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RIDGED DIAMOND ELEMENT BIT SETS ROP BENCHMARKS IN OMAN

By Smith Bits, a Schlumberger company

A development field in central Oman contains significant volumes of unconventional gas, distributed across a number of complex reservoirs. Due to the tight nature of the rocks, the wells need to be drilled with technologies that can withstand hostile downhole conditions and outlast long-interval drilling in a highly abrasive interbedded formations while continuously crushing and fracturing rock at target rates.

One of the first challenges for the operator in the deep gas field was finding a drill bit solution to drill the 12¼-in hole section, which historically required multiple runs.

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The section consisted of a wide range of formations, from soft limestone and shales to hard limestone and sandstones. This variety within the formations proved to be a difficult obstacle to effective drilling. The operator's ultimate goal was to drill the entire section, which spanned 2,500m on average, with the highest rate of penetration (ROP) possible.

Overcoming wear challenges

In collaboration with the operator's drilling team, engineers from Smith Bits, a Schlumberger company, developed a customized bit with the goal of meeting the objectives for the section. Extensive analysis by the two teams was completed during the technology development phase, which evaluated offset wells to pinpoint areas for improvement.

A detailed study using the IDEAS* integrated dynamic design and analysis platform led to the development of a six-bladed bit fitted with Axe* ridged diamond elements, an application-specific AxeBlade* ridged diamond element bit. This bit design withstands abrasive environments, minimizing the damage that traditional bits experience without significantly reducing drilling parameters to preserve the cutting structure (Figure 1).

INCREASED ROP AND IMPACT RESISTANCE

The new Axe ridged diamond element features a ridge-shaped geometry that combines the shearing action of a conventional polycrystalline diamond compact (PDC) cutter with the crushing action of a tungsten carbide insert cutter. Positioning Axe elements across the bit face results in the AxeBlade ridged diamond element bit (Figure 2).

Axe elements employ a unique geometry that cuts rock in a new way—a combination of shearing and crushing. This cutting method achieves at least 22 per cent deeper penetration, removing more formation to provide higher instantaneous ROP when using the same weight of bit and rpm applied to conventional PDC cutters. The diamond table on the element ridge, which is 70 per cent thicker than that of a conventional cutter, gives the new element increased impact resistance. For operators, this means that the new bit delivers improved durability and dull condition for maximum ROP throughout the run.

The reduced cutting force required by Axe elements translates to less overall torque, reduced reactive torque fluctuation, and better toolface control in curve applications. This advantage allows better build rates and higher overall ROP, helping maximize production zone exposure and minimize NPT by delivering better trajectory and well placement.

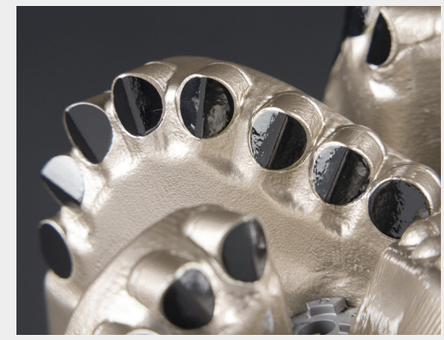

Figure 1.
Fitted with ridged diamond elements, the AxeBlade bit increases ROP and improves steerability through increased cutting efficiency and less torque fluctuations. (Image courtesy of Schlumberger)

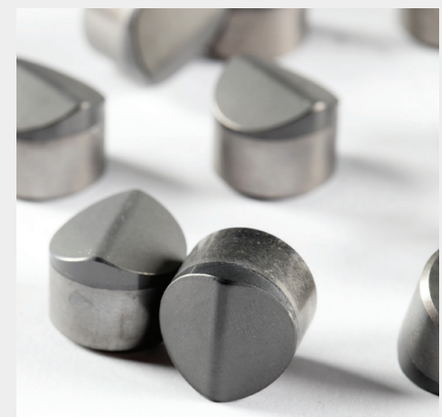

Figure 2.
The new Axe ridged diamond element features a unique ridge-shaped geometry that combines the shearing action of a conventional PDC cutter with the crushing action of a tungsten carbide insert cutter. (Image courtesy of Schlumberger)

CASE STUDY RESULTS

The six-bladed bit design was run on a well in the deep gas field and met the objective of drilling the entire 12¼-in hole section from the Natih limestone to the extremely abrasive Al Khlata sandstone.

To make a fair comparison of runs across the entire field, a normalised ROP was used. The normalized ROP excluded the drilling through the top two formations of Natih and Nahr Umr due to ROP being controlled to limit wellbore instabilities. Additionally, the final Al Khlata formation was not included because not all runs drilled the same interval, which affected the overall ROP averages.

The goal of drilling the section in a single run was accomplished while generating a normalized ROP of 27.5 m/h. This run enabled the operator to exceed the normalized ROP for the field by 42%, as well as outperform the existing field-best ROP by 18 per cent.

For more information about AxeBlade, please visit Schlumberger at booth 4356 or visit www.slb.com/AxeBlade.

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