ADVANCES IN DRILLING
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New drill bit technology: Greater durability, faster ROPs equal better economics

Drill bit costs, although not insignificant, are a small part of total well expense. The largest factor, by far, in escalating well drilling costs is the number of days spent. The newer drill bit designs all have the same ultimate goals—durability, efficiency, speed and delivery of a high-quality wellbore. Days saved equal money saved.

The keyword in modern drilling is control. As “unconventional” drilling becomes conventional, shale oil and gas reservoirs demand greater, more subtle control. With shale, PDC is the bit of choice, and while roller-cone technology is still valued for faster rates of penetration (ROP) and lower cost-per-foot, fixed-cutter bits now fulfill around 80% of hydrocarbon drilling. Hybrid drill bits, which have characteristics of both types, are finding a larger niche.

While other factors affect drilling performance and economics, including drilling fluids and good seismic data, the drill bit is the one part of the equation that makes the biggest difference. Tailor-made bits designed for a specific drilling application are becoming more common, and designers are becoming more adept at customization with shorter turnaround times.

Longer-term, operators are thinking more and more about the well in its entirety, seeking an engineered drilling system instead of a menagerie of components bolted together. More often, we begin to see a truly wholistic system, designed from the surface down to the bit itself.

SMITH BITS

Since the ONYX II premium PDC cutters were introduced last year by Smith Bits, a Schlumberger company, the company is seeing successful bit runs in North America and around the world. Robert Ford, Product Commercialization Manager, Smith Bits, told World Oil, “We have talked to customers about the applications, identifying areas where the bit was dulling out prematurely, analyzing excessive cutter wear. We identified their applications and tried to understand their drilling objectives. By doing this, we are able to identify the right locations to position ONYX II cutters into those particular bits.”

One example he cited is an 8¾-in. vertical section in the Williston basin. This very long section, 5,000–7,000 ft, would have been drilled, historically, with a six-blade-style bit with conventional ONYX cutters. “With the introduction of ONYX II, we were not only able to bring better cutter technology, we were able to reduce the wear on the bit, and were able to change the bit design,” said Ford. “We went to a five-blade design. It was a combination of a better cutter for better wear resistance, as well as a new design to improve ROP. Moving from a six to a five-blade design, with new cutter technology, improved performance in the application, and so it has become the standard for us in that particular application.”

Last year, Schlumberger introduced the PowerDrive Archer, high-build-rate rotary steerable system (RSS). The system is capable of drilling complex 3D trajectories and openhole side tracks from any inclination, and can also drill vertical and horizontal sections, in one run, without having to change the bottomhole assembly (BHA). The system’s hybrid steering combines both push-the-bit and point-the-bit technologies, allowing the tool to navigate in a way that was previously possible only with a downhole motor, and to deliver high build rates for any deviation from vertical.

The PowerDrive Archer RSS has been combined with new improvements in the SHARC high-abrasion-resistance PDC drillbits to significantly reduce rig time. SHARC bits are designed for superior performance in highly abrasive formations.

Optimizing the cutting structure yields a very stable bit that limits cutter wear and maximizes footage, without sacrificing rate of penetration (ROP). SHARC bits have two rows of cutters per blade, which enhances durability in the nose and shoulder areas, Fig. 3. The two rows of cutters are oriented to maintain...
hydraulic cleaning and cooling.

The Spear product line, the shale-optimized steel-body PDC, was designed exclusively for unconventional shale plays. Launched two years ago, the Spear bits have had more than 5,000 runs across the world, including North America, Argentina, China and Poland. Spear bits were specifically designed to improve shale play economics by efficiently drilling both curves and long lateral hole sections, while minimizing bit balling, thus improving ROP, and enhancing directional control.

The Spear drill bits minimize buildup of cuttings in front of the bit and improve ROP by utilizing directional mud flow, which cleans debris so that a sharp cutting edge always meets rock. The bullet-shaped body streamlines the bit, making it easier for cuttings to sweep around the body. Body diameter is smaller, increasing the distance between the borehole and the bit body in the junk slot, improving the ability of cuttings to pass through the slots. Smaller cutters are used to improve directional control, without affecting ROP.

“Over the past year, we have worked upon improving the original Spear design, and right now we’re in the process of releasing the next generation of the Spear drill bit,” said Ford. “We’ve actively introduced these into North American shale plays, especially the Eagle Ford and we’ve had success improving ROP and control with wellbore trajectory,” Fig. 4.

Every oil field target has different geological features that create unique drilling situations. To optimize drilling, the operator must choose drill bits with optimum characteristics to deal with expected lithology. Drill bits are an integral part of the drilling system, along with drillpipe, MWD tools, stabilizers, reamers and RSS (or downhole motors). Bits can be custom-designed for a given situation, providing maximum ROP and stability.

“What we are going to see more of are true, engineered drilling systems—optimizing the bit with the entire BHA—to deliver much better performance,” said Ford. “We are going to see more of these systems, coupled with improvements in individual components. You can improve a bit, but does the system affect wellbore tortuosity, or cause micro doglegs in the wellbore? If you design a system that can deliver wellbore quality with trajectory control, you can improve well construction efficiency such as running casing with no problems, improve borehole quality and critically deliver better reservoir productivity.

“Our ultimate goal is to deliver one bit run per section. With this focus and utilizing IDEAS integrated brilbit design platform, application-specific bit design is really what is driving us moving forward. Understand the requirements of the operator, and from that develop a bespoke bit design solution to help lower costs.”

Fig. 3. The SHARC MDSi716 8½-in drill bit with two rows of cutters in the critical shoulder area provides maximum durability in abrasive formations. Illustration courtesy of Schlumberger.

Fig. 4. The next-generation Spear shale-optimized steel-body PDC drill bit is tailored for unconventional shale plays. (Illustration courtesy of Schlumberger)