The Oil Drum
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

Oil and the Water pressure problem

Posted by Heading Out on April 15, 2005 - 5:56am

So you've had your coffee, done your math homework, and now it's time to celebrate. So break out the champagne (or if you don't want to waste it, try a bottle of soda water, but open it in the sink). Like all good celebrations you shake the bottle before opening it, and champagne sprays around and everyone is cheerfully soaked. But if you then put the bottle down, you would see that the gas pressure in the wine (or soda if you are as cheap as I), has only pushed out about a third, or less, of the wine out of the bottle.

That is, sort of, what happens with an oil well. Everyone has seen the gusher that shoot up into the air in the old movies, covering the dancing hero and his girl in oil. But the pressure that pushes the oil out of the ground is like the gas in the wine, it can only push so much of the oil out of the ground and the pressure is relieved, and the oil flow stops. In many places there is not enough pressure even to start a flow, and there pumping has to be used from the beginning.

It would be easier if the oil continued to flow out of the well by itself, and to get this to happen another fluid has to be pumped back into the ground to fill the space left by the oil and to keep the pressure up that is pushing the oil out. There are two ways this can be done. One is to pump in a gas, under pressure, into the rock just over where the oil is, and this will move the oil to the well. If you have that sort of imagination it is similar in effect to going from the small toy water pistol that I could just about hit my baby brother with when he was really close, and still a child, to now having one of those more modern Super Soaker water guns that pump air under pressure behind the water. Now you put out more water faster, and can hit that obnoxious kid over on the next block.

However when this is tried in an oil well, while the gas works, you have to get it fom somewhere, and it also turns out not to work as well as pumping in water below the oil. And so pumping water into the ground is often used, after the initial pressure has dropped, to keep some pressure in the well and help with what is known as secondary recovery (the initial flow being called primary).

In developing the large Saudi oil fields Aramco decided to speed the process up by combining the water flood with the initial extraction since, in this way they could keep a higher pressure in the rock, and the oil would thus flow out faster (the Super Soaker approach). While this works well to a point, it runs into a bit of difficulty when the water reaches the bottom of the oilwell since water now mixes with the oil and the amount of oil coming out of that well drops.

To solve this engineers came up with the idea of turning the oilwell direction so that, when it reaches the oil-bearing rock, the hole runs horizontally across the rock, rather than just going vertically down. This has both an advantage and a disadvantage. The advantage is that it allows more oil to be recovered faster and initially reduces the amount of water in the oil, since the well is now above the water level for longer. The Saudi Arabian large fields are now almost exclusively being extracted this way. And water levels in their oil dropped, and production has been good.

The downside comes when the water gets near the level of the wells, and starts to increase the water percentage in the flow significantly. That is when the long run of a highly productive well or oil field suddenly falls in the toilet. Production declines well over 10% a year can happen, and as I showed with the output from the Yibal field in Oman that was produced this way, suddenly production is over.

The big worry at present is that we may well be approaching this condition for the largest Saudi Arabian fields, they have been produced with water injection and now water percentages are rising so that a significant drop in production could be fairly imminent. In a later post I will go into why this is more likely, and will leave to your imagination what the effect of an imminent drop of say 600,000 bd in production from those fields will have on the demand:supply balance.

Technorati Tags: peak oil, oil
