

A Glossary of Terminology Used in Unconventional Oil Exploration

The terms used in oil and gas well exploration can be confusing to anyone not involved in the business. At worst, these terms can be used to mislead non-specialists who are trying to learn about the potential consequences of the industry. Fracking is only one of the techniques used to stimulate oil flow, and the oil industry tends to use the term very narrowly when compared to its use by the general public.

The province of Newfoundland and Labrador has imposed a temporary “moratorium” on fracking to allow time to investigate the safety of the procedure and to conduct public consultations. It is very important that we understand what these terms really mean if we are to protect what we value about western Newfoundland.

Aquifer An aquifer is a porous underground rock, sediment or soil containing water that can be extracted with a well.

Acidizing is a well stimulation technique designed to restore or increase the permeability of the reservoir rock. In low-pressure matrix acidizing, acid (hydrochloric or acetic) is pumped into the well where it dissolves the limestone, dolomite, or calcite cement between grains of sediment and restores oil flow. A second technique, fracture acidizing, uses acid pumped into the well under high pressure to fracture the reservoir rock, to widen channels for hydrocarbon flow, and to dissolve sediments that reduce permeability.

Drilling mud is dense, viscous mud, usually containing bentonite clay, used during the drilling of oil wells to carry rock chips to the surface and to cool and lubricate the bit. Brine, barite, sodium hydroxide, diesel oil, mineral oil, and other chemicals are often added.

Flow back, or backflow is the movement of liquids up and out of a drilled well due to pressure in the wellbore. The liquids can include fracking and drilling fluids, liquid and gaseous hydrocarbons, and produced water (water that had been trapped in permeable rock surrounding the wellbore).

Frac and **Frac'ing** are alternative spellings for *frack* and *fracking*, sometimes used to distance the technique from negative connotations garnered under the original spelling.

Fracking (see *Fracing*, *Hydraulic fracturing*) has become a common technique for stimulating the flow of oil and gas from shale deposits that could not be economically exploited using conventional well techniques. In industry terms, fracking (or hydraulic fracturing) is often used to refer only to the portion of the

well-drilling process during which the bedrock is fractured. Among concerned laymen, the term is often used to refer to the entire process of oil exploration using hydraulic fracturing. Although first crudely attempted in 1947, fracking in its current form has only been employed for oil and gas exploration since the 1990s.

Fracking fluid is the liquid injected under great pressure (up to 100 megapascals (15,000 psi) into a wellbore to cause fracturing of the bedrock that allows freer flow of the desired hydrocarbons. Chemicals are added to water to create predictable effects on viscosity, friction, bacterial growth, corrosion, and interaction with bedrock, and to control fluid loss. Fracking fluids fall into five categories: viscosified water-based fluids, non-viscosified water-based fluids, gelled oil-based fluids, acid-based fluids, and foams. Non-viscosified fracking fluid is generally necessary for deep high-pressure shales. Gel and foam fracking fluids are usually used in shallow, low-pressure shales.

Fracking fluid chemicals Numerous formulations of chemicals used in fracking fluid. Formulations are considered proprietary and their components are not disclosed. Fracking fluid is typically 95% water, 4.5% sand or other proppant to keep the fractures open, and 0.5% chemicals. However, since it can take between 15 and 25 million litres of water to frack a well, that can mean between 70 and 125 tonnes of chemicals injected into the ground per well. This can be multiplied since each well may be fracked several times, and multiple wells may be drilled from one pad. Three to twelve chemical additives are used, usually a combination of the following: hydrochloric or acetic acid (to clean and etch perforations), sodium chloride (to preserve other chemicals), polyacrylamide (to reduce friction), ethylene glycol (to stop scale formation within the borehole), borate salts (to maintain fluid viscosity), sodium and potassium carbonates, glutaraldehyde (to reduce bacterial growth), guar gum (to increase fluid viscosity), citric acid (to stop rust formation), isopropanol (to increase viscosity), plus other chemicals, some of which are known carcinogens (e.g. benzene, toluene, 2-BE ethylene glycol, chromium), others are caustic or hazardous in other ways.

Groundwater is the water beneath the surface of the soil and in bedrock. It accumulates from rainfall, and moves slowly through pores, rock fractures, and rarely caves. Groundwater flows to the surface at springs, seeps, and wetlands. Water wells are drilled down into an aquifer where the water seeps into the hole and can be recovered. Oil wells are usually drilled much deeper than drinking water aquifers, BUT they must be drilled down through ground water to reach the oil.

Horizontal well is usually a vertical well that is drilled down to the depth of the target rock, and then curved so that the drill enters the reservoir rock horizontally.

Hydraulic fracturing is a well-stimulation technique used in low-permeability formations to increase the permeability of the rock, and thereby the flow of oil and other hydrocarbons from the reservoir rock into the wellbore. The process uses shaped explosives to perforate the intake end of the well casing, then pressurized

liquid containing a mix of chemicals is rapidly pumped at high pressure into the well to fracture rock around the wellbore. The liquids contain particles of proppant that jam the fractures open. The fractures are usually less than 1 mm wide. The technique is also known as *induced hydraulic fracturing*, *hydrofracturing*, and *fracking*.

Hydrocarbons are organic molecules composed entirely of chains of hydrogen and carbon atoms, and can occur as gases, liquids, waxes, or polymers. Oil and natural gas contain many different hydrocarbons, including methane, ethane, propane, butane, pentane, hexane, heptane, octane, nonane, and decane. These can occur in several forms: single bond (saturated hydrocarbons or alkanes), double bond (unsaturated hydrocarbons or alkenes), triple bond (unsaturated hydrocarbons or alkynes), and cyclic (cycloalkanes, aromatic hydrocarbons or aranes).

Liquefied petroleum fracturing or “gas fracking” is a stimulation technique that uses gelled propane instead of water. While this technique has the potential to decrease the amount of water used in hydraulic fracturing, disadvantages include an increased explosion hazard and increased cost. This technique is being used in New Brunswick by the GasFrac company.

Non-hydraulic fracturing and stimulation techniques These include the use of nitroglycerine (since the 1860s) to shatter reservoir rocks and the injection of acid (since the 1930s) to etch rock fractures wider so that they cannot close.

Onshore-to-offshore drilling refers to the use of a drilling rig set up on an onshore pad to drill horizontally into oil-bearing rock under the ocean. This technique is useful for nearshore shales, and is much less expensive than a marine oil platform.

Organic molecules. In this case “organic” refers to the kinds of chemicals created by organisms, and those consist mostly of chemicals containing multiple hydrogen-oxygen bonds.

Permeability refers to the porosity of a rock formation, and the ease with which liquids and gasses can move within it.

Petroleum is a fossil fuel produced from the remains of dead organisms (usually marine plant and animal plankton) in sedimentary rock. Over long periods of time the organic remains are transformed by heat and pressure into a complex mix of hydrocarbons and other organic compounds. The word “petroleum” can be used to refer to both naturally occurring crude oil and to refined oil products.

Produced water is water naturally present in the bedrock that is released by the drilling of a wellbore. Produced water may contain high concentrations of dissolved salts, and may also be radioactive due to the presence of radon gas, which occurs naturally in some types of bedrock.

Proppant refers to particles such as sand grains, ceramic beads, or aluminium oxide grains that are pumped into a well during the fracking process to wedge minute bedrock fractures open and allow the movement of hydrocarbons into the wellbore.

Reservoir A petroleum reservoir is an underground “pool” of hydrocarbons contained in the minute spaces within porous rock, like water in the spaces within a sponge.

Shale oil vs Oil shale Oil shale is a fine-grained sedimentary rock that contains organic matter called *kerogen* that can be ignited. The hydrocarbons in kerogen have not been exposed to enough pressure and heat to convert them into crude oil, but industrial retorting can be used to convert them into useable fuel. Shale oil is crude oil (and gas) bound in oil-bearing shale. This ‘tight shale’ has low permeability and porosity, and is at sufficient depth that much of the kerogen in the rock has been converted into oil and gas.

Slickwater fracking fluid is fluid that has friction reducers added (often a polyacrylamide) so that fluid flow is increased. These fluids are designed for use in deep, high-pressure shales. The friction reducers make it easier to pump the fluid at high speed (as fast as 265 litres per second (100 bbl/min), almost twice faster than typical fracturing fluids) to fracture underground shale.

Tight oil, also known as *shale oil* and *light tight oil*, is crude oil that exists within siltstone, shale, dolomite, and limestone of low permeability. The oil cannot move easily within the rock, and must be extracted by hydraulic fracturing or some other well stimulation technique. The extraction of tight oil requires the drilling of many more wells than does conventional oil.

Unconventional oil, Unconventional well Unconventional in this context means that the hydrocarbons in a well are locked in tight rock and cannot be obtained by conventional drilling. Some form of well stimulation is required to obtain them.

Vertical well is a conventional borehole that is drilled straight down into an oil or gas reservoir.

Water table refers to the level to which an aquifer is saturated with water. The top of the water table is indicated by the level to which the water naturally rises in a water well.

Well stimulation is a term used to cover techniques used to restore or increase the flow of oil or gas into a drilled well from the surrounding rock. These techniques include hydraulic fracturing (fracking), and matrix treatments. Hydraulic fracturing creates small channels in the rock around the wellbore and increases the flow between the hydrocarbon reservoir and the well. Matrix treatments restore the permeability of the reservoir rock so that flow can be re-established after damage to

the wellbore. Well stimulation is also sometimes called enhanced oil recovery, well workover, or intervention.

Wellbore is the hole drilled by a drilling rig. Also called a borehole, it includes both the cased (casing is a metal pipe that is cemented into place to protect the hole from pressure, fluids, and instability of the wellbore) and uncased portions of the well.

Well failure Gas and oil leakage can occur at any time during the life of a borehole. The oil industry has reported that at least 6% of oil well casings fail within the first year, and more than 60% fail within 30 years (Brufatto et al. 2003). Eventually, all wells will leak hydrocarbons after being abandoned. Leakage and seepage of natural gas (especially ethane and methane), crude oil, fracking chemicals, saline produced water, arsenic, selenium, strontium, barium, and natural radioactive elements can permanently pollute both groundwater and water that flows to the surface.

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