

In this issue of PFAS Alerts...

There were numerous scientific publications and regulatory developments on PFASs to kick off the new year. More than 50 citations with abbreviated abstracts are in this issue, grouped by selected topic areas. The most notable developments are listed in the *Special Highlights* section.

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Special Highlights

- **Review paper highlights plausible mechanisms of toxicity of PFCA precursors and metabolites.** Rand and Mabury (2017) summarize the toxicity of FT-based substances and their bioactive intermediate metabolites. These substances are known to biotransform into PFCAs, but their toxicity and the extent to which they contribute indirectly to PFCA risk remains uncertain. This paper summarizes the state of the science and evaluates covalent bonding to biological nucleophiles (e.g., glutathione, proteins, and DNA) as a possible mechanism of toxicity.
- **Canada study shows weak correlation between maternal PFAS exposure and biomarkers of effect in newborns.** Ashely-Martin et al. (2017) performed an analysis of data from a 2008-2011 trans-Canada cohort study of 1,705 mother-infant pairs (the Maternal Infant Research on Environmental Chemicals [MIREC] Study). They found that maternal plasma PFAS concentrations were not associated with cord blood concentrations of leptin and adiponectin, which are indicators of metabolic function. A small but statistically insignificant negative relationship was observed between maternal plasma PFAS and birth weight.
- **Italy publishes screening levels accounting for ecorisk and human fish consumption pathway.** Scientists from the Italian National Research Council Water Research Institute (IRSA-CNR) and the Italian Ministry of the Environment, Land, and Sea published environmental quality standards (EQSs) for PFOA, PFBA, PFPeA, PFHxA, and PFBS (Valsecchi et al. 2017). EQSs were derived for different protection objectives such as direct ecological exposure, predator exposure via the food web, and human health via consumption of both fish and water. The final EQS for each PFAA is based on the lowest (i.e., most stringent) value. The final EQS for PFOA of 0.1 µg/L (or 100 ppt) is based on secondary poisoning of ecological predators in a freshwater ecosystem. EQSs for PFBA, PFPeA, PFHxA and PFBS of 7, 3, 1, and 3 µg/L, respectively, are based on drinking water consumption.

- **Cancer is not the key human health endpoint for PFOS - further support from researchers in Mexico.** Arrieta-Cortes et al. (2017) applied WHO's IARC process to evaluate carcinogenic risks of PFOS. They determined that there is inadequate evidence of PFOS carcinogenicity in both human and laboratory animal studies. They classified PFOS as a Group 3 chemical—not classifiable as carcinogenic to humans.
- **Evidence that 10:2 FTOH can be a source of PFCAs including PFOA and PFNA.** Zhao and Zhu (2017) investigated 10:2 FTOH degradation in soil, as well as uptake and metabolism in earthworms and wheat. They determined that several PFCAs are degradation products of 10:2 FTOH, including PFOA, PFNA, and PFDA. 10:2 FTOH was taken up by both the earthworms and wheat plants, where it was metabolized into PFPeA, PFHxA, PFUnDA, and PFDA.
- **NSF-funded research points to landfill leachate as a source of PFAS in U.S.** Lang et al. (2017) from NC State and Oregon State universities collected landfill leachate from 18 landfills across the U.S. in 2013. Variability in PFAS concentrations was correlated more strongly with climate (rainfall) than age of waste, though both PFNA and PFBS were elevated in younger waste.

Policy and Regulation

- **EPA Administrator Nominee Pruitt Mentions PFOA as a Priority during Confirmation Hearing**

During his January 18 confirmation hearing before the Senate Environmental and Public Works Committee, President Trump's nominee for EPA administrator, Scott Pruitt, stated that managing PFOA would be a priority under both the amended Toxic Substances Control Act and Safe Drinking Water Act. These statements resulted from a line of questions from Sen. Kirsten Gillibrand (D-NY) who pressed the nominee to commit to addressing the chemical. Pruitt did not provide specifics on how EPA would regulate PFOA, but stated that EPA would

collaborate with state and local governments. Pruitt suggested that small and disadvantaged communities utilize a grant program recently authorized by Congress to test for unregulated contaminants.

- **EPA Region 3 Amends the Drinking Water Order for the Former DuPont Facility in West Virginia**

In response to the EPA Office of Water's issuance of a lifetime health advisory for PFOA and PFOS of 70 ppt in 2016, EPA Region 3 amended the drinking water order for the former DuPont facility in West Virginia, lowering the trigger for when residents living near the facility must be provided with alternative sources of drinking water, and expanding the geographical area covered by the order. The amendment also added The Chemours Company to the order.

- **California Proposes New Regulations for Risk Assessments and Setting Remedial Goals**

California DTSC solicited comments through January 31 on revisions to its Human Health Toxicity Criteria for Site Cleanup that will have significant impact on chemical risk assessment at cleanup programs throughout the state. The new regulation will add text to the [CA Code of Regulations Title 22, Division 4.5, Environmental Health Standards for the Management of Hazardous Waste](#) and require (1) the point of departure for determining the screening or action level and associated remediation goals will be at the cancer risk at the 1×10^{-6} level, or noncancer cumulative hazard index of 1.0, for all COCs, across all pathways, and regardless of target organ; and (2) toxicity criteria shall be selected based on the most protective (i.e., most stringent) value available, regardless of source.

These changes ignore the risk management range for assessing cancer risk, and increase the conservative assumptions of additivity for all

noncancer risk calculations, disregarding the current standard of practice and guidance that requires consideration of common target organ(s) as a trigger for potential additivity. In addition, the selection of toxicity criteria based solely on stringency of the value ignores the toxicity criteria hierarchy and EPA directives and guidance on using the best science and most recent data.

- **New Hampshire Introduces House Bill Requiring Department of Environmental Services to Use Exposure Scenarios for Children to Determine Criteria for Emerging Contaminants in Drinking Water**

Representatives of the New Hampshire Senate and House of Representatives introduced [House Bill 485](#), which, if signed into law, will require the Department of Environmental Services to use conservative exposure scenarios for children and other “vulnerable populations” when determining criteria for emerging contaminants in drinking water. The stated objective is to focus on the “most conservative approach” for emerging contaminant criteria in drinking water.

- **Deriving Environmental Quality Standards for PFOA and Related Short Chain PFAAs**

S Valsecchi, D Conti, R Crebelli, S Polesello...; [J. Hazard. Mater., 2017](#)

The evidence that in Northern Italy significant sources of PFAA are present induced the Italian government to establish a Working Group on Environmental Quality Standard (EQS) for PFAA in order to include some of them in the list of national...

- **Carcinogenic Risk of Emerging Persistent Organic Pollutant PFOS: A Proposal of Classification**

R Arrieta-Cortes, P Farias, C Hoyo-Vadillo... ; [Regul. Toxicol. Pharmacol., 2017](#)

PFASs are stable synthetic chemicals, able to repel oils, fats, and water. These compounds have been used in the manufacturing of products such as Teflon®, lubricants, paints, fire-fighting foams, coatings for pans, carpets, clothes, and paperboard for... There is inadequate evidence of PFOS carcinogenicity in both human and laboratory animal studies.

Environmental Sources – Landfills and WWTPs

National Estimate of PFAS Release to US Municipal Landfill Leachate

JR Lang, BMK Allred, JA Field, JW Levis, MA Barlaz; [Environ. Sci. Technol., 2017](#)

The concentrations of 70 PFASs in 95 samples of leachate were measured in a survey of US landfills of varying climates and waste ages. National release of PFASs was estimated by coupling measured concentrations for the 19 PFASs where more than 50% of samples had quantifiable concentrations, with climate-specific estimates of annual leachate volumes. There were six PFASs that demonstrated significantly higher concentrations in leachate from younger waste compared to older waste, while no PFAS demonstrated significant variation with climate.

PFASs in Northern Spain Municipal Solid Waste Landfill Leachates

I Fuertes, S Gómez-Lavín, MP Elizalde, A Urtiaga; [Chemosphere, 2017](#)

This study presents data on the occurrence and concentration of 11 PFCAs and 5 PFASs in leachates from 4 municipal solid waste landfill sites located across northern Spain. PFCAs accounted for the majority of the detected PFASs and PFOA was the dominant compound in raw leachates (42.6%), followed by shorter chain PFHxA (30.1%), PFPeA and PFBA. Total PFAS increased following on-site treatment using

membrane bioreactors, possibly due to degradation of precursors and FTOHs.

Updated National Emission of PFASs from WWTPs in South Korea

HO Kwon, HY Kim, YM Park, KS Seok, JE Oh, SD Choi; [Environ. Pollut., 2017](#)

Measurements of PFAS in sludge from 81 wastewater treatment plants were used to estimate nationwide PFAS emissions. Monte Carlo simulations suggested that the realistic national emission of Σ_{13} PFASs is between 2 ton/y and 20 ton/y.

Mass Flows and Fate of PFASs in the WWTP of a Fluorochemical Manufacturing Facility

X Dauchy, V Boiteux, C Bach, A Colin, J Hemard...; [Sci. Tot. Environ., 2017](#)

This study entailed measuring concentrations, mass flows and the fate of 51 PFASs in an industrial wastewater treatment plant receiving raw effluents from a fluorochemical manufacturing facility. The overall PFCA mass flow ranged from 0.6 to 8.6 g/day and was negligible compared to the overall mass flow of FTs (from 647 to 2,892 g/day). Despite analyzing dozens of PFASs, adsorbable organic fluorine determination and oxidative conversion of PFCA precursors showed that a significant part of PFASs remained unidentified.

Fate and Transport

Adsorption of PFOS on Soils: Effects of Soil Characteristics and Phosphate Competition

J Qian, M Shen, P Wang, C Wang, J Hou, Y Ao, J Liu...; [Chemosphere, 2017](#)

In this study, the effects of soil characteristics and phosphate competition on the adsorption of PFOS on soils were investigated. Results from batch sorption experiments showed that a high amount of SOM in soil can increase the sorption affinity of PFOS on soils and that a greater amount of ferric oxides can reduce it.

Using Hydrodynamic Model to Predict PFOS and PFOA Transport in the Daling River and Its Tributary, a Heavily Polluted River into the Bohai Sea, China

Q Li, T Wang, Z Zhu, J Meng, P Wang...; [Chemosphere, 2017](#)

The objective of this study was to investigate the seasonal changes, fate and transport modeling of PFOS and PFOA concentrations using one-dimensional DHI MIKE-11 river model. Results indicate that PFOS and PFOA in the downstream of the Daling River are unlikely to reach a harmful level with the current load.

Environmental Occurrence of PFAAs and Novel Fluorotelomer Surfactants in the Freshwater Fish *Catostomus commersonii* and Sediments Following Firefighting Foam Deployment at the Lac-Mégantic Railway Accident

G Munoz, M Desrosiers, SV Duy, P Labadie...; [Environ. Sci. Technol., 2017](#)

On July 6, 2013, an unmanned train laden with almost 8 million liters of crude oil careened off the rails in downtown Lac-Mégantic (Québec, Canada). In the aftermath of the derailment accident, the emergency response entailed the deployment of 33,000 L of AFFF. This study examines the environmental occurrence of perfluoroalkyl acids (PFAAs) and newly identified per and polyfluoroalkyl substances (PFASs) in the benthic fish white sucker (*Catostomus commersonii*) and sediments from Lake Mégantic and Chaudière River.

BFRs and PFAAs in Groundwater, Tile Drainage, Soil, and Crop Grain Following a High Application of Municipal Biosolids to a Field

N Gottschall, E Topp, M Edwards, M Payne...; [Sci. Tot. Environ., 2017](#)

Dewatered municipal biosolids (DMB) were applied at a rate of 22 Mgdwha⁻¹ to an agricultural field in fall 2008. Concentrations of

polybrominated diphenyl ethers, other brominated flame retardants and PFAAs were monitored in tile drainage, groundwater, soil cores pre- and post-application, DMB aggregates incorporated into the soil post-application, and in wheat (*Triticum* spp.) planted post-application.

Predicting the Phase Behavior of Fluorinated Organic Molecules using the GC-SAFT-VR Equation of State

JD Haley, C McCabe; [Fluid Phase Equilibria, 2017](#)

The GC-SAFT-VR (group combination- statistical associating fluid theory-variable range) is used to describe the phase behavior of pure associating and non-associating fluids and their mixtures, with a minimal reliance on fitting the model parameters to experimental data. This study reports model parameters for the CF₃, CF₂, CF, CH₂F, CHF₂, and CHF functional groups and their cross interactions. Theoretical predictions are compared with experimental data for pure PFAs, PFAAs, and hydrofluoroethers, as well as binary mixtures of alkanes, alkenes, PFAs, PFAAs, and CO₂ in order to test the transferability of the new group parameters. The GC-SAFT-VR approach is found to accurately predict the phase behavior of the systems studied.

Monitoring – Environment

PFAAs in the Water Cycle from a Freshwater River Basin to Coastal Waters in Eastern China

X Zhu, L Jin, J Yang, J Wu, B Zhang, X Zhang, N Yu...; [Chemosphere, 2017](#)

This study investigated the occurrence of 12 PFAAs through a water cycle from the Huai River Basin to the Yellow Sea, including confined aquifers, unconfined aquifers, rivers, and coastal waters. PFAAs were detected in all types of samples, including those from confined

aquifers (2.7-6.8 ng/L). PFOS and PFOA were the major PFAAs in all samples, accounting for an average of 49.1% (0.8-84.8%) and 33.3% (6.3-92.2%) of total PFAAs, respectively.

Distribution of PFCs in Osaka Bay and Coastal Waters of Western Japan

VP Beškoski, K Yamamoto, A Yamamoto, H Okamura...; [Chemosphere, 2017](#)

PFAAs including PFSA and PFCAs were analyzed in sediment samples taken from Ajifu Waterway in Osaka city, from Osaka Bay, and from Kagoshima Bay, as well as in fifteen seawater samples collected from Osaka Bay and coastal waters of Western Japan. In all sediment samples, only PFCAs were detected, and the highest concentration was determined in Ajifu Waterway, where ΣPFAA was 58,990 ng kg⁻¹ dry weight.

Uptake and Metabolism of 10:2 Fluorotelomer Alcohol in Soil-Earthworm (*Eisenia fetida*) and Soil-Wheat (*Triticum aestivum* L.) Systems

S Zhao, L Zhu; [Environ. Pollut., 2017](#)

The behavior of 10:2 fluorotelomer alcohol (10:2 FTOH) in the systems of soil-earthworm (*Eisenia fetida*), soil-wheat (*Triticum aestivum* L.) and soil-earthworm-wheat, including degradation in soil, uptake and metabolism in wheat and earthworms were investigated. Several PFCAs as degradation products of 10:2 FTOH were identified in the soil, plant and earthworms. 10:2 FTOH could be biodegraded to PFOA, PFNA and PFDA in soil in the absence or presence of wheat/earthworms, and PFDA was the predominant metabolite.

Monitoring – Biomonitoring

Temporal Trends of PFASs, PFCAs, and Selected Precursors in Australian Serum from 2002 to 2013

U Eriksson, JF Mueller, LML Toms, P Hobson...; [Environ. Pollut., 2017](#)

In this study, pooled serum samples from Australia collected in 2002-2013 were analyzed for PFASs according to gender and age in total 54 pooled samples and 4,920 individuals. Changes in manufacturing processes were reflected in the temporal time trends, and differences in bioaccumulation potential between homologues could be associated with age trends.

A Sensitive and Accurate Method for the Determination of PFASs in Human Serum using a High Performance Liquid Chromatography-Online Solid Phase Extraction-Tandem Mass Spectrometry

CH Yu, B Patel, M Palencia, ZT Fan; [J. Chromatography, 2017](#)

A selective, sensitive, and accurate method has been developed for measuring PFASs in serum. LODs were <0.01 ng/mL, 5× more sensitive than previously published methods. pH levels in the mobile phase were found to be critical for peak retention, separation, and resolution.

Analysis of PFCs in Human Serum from the General Population in Shanghai by Liquid Chromatography-tandem Mass Spectrometry (LC-MS/MS)

M Wu, R Sun, M Wang, H Liang, S Ma, T Han, X Xia...; [Chemosphere, 2017](#)

Human serum samples collected from Jiading District, Shanghai adults ages 23 to 87 years old (12 male and 33 female) were analyzed for 17 PFCs. A novel method for the elimination of background contamination of PFOA generated from instrument by the modification of high performance liquid chromatography-tandem

mass spectrometry (HPLC-MS/MS) was developed and validated.

Contaminants of Emerging Concern in Caspian Tern Compared to Herring Gull Eggs from Michigan Colonies in the Great Lakes of North America

G Su, RJ Letcher, JN Moore, LL Williams, KA Grasman; [Environ. Pollut., 2017](#)

Eighty-seven contaminants of emerging concern, including 4 PFASs, 13 PFCAs and 5 emerging PFAAs or precursors were analyzed in Great Lakes Caspian tern eggs.

Treatment – Drinking Water

Human Health Screening and Public Health Significance of Contaminants of Emerging Concern Detected in Public Water Supplies

R Benson, OD Conerly, W Sander, AL Batt, JS Boone...; [Sci. Tot. Environ., 2017](#)

Co-authored by USEPA and USGS. The source water and treated drinking water from twenty five DWTPs across the United States were sampled in 2010-2012. Samples were analyzed for 247 contaminants using 15 chemical and microbiological methods. The margin of exposure (MOE) was calculated from the ratio of the DWEL (calculated as the toxicity value—NOAEL, BMDL, or LOAEL—times 80 kg body weight divided by 2.4 L/day water ingestion rate) divided by the measured drinking water concentration. While PFAS was measured, the analysis of the human health significance of exposure to PFAS will be reported in a future publication.

Superhigh Adsorption of PFOS on Aminated Polyacrylonitrile Fibers with the Assistance of Air Bubbles

P Meng, S Deng, B Wang, J Huang, Y Wang, G Yu; [Chem. Engineer. J., 2017](#)

This study proposes that air bubbles originally existing in solution or being formed during

shaking play an important role in the adsorption of PFOS on aminated polyacrylonitrile fibers, which are hydrophilic adsorbents. The contribution of air bubbles to PFOS adsorption increases with the decrease of initial PFOS concentrations and the increase of solution pH.

Recovery of PFOS and PFOA from Dilute Water Solution by Foam Flotation

YC Lee, PY Wang, SL Lo, CP Huang; [Separation Purification Technol., 2017](#)

The separation and recovery of surfactants, namely, PFOS and PFOA was conducted using foam flotation process aided by metallic activators, including Al (III), Fe (III), La (III), Ca (II), Fe (II), and K (I). These activators enhanced the foam separation. Removal efficiency was 99% using 11.5 mM of Fe(III) in 5 min.

Removal of PFOS by a Gravity-Driven Membrane: Filtration Performance and Regeneration Behavior

H Guo, J Wang, Y Han, Y Feng, K Shih, CY Tang; [Separation Purification Technol., 2017](#)

A gravity-driven filtration using a highly porous nanofibrous membrane was systematically investigated for PFOS removal. The best removal efficiency was obtained at pH 4 and 10 mM ionic strength as a result of the enhanced PFOS-membrane electrostatic attraction and/or weakened electrostatic repulsion.

Remediation – In Situ

Sorbent Amendment as a Remediation Strategy to Reduce PFAS Mobility and Leaching in a Contaminated Sandy Soil from a Norwegian Firefighting Training Facility

SE Hale, HPH Arp, GA Slinde, EJ Wade, K Bjørseth...; [Chemosphere, 2017](#)

PFOS up to 2,600 µg/kg was measured in soil. Sorbent amendment was tested using activated carbon (AC), montmorillonite, and compost soil. PFOS was immobilized in soil following sorbent

amendment. PFOS leaching was reduced by 99% for AC and 35% for montmorillonite and compost soil. Sorbent + soil-water partitioning coefficients for AC were estimated as 16,940 L/kg.

Plasma-based Water Treatment: Efficient Transformation of PFASs in Prepared Solutions and Contaminated Groundwater

GR Stratton, F Dai, CL Bellona, TM Holsen...; [Environ. Sci. Technol., 2017](#)

A process based on electrical discharge plasma was tested for the transformation of PFOA... adapted for two cases, high removal rate and high removal efficiency. During a 30 min treatment, the PFOA in 1.4 L of aqueous solutions was reduced by 90% with the high rate process (76.5 W input power) and 25% with the high efficiency process (4.1 W input power). Using groundwater samples, we also demonstrate that the process was not significantly affected by cocontaminants and that the process was capable of rapidly degrading PFOS. Preliminary investigation into the byproducts showed that only about 10% of PFOA and PFOS is converted into shorter-chain PFAAs.

Detailed NMR Investigation of Cyclodextrin-Perfluorinated Surfactant Interactions in Aqueous Media

MJ Weiss, KE O'Shea; [J. Hazard. Mater., 2017](#)

To assess the potential application of α -, β -, and γ -cyclodextrins for PFC remediation, we investigated their complexation with linear fluorinated carboxylic acids, sulfonates, and a sulfonamide with carbon backbones ranging from C4-C9. The strong encapsulation of PFCs by β -CD under a variety of water quality conditions demonstrates the tremendous potential of CD-based materials for the environmental remediation of PFCs.

Forensic Chemistry – Fingerprinting

Spatial Distribution and Source Tracing of PFASs in Surface Water in Northern Europe
MA Nguyen, K Wiberg, E Ribeli, S Josefsson, M Futter...; [Environ. Pollut., 2017](#)

The impact of point and diffuse sources for 26 PFASs in northern Europe were investigated by studying Swedish rivers (n= 40) and recipient seawater (Baltic Sea and Kattegat; n= 18). Different composition profiles were observed in the rivers, with ten rivers having a remarkably high fraction of perfluoroalkane sulfonic acids (PFASs; 65% of the ΣPFASs) as compared to other rivers (19%) suggesting major impact of one or several source types dominated by PFASs. Multiple regression analysis suggests the presence of mechanisms promoting higher prevalence of longer chained PFCAs in the north, e.g., precursor degradation, and/or aerosol associated stabilization of PFCAs and their precursors.

Analytical Chemistry

Novel PFCs Identified Using High Resolution Mass Spectrometry Downstream of Manufacturing Facilities near Decatur, Alabama

S Newton, R McMahan, JA Stoeckel, M Chislock...; [Environ. Sci. Technol., 2017](#)

High resolution mass spectrometry was used to investigate the occurrence and identity of replacement fluorinated compounds in surface water and sediment of the Tennessee River near Decatur, Alabama. Analysis of legacy PFASs revealed a marked increase in concentrations downstream of manufacturing facilities, with the most abundant compounds being PFOS, PFBS) and PFOA as high as 220 ng L⁻¹, 160 ng L⁻¹, and 120 ng L⁻¹, respectively. A series of nine polyfluorinated carboxylic acids was discovered, each differing by CF₂CH₂.

Analysis of PFASs in Serum and Plasma by Solvent Precipitation-isotope Dilution-direct Injection-LC/MS/MS

LM Harrington; [Anal. Methods, 2017](#)

A validated liquid chromatography tandem mass spectrometry (LC/MS/MS) method is presented for the analysis of PFASs in serum and plasma. The method employs stable-isotope labeled internal standard (IS) and surrogate recover standard (SRS) spiked serum or plasma samples that are mixed and precipitated with acetonitrile.

Stable Isotope Labeling Assisted Liquid Chromatography-tandem Mass Spectrometry for the Analysis of PFCAs in Serum Samples

S Zhang, Z Ji, Z Sun, M Li, C Sheng, M Yue, Y Yu...; [Talanta, 2017](#)

A new stable isotope labeling (SIL) reagent pair, 10-methyl-acridone-2-sulfonylhydrazide (MASH) and its deuterated counterpart d 3-MASH was synthesized and successfully applied to the analysis of PFCAs in serum samples.

A Robust Method for Routine Analysis of PFOS and PFHxS in Various Edible Crop Matrices

L Xiang, TF Sun, L Chen, T Xiao, QY Cai, H Li...; [Fd. Anal. Methods, 2017](#)

A reliable, sensitive, and efficient method was developed for routine analysis of PFOS and PFHxS in various edible crop matrices including cereal (grain), root vegetables (carrot), leafy vegetables (lettuce), and melon vegetables (pumpkin). The target analytes were extracted by ion-pair approach followed by solid-phase extraction clean-up and HPLC-MS/MS. The type of extraction solvent, clean-up cartridge, and the usage of Supelclean graphitized carbon were evaluated to reach an optimized pretreatment procedure.

Ecotoxicology

Aquatic Concentrations of Chemical Analytes Compared to Ecotoxicity Estimates

MS Kostich, RW Flick, AL Batt, HE Mash, JS Boone...; [Sci. Tot. Environ., 2017](#)

Co-authored by USEPA and USGS, this study provides screening level estimates of potential aquatic toxicity posed by 227 chemical analytes that were measured in 25 ambient water samples collected as part of a joint USGS/USEPA drinking water plant study. PFBS, PFHpA, PFHxA, and PFNA were among the more commonly detected organic compounds (n=24 of 25). Toxicity values were estimated using USEPA Ecotox database and EpiSuite, and results are reported in the [supplemental appendix](#).

Multi-generational Xenoestrogenic Effects of PFAAs Mixture on *Oryzias latipes* Using a Flow-Through Exposure System

JW Lee, JW Lee, YJ Shin, JE Kim, TK Ryu, J Ryu, J Lee...; [Chemosphere, 2017](#)

To elucidate the multi-generational estrogenic potential of PFAAs mixture, authors investigated vitellogenin (VTG) expression, growth indices, histological alteration, fecundity, hatching rate, larval survival rate, and sex ratio of Japanese medaka (*Oryzias latipes*) by exposing the fish to a mixture of PFOS, PFOA, PFBS, and PFNA for three generations (238 days).

Ecological Effect and Risk Towards Aquatic Plants Induced by PFASs: Bridging Natural to Culturing Flora

Y Zhou, T Wang, Z Jiang, X Kong, Q Li, Y Sun, P Wang...; [Chemosphere, 2017](#)

In the present study, the concentrations and proportions of PFASs in water and sediments (in different seasons) from the Qing River were investigated. Bioaccumulation factors (BAFs) of the aquatic plants indicated that absorption of PFASs was effective. BAFs in submerged plants increased with increasing chain length

accordingly. In general, aquatic plants had the absorption preference for long-chain PFASs, especially PFOS, which was the predominant compounds in both submerged and emergent plants.

Depuration of PFASs from the Edible Tissues of Wild-Caught Invertebrate Species

MD Taylor, KC Bowles, DD Johnson...; [Sci. Tot. Environ., 2017](#)

We present the results of a depuration trial for School Prawn (*Metapenaeus macleayi*) and Mud Crab (*Scylla serrata*), two commercially important crustaceans in Australia. Depuration was tested in uncontaminated water for 33 days.

The Presence of MWCNTs Reduces Developmental Toxicity of PFOS in Early Life Stage of Zebrafish

S Wang, C Zhuang, J Du, C Wu, H You; [Environ. Pollut., 2017](#)

Developmental toxicity of PFOS in the presence of multi-walled carbon nanotubes (MWCNTs) in the early life stage of zebrafish (from 3 h post fertilization (hpf) to 96 hpf) was investigated in this study. The embryos and larvae were exposed to PFOS (0.2, 0.4, 0.8, and 1.6 mg/L), MWCNTs (50 mg/L), and a mixture of both. Compared with PFOS exposure, the adverse effects induced by PFOS on the hatching rate of zebrafish embryos and the heart rate and body length of zebrafish larvae were reduced in the presence of MWCNTs, and mortality and malformation were also alleviated.

Toxicology – Mechanism of Action

Gestational Exposure to PFOA: Alterations in Motor Related Behaviors

DR Goulding, SS White, SJ McBride, SE Fenton...; [NeuroToxicology, 2017](#)

To examine a dose-response pattern of neurobehavioral effects following gestational exposure to PFOA, pregnant CD-1 mice received PFOA (0, 0.1, 0.3, 1.0 mg/kg/day) via oral gavage from gestational day 1-17 and the male offspring examined. Neurotoxicity of gestational PFOA exposure was not evident at dose levels of 0.1 and 0.3 mg/kg/day. Gestational exposure to PFOA 1 mg PFOA/kg/day diminished methamphetamine-induced activity.

Mother's Milk and the Environment: Might Chemical Exposures Impair Lactation

L Konkel; [Environ. Health Perspect., 2017](#)

Highlights concerns surrounding contaminant exposure, including PFASs, and impairment of lactation.

Novel Chlorinated Polyfluorinated Ether Sulfonates and Legacy PFASs: Placental Transfer and Relationship with Serum Albumin and Glomerular Filtration Rate

Y Pan, Y Zhu, T Zheng, Q Cui, SL Buka, B Zhang...; [Environ. Sci. Technol., 2017](#)

PFAS concentrations were analyzed in 100 paired samples of human maternal sera collected in each trimester and cord sera at delivery; these samples were collected in Wuhan, China, 2014. Higher transfer efficiencies of PFASs were associated with advancing maternal age, higher education, and lower glomerular filtration rate (GFR).

Oxidative Damage and Cytotoxicity of PFOS on *Chlorella vulgaris*

D Xu, X Chen, B Shao; [Bull. Environ. Contam. Toxicol., 2017](#)

We studied the effects of PFOS on the chlorophyll content, cell permeability, and antioxidant defense systems of the green alga *Chlorella vulgaris*. The results showed that the production of reactive oxygen species increased in a concentration-dependent manner after exposure to PFOS for 96 h.

Effects of PFOS on Immobilization, Heartbeat, Reproductive and Biochemical Performance of *Daphnia magna*

R Liang, J He, Y Shi, Z Li, S Sarvajayakesavalu...; [Chemosphere, 2017](#)

In the present study, *Daphnia magna* was used to investigate PFOS toxicity on their immobilization, heartbeat, reproductive and biochemical performance in acute, subchronic and chronic exposure. The results showed that the 48h-EC50 value for immobilization was 79.35 mg L⁻¹ and the toxicity was classified as intermediate.

PFASs Activate Human Pregnane X Receptor

YM Zhang, XY Dong, LJ Fan, ZL Zhang, Q Wang...; [Toxicology, 2017](#)

In this study, cell-based reporter gene assays were used to determine the activity of a variety of PFCs against the human pregnane X receptor (hPXR). We found that all tested PFCs can activate hPXR. The hPXR activity of the PFCs correlates with the carbon chain length and the functional group of the chemicals. PFCs may pose some potential endocrine-disrupting hormonal effects via activation of hPXR.

Effects of PFCs on Thyroid Function, Markers of Ovarian Reserve, and Natural Fertility

NM Crawford, SE Fenton, M Strynar, EP Hines...; [Reprod. Toxicol., 2017](#)

Co-authored by Univ. North Carolina, NIEHS, and USEPA. PFCs can act as endocrine-disrupting chemicals, but there has been limited study of their effects on ovarian reserve or fecundability. 99 women, 30-44 years old, without infertility

were followed until pregnancy. Although PFC levels were correlated with thyroid hormone levels, there was not a strong nor a significant association with ovarian reserve (AMH as a proxy). In our cohort, fecundability was not associated with serum PFC levels.

Persistent Alterations in Immune Cell Populations and Function from a Single Dose of PFNA in C57Bl/6 Mice

CE Rockwell, AE Turley, X Cheng, PE Fields...; [Fd. Chem. Toxicol., 2017](#)

Our previous study showed that PFNA has immunomodulatory effects on leukocyte populations and immune function. The present studies sought to determine whether, and to what degree, the immune system recovered 28 days after PFNA exposure. None of the parameters measured had fully recovered. The current study demonstrates that a single high dose exposure to PFNA (e.g., as might occur accidentally in an occupational setting) has long-lasting effects on the immune system.

Transcriptome Sequencing Reveals Prenatal PFOS Exposure Causes Liver Disorders

KP Lai, JW Li, A Cheung, R Li, MB Billah, TF Chan...; [Environ. Pollut., 2017](#)

In this report, we used transcriptome sequencing, followed by bioinformatics analysis, to elucidate the potential hepatotoxic and hepatocarcinogenic effects of prenatal PFOS exposure in the fetus. Our results demonstrated that prenatal PFOS exposure could activate the synthesis and metabolism of fatty acids and lipids, leading to liver damage and interference with liver development in the fetus. In addition, a number of cancer-promoting signaling pathways, including Wnt/ β -catenin, Rac, and TGF- β , were found to be activated in the fetal liver. More importantly, hepatic transaminase activity, including aspartate aminotransferase and alanine transaminase activity, was induced

in the liver of mice offspring after prenatal PFOS exposure.

Epidemiology

PFASs, Menstrual Cycle Length, and Fecundity: Findings from a Prospective Pregnancy Study

KJ Lum, R Sundaram, DB Barr, TA Louis, GMB Louis; [Epidemiology, 2017](#)

We recruited 501 couples from Michigan and Texas in 2005-2009 upon their discontinuing contraception and followed them until pregnancy or 12 months of trying... In this prospective cohort study, we observed associations between two PFASs (PFDeA; PFOA) and menstrual cycle length changes, and between PFNA and diminished fecundity at some (but not all) concentrations.

Maternal Concentrations of PFASs and Fetal Markers of Metabolic Function and Birth Weight: The Maternal-Infant Research on Environmental Chemicals (MIREC) Study.

J Ashley-Martin, L Dodds, TE Arbuckle, MF Bouchard...; [Am. J. Epidemiol., 2017](#)

We examined associations between first-trimester maternal plasma PFAS concentrations and birth weight and cord blood concentrations of leptin and adiponectin using data on 1,705 mother-infant pairs from the Maternal Infant Research on Environmental Chemicals (MIREC) Study, a trans-Canada birth cohort study that recruited women between 2008 and 2011. Maternal PFOA was inversely associated with birth weight z score, though the null value was included in all credible intervals...All associations between maternal PFAS concentrations and cord blood adipocytokine concentrations were of small magnitude and centered around the null value.

Circulating Levels of PFASs and Carotid Artery Atherosclerosis

PM Lind, S Salihovic, B van Bavel, L Lind;
[Environ. Res., 2017](#)

Carotid artery atherosclerosis was assessed by ultrasound in 1,016 subjects aged 70 years in the Prospective Investigation of the Vasculature in Uppsala Seniors (PIVUS) study. Eight PFASs were detected in >75% of participants' plasma ... a pronounced gender difference was observed regarding associations between some PFASs, especially the long-chain PFUnDA, and markers of atherosclerosis, with more pronounced relationships found in women. Findings suggest a sex-specific role for PFASs in atherosclerosis.

Association between PFAS Exposure and Asthma and Allergic Disease in Children as Modified by MMR Vaccination

CAG Timmermann, E Budtz-Jørgensen, TK Jensen...; [J. Immunotox., 2017](#)

PFASs are highly persistent chemicals that might be associated with asthma and allergy, but the associations remain unclear. Therefore, this study examined whether pre- and postnatal PFAS exposure was associated with childhood asthma and allergy among a cohort of Faroese children (n=559). Prenatal PFAS exposure was not associated with childhood asthma or allergic diseases regardless of MMR vaccination status. In conclusion, PFAS exposure at age 5 was associated with increased risk of asthma among a small subgroup of MMR-unvaccinated children but not among MMR-vaccinated children.

Exposure Pathways – Household

Multianalyte Profiling of PFASs in Liquid Commercial Products

P Favreau, C Poncioni-Rothlisberger, BJ Place...; [Chemosphere, 2017](#)

194 consumer products were screened for 41 individual PFASs. 24 PFASs were quantified in the 0.1–25,000 ppm range. Additional 8 new structural classes of PFAS were detected in AFFFs. Results indicate potentially significant human exposure to FTOHs.

Exposure Pathways – Dietary

PFASs in Food and Human Dietary Intake: A Review of the Recent Scientific Literature Occurrence

JL Domingo, M Nadal - [J. Agric. Fd. Chem., 2017](#)

This study is based on a review of publications on PFAS concentrations in food items during the period 2011–2016, and updates a similar publication by the same authors in [2012](#). Fish and other seafood seem to be the food group in which more PFASs are detected and where the concentrations of these compounds are higher. Large table summary of estimated dietary intake (ng/kg bw/day) for PFAS by country, with source citations. On the basis of the recommendation of EFSA on maximum dietary intakes of PFOS and PFOA in European countries, human health risks would not be a concern for nonoccupationally exposed populations. The authors report a remarkable lack of data for foods in Australia, Japan, and the U.S.

PFASs and Fish Consumption

KY Christensen, M Raymond, M Blackowicz, Y Liu...; [Environ. Res., 2017](#)

PFAS levels and determinants in the NHANES 2007–2014 data. Total fish and shellfish consumption were generally associated with higher PFAS. Certain specific fish and shellfish types were also associated with specific PFAS. Seven PFAS were detected in at least 30% of participants and were examined in subsequent analyses (PFDA, PFOA, PFOS, PFHxS, MPAH, PFNA, PFUA). The PFAS with the highest concentrations were PFOS, followed by PFOA,

PFHxS and PFNA (medians of 8.3, 2.7, 1.5 and 1.0 ng/mL).

Home Produced Eggs (HPE): An Important Pathway of Human Exposure to PFBA and PFOA around a Fluorochemical...

H Su, Y Shi, Y Lu, P Wang, M Zhang...; [Environ. Int., 2017](#)

Dietary intake is considered to be a major pathway of human exposure to PFAAs. Chicken egg is an important contributor to the Chinese diet. In the present study, PFAAs in HPEs and commercially produced eggs (CPE)... For the first time, PFBA was reported in eggs and detected in all egg samples. PFOA and PFBA were the predominant forms in HPEs, while PFOA, PFBA and PFOS dominated in CPEs. For PFOA, estimated daily intakes (EDI) were 233 ng/kg·bw/day for adults and 657 ng/kg·bw/day for children who consume HPEs at households about 2km away from the fluorochemical industrial park. The EDI of PFOA for children via HPEs exceeded the reference dose value (333 ng/kg·bw/day) proposed by the Environmental Working Group.

Is There a Human Health Risk Associated with Indirect Exposure to PFCAs?

AA Rand, SA Mabury; [Toxicology, 2017](#)

This study summarizes the work that has been done to characterize toxicity of the classes of FT-based substances shown to biotransform to PFCAs: the polyfluoroalkyl phosphate esters (PAPs), fluorotelomer alcohols (FTOHs), fluorotelomer iodides (FTIs), and fluorotelomer acrylate monomers (FTAcS).

Composition, Distribution, and Risk of Total Fluorine (TF), Extractable Organofluorine (EOF), and PFCs in Chinese Teas

R Zhang, H Zhang, Q Chen, J Luo, Z Chai, J Shen; [Fd. Chem., 2017](#)

To explore the residual characteristics of fluorine and PFCs in tea, the TF, EOF, and PFCs in 19 Chinese commercial teas. 50-99% of ΣPFCs in tea were short-chain (C≤6), while PFOA was the typical PFCs residual species. Less fermented teas contained significantly higher PFCs (mean, 20ng/g) than more fermented teas (3.0ng/g, p<0.01), suggesting that microbe may degrade PFCs during fermentation.

Notes: PFAS Alerts is based on reviews of literature identified from Google Scholar searches, and the following publications: Inside EPA, LAW360, Bloomberg BNA, CCNJ, and ChemInfo. This issue includes a subset of articles selected by Integral. Abbreviated abstracts are based on information presented by the authors. More detailed reviews in the Special Highlights are prepared by Integral based on the information available online. Integral has not verified the accuracy of information posted online.

Acronyms and Abbreviations

- AFFF = aqueous film-forming foam
- BFR = brominated flame retardant
- COC = chemical of concern
- DTSC = Department of Toxic Substances Control
- DWEL = Drinking Water Equivalent Level
- DWTP = drinking water treatment plant
- EFSA = European Food Safety Authority
- FT = fluorotelomer
- FTOH = fluorotelomer alcohol
- IARC = International Agency for Research on Cancer
- PFAA = perfluoroalkyl acid
- PFAS = per- and poly-fluorinated alkyl substance
- PFBA = perfluorobutanoic acid (C4)
- PFBS = perfluorobutane sulfonate (C4)
- PFC = perfluorinated compound
- PFCA = perfluoroalkyl carboxylate
- PFDA and PFDeA = perfluorodecanoic acid (C10)
- PFHxS = perfluorohexane sulfonate (C6)
- PFNA = perfluorononanoic acid (C9)
- PFOA = perfluorooctanoic acid (C8)
- PFOS = perfluorooctane sulfonate (C8)
- PFPeA = pefluoropentanoic acid (C5)
- PFSA = perfluorinated sulfonate
- PFUA and PFUnDA = perfluoroundecanoic acid (C11)
- WHO = World Health Organization
- WWTP = wastewater treatment plant