Introduction

As the PFAS story continues, it is becoming widely recognized that drinking water is not the only source by which humans can be exposed and suffer the effects of harmful contaminants. From its primary sources in fire suppression foams, industrial discharges, and consumer products, PFAS is also widely found in soils, sediments, surface water, groundwater, and wastewater discharges. In this blog, invited guest Dr. Craig Butt, Manager Applied Market, SCIEX, discusses a novel approach to monitoring human exposure to PFAS.

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Using Wastewater Monitoring to Assess Exposure to PFAS

Per-and polyfluorinated alkyl substances (PFAS) are known for their water- and grease-resistant properties, which make them useful in many everyday items. In fact, a study from 2020 estimated over 200 “use categories” covering more than 1,400 individual PFAS compounds in commercial products[1]—they are truly all around us. Due to their extensive presence and potentially harmful effects (these effects are still mostly uncertain), exposure to PFAS is a growing concern. Humans and wildlife have been exposed to these chemicals through a variety of routes, including food packaging, drinking water and cleaning products.[2]

The potential health risks of PFAS chemicals stem from a combination of "exposure" and inherent "toxicity," so it is essential to properly identify and quantify PFAS exposure. So, how do we monitor exposure to contaminants such as PFAS?

Monitoring human exposure to contaminants

When individuals are exposed to PFAS, the PFAS accumulate in protein-rich tissues such as blood, liver and kidneys. For this reason, biological examination of PFAS exposure is often conducted using blood matrices. However, many of the approaches used for this type of examination are difficult to conduct when looking at exposures across a population.[3] For example, obtaining a statistically significant sample size in a moderately sized city or country requires a lot of human samples. These large studies can be difficult to coordinate, not to mention the difficulties involved with handling human samples.

Another option is using environmental matrices to monitor exposure. Wastewater, for instance, can serve as a powerful tool for assessing the chemical use or consumption patterns of a population over time.[4] For many years, wastewater has been used to monitor contaminants such as personal care products and pharmaceuticals (PPCPs) and illegal drugs, and it can also play an important role with PFAS.

Understanding the fate of PFAS through water treatment plants (WTPs) and wastewater treatment plants (WWTPs) can benefit society in addressing PFAS issues.[5] While WTPs and

WWTPs can remove some contaminants, these plants are not designed to break down persistent organic pollutants such as PFAS, which means that they are detected in the final effluent. This, of course, has implications for aquatic toxicity in the receiving sources, but it can also inform us about PFAS exposure trends within the community.

Analyzing PFAS trends using wastewater

In a recent study from the Queensland Alliance for Environmental Health Sciences and its collaborators, scientists accessed a 10-year wastewater archiving program to conduct a temporal analysis of PFAS trends in an urban Australian population between the years 2010 and 2020. Although the results showed a decline in concentrations for most PFAS, the study also observed a shift in the types of PFAS compounds detected. Specifically, the researchers measured greater proportions of shorter chain-length PFAS as well as replacement compounds.[4] These results imply significant shifts in community exposure to PFAS—both the magnitude of exposure and the specific compounds that people were exposed to—which has an impact on the potential human health risk.

Observing these historical trends would have been extremely difficult using traditional exposure techniques such as measuring PFAS serum levels. This study is a useful example of how creative approaches and mass spectrometry can improve our understanding of the human health risk of PFAS.

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