Hydraulic Fracturing: The Process

What Is Hydraulic Fracturing?

Contrary to many media reports, hydraulic fracturing is not a "drilling process." Hydraulic fracturing is used after the drilled hole is completed. Put simply, hydraulic fracturing is the use of fluid and material to create or restore small fractures in a formation in order to stimulate production from new and existing oil and gas wells. This creates paths that increase the rate at which fluids can be produced from the reservoir formations, in some cases by many hundreds of percent.

The process includes steps to protect water supplies. To ensure that neither the fluid that will eventually be pumped through the well, nor the oil or gas that will eventually be collected, enters the water supply, steel surface or intermediate casings are inserted into the well to depths of between 1,000 and 4,000 feet. The space between these casing "strings" and the drilled hole (wellbore), called the annulus, is filled with cement. Once the cement has set, then the drilling continues from the bottom of the surface or intermediate cemented steel casing to the next depth. This process is repeated, using smaller steel casing each time, until the oil and gas-bearing reservoir is reached (generally 6,000 to 10,000 ft). A more detailed look at casing and its role in groundwater protection is available HERE ‡.

With these and other precautions taken, high volumes of fracturing fluids are pumped deep into the well at pressures sufficient to create or restore the small fractures in the reservoir rock needed to make production possible.

What's in Hydraulic Fracturing Fluid?

Water and sand make up 98 to 99.5 percent of the fluid used in hydraulic fracturing. In addition, chemical additives are used. The exact formulation varies depending on the well. To view a chart of the chemicals most commonly used in hydraulic fracturing and for a more detailed discussion of this question, click HERE ‡.

Why is Hydraulic Fracturing Used?

Experts believe 60 to 80 percent of all wells drilled in the United States in the next ten years will require hydraulic fracturing to remain operating. Fracturing allows for extended production in older oil and natural gas fields. It also allows for the recovery of oil and natural gas from formations that geologists once believed were impossible to produce, such as tight shale formations in the areas shown on the map below. Hydraulic fracturing is also used to extend the life of older wells in mature oil and gas fields.

Source: Modern Shale Gas Development in the United States, US Department of Energy

How is Hydraulic Fracturing Done?

The placement of hydraulic fracturing treatments underground is sequenced to meet the particular needs of the formation. The sequence noted below from a Marcellus Shale in Pennsylvania is just one example. Each oil and gas zone is different and requires a hydraulic fracturing design tailored to the particular conditions of the formation. Therefore, while the process remains essentially the same, the sequence may change depending upon unique local conditions. It is important to note that not all of the additives are used in every hydraulically fractured well; the exact “blend” and proportions of additives will vary based on the site-specific depth, thickness and other characteristics of the target formation.

1. An acid stage, consisting of several thousand gallons of water mixed with a dilute acid such as hydrochloric or muriatic acid: This serves to clear cement debris in the wellbore and provide an open conduit for other frac fluids by dissolving carbonate minerals and opening fractures near the wellbore.

2. A pad stage, consisting of approximately 100,000 gallons of slickwater without proppant material: The slickwater pad stage fills the wellbore with the slickwater solution (described below), opens the formation and helps to facilitate the flow and placement of proppant material.

3. A prop sequence stage, which may consist of several substages of water combined with proppant material (consisting of a fine mesh sand or ceramic material, intended to keep open, or “prop” the fractures created and/or enhanced during the fracturing operation after the pressure is reduced): This stage may collectively use several hundred thousand gallons of water. Proppant material may vary from a finer particle size to a coarser particle size throughout this sequence.

4. A flushing stage, consisting of a volume of fresh water sufficient to flush the excess proppant from the wellbore.

Other additives commonly used in the fracturing solution employed in Marcellus wells include:

• A dilute acid solution, as described in the first stage, used during the initial fracturing sequence. This cleans out cement and debris around the perforations to facilitate the subsequent slickwater solutions employed in fracturing the formation.

• A biocide or disinfectant, used to prevent the growth of bacteria in the well that may interfere with the fracturingoperation: Biocides typically consist of bromine-based solutions or glutaraldehyde.

• A scale inhibitor, such as ethylene glycol, used to control the precipitation of certain carbonate and sulfate minerals

• Iron control/stabilizing agents such as citric acid or hydrochloric acid, used to inhibit precipitation of iron compounds by keeping them in a soluble form

• Friction reducing agents, also described above, such as potassium chloride or polyacrylamide-based compounds, used to reduce tubular friction and subsequently reduce the pressure needed to pump fluid into the wellbore: The additives may reduce tubular friction by 50 to 60%. These friction-reducing compounds represent the "slickwater" component of the fracing solution.

• Corrosion inhibitors, such as N,n-dimethyl formamide, and oxygen scavengers, such as ammonium bisulfite, are used to prevent degradation of the steel well casing.

• Gelling agents, such as guar gum, may be used in small amounts to thicken the water-based solution to help transport the proppant material.

• Occasionally, a cross-linking agent will be used to enhance the characteristics and ability of the gelling agent to transport the proppant material. These compounds may contain boric acid or ethylene glycol. When cross-linking additives are added, a breaker solution is commonly added later in the frac stage to cause the enhanced gelling agent to break down into a simpler fluid so it can be readily removed from the wellbore without carrying back the sand/ proppant material.

‡ - *When you click links marked with the ‡ symbol, you will leave the FracFocus website and go to websites that are not controlled by or affiliated with this site.*

http://fracfocus.org/hydraulic-fracturing-how-it-works/hydraulic-fracturing-process