



WTF: What the frack is hydraulic fracturing?

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Frack.

Not since the Bush-Gore presidential election brought us “hanging chad” has a term entered the popular lexicon so quickly and so thoroughly.

When oil and gas companies developed the technology to pump water, chemicals and sand into the ground to fracture rock and release hydrocarbons, they called it “hydraulic fracturing.”

“Fracking” became the shorthand phrase, helped along by its similarity to an expletive and its affinity with drilling.

But verbs like “frack” tend to commingle rampantly beyond their original context, and opponents to drilling are now having a romp with the industry’s signature phrase.

“All Fracked Up” is the name of an anti-drilling documentary out of New York.

“No Fracking Way” is both a slogan and name of an anti-drilling group.

The variations have a rabbitlike fecundity.

There are people in the oil and gas industry who now say they wish they’d nicknamed their technique anything but that.

Despite the ubiquity of the phrase, there is widespread misunderstanding of what the process really is and what its dangers might really be.

In the beginning



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Donald Gilliland, The Patriot-News, file

A fracking operation near Troy, Bradford County, Pa.

A brief geology lesson.

Millions of years ago the plants and organisms living in the ocean that covered much of Pennsylvania settled to the bottom as they died. Over time, they were covered by layers of mud, which eventually became rock.

That process happened multiple times, creating multiple layers of buried organic material. As more time passed and more stuff accumulated above those layers, they were subjected to great pressure and heat.

The combination of pressure and heat began to convert the organic matter to coal and oil and gas. The deeper the layer of long-dead sea stuff, the greater the pressure and the faster the "cooking."

Edwin Drake was operating in the relative shallows when he drilled his well outside Titusville in 1858 and struck oil. His successors drilled deeper elsewhere and struck gas.

In both instances, and for years afterward, they were tapping pools of oil and gas that had accumulated in geologic pockets — in the case of gas, that which had migrated from its source rock into more porous rock nearby.

They were picking the low-hanging fruit, which over time became scarce.

Nearly 100 years after Drake, Stanolind Oil and Halliburton performed the first hydraulic fracturing of a well outside Duncan, Okla., on St. Patrick's Day in 1949. The idea was to crack open more of that porous rock and release more gas.

It worked, and was then repeated more than 2 million times in the succeeding 60 years. An estimated 90 percent of all gas wells in the United States have been hydraulically fractured.

So why is it an issue all of a sudden?

It's a matter of volume and scale.

The gas in that porous rock was running out, so engineers tried to see if they could tap the source: the layer of ancient sea stuff itself, which was now hard, black shale. That layer was relatively thin, compared to the porous rock above, and it was dense, so a vertical hole exposed only a small surface area, releasing only a small amount of gas. The return wasn't worth the effort.

So the engineers developed a way to drill down and then horizontally through the shale, so a much greater surface area was fractured and a much greater amount of gas was released.

It worked, but it required a massive volume of water.

"I've seen 22-stage frack jobs requiring 9 million gallons of water," said Scott Perry, head of **the oil and gas division of the state Department of Environmental Protection**. The average is 3 (million) to 4 million gallons. But that can release the gas from a square mile of shale, through just one well pad.

Big fracking mess

In the United States, politics and science have rarely married well, particularly if religion or money are issues.

By the opening years of the 21st century, reverence for the natural environment has taken on the aspect of religion for many, complete with all the differences in commitment and creed, blind contradictions and doctrinaire extremes.

At the same time, oil and gas have become very big money.

In such a climate, it's not easy to find consensus.

Mike Arthur, a geologist and co-director of **Penn State University's Marcellus Center for Outreach and Research** attempts to be a voice of reason. "Our message is not always received well," he said, "because we're trying to explain processes and what the real issues are — rather than the perceived issues — and that's difficult."

Reason swims uneasily in a sea of faith — whether that be a faith in love or easy lucre.

The chief proselytizer of the anti-fracking creed is Josh Fox, director of **the documentary film "Gasland."** The film has mobilized housewives and handymen around the country against fracking, regular people who recognize themselves in the film and who are now fearful they won't be able to drink the water.

It's great emotional filmmaking and absolutely rotten science, and it has become the source of most of the misconceptions about fracking.

On the other side of the ideological divide is a more nebulous collection of professional lobbyists and public relations experts paid handsomely by the oil and gas industry to convince everyone everything is fine. They are alchemists of fact and careful phrasing, who know the power of a dollar dangled before a needy eye.

One treads carefully between these camps.

What follows are the best answers to the biggest questions about fracking as could be determined from scientists, environmental groups with a history of reasoned analysis, research journalists, experts in industry and government regulators.

Q: Will fracking pollute my water?

The fracking process itself? Very unlikely. The products of fracking? They already have — but so have many other things.

The question becomes: at a dangerous level? And the answer is: maybe, depending on where you live. There are important distinctions — blurred masterfully in "Gasland." The first is between what happens below ground and what happens above ground.

The likelihood of the fracking process itself tainting anyone's drinking water is incredibly remote.

The layer of shale being fracked is a mile or more below the surface. Between that shale and the water are multiple layers of impermeable rock. Geologists say they can't guarantee frack water will never find some series of faults in those rocks and travel up to the aquifer, but they say it's very, very unlikely.

Every well keeps records of the extent of the fractures. None has come within half a mile of an aquifer.

What's more, because the frack water is incredibly salty — 10 times more salty than sea water — it is heavier.

As Scott Perry at the DEP explained, "Salt water is heavier than fresh water. It's not going to percolate up. We've got fresh water sitting on an ocean of brine already."

Q: Where do all those millions of gallons of water go?

With the exception of about 10 percent, which comes back to the surface with the gas, it stays down there.

What happens above ground with that 10 percent is a different story: one of accidents, spills and special permits. Accidents and spills — either on the well pad, **as happened in Bradford County last week**, or while being transported by trucks — could get into drinking water.

The state permits some waste treatment facilities to handle frack water, and the treatment is only partial. The tainted water is then released into rivers, which are expected to rapidly dilute it to safe levels before reaching public water intakes downstream.

That seems to be true thus far with radioactive particles, but not for bromides.

The bromides, safe by themselves, can react with chlorine in public water plants to create trihalomethanes, which are known to affect the central nervous system, liver, kidneys and heart and which are suspected to cause rectal, colon and bladder cancer in humans.

Last year, the DEP enacted the strictest water treatment standards in the nation, requiring treated water to meet drinking water standards before being released into the rivers. But existing treatment plant permits were grandfathered, meaning existing practice did not have to change.

The gas industry has begun recycling much of the flow-back fluid, using it in the next frack job. The number of treatment plants taking frack water has dropped from 27 to 15.

Last week the DEP — having detected high bromide levels in rivers in western Pennsylvania — **asked gas companies to stop taking frack water to treatment plants, indicating if there was not voluntary compliance by the end of next month, the state may ban the practice outright.**

Q: What about the secret chemicals?

They aren't secret anymore; in fact, they've been posted on the DEP website for nearly a year. The chemicals range from the mundane to the unsettling. Citric acid is what gives lemons their pucker. Trimethylbenzene, on the other hand, alters the reproductive systems and developing fetuses of animals after prolonged exposure.

Here too, there are questions of proportion.

All of the chemical additives combined account for less than one-half of 1 percent of the fracking "cocktail" injected into a well — the other 99.5 percent is water and sand.

It's still a lot of chemicals: some 780 million gallons in four years nationwide, according to a government report released last week. But that pales in comparison to the volumes used elsewhere in other industries and at home.

Chemicals used in fracking have been found in water wells in Pennsylvania and Wyoming, but that does not mean they came from fracking. In both cases the scientists conducting the tests warned against jumping to that conclusion.

Here's why. The chemical surfactant 2-butoxyethanol — also known as 2-BE — is sometimes used in fracking and was found in water wells in Wyoming. It can destroy red blood cells and damage bone marrow. Between 2004 and 2009 the gas industry used over 747,000 gallons of it in Pennsylvania.

Scary?

2-BE is also the chemical that gives Windex its distinctive odor, and is a common ingredient in dry cleaning solvents, fire fighting foam, asphalt, liquid soap and paint. 2-BE is all around us.

Immediately blaming 2-BE contamination on the gas industry is as inflammatory as saying it'll kill you.

Context matters.

The concern with the fracking water isn't so much the chemicals; it's the salts, radioactive particles and other crud it absorbs underground.

Flow-back water is "extremely polluted," Perry said. "It is very foul."

But he said, "If you fracked with distilled water, you'd still pick up all this stuff."

Q: What about the flaming tap water?

The iconic image from "**Gasland**" is people lighting their tap water on fire. But that has nothing to do with fracking.

It's caused by the initial drilling, which disturbs natural gas in rocks close to the surface. If the well bore isn't cemented sufficiently that gas will take the path of least resistance up through the fissures and into the aquifer.

Many think it's gas from the Marcellus, and conclude if the gas made it into wells, so could frack water.

But it's not Marcellus gas. We know because shale gas has a different isotopic signature. "We've never seen Marcellus gas in anyone's water supply," Perry said.

According to the DEP, less than one-quarter of 1 percent of all of the wells drilled over the last 15 years had any negative impact on water wells.

Migrating gas is nevertheless a problem, and one not always easily solved. New well casing standards help, but that's not always enough. For example, abandoned wells in the area could also provide a pathway for newly disturbed gas to rise to the aquifer or the surface.

One environmentalist said Pennsylvania could have had a moratorium like New York, planned extensively and still we'd have a problem with migrating gas.

An estimated 350,000 oil and gas wells have been drilled in Pennsylvania since Drake's first in Titusville.

More than half of them were never recorded. We have no idea where they are.

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