The Oil Drum
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

In coal mines, the Penitent really was

Posted by Heading Out on October 15, 2005 - 11:37pm
Topic: Supply/Production
Tags: coal, horizontal drilling, methane, natural gas, tech talk [list all tags]

This is a little technical meander that occurs with some regularity, on Saturdays. It is largely for background information, and is a very simplified explanation of what happens in drilling oilwells and for related underground resources. Because the series is now getting longer, references to earlier posts are given at the back end of this one. And to explain the title, and give an indication of today's topic; one of the nastier jobs in early coal mines was given to a man called a Penitent. He would wrap himself in wet rags and crawl along the floor holding a long stick with burning rags on it, ahead of him, and up against the local mine roof. The intent was to burn dangerous pockets of methane before they got large enough to explode.

There is a debate in Los Angeles about the risks involved in extending the subway from Wilshire Boulevard to the sea. The major concern is with methane pockets. Because

> Millions of years ago, the L.A. Basin was under the Pacific, and centuries of dead sea life created rich reserves of fossil fuel. By the early 20th century, the fuel was being pumped out in a maze of active oil fields. Today, many of the old pumps are gone, but significant pockets of explosive methane and other subterranean gases remain.
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> The Fairfax area -- home to the bubbling La Brea tar pits -- poses a particularly vexing problem for diggers.

Methane, or fire damp as it used to be called in coal mines, is a particular risk for underground workers. It is a gas often found in coal, the discontinued Bureau of Mines had evolved an equation that relates the gas volume to the depth of the coal.

Gas has always been a problem in mines, it is invisible and whether the mixture of carbon dioxide and monoxide called choke damp, or stythe, that lies in hollows in underground roads, or the methane at the roof, both are killers. Ventilation is designed to dilute these gases to the point that they are not dangerous, but as the gas issues from the coal, as it is ground from the face by mining machines, it can pass through the concentration range of 5 - 15% at which it can explode. If, at that instant, a mining pick strikes a layer of hard rock in the coal, the spark may be sufficient (or the hot rock) to ignite the methane. At that point the mine tunnels can become like a gun barrel as the methane blast stirs up the coal dust into an even greater explosive mixture. In such cases without proper safeguards all those in the mine at that time die.

Such a risk has led to a considerable effort to find ways of getting rid of the methane before the coal is mined. One way, with the side benefit of producing a salable product, is to drill wells into the coal, and extract the gas first. This coalbed methane has become a considerable resource with a growing potential as a resource.

But there is a problem. Coal seams (apart from such giant seams as those in Wyoming where they can be 100 ft or greater in thickness) are usually only about man-height. (Although if you have ever tried the historic method of mining with pick and shovel you will find that about 4 ft high is ideal). And the amount of gas (or oil from an oil reservoir) that you can get from a well is a function of the length of the well in the gas bearing layer. As a result if a vertical well was drilled into a coal seam, the amount of gas produced might only come from a 6 ft thick layer in the well. This does not drain much of an area, nor produce that much gas. And so the Federal Agency responsible (at that time the US BoM) carried out a considerable amount of work on developing ways to create a horizontal well from the surface.

Most coal seams are quite shallow (the deepest I have been in was around 3,000 ft in the South of England) at around 700 ft. This means that the wells, which start out vertical, must turn through 90 degrees, by the time that they reach the seam. As an early rule of thumb the build angle for such a well is around 8 degrees/100 ft. So to turn 90 degrees, would take some 1100 ft. Researchers at Pittsburgh found that by controlling the thrust across the bit they could steer it vertically to keep it in the seam, and, over time were able to drill out considerable distances.

> Pioneering independents, working in conjunction with the Bureau of Mines and later with the Gas Research Institute, were successful in establishing some coalbed production in the Black Warrior.
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> At about the same time, the San Juan Basin in New Mexico and Colorado was the site of early pioneering work by Amoco Production, which drilled its first coalbed methane well there in 1977-78 at the Cedar Hill Field. That first field came on line in 1979 with significant production figures, Murray said.
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> Unfortunately, natural gas prices were soft and coalbed completion techniques were far from perfected, making progress very slow.
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> But companies continued to further the science of coalbed methane drilling and production through the 1980s -- through persistence and the financial boost of Section 29 tax credits for unconventional natural gas sources -- and by the early 1990s the San Juan Basin coalbed play was an unqualified success story.

. One of the pioneers was a fellow called Maurice Deul. The technology has spread to Australia more recently. It is attractive particularly in Queensland and New South Wales. Within the United States it is now being recognized more and more as a potential resource, with the need for horizontal drilling now well recognized.

In Australia the technology is somewhat further advanced. It already provides a third of the natural gas consumed in Queensland. And Australian investigators, working from an originally American idea, have also dramatically reduced the turning radius, so that the horizontal well can be kicked off in a much tighter radius. In fact the smallest radius achieved is around nine-inches. This uses a high-pressure waterjet drill as the drilling method, a third method to add to the technical toolbag, to go along with roller cones and diamond bits.

I have discussed the development of horizontal well drilling in coal, for gas recovery, rather than for oilwell use, because, although the techniques are quite similar, in some ways the coal development is somewhat further ahead. Tight radius drilling, or its equivalent, in oilwell use is limited to drilling short laterals. These are typically only some 50 - 100 ft long and drill out from a well. They have benefit in rocks such as the Austin Chalk, which carries oil often in vertical fractures. This means that if you drill a vertical well and just miss one of these your well might be dry, but by drilling a short lateral then you can hit the crack and bring in considerable production. Thus production can be several times that of a vertical well, both in terms of rate and of overall production. More conventional horizontal wells are generated using conventional turbine motors, and steering is done with a bent sub with wells that can now run horizontally out up to 6 miles. (I will try and explain the coiled tubing/bent sub steering method in a later post).

Horizontal well drilling remains more expensive than vertical well drilling, since among other things it can be harder to get the cuttings out of the well, since they tend to settle to the bottom of the hole, and form little dunes. But, increasingly it is becoming the way of the future. And in this application it is being used for horizontal drainage, more frequently than the original oilwell use, which was to extend the reach of the drilling platforms to access oil pools that were close, without needing to move the platform.

This is part of an ongoing weekend series on technical aspects of oilwell (and natural gas) drilling. Previous posts can be found at::

the drill

using mud

the derrick

the casing

pressure control

completing the well

flow to the well

working with carbonates

spacing your well

directional drilling 1

directional drilling 2

types of offshore drilling rigs

As ever, if this is not clear, or if there is disagreement then please feel free to post, and I will try and respond.