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Big oil is tuning into hard rock to get to petroleum resources

A move is under way that could mean cheaper natural gas for America and bigger profits for the petroleum industry.

HARD-ROCK DRILLING

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It is called hard-rock drilling, a term that references the tough rock formations blocking access to many domestic petroleum reserves.

Drilling through hard rock is not new, of course. E&P companies typically encounter hard rock on more than one-third of the vertical wells they drill in the U.S. The problem, however, is growing as the industry turns to deeper, unconventional deposits of natural gas — deposits like those found in the Rockies and other regions. In these areas, widespread intervals of subterranean hard rock make it prohibitively expensive to tap the resources underneath.

The reason is simple: The harder the rock, the longer it takes to drill. And the longer it takes to drill, the more it costs. It is common for hard-rock formations to account for 70 percent or more of a well's total drilling costs, even though such formations make up only a small percentage of the total depth of the well.

Such high costs can be traced back to the drilling technology itself, especially the drill bit. While a large number of components make up a drill string, the real work happens at the bit. There, mechanical forces like weight, torque and rotary speed all combine to construct the well.

For hard-rock formations, this means drilling through rock so strong or abrasive that it can cause a bit to fail after only a few hundred feet of drilling — a problem that is complicated by the fact that many hard-rock formations occur at depths of more than 10,000 feet.

THE USUAL BITS

Traditionally, the industry has relied on two types of bits for hard-rock drilling: tricone-roller bits and fixed-cutter bits. Tricone-roller bits feature three cones mounted at the end of the bit. The cones rotate on bearings and feature teeth or buttons that chip and crush the earth at the bottom of the well. Fixed-cutter bits, in contrast, are very similar to the hand-drill bits people use around the house every day. There are no moving parts on the bits themselves. Instead a cutting structure of natural or man-made diamonds does the work.

New drill bits accelerate hardened steel particles through specially-designed nozzles

While both types of bits are capable of drilling hard rock, they have significant limitations when operating in these formations. Most importantly, they drill very slowly and wear out quickly, which means they must be replaced often.

Replacing a drill bit is not an easy process. The operator must pull the entire drill string back to the surface and then fit the new bit to the end. This takes up to an hour for every 1,000 feet of drill string the operator has to retrieve. As a result, repeated failures can add days to a drilling cycle that already takes more than a month per well.

These delays can also add big dollars to the drilling process. Since it typically costs more than $35,000 per day to run a drilling rig, any nonproductive time can cost E&P companies tens of thousands of dollars.

By that same metric, any amount of time that an E&P company can shave off the drilling cycle adds up to big savings. In the Rockies, for instance, tripling the rate of all hard-rock drilling could save the industry more than a half-billion dollars annually. In areas like the Permian Basin and the midcontinent region, it could save the industry between $250 million and $275 million a year.

NEW TECHNOLOGIES

All of this is simply academic, however, without the ability to actually speed hard-rock drilling. That is where a slew of new technologies come in. Some of the biggest advances are in the coatings and materials used in the bit itself. E&P companies are turning to materials like tungsten carbide to increase a drill bit's resistance to abrasion and wear, while also adding synthetic diamonds to drill bits to give them tremendous hardness.

More important, they are turning to newly commercialized drilling systems that radically depart from traditional technologies. One example is Particle Impact Drilling, or PID. Unlike most drilling systems, which crush, grind and scrape the hard rock, PID blasts it away using small particles of hardened steel that are entrained in the drilling fluid. The PID system accelerates these particles through specially designed nozzles in the bit, impacting the hard rock more than 4 million times per minute. It is the equivalent of continuously firing a shotgun at the hard rock from point-blank range.

The PID system already is in testing in Utah and East Texas, where it is changing the rules of the drilling game. In recent field-testing, for example, PID technology took only eight hours to drill a 120-foot hard-rock interval at depths exceeding 11,000 feet. Drilling through this same amount of hard rock with conventional technologies typically takes more than 24 hours — three times longer than PID technology.

Clearly, new hard-rock technologies could dramatically impact the oil-and-gas industry, providing it with increased savings and lowering the bar for economic recovery of considerable natural gas reserves. More important, however, the technology could help the nation tap unconventional domestic reserves and reduce dependence on foreign imports.

Who knows, pretty soon everyone may be tuning in to hard rock.

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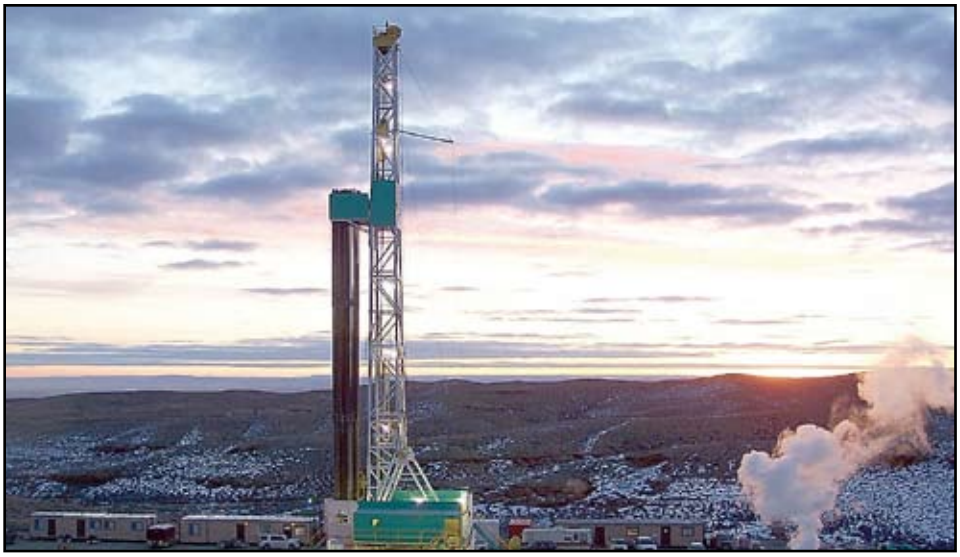

PHOTOS COURTESY OF PARTICLE DRILLING TECHNOLOGIES

Hard-rock formation makes it expensive to drill for natural gas in the areas such as the Rockies.