Per- and Polyfluoroalkyl Substances (PFAS) Fact Sheets

1 Introduction

The Interstate Technology and Regulatory Council (ITRC) has developed six fact sheets to summarize the latest science and emerging technologies for per- and polyfluoroalkyl substances (PFAS). The fact sheets are tailored to the needs of state regulatory program personnel who are tasked with making informed and timely decisions regarding PFAS-impacted sites. The content is also useful to consultants and parties responsible for the release of these contaminants, as well as public and tribal stakeholders. The fact sheets in the series are:

1. Naming Conventions and Physical and Chemical Properties
2. Regulations, Guidance, and Advisories
3. History and Use
4. Environmental Fate and Transport
5. Site Characterization Tools, Sampling Techniques, and Laboratory Analytical Methods
6. Remediation Technologies and Methods.

Information about each fact sheet is included in this document.

1.1 What are PFAS?

PFAS are a complex family of more than 3,000 manmade fluorinated organic chemicals (Wang et al. 2017), although not all are in current use or production. PFAS include both per- and polyfluorinated chemicals. Perfluorinated chemicals, such as perfluorooctanoate (PFOA) and perfluorooctane sulfonate (PFOS), are a subset of PFAS with carbon chain atoms that are totally fluorinated, while polyfluorinated chemicals have at least one carbon chain atom that is not totally fluorinated (Buck et al. 2011). Due to unique physical and chemical properties (for example, surfactant, oil-repelling, water-repelling), PFAS have been extensively manufactured and used worldwide. Some PFAS are environmentally stable, mobile, persistent, and bioaccumulative.

1.2 Why are PFAS Important?

The scientific community is rapidly recognizing and evolving its understanding of PFAS in the environment. PFAS in the environment are considered to be contaminants of emerging concern (CECs). CECs are those chemicals that present known or potentially unacceptable human health effects or environmental risks, and either: (1) do not have regulatory cleanup standards, or (2) regulatory standards are evolving due to new science, detection capabilities or pathways, or both (USDOD 2009).

PFAS are found globally in both remote and urban environments, and some PFAS are present in various matrices including human blood (whole, plasma, and serum), sediments, surface and groundwater, and wildlife (Kannan et al. 2004; Yamashita et al. 2005; Higgins et al. 2005; Rankin et al. 2016). There is evidence there may be health effects associated with exposure to some PFAS (USEPA 2016b, c). In May 2016, USEPA issued Lifetime Health Advisories (LHAs) for two of the most widely detected perfluoroalkyl acids (PFAAs); PFOA and PFOS, of 70 nanograms per liter (ng/L, equivalent to parts per trillion [ppt]) in drinking water for each substance, as well as when combined. In addition, several states have set guidance values for additional PFAAs.

2 Fact Sheet Overviews

The following sections briefly describe the fact sheets included in this series. They will be available for download from the ITRC web site.

2.1 Naming Conventions and Physical and Chemical Properties

The naming conventions for the many, varied PFAS are complicated and have changed over time as more information has become available. It is important to have an up-to-date summary of the terminology, names, and acronyms for PFAS. This fact sheet focuses on the names of the PFAS most commonly found in the environment, provides an overview of known physical and chemical properties, and current data gaps for PFAS properties.

2.2 Regulations, Guidance, and Advisories

Important regulations and advisories for PFAS in the environment have been recently released by USEPA and several states, although these are likely to expand and change as more information becomes available. This fact sheet

provides a brief overview of the existing regulatory and guidance values. The fact sheet describes the primary state and U.S. programs used to regulate PFAS, summarizes current values for groundwater, drinking water, surface water/effluent, and soil, and discusses the basis for differences in various federal and state drinking water criteria for PFOA and PFOS.

2.3 History and Use

The fact sheet provides a brief history of the discovery and development of PFAS, their subsequent detection in the environment, emerging concerns of potential adverse human health effects, and efforts to reduce their use or develop less toxic replacement formulations. It also describes the sources of PFAS in the environment and the specific contaminants likely associated with those sources.

2.4 Environmental Fate and Transport

The fate and transport of PFAS are complicated by the number and diversity of substances involved, their frequent occurrence as mixtures, and by the variety of PFAS source materials. This fact sheet describes key processes associated with four of the most common PFAS sources: fire training/fire response sites, industrial sites, landfills, and wastewater treatment plants/biosolids. The processes described are partitioning, transport in air and water, and both abiotic and biotic transformations. The fact sheet also summarizes PFAS occurrences in air, surface water, groundwater, soil/sediment, and biota (plants, invertebrates, fish, and humans), and identifies the processes that influence the concentrations found in each of these media.

2.5 Site Characterization Tools, Sampling Techniques, and Laboratory Analytical Methods

PFAS contamination poses several unique site characterization and analytical challenges because very low concentrations of several different substances must be sampled and analyzed, and these substances often occur in complex mixtures that can change over time. This fact sheet describes the characterization tools, sampling techniques, and analytical methods that are special or unique to PFAS, many of which have been developed only recently.

2.6 Remediation Technologies and Methods

PFAS are very resistant to destructive treatment technologies and can be expensive to remove using existing technologies. Several innovative technologies for PFAS removal and treatment have been recently commercialized, while others are under development. This fact sheet provides an overview of the technologies and methods currently available for both soil and water treatment, and also identifies and describes the general treatment processes under development. Challenges and limitations are discussed for each process.

3 Supporting Information

The ITRC PFAS web page includes lists of acronyms and combined references for the fact sheets. Supplementary information for some of the fact sheets is also available, as Microsoft Excel files. These tables will be updated periodically as new information is gathered. The fact sheet user is encouraged to visit the ITRC PFAS web page to access current versions of the tables.

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