

PFOS and PFOA

A global emerging concern

Polyfluorinated and perfluorinated alkyl substances (PFAS) are detected in waters around the world, posing a threat to drinking water quality.

In May of 2016, the United States Environmental Protection Agency (EPA) issued a drinking water health advisory for two chemicals that are sometimes found as contaminants in drinking water sources and are now considered to be chemicals of emerging concern. The chemicals perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS) are polyfluorinated and perfluorinated alkyl substances (PFASs). These chemicals have been found in waters throughout the United States (US) and beyond.

PFASs are substances that have many manufacturing and industrial applications and have been used over the last 65 years to make everyday products more resistant to stains, grease, and water. PFASs are used, for example, to keep food from sticking to cookware, to make sofas and carpets resistant to stains, or to make clothes and mattresses more waterproof. They are also found in cleaners, textiles, leather, paper and paints, fire-fighting foams, and wire insulation. These chemicals also help to reduce friction, so they are also used in a variety of other industries, including aerospace, automotive, building and construction, and electronics.

PFOA and PFOS are environmentally persistent and do not easily breakdown. As such, these compounds are found globally in the environment in bodies of water, soil, dust, and the air. They bioaccumulate (accumulate in individual organisms) and biomagnify (accumulate in the food chain). More significant concentrations are found where the compounds are manufactured or made; however, they have also been found in the open ocean and in the Arctic.

Screening conducted by the US Centers for Disease Control and Prevention found that widespread PFOA human exposure has occurred. The results of its study based on blood testing conducted in the early 2000s are published in the *Fourth National Report on Human Exposure to Environmental Chemicals*. In 2009, EPA published provisional health advisories for PFOA and PFOS based on the evidence available at that time.

PFOA and PFOS are considered emerging concerns, as there are currently no enforceable rules or laws at the federal level or in the State of California regarding exposure to the contaminants, yet studies indicate that they are harmful to people.

PFOAs and human health concerns

On May 2, 2012, the EPA published the third Unregulated Contaminant Monitoring Rule (UCMR 3), which required water districts across the country to conduct water monitoring and sampling for 30 contaminants (28 chemicals and two viruses) for a fixed time between 2013 and 2015. The results of the UCMR monitoring data provide a basis for future federal regulatory actions to protect public health and serve as a primary source of occurrence and exposure information that the US EPA uses to develop regulatory decisions.

In July 2016, the EPA reported that PFOS was detected across the US in 46 public water supply wells, and PFOA was detected in 13 supply wells above the 70 parts per trillion health advisory limit. The EPA also reviewed the best available peer-reviewed studies, which included research on laboratory animals (rats and mice) and findings reported by epidemiological studies of human populations that have been exposed to PFASs. These studies indicate that exposure to PFOA and PFOS exceeding certain levels may result in adverse health effects, including developmental effects to fetuses during pregnancy or to breastfed infants (e.g., low birth weight, accelerated puberty, skeletal variations), cancer (e.g., testicular, kidney), liver effects (e.g., tissue damage), immune effects (e.g., antibody production and immunity), thyroid effects, and other effects (e.g., cholesterol changes). Based on the results of the UCMR data and the studies of the effects of PFOA and PFOS, the EPA issued a health advisory for these contaminants in May of 2016.

The EPA lifetime Health Advisory Level (HAL) for PFOA and PFOS is 0.070 micrograms per liter (µg/L), or 70 parts per trillion. When both PFOA and PFOS are found in drinking water, the combined concentrations of PFOA and PFOS should be compared with the 70 parts per trillion HAL.

EPA's health advisories are non-enforceable and non-regulatory while providing technical information to state agencies and other public health officials on health effects, analytical methodologies, and treatment technologies associated with drinking water contamination. The EPA health advisory recommends that when water districts detect PFASs, water system officials should:

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- Quickly undertake additional sampling to confirm and assess the level, scope, and localized source of contamination
- Promptly notify their state drinking water safety agency and consult with the Division of Drinking Water (DDW) on the best approach to conduct additional sampling.

Additionally, public health officials should promptly provide consumers with information about the levels of PFOA and PFOS in their drinking water.

Although the EPA recommends these steps, they are not enforceable, and water districts are not required to follow the recommendations. Some water districts, such as the Orange County Water District in California, have made active efforts to meet EPA recommendations and have published information regarding PFOA and PFOS in their water supply wells.

PFOS and PFOA management

Worldwide, the fate and transport of PFOS, PFOA, and other perfluorinated chemicals has been closely monitored, and environmental effects are being investigated. They have been found in surface and tap water in both developed and developing countries.

In 2006, the EPA established contacts with chemical companies and foreign governments

regarding PFOS and PFOA. The EPA led a voluntary global stewardship program, which included the eight leading global companies who manufacture PFOS and PFOA. Sites covered by the program are in five European Union (EU) countries – the United Kingdom (UK), Germany, France, Italy and the Netherlands – as well as the US, China, and Japan. The goal of the program was to reduce global facility emissions by 95 percent by 2010 and to work toward eliminating emissions and PFOS- and PFOA-related products by 2015. All eight companies meet the goals; these include Arkema, Asahi, BASF Corporation (successor to Ciba), Clariant, Daikin, 3M/Dyneon, DuPont, and Solvay Solexis.

Within the EU, PFOS is considered persistent, bioaccumulative, and toxic. PFOS (and PFOS derivatives) have been severely limited in the EU since June 2008 under a 2006 Directive (2006/122/ECOF). This directive restricts the use of PFOS for most applications and products where PFOS was intentionally added above a nominal percentage.

In 1995, the Governing Council of the United Nations Environment Program (UNEP) called for global action to be taken on Persistent Organic Pollutants (POPs), which it defined as “chemical substances that persist in the environment, bio-accumulate through the food web, and pose a risk of causing adverse effects to human health and the environment.” The Stockholm Convention on POPs, signed in 2001, and effective from May 2004, is an international environmental treaty that aims to eliminate or restrict the production and use of POPs. It has defined a binding global ban on the production of and trade in twelve POPs. In May 2009, PFOS and PFOS derivatives were added to the POPs list, which requires the parties to the Convention to restrict the production and use of the substance.

Protecting drinking water

In most countries, surface waters (rivers) are the source of tap water, which is one of the important pathways in which PFASs reach humans. In 2000, the EU Water Framework Directive was initiated, providing integrated river basin management for Europe and establishing a framework for community action in the field of water policy. The EU directive commits the EU member states to achieve good qualitative and quantitative status of all water bodies. On April 17, 2013, PFOS- and PFOS related substances were listed as a priority substance in the Water Framework Directive 2013/39/EU. The maximum annual average for PFOS is 0.00065 ug/L (or 0.65 parts per trillion), and the maximum allowable concentration is 36 ug/L (or 36,000 parts per trillion) within inland waters.

In Europe, drinking water quality is managed by the Drinking Water Directive, which was last revised in 2013. This directive concerns the quality of water intended for human consumption, and its objective is to protect human health from adverse effects of contamination. No standards in the Drinking Water Directive are apparent regarding the regulation of PFOS or PFOA in drinking water. However, when translating the Drinking Water Directive into their own national legislation, member states of the EU can include additional requirements, e.g., regulate additional substances that are relevant within their territory or set higher standards. Apart from a few exceptions, there does not seem to be evidence for the standard testing for PFOS or PFOA in EU member states; however, it is possible that some countries will take the leap from monitoring surface water for PFOS to monitoring drinking water for PFOS.

A few countries are in the process of approving policies that protect the public from PFOS and PFOA in drinking water. The Federal-Provincial-

Territorial Committee on Drinking Water (CDW) in Canada currently has legislation under review in addition to public comment that will set the maximum acceptable concentration (MAC) of 0.6 µg/L, or 600 parts per trillion, for PFOS in drinking water, based on liver effects in rats. In England and Wales, the Drinking Water Inspectorate (DWI) was formed in 1990 to provide independent reassurance that water supplies in England and Wales are safe and that drinking water quality is acceptable to consumers. The DWI has put into place the requirement to monitor and test when PFOS and PFOA are detected in drinking water above 300 parts per trillion.

Risk moves to less restrictive economies

Most of the world is phasing out PFOS and PFOA by restricting production and use while starting to address the problems they have caused. However, PFOS and PFOA production and manufacturing have moved to many developing countries and countries with transitional economies that have fewer restrictions. In China, the business has truly boomed, keeping global output of PFOS and PFOA steady, even as the industry grinds to a virtual halt everywhere else. Therefore, although there has been progress to identify, mitigate, and eliminate the environmental and health risks and future damage in North America, Europe, and elsewhere, the problem appears to be relocating to other areas of the world.

Author's Note

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