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Hydraulic Fracturing and Your Health: Water Contamination

What is Fracking?

High-volume horizontal hydraulic fracturing, commonly known as "fracking,"[a] is a method of extracting natural gas and oil extraction from deep underground bands of porous rock. The fracking process forces a mixture of water, sand, and chemicals underground under high pressure, fracturing deep rock formations. Bubbles of fossil fuel trapped in the rock are freed to enter the well and make their way up to the surface. The rock is usually shale, which is why the captured substance is called "shale oil" or "shale gas."

Industry sources estimate that an estimated 35,000 wells in the U.S. are now using the hydraulic fracturing method.[1] These wells are located across the U.S., with significant concentrations in the Marcellus Shale (PA, NY, OH, MD, WV, VA, NJ, KT, TN), the Bakken Shale (ND, MT), the Haynesville Shale (AR, LA, TX), the Eagle Ford Shale (Southern TX), and in Colorado, Wyoming, New Mexico, Kansas, and the Gulf of Mexico.[2]

[a] We use the term "fracking" to reference both the process of fracturing the rock formations, and the associated operations that extract, process and transport the natural gas or oil. The process encompasses land clearing, well drilling, construction of the well casing, flaring, wastewater extraction and storage, processing, compression, disposal of wastes, and transportation. While the process presents risks to health at many steps, we focus here on impacts on water.

Water: Massive Consumption, Massive Contamination

Fracking operations consume and contaminate enormous quantities of water. In order to fracture a *single* well site, natural gas companies typically use over 4 million gallons of water. This amount of water is equivalent to what 11,000 American families use in a day.[3] Such intensive water use has become an issue in states such as California, which is experiencing a historic drought, and places hydraulic fracturing in competition with other consumers of water including households, agriculture, industry, and recreation. Nearly half of all fracking operations occur in areas with high or extremely high water stress.

Hydraulic fracturing combines water with an array of chemicals, some of which are carcinogenic, endocrine-disruptive, or otherwise toxic. The result is the contamination of huge quantities of water, with potential immediate and long-term threats to health. Only a fraction of this water (an estimated 20 to 40 percent) is brought back up to the surface, where it is classified as wastewater.[4] It is estimated that oil and gas operations in the U.S. produce more than two billion gallons of fracking wastewater a day.[5]

Selected Chemicals of Concern in Hydraulic Fracturing Fluid	
Benzene	Known carcinogen. May cause anemia; can lessen white blood cell count, weakening the immune system.[6] Prolonged exposure may result in blood disorders like leukemia, reproductive and developmental disorders, and other cancers.[7]
Toluene	Long-term exposure may affect the nervous system, cause irritation of the skin, eyes, respiratory tract, and birth defects.[8]
Ethylbenzene	Long-term exposure may result in blood disorders.[9]
Xylenes	Short-term exposure to high levels may cause irritation of the nose and throat, nausea, vomiting, gastric irritation, and neurological effects. Long-term exposure at high levels may affect the nervous system.[10]
Methanol	Exposure can result in blurred vision, headache, dizziness, and nausea.[11]
Napthalene	May cause abdominal pain, nausea, vomiting, and fever. Chronic exposure can result in coma, confusion, convulsions, tachycardia, low blood pressure, and/or jaundice.[12]
Formaldehyde	A probable human carcinogen. Chronic exposure associated with lung and throat cancer.[13]
Acrylamide	A probable human carcinogen. Short-term exposure may cause damage to the nervous system.[14]
Ethylene Glycol	At high exposures, may affect the central nervous system, heart and kidneys.[15]

Despite high-volume use of chemicals in fracking, only partial information is available on what these chemicals are or how they can affect health. Some companies engaged in hydraulic fracturing will not identify the chemicals they use, citing confidential business information ("trade secrets"). Others cannot identify the chemicals because they receive them as a pre-mixed chemical cocktail. The Endocrine Disruption Exchange examined the toxicity of 353 chemicals used in fracking. Of those, they found that 25 percent can cause cancer and mutations; 37 percent affect the endocrine system; 40 to 50 percent affect the brain, kidneys, and nervous, immune, and cardiovascular systems; and more than 75 percent affect the skin, eyes or other sensory organs, and the respiratory and/or gastrointestinal system.[16]

Naturally Occurring Toxics Coming to Surface with Fracking Water	
Arsenic	Can cause stomach pain, partial paralysis, blindness, and cancer of the bladder, lungs, skin, kidney, nasal passages, liver, and prostate.[17]
Strontium	Linked to bone cancer, cancer of the soft tissue near the bone, and leukemia.[18]
Iron and Magnesium	Low levels of exposure may cause diarrhea, nausea and abdominal cramping. High levels of exposure may cause nausea, vomiting, depression, muscle weakness, difficulty breathing, extreme hypotension, irregular heartbeat, and cardiac arrest.[19]
Methane, Ethane, Propane	May cause rapid breathing, rapid heart rate, clumsiness, emotional upset and fatigue. At greater exposure, may cause vomiting, collapse, convulsions, coma and death.[20]
Radon and Radium	Radioactive elements for which long-term exposure via ingestion or inhalation increases the risk of developing lymphoma, leukemia and aplastic anemia; can increase risk of cancer in all tissues and organs.[21, 22]

According to a 2011 Congressional report, of the 750 known fracking substances accounted for in the study, 29 of the most commonly used are dangerous enough to be regulated under the various environmental protection laws that

fracking has been exempted from, including the Safe Drinking Water Act and the Clean Air Act.[23]

Fracking wastewater combines withdrawn fracking fluids with naturally occurring brines – waters that contain salts and other substances brought to the surface from deep underground. [24] Natural brines are highly saline and may contain toxic levels of elements like barium, arsenic and radioactive radium.[25] This wastewater is categorized by the EPA as "special wastes" and as such is exempted from federal hazardous waste regulations under the Resource Conservation and Recovery Act (RCRA).

Pathways to Exposure

➢ Contamination of Underground Aquifers

Toxic fracking chemicals and wastes can come into contact with humans at numerous points in the fracking process, creating risks for health. One risk is the contamination of aquifers, which are huge natural reserves of underground water. Hydraulic fracturing pipes often pass through shallow aquifers. If well casings crack, fracking chemicals can contaminate the aquifer, which may be the sole water source supplying local wells. As a result, nearby residents may be subject to exposures as they drink water, cook, bathe, etc. (More than 15 million American households regularly depend on well water.)[26] In one study conducted in northeastern Pennsylvania, methane was detected in 82% of drinking water samples, with homes less than one kilometer from natural gas wells exhibiting average concentrations six times higher than those located far away. Ethane and propane were also found, again with higher concentrations close to fracking wells.[27]

➢ Surface Contamination

When fracking wastes are returned to the surface, they can pose exposure threats to workers, local residents, and animals, as well as possibly contaminating local surface waters and shallow groundwater. Exposure can arise from spills, leaks, unintentional and intentional releases. A few states still allow untreated wastewater to be sprayed on roads for dust control, or directly onto the land.

Holding ponds, where fracking wastewaters sit until disposal, are another potential source of exposure. These open-air pits may be located near households and agricultural sites, placing children, pets and farm animals at particular risk. Animals that drink water contaminated with fracking fluids may bring unidentified chemicals into the human food chain through the sale of their meat and milk.

➢ Wastewater Treatment and Disposal

Fracking wastewater is generally so severely contaminated that conventional water treatment facilities cannot purify it.[28] Some wastewater is sent to desalination facilities, but these too may be inadequate to the task. A study of one such facility in western Pennsylvania, where treated water is discharged to local streams, found increased stream levels of chloride and bromide, as well as radium levels 200 times greater than background levels, exceeding radioactive waste disposal threshold regulations and posing potential risks of radium bioaccumulation.[29]

Due to the expense of proper disposal of fracking fluids, many drilling companies use misters to spray wastewater into the air so as to speed evaporation,[30] thus reducing the volume of waste fluids. This has the effect of transferring toxic substances from the water to the air, where they may cause harm to health via inhalation.

In the U.S., over 95 percent of fracking wastewater is pumped into injection wells.[31] Most are old oil wells where the wastewater is used to flush out additional oil. An estimated 30,000 injection wells, however, serve as permanent storage sites for fracking fluids.[32]

In some cases, the injection of large amounts of fracking fluids has been associated with earthquakes, including in Ohio[33] and Oklahoma,[34] which in November 2011experienced a destructive 5.7 magnitude quake. Deep injection of wastewater is not permitted in Europe except for stimulation of gas and oil wells.

Conclusion

Physicians for Social Responsibility (PSR) is concerned about the multiple serious threats to human health posed by hydraulic fracturing. PSR supports a precautionary approach that includes a moratorium on the use of hydraulic fracturing until such time as impartial federal agencies such as the U.S. Environmental Protection Agency develop and implement enforceable rules that provide adequate protection for human health and the environment from fossil fuel extraction processes that use hydraulic fracturing.

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