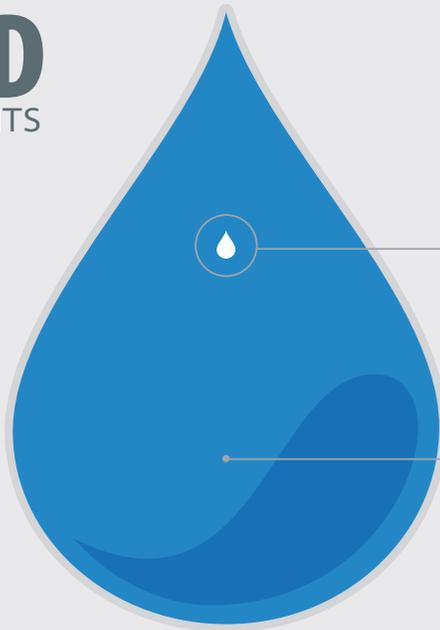


Hydraulic Fracturing Fluid

FLUID COMPONENTS



SOME OF THE SAME ADDITIVES ARE USED IN EVERYDAY CONSUMER PRODUCTS.

ABOUT
0.5%

ADDITIVES

UP TO
99.5%

WATER AND SAND

| ADDITIVE TYPE | MAIN COMPONENT | PURPOSE | OTHER COMMON USES |
|-------------------------------|----------------------------|---|--|
| Acid | Hydrochloric acid | Helps dissolve minerals and initiate fractures in the formation | Swimming pool chemical and cleaner |
| Biocide (antibacterial agent) | Glutaraldehyde | Eliminates bacteria in the water | Disinfectant (sterilizer for medical and dental equipment) |
| Breaker | Ammonium persulfate | Breaks down polymer chains to reduce viscosity of fracturing fluid | Disinfectant and hair coloring |
| Buffer | pH adjusting agent | Controls pH of fluids to maintain effectiveness of other components, such as crosslinkers | Detergent, soap and water softener |
| Corrosion inhibitor | N, n-dimethyl formamide | Prevents the corrosion of the well casing | Pharmaceuticals, acrylic fibers and plastics |
| Crosslinker | Borate salts | Maintains fluid viscosity as temperature increases | Laundry detergent, hand soap and cosmetics |
| Friction reducer | Mineral oil/polyacrylamide | Minimizes friction between the fluid and pipe | Water treatment, soil conditioner, makeup remover and candy |
| Gelling agent | Guar gum | Thickens the water to suspend the proppant | Cosmetics, toothpaste and ice cream |
| Iron control | Citric acid | Prevents precipitation of metal oxides | Food additive, food and beverage flavoring, and lemon juice |
| Potassium chloride | Potassium chloride | Creates a brine carrier fluid | Low sodium table salt substitute |
| Oxygen scavenger | Ammonium bisulfate | Removes oxygen from the water to protect the pipe from corrosion | Cosmetics, food and beverage processing, and water treatment |
| Scale inhibitor | Ethylene glycol | Prevents scale deposits in the pipe | De-icer, household cleansers and paints |
| Surfactant | Isopropanol | Reduces surface tension of fracturing fluids to improve the liquid recovery | Glass cleaner, deodorant and hair color |

Customized for Each Reservoir

Our engineers work with service company experts to tailor fracturing fluids to meet the specific needs of each well environment. Geologic and reservoir characteristics, such as mineralogy, rock strength, permeability, reservoir fluid composition, pressure and temperature, are just a few of the factors considered in selecting an appropriate fracturing fluid. Although the majority of the fracturing fluid is composed of water and sand (proppant), small amounts of chemical additives are necessary to achieve the fluid properties required to effectively stimulate the reservoir. Service companies developed a number of different hydraulic fracturing fluid recipes to more efficiently induce and maintain productive fractures. These solutions have unique characteristics, and therefore, the exact concentrations of some additives are protected as proprietary information.

Mostly Water and Sand

Water and sand comprise up to 99.5 percent of the mixture. Water is used to fracture the formation containing trapped oil or natural gas resources and acts as the carrier fluid for the chemical additives and proppant (typically sand). Proppant allows fractures to remain open so hydrocarbons can flow more easily into the wellbore. Small amounts of chemical additives are necessary to reduce fluid friction, kill bacteria that are present in the formation and enhance the fluid's ability to transport the propping agent. Many of these chemical additives are also commonly used in everyday consumer products, such as toothpaste, ice cream, cosmetics, household cleaners and deodorant.

One Time Water Use

Hydraulic fracturing treatments typically require a one-time use of between 2 million and 5 million gallons of water per horizontal well, depending on the basin and formation characteristics. This is the equivalent amount of water typically consumed by 24 households in one year. However, that same well would produce enough natural gas to heat 30,000 homes for 1 year. According to the USGS, natural resource extraction (minerals, oil and gas) consumes only about 1 percent of the total water used in the United States.¹ Hydraulic fracturing water use is a fraction of this 1 percent.

We understand that in some regions significant use of water for oil and natural gas production may affect the availability of water for other uses. We work collaboratively with appropriate water-management agencies to obtain necessary permits. These permits ensure our water use does not interfere with the available water supply for other users and does not adversely impact stream flows, fish and wildlife, or sensitive habitats.

Supporting Disclosure

We support disclosure of the chemical ingredients used in hydraulic fracturing fluids in a way that informs the public and protects proprietary industry information. In the U.S. we are participating in the Ground Water Protection Council and Interstate Oil and Gas Compact Commission's (IOGCC) voluntary chemical disclosure website, *Frac-Focus.org*. This landmark web-based national registry was launched in April 2011 to provide information about chemicals used to fracture oil and natural gas resources on a well-by-well basis. The website also provides educational information on hydraulic fracturing, the means by which groundwater is protected and links to state regulatory websites. Learn more at <http://fracfocus.org>. Many states now have statutes or regulations that require public disclosure of the chemicals used in hydraulic fracturing utilizing FracFocus.

FREQUENTLY ASKED QUESTIONS

Are fracturing fluids dangerous?

Additives used in fracturing fluids are chemicals commonly used in everyday life and are safe when properly handled and used appropriately. Fracturing fluids require safe work practices, which include storage, transportation, handling and disposal. Each step is regulated to ensure protection of the public, personnel at the well site and the environment. Chemicals used during the fracturing process must have a Material Safety Data Sheet (MSDS) available for all on-site personnel, medical staff and emergency responders. The MSDS outlines the hazards associated with well site chemicals and the appropriate steps to protect the user and the environment.

Where does the water come from?

Our company uses various water sources, depending on the region and availability of water near our drilling sites. The sources of water used in our fracturing fluids typically come from private and public lakes, ponds, rivers, groundwater, and municipal supplies.

How much is 5 million gallons of water?

Five million gallons is the amount of water consumed by:

- A golf course in 25 days (source: *Colorado Oil & Gas Conservation Commission*).
- 7.5 acres of corn in a season (source: *Colorado Oil & Gas Conservation Commission*).
- About seven Olympic-size swimming pools (source: *EPA*).

¹Source: USGS, *Estimated Use of Water in the United States*, 2005. As new USGS figures become available, water consumption for natural resource extraction will be updated.