Perfluorinated Chemicals: An Emerging Contaminant

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An emerging contaminant of significant interest to regulators and the public is a class of chemicals known as perfluorinated chemicals (PFCs), human-made chemicals that do not naturally occur in the environment. PFCs are persistent in the environment (i.e., there is no natural degradation process) and have been linked to a number of adverse health effects.[1,2] Although there are several specific types of chemicals under the broad category of PFCs, the two of greatest interest are perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS), which are typically found in the environment at higher concentrations than other PFCs.

Uses of PFCs and Sources in the Environment

Because PFCs repel water and oil and are resistant to heat and chemical reactions, they were used in the historical manufacturing of several materials, including waterproof and stainproof fabrics and carpets, some non-stick cookware, leak-proof coating on packaging materials, and aqueous film-forming foam, a type of fire-fighting foam. PFCs are also used as an additive in enhanced petroleum recovery.

Contamination from PFCs can be found at commercial and military airports, fire-fighting training facilities, oil refineries, landfills, and agricultural land receiving applications of PFC contaminated wastewater and biosolids.

Manufacturing plants are some of the biggest contributors of PFCs to the environment through improper disposal of solid and liquid waste containing PFCs. In West Virginia, the DuPont manufacturing plant was found to be responsible for a significant PFC release that resulted in several class action lawsuits and a settlement for $16.5 million with the Environmental Protection Agency (EPA).[3] In Minnesota and Alabama, 3M was found to be responsible for significant amounts of PFC contamination. While 3M has largely avoided serious financial and legal consequences, they are still being pursued through several lawsuits.[4]

PFCs have been found in air, water, and soil throughout the United States. Because PFOA and PFOS are stable in the environment and do not naturally degrade over time, concentrations accumulate in these media, most significantly in groundwater. PFOA and PFOS in groundwater are a unique concern because they tend not to stick to aquifer materials and can travel long distances from the source of contamination.[1,2] Where groundwater is used as drinking water, it is a direct source for human exposure.

Health Effects Caused by Exposure to PFCs

Potential pathways for human exposure include ingestion of contaminated food and water, inhalation of contaminated air, and use of commercial products containing PFCs. Studies have shown that PFOA and PFOS can be found in human blood samples from the general United States population, suggesting that exposure to PFCs is widespread.[5]

Exposure to PFCs has been shown to have several adverse effects on human health, including delayed fetal and neurological development and reduced liver, kidney, and immune function. Additionally, exposure to PFCs has been linked to kidney, liver, testicular, thyroid, and pancreatic cancers.

Regulations on PFCs through EPA

EPA has taken several regulatory steps to limit and terminate the use of PFCs in the U.S. over the past few decades. EPA also sets nonregulatory Health Advisories, which provide information regarding contaminant concentration levels for which adverse effects are not anticipated. The table below shows how EPA Health Advisory concentration levels for PFOA and PFOS in groundwater have decreased over time, suggesting that the acceptable level at which human health is not affected is still unknown.

EPA Health Advisory Concentration Levels			
Year	PFOA (parts per billion)	PFOS (parts per billion)	Source
2002	150	--	Emergency administrative order under Safe Drinking Water Act in West Virginia[6]
2006	0.50	--	Second emergency administrative order under Safe Drinking Water Act in West Virginia[6]
2009	0.40	0.20	Provisional Health Advisories for PFOA and PFOS[1,2]
2016	0.070*	0.070*	Drinking Water Health Advisory for PFOA[1] and Drinking Water Health Advisory for PFOS[2]

* For individual or combined concentrations of PFOA and PFOS.

Treatment Options for PFC Contamination

While the technology to remove PFC contamination from soil is limited, several technologies exist to remove PFCs from drinking water with varying degrees of success. In most cases, sites with known contamination extract the contaminated groundwater, treat it, and then discharge the treated water to the sanitary sewer or a surface water body.

Standard municipal and home treatment technologies do not employ the methods that remove PFCs in drinking water. Some of these technologies can be used in-home, but are expensive, require in-home installation, and need monitoring and maintenance. Many counties that have detected PFCs in drinking water are either are not pumping water from contaminated wells or are blending contaminated water with uncontaminated water to reduce concentrations of PFCs.[7]

The Future of PFC Contamination in Groundwater

As government and private research facilities continue to study the effects of exposure to PFCs on human health, it can be expected that acceptable concentration levels will continue to decrease and will include enforceable regulatory limits. Testing of drinking water, both public and private, for PFCs will likely increase.

It is highly unlikely that public water agencies and private well owners will have the funds to treat contaminated water or the supply available to dilute it. Rather, it is more likely that these stakeholders will try to find the sources of the contamination by testing groundwater at existing and new wells, and then holding emitters of PFCs responsible for the cost of remediation.

Depending on the extent of contamination, the remediation process could be very costly for responsible parties, and likely will include significant additional costs for responsible parties from class-action lawsuits filed by injured parties.

PFCs are not the only emerging contaminants under scrutiny by EPA. Staying abreast of information about emerging contaminants such as PFCs is an important way for companies to determine the best possible environmental management practices and to minimize possible future liability.

1. U.S. Environmental Protection Agency (EPA). 2016. *Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOA)*. EPA Document No. 822-R-15-005. May.

2. EPA. 2016. *Drinking Water Health Advisory for Perfluorooctane Sulfonate (PFOS)*. EPA Document No. 822-R-15-005. May.

3. Rich, Nathaniel. 2016. "The lawyer who became DuPont's worst nightmare." *The New York Times*. January 6. http://www.nytimes.com/2016/01/10/magazine/the-lawyer-who-became-duponts-worst-nightmare.html?_r=0

4. Lerner, Sharon. 2016, "Lawsuits charge the 3M knew about the dangers of its chemicals." *The Intercept.* April 11. https://theintercept.com/2016/04/11/lawsuits-charge-that-3m-knew-about-the-dangers-of-pfcs/

5. EPA. 2014, *Emerging Contaminants Perfluorooctane Sulfonate (PFOS) and Perfluorooctanoic Acid (PFOA).* EPA Fact Sheet No. 505-F-14-001. June.

6. EPA. 2006. *E.I. du Pont de Nemours and Company, Order on Consent.* Docket No. SDWA-03-2007-0039-DS. November.

7. Lerner, Sharon. 2016. "With new EPA advisory, dozens of communities suddenly have dangerous drinking water." *The Intercept*. May 19. https://theintercept.com/2016/05/19/with-new-pfoa-drinking-water-advisory-dozens-of-communities-suddenly-have-dangerous-water/