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Hydraulic Fracturing -- Is it all it's cracked up to be?

The holy grail of energy independence or a groundwater nightmare in the making?

By Keith Hall Dec 20, 2010

Hydraulic fracturing has received significant attention recently, particularly in connection with the production of natural gas from shale. Many organizations (including Louisiana Oil & Gas Association, the Marcellus Shale Coalition, and the American Petroleum Institute) have hailed the process as one that will provide economic, national security, and even environmental benefits to the United States. Others, such as the Environmental Working Group and Public Citizen, have claimed it is a serious threat to the environment.

"Fracking" or "fracing" has aroused interest throughout the United States — not only because the process raises important issues, but also because shale formations are in a majority of states. Most of the drilling activity has been in the Marcellus and Devonian Shale formations, which extend from New York, down through Pennsylvania, Ohio, Maryland, West Virginia, Virginia, and Kentucky; the Barnett Shale in the vicinity of Fort Worth, Texas; the Haynesville Shale in northwestern Louisiana; and the Fayetteville and Woodford Shale formations in Arkansas and Oklahoma. Other shale formations have attracted activity in Michigan's lower peninsula, northern Montana and North Dakota, South Dakota, south Texas, Illinois, Indiana, California, Arizona, New Mexico, Utah, Colorado, Wyoming, Kansas, Mississippi, Alabama, Tennessee, and Maine.

Production Basics

Oil or natural gas is found in the pore spaces of underground rocks. To produce oil or gas, an operator drills down to the rock formation, creating an opening between the rock where the oil or gas is found and the drilling rig on the surface. High pressure sends the oil or gas up to the surface. Before oil or gas can flow into the well, it must travel through the rock formation to the well pipe. It moves either along naturally occurring cracks in the rock or, more commonly, through pore spaces in the rock.

Some rocks have larger and more numerous connections between pores than others. Other things being equal, oil and gas flows more easily through rocks that have larger and more numerous connections between pores as well as larger and more numerous pores. If a rock formation is not very permeable, oil or gas will not pass through it very quickly. Petroleum geologists refer to such a formation as being "tight" and this type does not lend itself to economical oil or gas production.

Shale often contains natural gas, but it has a very low permeability, resulting in very slow flow. This type of rock often contains natural fractures, and gas can flow through those fractures as well as through pores, but generally shale does not have enough natural fractures to make up for its low permeability. For that reason, it traditionally has been uneconomical to produce gas from shale.

Enter Fracking and Horizontal Drilling

Since the 1860s, oil well operators sometimes have increased production rates by increasing the number of fractures in rock formations. The earliest method was explosive fracturing, but by the late 1940s, hydraulic fracturing was developed. In this process, the operator pumps water into a rock formation at extremely high pressure to create fractures. When the high pressure water is withdrawn, so that oil or gas production can begin, the rock faces tend to come back together, thereby closing the crack. Companies have added proppants —small particles that can travel with the high-pressure water into the newly-created spaces — to keep the fractures "propped" open. The most common proppant is sand, although small ceramic particles also have been used.

Hydraulic fracturing remained uneconomical to produce natural gas from shale until relatively recently due to technology improvements in the process as well as in horizontal drilling.

In horizontal drilling, the operator drills down toward the target formation, just as in a traditional well, but then turns the drill bit so that it gradually veers in a horizontal direction. By the time the

bit reaches several feet into the target formation, it is in a horizontal position. This drilling continues for thousands of feet, and after the drilling is complete, the piping is perforated, resulting in a much longer section of perforated piping than in vertical drilling.

Shale Gas Drilling Pros and Cons

Shale gas production is beneficial for several reasons, including:

- Production reduces U.S. dependence on foreign sources of energy, which could improve the economy and protect national security;
- The supply of natural gas in domestic shale formations is enormous -- by some estimates, shale and other unconventional sources that require hydraulic fracturing could produce enough gas to supply this country's needs for at least 90 years;
- Natural gas produces the least amount of carbon dioxide when burned, resulting in fewer greenhouse gases than oil or coal;
- Job creation, increased sales tax revenue, and economic benefits to private landowners.

Commentators have stated that the concerns of some people arise from the fact that basic oil and gas activity is new to them — in addition to the economic boost are the tradeoffs of increased traffic, noise, dust, and odors, for example. These tradeoffs are similar to those of other industrial activities and with large-scale activity of any kind.

Some people worry that fracking will contaminate drinking water aquifers with natural gas or added chemicals from the process water. Proponents argue that the rock formations that are being fractured typically are located thousands of feet below drinking water aquifers, and the fractures will not travel that far. They acknowledge that the vertical section of a well will pass through the aquifer, but the same is true for virtually any oil or gas well, including many of the thousands that have been drilled for decades. Drillers have established proven techniques to seal aquifers from oil and gas wells, and the vertical section of a shale gas well is no different from a conventional well in this respect.

Critics are still unconvinced. In part, their concerns arise from a belief that hydraulic fracturing is not sufficiently regulated. All states regulate oil and gas wells but, under a 2005 amendment, the federal Safe Drinking Water Act does not apply to hydraulic fracturing operations (though federal laws do govern the disposal of hydraulic fracturing fluid, much of which is recovered after a fracturing operation is complete).

Many people also are concerned about the lack of information about what chemicals are added to hydraulic fracturing water. Operators add biocides to control microorganism growth, corrosion inhibitors to protect well piping, other chemicals to decrease friction between the pipe and the water, and additives to increase process water viscosity. The companies that perform hydraulic fracturing historically have treated this chemical information as proprietary.

But the U.S. Environmental Protection Agency recently pressured companies to disclose those chemicals and most have agreed to do so. Further, some states, including Pennsylvania and Wyoming, have enacted laws requiring some chemical disclosure. A few companies have voluntarily posted such information on their websites. These disclosures will not eliminate all concerns, but the disclosures at least should decrease the fear-of-the-unknown factor.

Mostly anecdotal accounts of drinking water well contamination have been made so far. To the extent that incidents have been documented, most or all arise from something other than the fracturing process. For example, in northern Louisiana, several cows owned by one farmer died. The farmer believes that fracturing fluid spilled onto the ground at the well site, that the fluid made its way into a ditch, and that his cows drank and were poisoned by it. If the farmer is correct, the incident would demonstrate a problem with chemical storage or handling, not with the hydraulic fracturing process. There also is a report that Cabot Oil and Gas failed to properly install the casing and the cement that isolate a well from an aquifer through which the well bore passes. But again, that problem does not relate to the fracturing process.

In 2004, EPA conducted a study of hydraulic fracturing in coal seams. The agency concluded that fracturing in coal beds "poses little or not threat" to sources of underground drinking water, and that fracturing did "not justify additional study at (that) time." But concerns remained, and the EPA announced earlier this year that it will conduct another study on the potential effects of hydraulic fracturing on drinking water. The new study should be complete in 2012. If that study concludes that hydraulic fracturing poses little risk, that may decrease fears, but concerns about the potential effect on drinking water are unlikely to disappear entirely, no matter what the study concludes.

A separate concern is the question of where operators obtain the water used for hydraulic fracturing. To hydrofracture a single well, an operator uses several hundred thousand to perhaps a few million gallons of water. Even in water-rich states such as Louisiana, there is concern, and some shale formations exist in North Dakota, Wyoming, and other states where water is less plentiful.

Hydraulic fracturing operators point out that, although the amounts of water used in fracturing sound high to many people and, though the availability of water is a valid concern in some states, the amount of water used in hydraulic fracturing is not very high compared to some other industrial processes and is comparable to the amount that a golf course uses every couple of weeks. Companies that perform hydraulic fracturing also are developing methods to recycle a portion of fracturing water and to use produced water for hydraulic fracturing (produced water is water that often comes up naturally with oil or gas that is produced).

New York and Pennsylvania have placed limits or moratoriums on the issuance of drilling permits while they study hydraulic fracturing. Some congressional Democrats have pushed for regulation through the Safe Drinking Water Act, but such efforts do not appear likely to be enacted soon.

It is likely that additional regulations and disclosure requirements will be enacted but it seems unlikely that hydraulic fracturing operations will be banned altogether. Hydraulic fracturing has been practiced for about 60 years, largely without incident. Indeed, a large fraction of wells, even those that are drilled into rock formations other than shale, are fractured at some point.

Some of the regulations likely will take involve disclosing chemical composition of fracturing water and demonstrating that fractures do not propagate to reach drinking water aquifers. Regulators may bar the use of certain chemicals as additives although it seems highly unlikely

that operators would be limited to using only water and sand. In response to concerns, some companies are reporting that they are using only safe chemicals. Indeed, Halliburton recently stated that it has produced a line of hydrofracturing chemicals that are all drawn from the food industry.

Ongoing studies and new regulations will not erase every person's concerns, but likely will address these concerns sufficiently to allow hydrofracturing to continue to be used with increasing frequency for the benefit of this country.

About the Author

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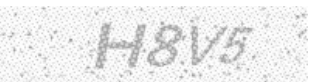

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