

The topic of “Perfluorinated Chemicals” (PFCs) has appeared with increasing frequency in popular news articles as well as research publications, particularly in the fields of environmental sciences and toxicology. Indeed, before the turn of the century, there were fewer than 300 research papers devoted to this subject; since then, well over 3,000 papers have been published on these chemicals, describing their worldwide detection in various environmental media, human populations and wildlife animals, their toxicological characteristics and mechanisms of toxicity, as well as their human and ecological health risks. In fact, several reviews have appeared periodically describing interim progress in specific areas of research (e.g., Kennedy et al., 2004; Lau et al., 2004; 2007; Houde et al., 2006; 2011; Kovarova and Svobodova, 2008; Suji et al., 2009; Olsen et al., 2009; Giesy et al., 2010; D’Hollander et al., 2010; Lindstrom et al., 2011; Giesy et al., 2010; Young and Mabury, 2010; Lau 2012; DeWitt et al., 2012; Post et al., 2012; Butt et al., 2014; Ahrens and Bundschuh, 2014). This volume summarizes our current understanding of the adverse health effects of this interesting group of chemicals. Many aspects of PFCs are described in detail, ranging from chemical detection to exposure assessment, from pharmacokinetics to toxicity characterization and associated modes of action, from epidemiological surveys to health risk assessment, and from description of emerging replacement compounds to discussion of research needs in the future. The goal of this introductory chapter is to provide a brief overview of these aspects, highlighting the salient features of historical discoveries about these chemicals and contemporary progress that has enhanced our knowledge base. It is strongly recommended that readers consult individual chapters for in-depth discussions of specific topics of interest covered in this volume.

So, what are these perfluorinated chemicals and why have they drawn such immense interest for investigation? Buck et al. (2011) have published an excellent review on the terminology, classification and origins of these chemicals, and only a brief description is provided here. By definition, perfluorinated chemicals are organic compounds where every hydrogen atom bonded with a carbon atom on the alkane backbone is replaced by a fluorine atom. They may include perfluoroalkanes, perfluoroalkyl acids (PFAAs) and their precursors, and a number of surfactants and fluoropolymers. Perfluoroalkanes are a unique group of chemicals used primarily for clinical purposes in oxygenation and respiratory ventilation, but are not a subject for discussion in this volume. Perfluoroalkyl acids found in the environment are compounds with a perfluoroalkyl backbone (typically with carbon-chain lengths ranging from 4 to 14) attached to a functional group. These chemicals are largely man-made, as naturally occurring perfluorinated organic chemicals are rare (Key et al., 1997). To date, three groups of PFAAs have been identified: perfluoroalkyl sulfonates (PFSAs), perfluorocarboxylates (PFCAs) and perfluoroalkyl phosphonates or phosphinates (PFPA). While the first two groups have been detected ubiquitously since the early 2000s, the presence of PFPA was first reported by D'eon et al. (2009) in Canadian surface waters and waste water treatment plants, and subsequently by Busch et al. (2010) in landfill leachates in Germany, Esparza et al. (2011) in water and sludge in the Netherlands, and Liu et al. (2013) in sewage sludge in China, suggesting their wide distribution, similar to that seen with PFSAs and PFCAs. Little is known about the toxicity of PFPA except their pharmacokinetic profiles in the rat (D'eon and Mabury, 2010) and a preliminary report on their developmental toxicity in mice (Tatum-Gibbs et al., 2010). Thus,