PEP

POWER EFFICIENCY PROJECT

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Hydraulic Fracturing

Fossil fuels, such as oil and natural gas, are non-renewable resources because humans use these fuels at a rate faster than they can be replenished. As energy needs have increased and energy resources decreased, engineers have found new ways to access hard-to-reach resources. One way to access these resources is a process called **hydraulic fracturing**. Hydraulic fracturing, or fracking, has been used since the 1940s to obtain oil and natural gas contained in impermeable rock formations, such as shale.[1]

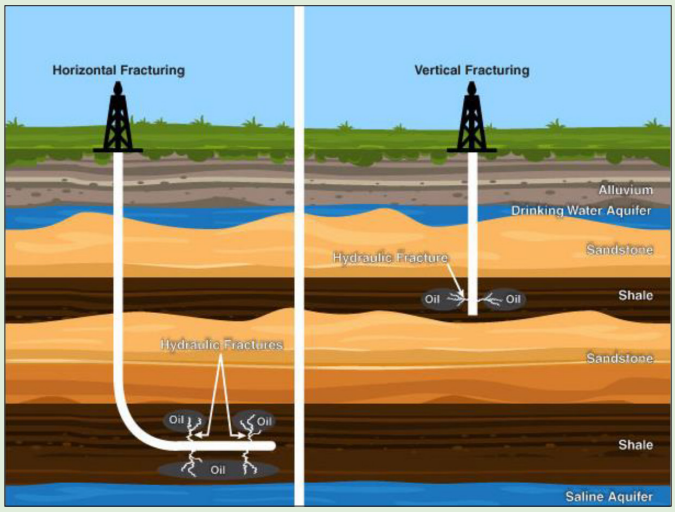
The Process of Hydraulic Fracturing

Shale formations, a type of sedimentary rock, are known to be filled with oil and gas, but are not permeable enough for typical extraction techniques. **Permeable** means that liquids or gases are able to pass through them. Hydraulic fracturing gives us access to these fossil fuels by increasing the shale's permeability.

The first step in the fracking process is drilling a vertical well about 6,000 to 10,000 feet below the earth's surface. Once that is completed, the **horizontal drilling** process begins.[2] At this depth, which is called the "kick-off point," the well bore begins to drill horizontally. An advantage of horizontal drilling is the ability to drill multiple horizontal wells across a large area of land from only one vertical well. This reduces the disruption on the surface.[3] An example of what this looks like is shown in **Figure 1**.

After the drilling process is complete, a perforating gun is sent to the end of the horizontal well. The perforating gun carries explosive charges that are detonated in order to pierce through the piping into the shale. After the explosive charges create the initial fissures in the shale formation, the true hydraulic fracturing process can begin. A mix of water, sand, and chemicals, called "fracking fluid" is pumped at high pressure through the fissures made by the explosives. This creates fractures in the shale rock, which contains the oil or gas. Sand from the fracking fluid holds the fractures open, which allows the oil or gas to flow into the well and be recovered by the crew at the earth's surface. This entire process of creating an operational fracking site takes about three to five months. The well can then potentially be used to produce oil or natural gas for the next 20 to 40 years.[3]

Figure 1: Horizontal and vertical hydraulic fracturing wells.
Source: http://www.lao.ca.gov/Publications/Report/3513



Fracking fluid is almost entirely water, with a small percentage of special-purpose chemical additives and proppant. **Proppant** is made of synthetic or natural silica sand. It is used to hold open fractures in rock to make it easier to obtain the natural gas or oil.[1] Other additives include acids, friction reducers, surfactants, scale and corrosion inhibitors, and biocides.[4] The fracking fluid is injected at high pressure to open pores in the rock layer. **Figure 2** (on the next page) shows the process of using fracking fluid in a horizontal well.

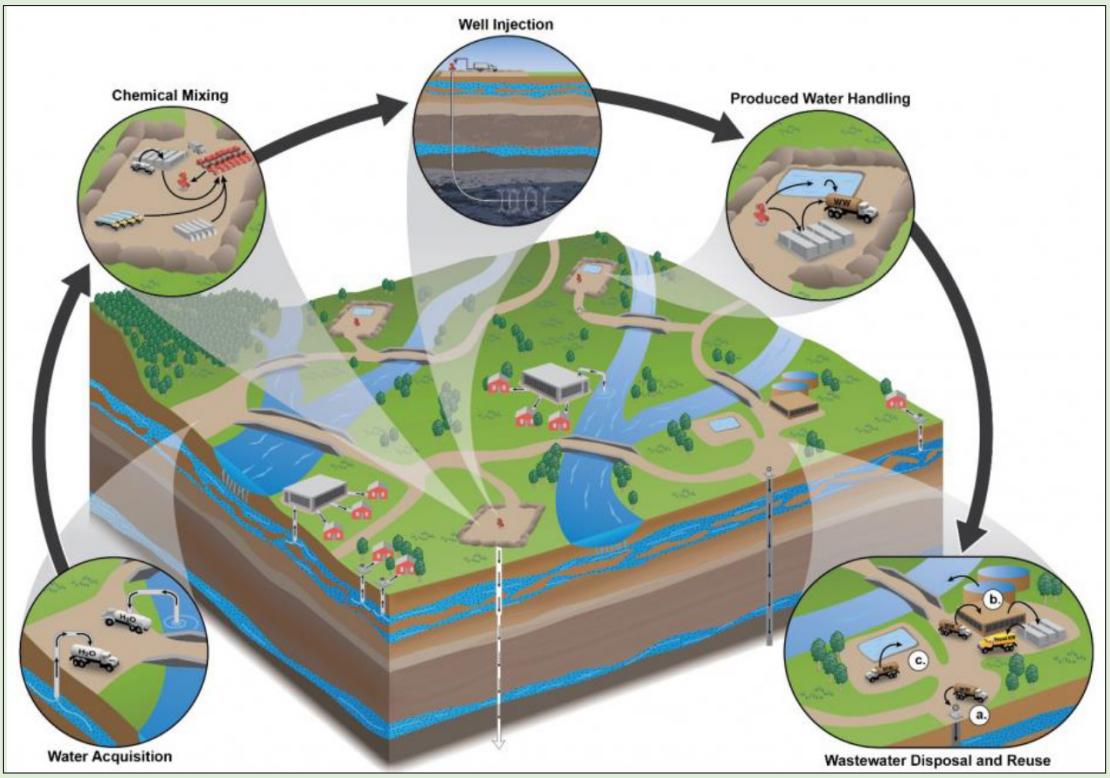


Figure 2: Hydraulic Fracturing Water Cycle.

Source: https://www.epa.gov/hfstudy/hydraulic-fracturing-water-cycle

Environmental, Health, and Safety Concerns

Despite the advantages, fracking has environmental, health, and safety concerns including using large amounts of water, creating wastewater, contaminating groundwater, negatively affecting air quality, and potentially causing earthquakes.

Kansas has several shale formations in the eastern region. The Kansas Corporation Commission (KCC) and the Kansas Department of Health and Environment (KDHE) regulate and inspect hydraulic fracturing operations. No ground-water contamination has been reported in Kansas.[5]

Curriculum & Activity Links

Primary

- Hands-On Activities: Wonders of Oil and Gas: Teacher Guide, Grades 3-5, http://www.need.org/files/curriculum/guides/wondersofoilandgas.pdf

Intermediate | Secondary

- Hands-On Activity: Making a Fracking Model Activity, Grades 6-12, https://www.airwatergas.org/resources/curriculum/make-a-fracking-model-activity/
- Hands-On Activity: Rock Porosity Experiment, Grades 6-10, https://www.airwatergas.org/resources/curriculum/rock-porosity-experiment/

References

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2. "Hydraulic Fracturing: The Process." FracFocus. FracFocus: Chemical Disclosure Registry, n.d. Web. 05 Nov. 2016. https://fracfocus.org/hydraulic-fracturing-how-it-works/hydraulic-fracturing-process
3. "Drilling and the Hydraulic Fracturing (Fracking) Process." Drilling and the Hydraulic Fracturing (Fracking) Process, United Kingdom Onshore Oil and Gas, 2017, www.ukoog.org.uk/onshore-extraction/drilling-process
4. Draft Plan to Study the Potential Impacts of Hydraulic Fracturing on Drinking Water Resources. Yosemite Home. US Environmental Protection Agency, 7 Feb. 2011. Web. 31 Oct. 2016. https://yosemite.epa.gov/sab/sabproduct.nsf/0/D3483AB445AE61418525775900603E79/SFile/Draft+Plan+to+Study+the+Potential+Impacts+of+Hydraulic+Fracturing+on+Drinking+Water+Resources-February+2011.pdf
5. Suchy, Daniel R., and K. David Newell. "Hydraulic Fracturing of Oil and Gas Wells in Kansas." KGS. Kansas Geological Society, 15 May 2012. Web. 05 Nov. 2016. http://www.kgs.ku.edu/Publications/PIC/pic32.html

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