THE AMERICAN OIL & GAS REPORTER®
APRIL 2019

The "Better Business" Publication Serving the Exploration / Drilling / Production Industry

New Downhole Data And Precise Engineering Boost Drill Bit Performance

By Colter Cookson

For drill bit engineers, knowledge truly is power. By analyzing everything from why bits fail to how cutters interact with different formation types, they are responding to the trend toward longer laterals with solutions that drill faster and stay in hole longer to reach total depth in fewer runs. The newest-generation bit designs help achieve simultaneous improvements in rates of penetration and footage drilled through more effective hydraulics, fine-tuned cutting structures and novel cutter elements.

These innovations could not have come at a better time. As average lateral lengths continue to rise, so has the demand for efficient drill bits. Longer laterals and increased drilling in North America helped the worldwide bit market grow 20 percent in 2018 to reach $3.3 billion, according to Spears & Associates. The firm predicts additional growth for the near term as drilling activity recovers in other regions.

To develop and refine the latest bits, designers say they are gathering more data from the lab and the field–including data from in-bit sensors–to deepen their understanding of how every component of the drill string behaves downhole. The insights the data provide are helping them deliver successful runs that shave days off drilling times through everything from soft shales to hard, interbedded formations.

Ripple Effects

Improving one element of a bit design often can yield unintended benefits, observes Chris Casad, innovation project manager at Ulterra. He offers the company's SplitBlade™ bits as a case in point. These bits' primary blades are divided into two parts, with the outer half offset from the inner half. According to Casad, this offset significantly improves cuttings evacuation by allowing the bit designer to place an extra nozzle next to each primary blade to create separate flow paths for cuttings from the cone and shoulder.

"We developed SplitBlade so operators could evacuate cuttings quickly enough to achieve higher ROP in soft shales such as the Eagle Ford," he recalls. "We have since discovered that the bits also excel in hard and interbedded formations, including the Cotton Valley in East Texas, which has hard and abrasive fine grain quartz sandstone interbedded with shale, pyrite and limestone. That combination makes the Cotton Valley so challenging to drill through that many cutter test programs use it as a proving ground for new abrasion-resistant cutters."

Ulterra discovered the bit's exceptional durability by accident, Casad notes. "Ulterra was asked to design a bit to drill through 2,000-4,000 feet of rock above the Cotton Valley as fast as possible," he relates. "The bit initially missed the instantaneous ROP we were targeting, but when it transitioned past 10,000 feet into the Cotton Valley, it drilled at record footages and speeds to surpass our expectations for the entire section."

The bit's durability comes, in part, from the enhanced hydraulics, which keep the cutters cool to reduce thermal wear, Casad says. "However, there are other factors at play. For example, the blades' patented geometry enables bit designers to lay out cutters in unique configurations that allow them to overlap and support one another. This enhances both footage and ROP by keeping the cutters sharp."

Other benefits occur because the bit geometry pushes the cone forward in the junk slot, Casad contends. "This means that the cutters in the cone engage the formation farther ahead of the cutters on the shoulder than normal," he notes. "The cone's bite into the formation stabilizes the bit and pre-fractures the rock, making it easier for the other cutters to drill through once they arrive. This minimizes torque fluctuations, which improves tool face control and allows the driller to apply more energy to the bit without worrying about excessive vibration."

The cone's forward position contributes to faster ROPs in at least one other way, Casad adds. "When the cone grabs the formation as the bit moves through the curve, it becomes a 'lever' that applies the weight on bit more directly to the formation," he explains. "This means the driller can cut more rock with the same amount of energy."

How much SplitBlade improves tool face control and ROP will vary with the application, but Casad says the improvement can be significant. "In one Rocky Mountain application, the blade geometry reduced sliding percentages 30 percent and increased ROP while sliding, also by 30 percent," he reports.

Other SplitBlade bits have set footage records in West Texas and statewide ROP records in Oklahoma, Casad reports. The bits also are performing well in Canada, the Middle East and the Asia Pacific, he says.

"In a hard and abrasive formation in Egypt, the technology allowed us to replace a two-bit run with a single-bit run at 30 percent higher ROP," Casad concludes. "This took two days off the drilling time, providing almost $50,000 in cost savings and bottom-line value for that customer." ❐

By splitting bits' primary blades into two halves, Ulterra creates the space for extra nozzles. The company says this gives the blades dedicated hydraulics for the cone and shoulder, which helps the bits excel in a variety of formation types–from soft, easily-sheared shales to hard and interbedded formations–by improving cuttings evacuation and keeping the cutters sharp and cool.