Hydraulic Fracturing

This column is presented weekly by the Public Education sub-committee of the Clinton County Natural Gas Task Force in an effort to provide accurate, up-to-date information on activities surrounding the Marcellus Shale formation and the natural gas exploration industry.

This week's article provides an overview of hydraulic fracturing technology (commonly known as hydrofracing or fracing), the technology used in drilling within the Marcellus Shale, and addresses some of the challenges and concerns about fracing technology. Hydrofracing is a process where water, pressure, and additives/chemicals are used to create small cracks in the Marcellus Shale. These small cracks are more than a mile under the surface of the earth but are what enable natural gas to be released from the very hard and dense Marcellus Shale. Although the technology has evolved over time, the key concepts of hydraulic fracturing have been around for more than 60 years and used on more than a million wells in the United States to produce oil and natural gas from deep geologic reservoirs. North America has abundant natural gas resources. However, natural gas is often "trapped" within tight rock formation that cannot be produced without the use fracturing technology.

As the United States looks to increase its domestic fossil fuel and renewable energy portfolio, natural gas extraction has become a key part of that portfolio. Advances in directional drilling and hydraulic fracturing technology have unlocked unconventional shales, like the Marcellus, and the availability of natural gas in North America. That being said, development of natural gas is not without its critics as many environmental groups and landowners are raising concerns about the potential for water resource impacts from the hydrofracing process.

Let's first get a better understanding of the technology so we can address the controversies.

Horizontal drilling into the Marcellus Shale occurs by drilling vertically to depths ranging from 5,000 to 9,000 feet below ground, and then turning the well and drilling horizontally another 3,000 to 5,000 or more feet through the Marcellus Shale. During the drilling process multiple strings of steel casing (pipe) are cemented at various depths to provide a seal to prevent natural gas or the hydrofracing fluids from leaking into other geologic formation such as surface water, groundwater, or water supply wells. Once the well has been drilled, hydraulic fracturing is used to release the natural gas. Hydrofracing releases natural gas by injecting a mixture of water, sand, additives, and chemicals under high pressure into the formation which creates a network of fractures in the otherwise impermeable shale. The small fractures that are created allow natural gas to flow into the well. Without the fractures the natural gas would remain trapped in the impermeable shale. The volume of water, sand, and additives used for hydrofracing a horizontal well is about five million gallons, but can vary from three to seven million or more gallons dependent on the frac design. After a well has been hydrofraced approximately 20% of the injected mixture returns to the surface as flow-back liquid where it must be captured and either treated, prepared for reuse, or transported for disposal.

There has been and continues to be much controversy surround the hydrofracing "recipe" that many critics refer to as a "toxic brew". Much of the controversy revolves around the gas companies not having to publically disclose their hydrofracing recipes. Responding to public concern, several companies, most notably Range Resources and EQT, are voluntarily disclosing their typical hydrofracing mix, which consists of nearly 99.75% water and sand, along with a relatively small, but still significant amount (0.25%) of special-purpose additives/chemicals. Since most of the mystery and controversy surround the special-purpose additives and chemicals, let's use EQT's disclosure for their "Halliburton" recipe (found at www.eqt.com/production/compositions.aspx) as an example and explore a little further.

According to EQT's website the following components make up a typical hydrofracturing recipe and serve the described purpose:

1. Water (4,127,000 gallons per well or 95.5297%) - Creates fracture network in shale and carries sand into the formation;
2. Sand proppant (182,446 gallons per well or 4.2232%) - Enables fractures to remain open and allow gas to escape into the wellbore;
3. Friction Reducer (4,127 gallons per well or 0.0955%) - Reduces friction between fluid and casing;
4. Antimicrobial Agent (2,137 gallons per well 0.0495%) - Eliminates bacteria in the water that can produce corrosive byproducts;
5. Hydrochloric Acid (2,503 gallons per well 0.0579%) Dissolves cement and minerals in the perforations;
6. Scale Inhibitor (1,142 gallons per well or 0.0264%) - Prevents scaling in pipe;
7. Gelling Agent (720 gallons per well or 0.0167%) - Creates viscosity to ensure sand is transported into the fractures;
8. Oxidizing Breaker (31 gallons per well or 0.0007%) - Adds viscosity to the fluid;
9. Enzyme Breaker (15 gallons per well or 0.0004%) - Reduces viscosity of the fluid.

Would you want these compounds in your drinking water? Obviously not! That is why there are a variety of safety and monitoring practices in place to help maintain the integrity of the well, to protect the local environment, and the people around the well. Some of the common practices energy companies use includes using four different pipes and cement layers to protect water, monitoring wells, plastic liners under well pads, and testing drinking water supplies at least 1,000 feet from the well and in most cases testing private water supplies within 2,500 feet of the natural gas well.

There is a common misperception that the hydrofracturing process can cause cracks that leave the Marcellus and go all the way to the ground surface and impact the aquifer's groundwater quality. Fortunately the fractures only propagate out from the well approximately 300 to 500 feet and largely stay in the Marcellus Shale or adjacent rock formations. The fractures are separated from ground water and surface water resources by a variety of impermeable rock layers spread over more than a mile between the shale layer and the surface.

Most people will ask, if there are all these safeguards in place for drilling and fracing how are private wells and water quality being adversely impacted in areas such Dimock, Susquehanna County, Pennsylvania? For those unfamiliar with Dimock, the Department of Environmental Protection has an active investigation into how 14 private wells were impacted during the drilling of Marcellus Shale wells.

There are a few potential scenarios where Marcellus gas development could adversely impact water resources. Both are unrelated to the actual hydraulic fracturing process, but still important. One scenario involves a casing (pipe) and cement used during the drilling process not properly sealing off other geologic formations. If a well has an improper casing or cement, natural gas (methane) could leak up along the well during the drilling process resulting in groundwater contamination. Poor casing and cement is what reportedly occurred in Dimock. As a result, the Pennsylvania Department of Environmental Protection has recently drafted more stringent well casing standards that would prevent future instances of methane migration.

A second scenario that could cause adverse water quality impacts would be a release of the flowback water at the surface if not properly contained, resulting in a spill that could seep into groundwater or into a stream. There have been several instances of flowback water being released, most notably this June in Clearfield County where a well uncontrollably released flowback water for 16 hours until trained personnel were brought in from Texas to shut down the well. The Clearfield County event allowed flowback water, which is characterized as having high, naturally-occurring salt and metal concentrations that are dissolved from the Marcellus shale, to be released onto the ground surface and into a nearby tributary. The Clearfield County blowout was a near miss and fortunately no one was injured and the environmental impact appears to be moderate.

Both of these scenarios have one thing in common - they were preventable and therefore could have been avoided if best management practices had been used. If drilling will be occurring within 1,000 feet of your property then the gas company must give the landowner an opportunity to have their well water quality tested by a third-party laboratory at no cost to the landowner before drilling occurs. At this point pre-existing water quality can be documented prior to any drilling to ensure that well water quality is not affected by the drilling or hydrofracturing process. If there is a significant change in water quality in a landowner's well within six months of the well drilling then the gas company is presumed liable and must provide an alternate water supply.

Hopefully, some of the information in this article will help clear up some common misperceptions about hrydrofracing. While there can be no absolute guarantees, responsible companies with the safest operating standards will be proactive and follow state and federal law, well construction best management practices, and water monitoring requirements. For more information on natural gas development point your web browser to www.naturalgas.psu.edu or www.marcellus.psu.edu.

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