WHITE PAPER

A Holistic Path to Treating PFAS in Water and Wastewater

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PFAS, or per- and polyfluoroalkyl substances, are the subject of intense discussion in the water and wastewater industries. With the U.S. Environmental Protection Agency (EPA) poised to issue new rules governing the management of these "forever chemicals" in coming years, many utilities are debating how to manage the risks they pose in the meantime. Long-term public health protection and fiscal prudence call for a holistic approach, beginning with a process evaluation to measure contaminants accurately and determine next steps.

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PFAS are a group of persistent synthetic chemicals used for decades in many products, including firefighting foam and nonstick cookware. The properties that made these chemicals so effective in these applications also make them difficult to remove from water and wastewater using conventional treatment technologies.

Given their toxicity, persistence in the environment and ability to bioaccumulate, PFAS are now under EPA scrutiny. The agency is expected to roll out a series of new federal regulations governing their management in water, wastewater and air in coming years. Rather than wait, some municipalities and states are making plans now to identify treatment requirements and compliance timelines.

They do so recognizing that any infrastructure solutions implemented today are at risk of becoming obsolete as PFAS regulations and treatment technologies become more defined and mature. To mitigate those risks and create sustainable, long-term solutions, utilities are exploring ways to manage PFAS during this period of uncertainty. This path begins with a process evaluation that traces water's journey from its source through water and wastewater treatment and concludes with the disposal of concentrated waste streams or utilization of any resulting biosolids.

Key Components of a Process Evaluation

By beginning with a process evaluation, utilities can develop PFAS treatment solutions that are better aligned with the actual makeup of the utility's water supply, existing treatment strategies and finished water goals. Other infrastructure investment decisions can likewise be informed by process evaluation findings. Information is power, and a process evaluation enables a utility to be more informed about its potential exposure, confident in its decision-making and effective in its public outreach.

Starting with a comprehensive process evaluation is particularly valuable in municipalities where different agencies manage the water and wastewater operations. Communication between the two sides is key. The water treatment plant's approach can significantly impact wastewater treatment and biosolids disposal. And vice versa. When it comes to PFAS management, it is important for both sides to work together and begin planning now.

Identifying PFAS at Their Sources

EPA has identified source reduction as a suggested area of focus in a broad-based approach to managing PFAS compounds. Pretreatment ordinances have historically been used by utilities and municipalities on other contaminants of concern to reduce the loading to downstream wastewater treatment plants. It is far easier to address 100 gallons of PFAS-containing effluent while it is still at its source than to treat it when it becomes diluted in millions of gallons of water entering a water or wastewater treatment plant each day.

Industrial facilities and manufacturers are not currently required to track or report discharges of PFAS into municipal collection systems. But that is likely to change based on EPA's recently released Effluent Guidelines Program Plan 15. These plans historically have been issued biennially and used to set limits on specific pollutants introduced to publicly owned treatment works collection systems by industries and manufacturers.

Plan 15 suggests that effluent limitation guidelines and treatment standards are warranted for reducing PFAS discharges from some industries, including metal finishing, chemicals and plastics. EPA plans to conduct rule-making on PFAS discharges for these industries. Studies are also planned on PFAS discharges from landfills, textile and carpet manufacturers, and the electrical and electronic components industry.

Discharge limits for upstream sources of PFAS will potentially prevent or reduce the need for significant PFAS treatment at water and wastewater treatment plants. This approach may also reduce the need for alternative disposal methods for biosolids. Utilities can begin conversations with industrial customers now, supporting efforts to fast-track the PFAS identification process and find ways to pretreat PFAS compounds or minimize their generation.

Accounting for source reduction can be an important component of a process evaluation, which includes:

Monitoring and Measuring PFAS at Drinking Water Treatment Plants

When conducting a process evaluation, a utility's water treatment operation merits early attention. EPA's initial PFAS rules will likely focus on utilities' water treatment operations.

While more than 6,000 PFAS compounds have been identified, only 256 are reported to have been commercially produced over the past 60 years. Some of these compounds have been named by EPA as contaminants of concern and assigned a health advisory level.

Beginning in 2023, EPA will require drinking water utilities to measure 29 of these compounds as part of Unregulated Contaminant Monitoring Rule 5. Within one to two years, EPA is expected to specify maximum concentration levels (MCLs) for select PFAS compounds and to consider regulatory action on groups of PFAS supported by the best available science.

It is therefore critical for water utilities to understand the PFAS makeup of water entering their water treatment plants. By tracking the presence and concentration of these compounds, how they are treated and where they go next, utilities can put themselves in a position to predict if and how PFAS rules may impact operations, as well as assess options when EPA announces the action threshold for PFAS removal. Characterizing source water to understand its chemistries can also influence treatment technology performance.

Should the water entering a water treatment plant exceed action levels for PFAS, current treatment strategies will be limited and likely require two or more technologies in series. Current technologies — granular activated carbon, reverse osmosis and ion exchange — are a good start and have potential. But each is limited by what PFAS compounds it can remove, how they are concentrated and where they can be disposed.

Even if a utility discovers that the PFAS concentration in its finished water falls below actionable levels, PFAS compounds can accumulate in the water treatment residuals, concentrates and solids that are often passed on to a wastewater treatment facility or enter other waste streams. Current operational practices of sending concentrated solutions or solids to wastewater treatment plants, landfills, wells or land applications could potentially be prohibited under future PFAS regulation.

PFAS concentrations will continue to persist in the water cycle, making it imperative for utilities to understand downstream impacts before the water or waste streams leave the water treatment plant.

Current treatment processes are not effective in removing all PFAS from wastewater.

By proactively developing a long-term PFAS strategy, water and wastewater utilities can avoid sinking money into solutions that shift PFAS issues elsewhere or that may be obsolete sooner rather than later.

Understanding the Impact of PFAS Compounds on Wastewater Treatment

PFAS treatment becomes more complicated at wastewater treatment plants. In addition to PFAS compounds arriving in residuals, concentrates or solids, sewers may deliver significant PFAS mass to wastewater treatment plants. In fact, a recent survey of wastewater treatment plant operators conducted by a group led by the Water Environment Federation (WEF) found average PFAS concentrations of 70 to 125 parts per trillion (ppt) in influent water and 115,000 to 200,000 ppt in the biosolids. By comparison, EPA's recent lifetime drinking water health advisory calls for just 0.02 ppt for perfluorooctane sulfonic acid (PFOS), one individual PFAS.

Treated water from wastewater treatment plants is regulated through the National Pollutant Discharge Elimination System (NPDES) program. Ongoing EPA-led studies on the impacts of PFAS on human health and aquatic life may result in the establishment of PFAS limits in NPDES permits. The aquatic life studies are anticipated to be complete in 2023, with the studies on human health slated for completion in fall 2024.

As with drinking water, current wastewater treatment processes are not effective in removing PFAS from wastewater. The potential use of granular carbon or selective ion exchange resins — beads made up of highly porous, polymeric material that adsorb PFAS and other contaminants moving through a water system — are two potential avenues for wastewater after secondary treatment and clarification is complete, but both pose challenges with cost and the disposal of spent media. The good news is that resins now being engineered have been shown to be effective in removing many of these compounds. Ultimately, technology choices will depend on ongoing studies of the long-term behavior of these materials through various treatment processes.

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Rethinking Biosolids Management

A large portion of PFAS currently leave wastewater treatment plants bound to biosolids. Treatment of these biosolids is complicated, with no single technology providing a complete solution. Traditional biosolids treatment and stabilization methods do not appear to be effective in reducing PFAS compounds. Newer treatments have not yet achieved scalability or present other limitations that currently prevent their commercialization. The absence of any cost-effective biosolid treatment solutions at scale makes it even more imperative for utilities to seek PFAS solutions at their sources and in upstream liquid treatment processes.

An EPA-led risk assessment for PFAS, including perfluorooctanoic acid, in biosolids is ongoing and projected to be completed in late 2024. Whatever the result, complying with PFAS regulations for biosolids is expected to require an investment. WEF study data from 2020 and 2021 found that when biosolids management programs were changed to address PFAS, costs increased anywhere from 37% to 72% between those two years at utilities in Arizona, Maine, Michigan and New Hampshire.

Developing Engineered Solutions

When it is not feasible to reduce or eliminate PFAS, water and wastewater utilities may need other solutions that address PFAS discharges that exceed regulatory limits. Those solutions could range from a change in an existing process, installation of some future PFAS removal or control technology, or a combination of both. A one-size-fits-all solution is rarely the most effective treatment approach.

The costs associated with any changes will vary by facility but may be significant. The federal infrastructure funding package passed by Congress in 2021 includes $10 billion to support PFAS treatment in drinking water. As future methodologies of managing PFAS at water and wastewater facilities are further developed, expect other funding opportunities to emerge, likely focusing first on economically disadvantaged communities and in areas where PFAS concentrations in source waters are highest.

The Bottom Line

When a utility invests tens of millions of dollars in a solution to reduce PFAS, it does not want to learn just a few years later that it chose to target the wrong compounds or that the technology cannot achieve the MCL mandated by new federal regulations.

A holistic approach should be forward looking, reducing long-term risks by recommending solutions that can be adaptable to changing requirements. A process evaluation can provide a comprehensive direction forward, identifying overuse of chemicals or efficiency opportunities. A utility is wiser to spend a fraction of that amount on a holistic process review of its water and wastewater operations in consideration of pending regulations.

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