



Per- and polyfluoroalkyl substances (PFAS)—contaminants of emerging concern

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Per- and polyfluoroalkyl substances (PFAS) are a family of persistent organic pollutants of global concern due to correlations between human exposure and adverse health outcomes including organ damage, cancers, decreased fertility, and impacts on the immune system. PFAS are highly fluorinated anthropogenic chemicals first developed in the 1940s during the Manhattan Project to enrich uranium. Due to their unique and highly stable carbon–fluorine bonds, PFAS possess distinct physicochemical properties such as resistance to grease, oil, water, and heat. These characteristics therefore make PFAS intrinsically suited for many household and industrial applications. To date, PFAS have been incorporated into commercial products including non-stick cookware, food packaging, stain- and water-resistant fabrics, carpeting, cleaning products, paints, and firefighting foams, just to name a few. However, over the last 50 years and mainly the last decade, increasing concerns pertaining to PFAS persistence in both the environment and human body have arisen. For example, some legacy PFAS have even been detected in samples from the 1950s, showing they are still present 70 years later. Additionally, current estimates suggest many PFAS have half-lives of years in the human body, which is greatly concerning for both the bioaccumulation and biomagnification of the whole family of molecules. PFAS are also readily found in drinking water and many food products, and their detection in the blood of >98% of

humans studied for their presence is alarming. While the production of legacy PFAS such as perfluorooctanoic acid (PFOA) and perfluorooctane sulfonic acid (PFOS) has been discontinued in certain parts of the world, their replacement species, termed emerging PFAS, are currently being synthesized to be less bioaccumulative yet still provide the desired characteristics necessary in many applications. While it was hoped that adding an ether linkage or other chemical modifications would make the replacements more degradable, recent publications have shown that this is not the case. GenX, for example, is as equally persistent as PFOA and PFOS under very harsh oxidizing conditions. Additionally, the toxicity of these emerging species is still vastly unknown, so improved analytical evaluations and monitoring capabilities are essential to determine their effects on the environment and human health. Furthermore, PFOA, PFOS, and many other legacy PFAS are routinely detected in human blood and the environment due to their chemical persistence, so these legacy PFAS must also be evaluated alongside the emerging species. The simultaneous detection of both emerging and legacy PFAS however causes challenges and is driving many current analytical developments.

To date, the Environmental Protection Agency (EPA) has estimated over 9000 different PFAS exist including the parent PFAS and their metabolic and degradation products. Therefore, over the last decade, concerns about the numerous PFAS species and adverse human health connections have continued to mount. Recently movies such as *The Devil We Know* and *Dark Waters* have brought the history of PFAS and their toxic attributes to the forefront of public awareness. Furthermore, in October 2021, both John Oliver and Trevor Noah had special segments highlighting PFAS presence and related health effects. We feel these broadcasts are essential to continue educating both the scientific community and the general public of the PFAS epidemic and corrective measures needed at both the state and federal level. We therefore determined that it was imperative to assemble this PFAS topical collection to be a critical resource as

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the field continues its forward momentum. Specifically, the articles included in this topical collection detail evolving and innovative analysis strategies for PFAS assessments and range from PFAS detection in processed foods, dairy milk, and human plasma to novel instrumental platforms and data analysis tools for the assessment of unknown PFAS. We believe this topical collection highlights the current state of the field and showcases certain directions that PFAS research must continue towards to advance our knowledge of PFAS toxicity, persistence, and remediation for both the legacy and emerging species.

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