Case study: China

NANOSHIELD polymer enabled drilling in highly unstable shale gas block

Wellbore instability has become one of the biggest challenges in the development of southwest China's shale gas reservoirs. The Longmaxi formation has a particular risk of wellbore instability due to its high brittleness and microfracture structure—making drilling in this environment more difficult than in other shale gas blocks across the globe.

During the last few years, shale gas operations in this region have experienced wellbore collapses, stuck pipes, and loss of rotary steerable system tools downhole while using both water-based mud (WBM) and oil-based mud (OBM).

Also, wellbore instability is a critical factor that negatively limits the efficient development of shale gas in this area.

When Baker Hughes first applied **NANOSHIELD™ wellbore sealing polymer** in the Sichuan shale gas block, it was to help a customer drill a very challenging horizontal well. As the third sidetrack on the same well, Baker Hughes successfully drilled the well to total depth (TD) at 15,112 ft (4,606 m) by adding NANOSHIELD polymer to the competitor's existing OBM system at 9,186 ft (2,800 m) with no wellbore instability issues.

Two previous attempts at this well resulted in lost-in-hole incidents, which caused the customer to plug the horizontal sections and sidetrack to re-enter the reservoir.

Before initiating this field operation, Baker Hughes performed numerous lab tests with the customer to verify the optimum concentration of NANOSHIELD polymer with minimum impact on the fluids' rheology. By adding 4.0 ppb (11.4 kg/m^3) of NANOSHIELD polymer to the entire existing OBM system at the start, the concentration was maintained throughout the drilling period.

NANOSHIELD polymer improved the performance of the fluid from multiple operation perspectives, among them:

- Drilling proceeded through the previous stuck point depths with no issue, and without observing caving, stuck pipe, or abnormal torque and drag
- Maintaining wellbore stability allowed for the average rate of penetration (ROP) to increase from 7.5 m/hr to 12 m/hr
- Reducing torque and drag during tripping and the maximum over-pull was 20 tons (18,144 kg) compared to the previous 50 tons (45,359 kg)
- Satisfied with our performance the customer decided to run casing after only one clean-out run, which saved one trip compared to the standard two clean-out runs commonly used in the same block.

NANOSHIELD polymer worked efficiently and was compatible with the local OBM formulation and exhibited minimum impact on the fluid's rheology.

Additionally, the nano-scale particle size distribution efficiently sealed the microfractures and enhanced the wellbore stability in these complicated shale gas operations—achieving a more intact wellbore and experiencing a higher ROP.

Challenges

- Risk of wellbore instability due to brittleness and microfracture structure
- Wellbore collapse, stuck pipes and loss of rotary steerable tools downhole experienced in the region

Results

- Maintained wellbore stability, averaging an ROP increase from 7.5 m/hr to 12 m/hr
- Reduced torque and drag during tripping with a maximum over-pull of 20 tons (18,144 kg) vs. 50 tons (45,359 kg)
- Casing run after one clean-out run saved the customer one trip compared to the standard two clean-out runs