NYS CENTER OF EXCELLENCE
HEALTHY WATER
SOLUTIONS

PFAS Research Priorities

New York State Center of Excellence in Healthy Water Solutions

Clarkson University and the State University of New York of
Environmental Science and Forestry

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Discussion Among Experts in New York State

Per and polyfluoroalkyl substances (PFAS) entail thousands of chemicals widely used in consumer and industrial products. With possible human health impacts resulting from even low exposure levels, in 2020 New York State (NYS) established a regulatory limit for PFOA and PFOS of 10 parts per trillion in drinking water. Expanded PFAS monitoring throughout the state in the last several years has detected PFAS widely in ground and surface waters, sometimes above this limit (apps.health.ny.gov/statistics/environmental/public_health_tracking/tracker/index.html#/waterMaps).

PFAS' prevalence and resistance to natural degradation necessitates new methods for removing PFAS from water as well as improving monitoring methods to more quickly and comprehensively characterize PFAS concentrations in the environment.

With PFAS having gained widespread recognition of its prevalence only in the last decade, there is still a need to enhance the network of regulatory, technical, and analytical expertise to address PFAS. The New York State Center of Excellence in Healthy Water Solutions organized a workshop in October 2023 at the Clarkson University Capital Region campus, in Schenectady, NY, to share information, build new connections, and identify priorities for next steps in building capacity to monitor, manage, and remediate PFAS within New York. This paper summarizes presentations and discussions from the approximately 40 workshop participants representing academia, government, and industry.

Monitoring and Assessment

The monitoring and assessment session was anchored by two talks: Dan Rearick from NYS Department of Environmental Conservation (NYSDEC) presented information on the inclusion of PFAS monitoring within the screening network of the Rotating Integrated Basin Studies (RIBS, www.dec.ny.gov/chemical/23848.html#Rotating) over the last two years. To date, this program has monitored ambient surface water for 40 PFAS constituents throughout lakes and streams in six of the seventeen major drainage basins within NYS. Molly Trembley from NYSDEC presented a new project to monitor PFAS in influent, effluent, and biosolids at approximately 90 wastewater treatment plants (WWTP) in New York.

Besides these two monitoring programs, participants also noted on-going monitoring of PFAS in fish by NYSDEC, Clarkson, ESF and other entities in the state. Additionally, there was mention of monitoring being done on multiple water types (well, small streams, tap water) in the Ithaca region by the Damian Helbling's research group at Cornell University.

The presentations initiated a range of discussions. The presentation on WWTP monitoring raised questions on the extent of PFAS contamination in soils due to biosolids application on farm fields (biosolids are solids removed from sewage at WWTPs). The state is waiting for specific US Environmental Protection Agency (EPA) guidance on managing PFAS in biosolids, but there is already testing of PFAS in biosolids at a number of WWTPs. NYSDEC has established different action thresholds for facilities that they are monitoring. If PFAS are found above 50 ppb, the biosolids material is not allowed to be spread and the facility must track down PFAS sources. For concentrations between 10 and 20 ppb, a reduction plan must be developed.

One area of particular discussion centered on the ideal approach for quantifying PFAS in the environment. The current EPA Draft Method (1633) analyzes for 40 constituents. However, there are many thousands of PFAS chemicals. There remains an open question of whether the subset of PFAS chemicals currently analyzed represent the different human health, transport, and degradation characteristics of the full range of different PFAS. There is an option to use broad spectrum analytical techniques such as measuring total organic fluorine or total absorbable fluorine. However, this leads to its own set of drawbacks. Such broad-spectrum methods may detect non-PFAS chemicals that are also fluorine based. Additionally, such monitoring may distract from quantifying specific PFAS constituents of higher concern. There was a general consensus that regulation of a class of chemicals can be much more difficult compared to regulating specific constituents.

Also shared during the session was the value in the perspective that can be gained by looking at other locales dealing with PFAS and other chemicals besides PFAS. Monitoring, treatment, and remediation of PFAS shares similarities with work to address PCBs in water and sediments that has taken place over the past several decades. Additionally, Europe is having ongoing discussion as to the extent that PFAS could be entirely banned in all consumer products and industrial uses. A complete or even partial reduction in PFAS usage could provide an initial indication of how residual levels of PFAS in US waterways may decline if new PFAS use legislation were passed. The debate also gives insights into whether there are viable substitutes for essential applications (i.e. firefighting, semiconductor manufacturing) certain PFAS are used for (Scott, Chemical and Engineering News, V101, Sept. 18 2023, cen.acs.org/policy/chemical-regulation/battle-over-PFAS-Europe/101/i31).

Treatment and Remediation

A treatment and remediation session was covered by two talks. Scott Grieco from Jacobs discussed the current state of PFAS separation technologies, comparing existing technologies (granular activated carbon, reverse osmosis, and ion exchange) to emerging technologies (foam fractionation and the absorbent Fluro-sorb). Thomas Holsen from Clarkson presented on destructive technologies including electrochemical oxidation, sonolysis, supercritical water oxidation, and plasma. For all four processes, several federally funded pilot scale trials are underway, including several by Clarkson faculty. Of note was the complementary nature of separation and destructive technologies. Separation technologies are more appropriate for higher volume, lower concentration treatment. Destructive technologies are more appropriate for lower volume, higher concentration treatment, including residual waste from separation technologies.

Follow-up discussions covered a range of topics.

There was recognition that, aside from EPA-regulated PFAS, practitioners should be aware of unknown PFAS precursors. These transformations of precursors to form PFAS products can complicate the operation and compromise the treatment performance. Thus, besides only monitoring for PFAS, there is a need to include PFAS precursors in surveillance studies and regulate the source discharge accordingly.

In terms of identifying the viability of new treatment technologies, there is a need to benchmark new technologies against existing technologies. No technology works under all conditions so there is a particular need to identify the niche under which a technology may be best suited (i.e. electrochemical oxidation works best in highly conductive solutions and may be appropriate for treating reverse osmosis residual).

In terms of paying for remediation, it would be ideal to follow the "polluter pays principle." However, enforcing that policy requires the assistance of forensic analytical approaches to identify the source. Fast-response real-time screening tools and technologies could be important in doing this forensic work.

In terms of controlling PFAS chemicals before they enter the environment, there was discussion of the need for applying more stringent scrutiny of the environmental implications of new fluorochemical products before they are approved for widespread production. Once PFAS chemicals are in the environment, there could be further prioritization of PFAS with the most significant environmental and health impact.

Priorities

A closing session to the day sought to identify next steps and research priorities moving forward. Several different priority areas emerged:

A. PFAS Sensors: PFAS detection necessitates sending samples for lab analysis. While highly accurate, lab analyses are expensive and can take weeks or longer to complete. Especially for screening purposes, sensors that could be deployed in the field would expand the number of sites at which PFAS could be monitored and the type of time-dependent conditions (i.e. changing stream flow, changing inflow sources). (Menger, et al. Chemical Engineering Journal Volume 417, 1 August 2021, doi.org/10.1016/j.cej.2021.129133.)

B. Standardization of the Data Format Used for Remediation Projects in New York: There are numerous projects underway in New York that entail PFAS treatment or site remediation. However, much of this remediation and treatment work is being done by environmental consultants and not state agencies. Data related to these projects is not immediately publicly available, but it will become public as the data is reported to regulatory agencies such as NYSDEC.

Given that such projects are being carried out by a number of different entities, the data will be in numerous different formats when publicly reported. To allow for the possibility for synthesis and analysis of data across projects, it would be valuable to establish data standardization protocols. This ability to efficiently evaluate data from across projects will allow for more rapid identification of the best practices and approaches to implement.

C. Assessment of Chemicals Before They Go to Market: New fluorinated chemical compounds are continuously being developed. New chemicals that will be processed or manufactured in the United States must be approved and registered within the TSCA Inventory (www.epa.gov/tsca-inventory/about-tsca-chemical-substance-inventory). Preventing toxic chemicals from being manufactured in large quantities would be more favorable than remediating contaminated sites after toxic chemicals are in the environment. There is a need to develop new tools and regulatory guidelines for improved screening of chemicals such that particularly toxic, mobile, and persistent chemicals do not become listed on the TSCA Inventory.

D. PFAS Monitoring of Soils: Within New York, most PFAS monitoring to date has focused on water or animal tissue. Much less monitoring has been done of soils, especially those used for agriculture. Because biosolids from municipal sewage treatment have sometimes been applied to agricultural lands, there is a chance some agricultural areas may have elevated PFAS soil concentrations. States such as Maine have already done more extensive sampling, in some cases finding agricultural land with high PFAS levels (pfas-1.itrcweb.org/wp-content/uploads/2022/10/Biosolids_PFAS_Fact_Sheet_102022_508.pdf).

E. Quantification of Cost-Benefit of Implementing High End Treatment to Avoid Future Upgrades for Yet Unidentified Contaminants: Every several years, the EPA coordinates with water utilities to do limited monitoring of yet unregulated chemicals to identify if there are newly emerging contaminants that may pose risks to human health (i.e. Unregulated Contaminant Monitoring Rule). It is possible that in several years, there may be another new set of contaminants - besides PFAS - that will also require removal from drinking water. Certain treatment processes – such as reverse osmosis – may be expensive but it may also effectively remove a wide range of contaminants, both current and newly emergent in the future. It could be beneficial to carry out a cost-benefit analysis of whether installation of certain treatment processes typically regarded as expensive (i.e. reverse osmosis) may provide expansive protection against any future contaminants and avoid upgrades and further redesign of facilities in the future, all while maximizing the level of water quality right now.

F. Evaluation of Analytical Approaches of Monitoring for PFAS: While PFAS entails an assortment of thousands of chemicals, standard EPA analytical methods characterize at most 40 constituents (EPA Draft Method 1633). Methods to evaluate PFAS chemicals as a class also exist and are being used as screening tools (total organic fluorine and total organic precursors). Evaluating a class of chemicals may avoid missing chemicals not within EPA Draft Method 1633, but it may also exaggerate the hazard or identify non-PFAS chemicals. There should be further consideration of the benefits and limitations of both targeted and screening level analytical methods.

G. Pilot Testing Site in New York: Prior eras of water treatment technology development have benefitted from remediation sites where multiple treatment options could be pilot tested under similar conditions. A long-term Department of Energy clean-up site at Savannah River in Georgia provided this opportunity for a number of decades, but there is less activity at the site now. It may be valuable to develop such a site in New York, to allow side-by-side testing of multiple methods of water treatment or field remediation.

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In 2019 New York State designated Clarkson University and SUNY College of Environmental Science & Forestry (ESF) to co-lead the Center of Excellence (CoE) in Healthy Water Solutions. NYS Centers of Excellence are funded by the New York State Department of Economic Development's Division of Science, Technology, and Innovation (NYSTAR) to foster collaboration between the academic research community and the business sector to develop and commercialize new products and technologies, to promote critical private sector investment in emerging high-technology fields in New York State, and to create and expand technology-related businesses and employment.

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