

Metropolitan Water Reclamation District of Greater Chicago

Emerging Contaminants – PFOS-PFAS

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PFOS: Perfluorooctanesulfonic acid is a perfluorinated sulfonic acid



PFOA: Perfluorooctanoic acid is a perfluorinated carboxylic acid



PFAS: Per- and Polyfluoroalkyl Substances



Many PFAS Telomers

	Sub-classes of PFASs	Examples of Individual compounds*	Number of peer-reviewed articles since 2002**
		O PERA $(n-4)$	029
		• PFPeA (n=s)	498
		 PFHxA (n=6) 	1081
		 PFHpA (n=7) 	1186
		 PFOA (n=8) 	4066
	PFCAso	0 PFNA (n=9)	1496
	(C _n F _{2n+1} -COOH)	0 PFDA (n=10)	1407
		0 PF0nA (n=11)	1069
		0 PFD0A (n=12)	- 1016
		0 PFTeA (n=14)	
		PEBS (n=4)	(5/
	DEC.	O PEHxS (n=6)	1081
	PFSAso	 PFOS (n=8) 	3507
	$(C_{p}F_{2p+1}-SO_{2}H)$	 PFDS (n=10) 	340
perfluoroal	kyl acids o	PFBPA (n=4)	3
(PFAA	S) DEDAC	• PFHxPA (n=6)	33
	r rraso	 PFOPA (n=8) 	31
	$(C_n F_{2n+1} - PO_3 H_2)$	 PFDPA (n=10) 	35
		 C4/C4 PFPiA (n,m=4) 	4
	PEDiAco	 C6/C6 PFPiA (n,m=6) 	12
		 C8/C8 PFPiA (n,m=8) 	12
	$(C_nF_{2n+1} - PO_2H - C_mF_{2m+1})$	 C6/C8 PFPiA (n=6,m=8) 	
/		ADONA (CF ₃ -O-C ₃ F ₆ -O	-CHFCF ₂ -COOH) 4
/	PFECAs & PFESAso	 GenX (C₃F₇-CF(CF₃)-COC 	DH) 26
/		EEA (C ₂ F ₅ -O-C ₂ F ₄ -O-C	F ₂ -COOH) 6
/	$(C_n F_{2n+1} - O - C_m F_{2m+1} - K)$	F-53B (CI-C ₆ F ₁₂ -O-C ₂ F ₄ -	-SO ₃ H) 14
/		 MeFBSA (n=4,R=N(CH₃)H 	25
		 MeFOSA (n=8,R=N(CH₃)H) 134
	DACE haved	\circ EtFBSA (n=4,K=N(C ₂ H ₅)H)	7
PFASs o	PASE-Dased	O MEERSE (n=4,R=N(CH)C	H OH) 259
	substanceso	 Merose (n=8 R=N(CH_)C 	H OH) 24
(Cn ² n+1 ×)	$(C_n F_{nn} - SO_n - R)$	 EtFBSE (n=4,R=N(C,H_c)C, 	H,OH) 4
	11 20+1 2 7	 EtFOSE (n=8,R=N(C,H_c)C, 	H ² OH) 146
> over 3000		 SAmPAP {[C₈F₁₇SO₂N(C₂H,)C ₂ H ₄ O] ₂ -PO ₂ H} 8
PFASs may	PFAAo	 100s of others 	
have been	precursors	 4:2 FTOH (n=4,R=OH) 	106
on the global		6:2 FTOH (n=6,R=OH)	375
market	fluorotelomer-based	 8:2 FTOH (n=8,R=OH) 	412
market	substanceso	 10:2 FTOH (n=10,R=OH) 	165
		0 12:2 FTOH (n=12,R=0H)	42
	(Cn' 2n+1 - C2' 4 - K)	0 6:2 dIPAP [(C ₆ F ₁₃ C ₂ H ₄ O) ₂ -	PO_H] 23
		0.1005 of others	25 Z5
	\backslash	o polytetrafluorosthylens (PTEE)
	fluoropolymerso	 polytetranuoroethylehe (polyvinylidene fluoride (P) 	VDF)
		 polytinyindene huonde (r fluorinated ethylene proc 	vlene (FEP)
	otherso	 perfluoroalkoxyl polymer 	(PFA)
	o perfluoro	polyethers (PFPEs)	

Wang, Z., DeWitt, J.C., Higgins, C.P., and Cousins, I.T. (2017). A never-ending story of per-and polyfluoroalkyl substances (PFASs)? Env. Sci. & Tech. (51) 2508-2518





- **Used commercially since the 1940s**
- (Bio)Physicochemical Properties:
- Soluble in water
- > Resistant to degradation (persistent)
- > Bioaccumulative
- Low volatility



PFAS in Drinking Water

- Drinking water supplies for 6 million U.S. residents exceed US EPA's lifetime health advisory (70 ppt) for PFOS and PFOA
- Military bases and civilian airports with aqueous film-forming foams were significantly associated with increased use of PFOS and PFOA

Hydrological units with detectable PFASs



Hu, X.C., Andrews, D.Q., Lindstrom, A.B., Bruton, T. A., Schaider, L.A., Grandjean, P., Lohmann, R., Carignan, C.C., Blum, A., Balan, A., Balan, S.A., Higgins, C.P., and Sunderland, E.M. (2016). Detection of poly-and perfluoroalkyl substances (PFASs) in US drinking water linked to industrial sites, military fire training areas, and wastewater treatment plants. *Environ. Sci. & Tech. Letters.* 3(10): 344-350



USEPA Per- and Polyfluoroalkyl Substances (PFAS) Action Plan

DRINKING WATER

EPA is moving forward with the Maximum Contaminant Level (MCL) process for PFOA and PFOS—two of the most well-known and prevalent PFAS chemicals. The Agency is also gathering and evaluating information to determine if regulation is appropriate for a broader class of PFAS.

The next step in the Safe Drinking Water Act process for issuing drinking water standards is to propose a regulatory determination. This provides the opportunity for the public to contribute to the information the EPA will consider related to the regulation of PFAS in drinking water.

CLEANUP

EPA continues strengthening enforcement authorities and clarifying cleanup strategies through actions such as designating PFOA and PFOS as hazardous substances and developing interim groundwater cleanup recommendations.

This important work will provide additional tools to help states and communities address existing contamination and enhance the ability to hold responsible parties accountable.

TOXICS

EPA is considering the addition of PFAS chemicals to the Toxics Release Inventory and rules to prohibit the uses of certain PFAS chemicals.

The Toxics Release Inventory would make information about certain PFAS releases reported by certain industrial sectors and federal facilities available. Additionally, the TSCA new chemicals program will help manage and, as necessary, reduce risk to human health and the environment from new PFAS.

MONITORING

EPA will propose nationwide drinking water monitoring for PFAS under the next UCMR monitoring cycle.

Monitoring results will improve understanding of the frequency and concentration of PFAS occurrence in drinking water, which can be used to inform regulatory action.

RESEARCH

EPA is rapidly expanding the scientific foundation for understanding and managing risk from PFAS.

Improved detection and measurement methods, additional information about PFAS presence in the environment and drinking water, better understanding oj effective treatment and remediation methods, and more information about the potential toxicity of a broader set of PFAS will help EPA, states, and others better manage PFAS risks.

ENFORCEMENT

EPA uses enforcement tools, when appropriate, to address PFAS exposure in the environment and assist states in enforcement activities.

EPA seeks to support communities that have PFAS releases by using federal enforcement authorities, where appropriate.

RISK COMMUNICATIONS

EPA will work collaboratively to develop a risk communication toolbox that includes multi-media materials and messaging for federal, state, tribal, and local partners to use with the public.

This will help ensure clear and consistent messages to the public and will help address concerns related to PFAS.



USEPA and Drinking Water



In 2009, USEPA established health advisories of 400 ppt for PFOA and 200 ppt for PFOS

In 2016, USEPA revised those health advisories levels to <u>70 parts per trillion (ppt)</u> when both PFOA and PFOS are found in drinking water

Meaning, the <u>combined</u> concentrations of PFOA and PFOS should be compared with the 70 ppt health advisory level

Health advisories are:

- > non-enforceable,
- non-regulatory, and
- provide technical information on health effects, analytical methodologies, and treatment technologies associated with contaminants



ATSDR and Health Effects



Toxicological Profile for Perfluoroalkyls

Draft for Public Comment

June 2018

- Following mounting congressional pressure, the Agency for Toxic Substances and Disease Registry released the draft toxicological profile for perfluoralkyls in June, 2018
- Lowest level for most sensitive population included in the report was <u>12 ppt</u>, 80% lower than EPA's health advisory level

State Drinking Water Restrictions



State	Drinking Water Action	Compound	Level (ppt)
California	Notification Levels	PFOA PFOS	14 13
Connecticut	Action Level	Sum of PFOA, PFOS, PFNA, PFHxS, PFHpA	70
Minnesota	Health Based Guidance for	PFOA	35
	Water	PFOS	27
	Surrogate of PFOS HBV	PFHxS	27
New Hampshire		PFOA	38
	<u>Rulemaking Initiated</u> <u>12/31/18</u>	PFOS	70
		Sum of PFOA and PFOS	70
		PFHxS	85
		PFNA	23
New Jersey	Adopted Regulation	PFNA	13
	Regulation in Development	PFOA	14
	Guidance Value	PFOS	13
North Carolina	Health Advisory	GenX	140
Vermont	Drinking Water Health	Sum of PFOA, PFOS,	20
	Advisory	PFNA, PFHxS, PFHpA	20

Association of State Drinking Water Administrators. (2019). Per- and Polyfluoroalkyl Substances (PFAS) and State Drinking Water Program Challenges. Fact Sheet. <u>https://www.asdwa.org/wp-content/uploads/2019/03/ASDWA-PFAS-2-Pager-March-2019.pdf</u>

Maine: 70 ppt PFOA/PFOS Combined; Guideline
 Michigan: 420 ppt PFOA; 11 ppt PFOS



- Would require USEPA to designate PFAS chemicals as hazardous substances under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), better known as Superfund
- Triggers requirements to report releases of chemicals into environment and cleanup contaminated sites
- Allows the government to sue polluters to recover the costs of cleanup.





STATE OF MAINE DEPARTMENT OF ENVIRONMENTAL PROTECTION



GOVERNOR



GERALD D. REID COMMISSIONER

- March 2019 memo sent to all licensed facilities that landapply, compost, process sludge in Maine
- Solid Waste Management Rules: Beneficial Use of Solid Wastes was revised to include screening concentrations:
 - PFOA (0.0025 mg/kg)
 - PFOS (0.0052 mg/kg)
 - **PFBS (1.9 mg/kg)**



PFAAs in Biosolid & Non-biosolid Commercial Fertilizers



Kim Lazcano et al., Manuscript in preparation *Assumes PFAAs negligible in the > 2 mm fraction PFAAs quantified in the < 2mm fraction (36-80%)



NACWA's Comments to USEPA Following May 2018 PFAS Summit

- * "Municipal wastewater and biosolids are not 'sources' of PFAS but can act as the pathway through which the original sources of PFAS contaminate the environment"
- "Conventional wastewater treatment plants are not designed to remove these synthetic industrial chemicals, and communities could face considerable operational and technical challenges as well as substantial costs if required to treat for or otherwise address the presence of these substances in wastewater effluent and biosolids"
- "Because PFAS are not a product of the wastewater treatment process and originate from outside POTWs, solutions for addressing PFAS contamination must focus on their original source"

Pharmaceutical and Personal Care Product Compounds (PPCPs)

PPCPs	2012	2013	2014	2015	2016	2017	
		μg/day/person					
Carbamazepine	108±9.3a	137±15a	187±78a	128±11a	103±8.9a	204±49a	
Ciprofloxacin	2,258±326a	1,921±276ab	779±138c	1,232±247bc	1,372±256abc	2,263±524a	
Codeine	52±11a	107±17a	89±15a	104±14a	111±26a	126±19a	
Diphenhydramine	281±61b	433±49b	327±51b	471±53b	410±56b	756±51a	
Fluoxetine	21±2.2a	33±4.7a	22±3.7a	24±4.2a	29±4.2a	26±3.0a	
Gemfibrozil	613±94a	685±94a	567±122a	633±71a	529±55a	428±37a	
Ibuprofen	5,369±662a	6,620±260a	6,128±554a	6,494±535a	6,016±482a	6,121±521a	
Naproxen	5,161±591a	6,209±499a	6,603±759a	6,949±659a	6,224±634a	6,113±783a	
Thiabendazole	13±1.9a	26±6.0a	18±3.3a	15±2.7a	18±2.4a	20±2.3a	
Triclocarban	1,627±320a	1,286±187a	581±154c	863±318bc	592±149c	455±141c	
Triclosan	2,811±355a	2,335±226ab	1,655±337abc	1,536±294bcd	1,027±211cd	811±187d	



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