TAQA

Case Study:

FloSure AICD Improves Oil Recovery and Reduces Water Cut in Colombian Heavy Oil Field

Advanced completion design for heavy oil/water wells to optimize return on investment

Well Data

Location: Colmmbia

Reservoir Type: Sandstone

Application: Heavy Oil, High Water Cut, Unconsolidated Sandstone

Well Design: Horizontal with AICDs, screens and Swellable Packers

Installation Date: November 2018

Background

This was a three well pilot project where many wells experience early water breakthrough driven by strong aquifer flow. Wells typically produce up to 8,000 bpd of total fluid and must be produced above 95% BSW for long periods of time. These wells are produced using electrical submersible pumps (ESP) without the use of any thermal recovery methods. The loosely consolidated sandstone reservoir has variable water saturation and permeability, which continuously frustrated operators attempts to manage water production ever since the field was first brought online in the 1980s.

The Challenge

Given the highly heterogeneous nature of the reservoir, it is impossible to predict when and where water breakthrough will occur. Since ultimately the goal was to restrict water in some parts of the well, while allowing unrestricted oil flow in all other areas, it was necessary to use technology that would autonomously change it's behaviour depending on the fluids it sees.

The combination of horizontal wells, unfavourable oil mobility, and strong bottom water pressure made the field an ideal candidate for AICD technology to improve oil recovery and to manage water production. Since the pressure in the reservoir was sustained by an aquifer, the additional pressure drop from an AICD equipped completion will not reduce ultimate oil recovery.

TAQA Solution

Having identified the challenge, the production data from several offset wells was used to create a well model for the Colombia AICD candidate wells. Software was used for static simulation and nodal analysis of the base case wells, and then applied to the AICD completion design. Variations in permeability and water saturation can be unpredictable, so the available data was used to create synthetic profiles and match them to well performance.

Well performance modeling was used to establish the critical completion design parameters for the AICD completion, such as number of stages, and the number and size of AICD devices per stage. The modeling was also used to estimate the production performance improvements to be expected with the AICD completion in order to calculate the economic benefit of using the technology.

All three wells had similar depths, but lateral lengths varied. Well A had an 810ft horizontal section and was completed with 7 swellable packers to create 8 AICD compartments of 80-100ft spacing. Well B was designed with a longer horizontal section of approximately 1200ft completed with 12 AICD stages. Well C had a shorter 800ft lateral section and was completed with 8 AICD stages.

Project Results

The overall effect of AICD completions at the macro/field level can be observed in the plot of cumulative oil production (Np) vs cumulative water production (Wp) in figure 1.

Considering all the geological factors and drilling risks, the production profiles for 13 offset wells with slotted liner completions in the area are plotted with P10 and P90 results to create an expected range for Np vs Wp for the area. Comparatively, the expected production range for AICD completions is also plotted, which tracks with the initial production data of the 3 wells.

The overall result is a shift to the right of P10/P90 production range with AICD completions, resulting in statistically lower water volumes and more productive oil wells in the field.

The impact of AICD technology reduced capital cost, lowered operating cost and improved oil recovery.

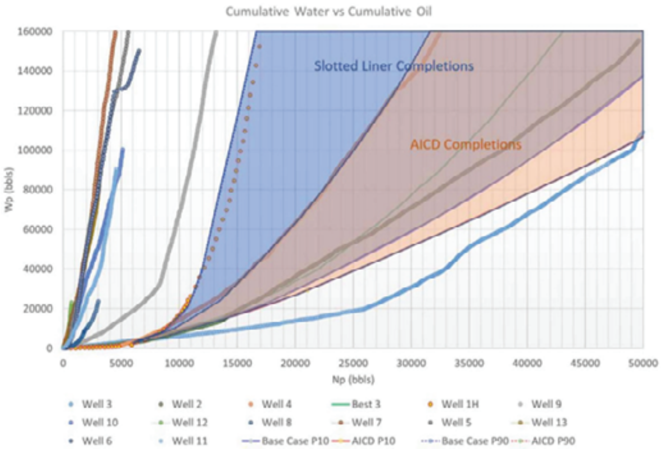

Figure 1 **Expected well production for area with AICD vs slotted Liner**

Figure 2 **AICD completion**