The Oil Drum
DISCUSSIONS ABOUT ENERGY AND OUR FUTURE

On Mining Energy, Chinese Coal and Wisconsin Wind

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Well, what with all that has been going on in the world recently I haven't posted much about technology at the weekends for a while. There has, however, been the odd comment about the energy costs of mining and how these are inevitably going to go up, as the resource base gets a little smaller. So I thought, since we try to be a fact-based site here, that I would give you a little homework to amuse you for a few moments and perhaps show you why there are ways in which mining can be made less energy expensive than it currently is. You will need a matchbox (or similar rectangular object of about that size), a cake and a knife (who said science couldn't be fun).

When we first started doing these technical talks (and I say we since Stuart is also now putting some of his posts together in the same way), I mentioned that as you go deeper into the ground, the pressure on the rock goes up by about one pound per square inch (psi), for every foot that you go deeper. This is based on a simple approximation that the weight of the rock is 144 lb/cu.ft., which is a reasonable first assumption. So as you go deeper into the ground the weight of the overlying rock, which is often called the overburden pressure, goes up. Let us say that we are about a thousand feet down (an average depth for many mines), then the background overpressure would be 1,000 psi. But, because we have driven a tunnel into the rock, the rock on either side of the tunnel (or drill hole) also has to carry the weight of the rock that used to rest on the rock where the tunnel is. So the pressure on that rock might be double the normal pressure, or say 2,000 psi. This overpressure makes it harder to break the rock, by quite a significant amount.

To illustrate the point you need the matchbox. Put it on the table with the long axis vertical. Now take your finger and push it over. Notice how little force it took to push it over. Now put the matchbox back where it was, lean some of your weight on it with one hand, and try pushing it over with the other. It becomes a bit more difficult and takes a bit more force.

In most cases when breaking rock underground the rock is confined by the roof and floor, and under the overburden pressure I mentioned. It is therefore harder to break out, just as moving the matchbox was. But if the rock is cut, at edge of the hole, then that rock cannot carry the weight of the overlying rock (the pressure moves further into the wall) and now the rock is like the matchbox without any weight on it, and it becomes a lot easier to break.

How much easier? Well when this idea was tested in drilling holes for oilwells, it more than doubled the speed at which the drill could penetrate the rock in most rock types, in some cases giving more than a three-fold increase. It is still not very widely used, for a variety of reasons, but does indicate one way in which technology can advance - since it also works when grinding coal from the rock face in mining minerals.

Which brings me to the second, tastier, example. You have the cake, and a knife, cut yourself a

piece of cake. If you are a normal person, then you take the knife, make two cuts, one on either side of the piece of cake that you want to eat, and then pick the piece out of the cake in a single gesture. Eat and enjoy!

But in normal mining practice the rock is broken in a different way. To illustrate this, go back to the cake and take the knife, and to remove the next slice, start chopping the side of the cake in pieces no bigger than about 1/8th of an inch. Notice two things. Firstly it is taking a lot longer, and a lot more energy to break the cake into these smaller pieces, and secondly you are starting to make a bit of a mess. You then have to pick up the cake and eat it. Notice that it gets harder to collect all the fragments, and to pick them up and eat them.

To take this analogy one step further, let the cake have a layer of cream in the middle. Let us assume that the cream layer is the valuable mineral (gold occurs like this in South Africa). Now if we want to separate the gold from the cake, with normal mining practice we chop up the cake into little bits again, then we have to wash off each particle of cake to separate the cream so that we can eat it.

However, if we took our finger (Miss Manners not being around) and ran it along the cream layer, we could get the cream out without having to move the rest of the cake. Until we reached a point our finger couldn't go any deeper. Then we would have to take away some of the cake. But if we only wanted the cream, then we could cut big slabs of the cake away and leave them beside where we were digging out the cream, without having to gather them up and carry them away.

No, they are not doing much of that either, but this example tries to show that there are, for some ores, ways of mining out the valuable layers within the rock mass, at a lower energy cost than grinding the full face into little bits, and then carrying them all away.

There are other approaches that can be carried out to lower energy costs of mining, in most cases there hasn't been the need to think about these since energy costs have been low, but now that costs are going up, were there that many excavation engineers around the world, then some of these may well be implemented in the years ahead.

I noticed that there was a long article today on coal mining in China in the NYT. It discusses some of the energy pollution problems that this is generating for the world, though it also does make a token nod in the direction of global dimming though in a slightly deceptive way.

> The sulfur pollution is so pervasive as to have an extraordinary side effect that is helping the rest of the world, but only temporarily: It actually slows global warming. The tiny, airborne particles deflect the sun's hot rays back into space.
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> But the cooling effect from sulfur is short-lived. By contrast, the carbon dioxide emanating from Chinese coal plants will last for decades, with a cumulative warming effect that will eventually overwhelm the cooling from sulfur and deliver another large kick to global warming, climate scientists say. A warmer climate could lead to rising sea levels, the spread of tropical diseases in previously temperate climes, crop failures in some regions and the extinction of many plant and animal species, especially those in polar or alpine areas.

Note that, as long as the power plants are operating the particles will still be generated, so their short atmospheric life individually, does not affect the sustained cooling that they achieve. And

also note that there are no positive aspects given to global warming. (Such as the greening of the Sahara). But then all reporters are unbiased (grin). In which vein, I did note comments which are also inherent in this story, that mines always leave a permanent scar on the landscape and copious pollution. I suspect, for many who hold those views, that I could stand them near mine site after mine site that has been restored, defy them to tell me where the mine was, and would still be unable to change their minds. So that's why this post has another major theme.

But along the same vein, and for those who see wind as a help in meeting future energy needs, there is bad news in that wind power projects are being halted in the Midwest. There are a couple of interesting points to the story. The first is that the hold has been applied by the DoD, who need to determine whether wind turbines interfere with military radar. This may mean that the hold could be around for a while.

> This spring, facilities in the works in North Dakota, South Dakota, Illinois and Wisconsin received "proposed hazard" letters from the Federal Aviation Administration saying the projects must be halted pending the Defense Department study.

However, on the other hand, the article points to the growing popularity of wind turbines, and the economic return that they can bring to a farmer.

> The FAA has received more than 4,100 wind turbine applications so far this year, compared with about 4,300 in 2005 and 1,982 in 2004. An offshore wind farm of as many as 170 turbines is planned in the Gulf of Mexico off South Padre Island, Tex. The $2 billion project will generate enough electricity for 125,000 homes. At meetings in Madison, Wis., and Toledo this month, industry and government officials will discuss an offshore wind farm in the Great Lakes. . . . . A farmer who has a turbine on their land gets $4,000 to $5,000 per year for that turbine.