT RPM within the field. Some of the wells were also stimulated and re-perforated.

Water production decreased by an average of 200 BWPD, with decreases of up to 900 BWPD in some wells. An average 12 percent reduction was observed among all wells treated.

Hydrocarbon production improved on average by 43 percent, with some wells up to 100 percent increase compared to pre-treatment production. None of the wells treated with Aquacut RPM presented reduction on hydrocarbon production.

Water cut was decreased by 55 percent in wells where AquaCUT RPM was applied through matrix-type pumping or as a pre-pad stage in hydraulic fracturing.

Additionally, field production history has demonstrated sustainable water reduction for more than two years post treatment.

On average, the value created to the customer, in terms of NPV, only due to the extension on the well economic life generated by the water reduction, was estimated at $3.5M USD per well with ROII of 902 percent. Extrapolating the average NPV for the 30 wells treated, the total value created was as high as $105M USD.

Challenges

- Keep oil production and profitability in a mature field with high water cut (above 90 percent in some wells)
- Depleted formations with pressure gradients close to 0.25 psi/ft
- Long perforated intervals and variable permeabilities (from 500 mD to 3000 mD)

Results

- Decreased water production by an average of 200 BWPD (12 percent), with decreases up to 900 BWPD in some wells
- Improved hydrocarbon production an average of 43 percent, and doubled production in some wells
- Continues to maintain water reduction results two years post treatment
- Value creation for customer attributed exclusively to extension on well economic life due to water reduction was estimated at $3.5M USD per well with ROII of 902 percent
- Value creation for customer also considering the average increase in hydrocarbon production was estimated in $9.6M USD per well with ROII of 1,493 percent

Besides the water reduction, also considering the increase in the oil production presented by some of the wells, the value created in terms of NPV was estimated at $9.6M USD per well, on average. Considering that about 60 percent of the wells treated with Aquacut within the field presented water reduction and increase in oil production, the total value created for the field in terms of NPV was as high as $215M with ROII of 1,493 percent.