Water and Wastewater Regulatory Compliance Corner
Per- and Polyfluoroalkyl Substances (PFAS)
Published June 9, 2021

Introduction to Per- and Polyfluoroalkyl Substances

Emerging contaminants are synthetic or naturally occurring chemicals that are not commonly monitored in the environment but have the potential to enter the environment and cause known or suspected adverse ecological and/or human health effects. As new research and testing methods are developed to help better assure the quality of water for customers, new emerging contaminants may be able to be detected. PFAS are one such emerging contaminant that has become of growing concern and focus by the scientific community.

What are PFAS?

Per- and Polyfluoroalkyl substances (PFAS) is a chemical family that comprises over 5,000 individual chemical species. While each species contains its own unique name and characteristics, the similarity is that each species contains structural elements known as a perfluoroalkyl group. PFAS are diverse and complex. This complexity makes them difficult to regulate, treat, and monitor. Research has identified human health and ecological impacts of PFOS and PFOA (two of the most researched classes), but little is known about the impact of several other groups of PFAS. This grey area makes it difficult to identify an appropriate regulatory target.

Why should I care?

What are the health effects? If people ingest PFAS (consuming food/water/products that contain PFAS), the chemicals are absorbed, and can accumulate in the body. PFAS stays in the human body for long periods of time. As a result, as people get exposed to PFAS from different sources over time, the level of PFAS in their bodies may lead to adverse health effects. The likelihood of adverse health effects depends on several factors such as the amount and concentration of PFAS ingested as well as the time span of exposure.

Scientists are still learning about the health effects of exposures to PFAS. The biggest concerns are for children and people who are pregnant or likely to become pregnant. Although more research is needed, some studies have shown that certain PFAS, like PFOA and PFOS, may:

- cause developmental effects in infants
- damage kidney functions (exposure was also associated with alterations and disruptions in multiple pathways related to kidney disease, seen in several studies[1])
- lower a person's chance of getting pregnant
- increase a person's blood pressure during pregnancy
- lower infant birth weights
- interfere with the body's natural hormones
- increase cholesterol levels
- affect the immune system
- increase the risk of cancer

1 https://dceg.cancer.gov/news-events/news/2020/pfoa-kidney

BIOACCUMULATION AND BIOMAGNIFICATION

PFAS do not break down in the environment. They can move through soils and contaminate drinking water sources, and they build up in fish and wildlife. This buildup is called bioaccumulation. As humans, or other animals, consume these fish and wildlife, PFAS biomagnified.

EXAMPLE
A human who eats three fish that bioaccumulated PFAS now has the levels present in those three fish. The PFAS concentrations magnified from 1 to 3.

Where do they come from?

PFAS have been used in production in varying capacities since the 1940's. PFAS are used to make fluoropolymer coatings and products that resist heat, oil, stains, grease, and water. Below is a brief list of several industries and the applications where PFAS are used.

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Applications	Found in…	Description
Apparel	• outdoor (rain-resistant) and sportswear (sweat wicking) • military clothing • workwear for medical staff, pilots, and fire fighters	Fluorinated polymers are used as long-lasting durable water repellent (DWR) finishes in apparel. DWRs provide water and oil repellency (UNEP 2017; FluoroIndustry 2019).
Building Construction	• concrete • tiles • OSB and wood • insulation materials • mounting and sealing foam • polystyrene	Building materials such as metals, stones, glass fabrics, tiles, and concrete were typically coated with fluoropolymers to improve fire and weather resistance in various construction-related applications (OECD 2013).
Food Packaging	• plates • food containers • cupcake forms • popcorn bags • pizza boxes • baking paper • candy and fast-food wrappers	For applications where the packaging needs to be made oil and water repellent, PFAS are often used.
Household	• piping • dishwashing liquids • car wash products • floor cleaning products • carpet spot cleaner	Teflon tape (PTFE) has been used for sealing of threads and joints for domestic piping and plumbing applications. Fluorinated surfactants lower the surface tension and improve wetting and rinse-off in a variety of industrial and household cleaning products.
Medical Utensils	• dialysis equipment • catheters • stents • needles	Fluoropolymers are used in protein-resistant and sterile filters, tubings, O-rings, seals and gaskets for kidney dialysis machines and immuno-diagnostic instruments. Fluoropolymers provide low-friction and clot-resistant coatings for catheters, stents, and needles.

Applications	Found in…	Description
Personal Care	• anti-aging, anti-frizz products • bar soap • blush/highlighter • body lotion/body cream • body oil • brow products • concealer/corrector • cream/lotion • cuticle treatment • eye cream/eyeshadow • eye pencil/eyeliner • face cream • facial cleanser • hair creams and rinses/conditioner • hair spray/mousse • hair shampoo • hand sanitizer • highlighter • lip balm/lip stick/lip gloss • manicure products • makeup remover • mascara/lashes • nail polish/nail treatment • powder • shaving cream/shaving • foam/shaving gel • sunscreen	PFAS in hair-conditioning formulations can enhance wet combing and render hair Oleophobic (lacks affinity for oil) (Kissa 2001). PFAS have been used in personal care products (e.g., to make creams penetrate the skin more easily, make the skin brighter, make the skin absorb more oxygen, or make the cosmetic product more durable and weather resistant).
Pesticides	• active ingredients • formulation additives	The mechanism of insecticidal activity appears to be suffocation of the insect by the adsorption of the PFAS (Kissa 2001). PFAS have also been used in pesticides as dispersants, to facilitate the spreading of plant protection agents on insects and plant leaves and to increase uptake by insects and plants.

How do they get into the water supply?

PFAS are highly mobile in the environment. From industrial waste and runoff, solid waste leachate, and byproduct from human consumption, these "forever chemicals" can infiltrate the water cycle at a variety of entry points. Due to characteristics such as their high solubility and persistence, PFAS are mobile in soil, are prone to leaching into groundwater and can travel large distances.

Because these chemicals take an indefinite amount of time to break down, they can flow from one location to the next without undergoing any chemical changes or degradation, meaning they do not go away without treatment.

FOREVER CHEMICALS
PFAS are known as "forever chemicals" because once released into the environment they do not break down, and they seemingly exist in the environment forever.

What are the federal regulations for PFAS?

There is no federal regulation establishing a Maximum Contaminant Level (MCL) for PFAS in water systems. However, EPA has issued a health advisory for PFOA and PFOS.

WHAT IS A HEALTH ADVISORY?

Health advisories are informal technical guides to assist federal, Tribal, state, and local water systems in assessing non-regulatory concentrations and health risks of drinking water contaminants. EPA's health advisories are non-enforceable and non-regulatory and provide technical information to governing agencies and other public health officials on health effects, analytical methodologies, and treatment technologies associated with drinking water contamination.

EPA'S 2016 LIFETIME HEALTH ADVISORY

To provide populations with a margin of protection from a lifetime of exposure to PFOA and PFOS from drinking water, EPA established the health advisory levels at 70 parts per trillion. When both PFOA and PFOS are found in drinking water, the combined concentrations of PFOA and PFOS should be used when comparing to the 70 parts per trillion health advisory level.

PFAS AND THE SAFE DRINKING WATER ACT

EPA has not established national primary drinking water regulations for PFOA and PFOS. EPA is evaluating PFOA and PFOS as drinking water contaminants in accordance with the process required by the Safe Drinking Water Act (SDWA). To regulate a contaminant under SDWA, EPA must find that it:

1. may have adverse health effects;
2. occurs frequently (or there is a substantial likelihood that it occurs frequently) at levels of public health concern; and
3. there is a meaningful opportunity for health risk reduction for people served by public water systems.

In February 2020, EPA announced that it is proposing to regulate both PFOA and PFOS under the SDWA. This preliminary determination is a step toward providing Tribal Nations, states, and local communities with key information about PFOA and PFOS in drinking water.

In the proposal, EPA is also asking for information and data on other PFAS substances, as well as seeking comment on potential monitoring requirements and regulatory approaches EPA is considering for PFAS chemicals. If the positive regulatory determination is finalized, the agency would begin the process to establish a national primary drinking water regulation for PFOA and PFOS.

PFAS IN COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT (CERCLA)

PFAS, including PFOA and PFOS, are not listed as CERCLA hazardous substances but may be addressed as CERCLA pollutants or contaminants in the future. CERCLA investigations are beginning to include PFAS. PFAS have been reported present at many federal and private CERCLA sites.

EPA INTERIM STRATEGY FOR NPDES PERMITS FOR WASTEWATER AND STORMWATER SYSTEMS

EPA's interim NPDES permitting strategy for PFAS provides recommendations on an interim approach to include PFAS-related conditions in EPA-issued NPDES permits. It advises EPA permit writers to consider:

1. Include permit requirements for phased-in monitoring and best management practices, as appropriate, taking into consideration when PFAS are expected to be present in point source wastewater discharges.
2. Include permit requirements for phased-in monitoring and stormwater pollutant control, as appropriate, taking into consideration when PFAS are expected to be present in stormwater discharges.
3. Information sharing on permitting practices and the development of a permitting compendium, an information sharing platform, and continuation of the workgroup.

How can I detect PFAS?

Due to the nature and wide variety of PFAS chemicals, testing and detecting PFAS families is an intensive process. Proper analysis involves using laboratories that use EPA-validated testing procedures. USET will offer to cover

Tribal Nation water analysis expenses at a validated testing facility on a first-come, first-served basis. This analysis will meet EPA required standards for testing procedures to ensure accurate and reliable results.

DRINKING WATER METHOD 533

In December 2019, EPA announced Method 533, a new validated method for testing additional PFAS in drinking water. The new validated test method complements other actions the agency has taken under the Action Plan to help communities address PFAS nationwide. This method makes it possible for both government and private laboratories to effectively measure more PFAS chemicals in drinking water than was possible before. With this new method, the agency can measure 29 PFAS types.

Moving Forward

TREATMENT AND DISPOSAL RESEARCH

Most traditional water and wastewater treatment processes do not remove PFAS. A wastewater plant could receive PFAS-contaminated influent which it then passes to other sources through its effluent. Half of the domestic sewage sludge produced by wastewater treatment in the United States is applied to agriculture as biosolids, allowing PFAS to enter the food chain.

EPA has numerous PFAS treatment and disposal research projects underway, including on high temperature incineration and other methods. The agency is collaborating with other federal partners, including the Department of Defense, on efforts to increase the agency's understanding and availability of treatment technologies for PFAS, including analytical methods.

HOW TO PLAN

As these regulations and requirements for emerging contaminants grow and change, utility managers and personnel can best prepare themselves by learning of PFAS chemicals and their prevalence in the water system. Utilities can stay in the regulatory loop by keeping up with the regulations as they develop and determining how that may affect operations by including an emerging contaminants project in the Capital Improvement Plan and help add to the body of knowledge EPA is gathering by working with USET to receive and test samples from your Tribal Nation. Having this data will help EPA work with Tribal Nations in dealing with the emerging threats of PFAS. If you have any questions regarding getting your utility's water, wastewater, or sludge monitored for PFAS, please contact Michael Purvis at mpurvis@usetinc.org.