Per and Polyfluorinated Alkyl Substances (PFAS)

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Michigan Department of Health and Human Services
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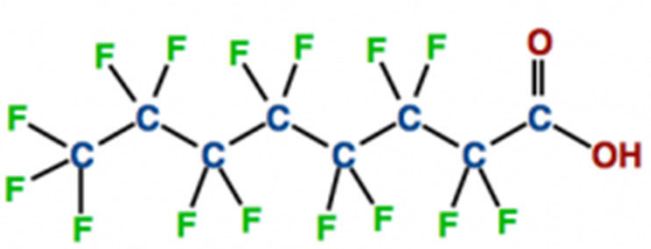
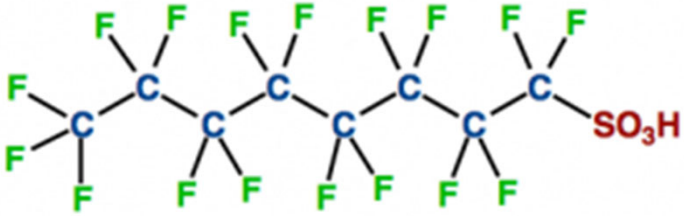
PFAS

- Synthetic class of compounds
- About 4600 chemicals
- Well known and well studied – PFOA and PFOS
- PFOA – **P**er**F**luoro**O**ctanoic **A**cid (1947 – 2002)
- PFOS – **P**er**F**luoro**O**ctane **S**ulfonate (1949 – 2002)



PFOA - perfluorooctanoic acid



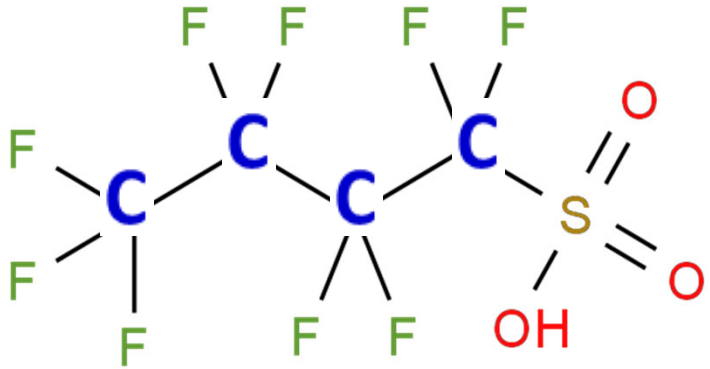
PFOS - perfluorooctanesulfonic acid

Chain Lengths

Short-chain

PF**B**S n = 4

PF**Pe**S n = 5



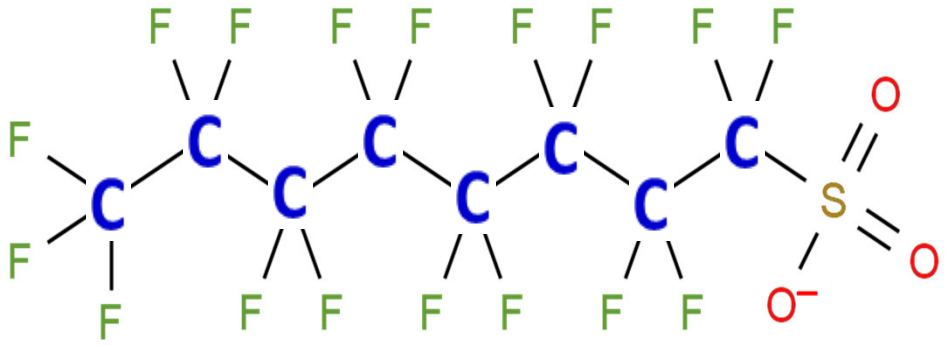
PFBS

Long-chain

PF**Hx**S n = 6

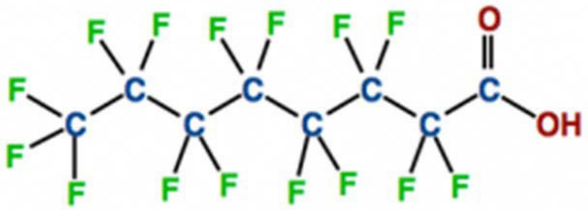
PF**Hp**S n = 7

PF**O**S/PF**O**A n = 8

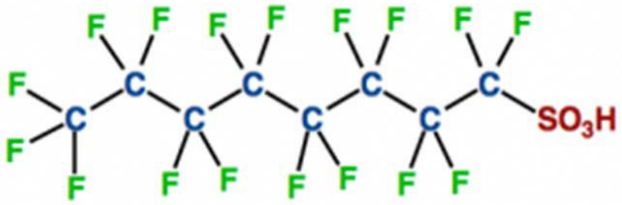


PFOS

Characteristics

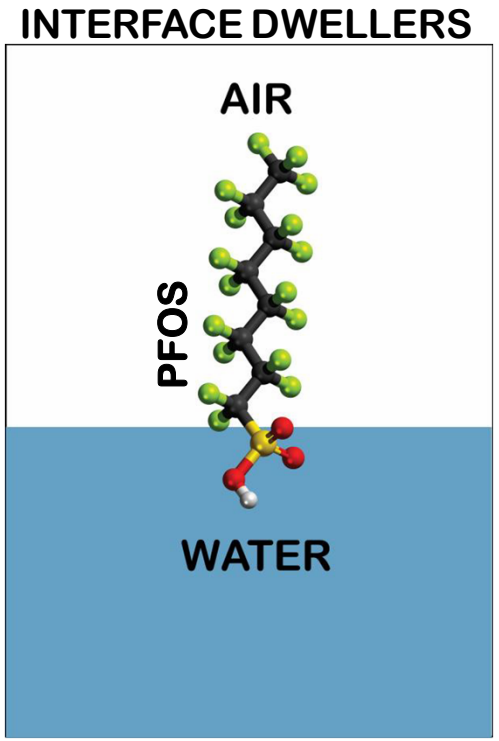


PFOA - perfluorooctanoic acid



PFOS - perfluorooctanesulfonic acid

- Incredibly Stable
- Highly soluble and mobile
- Grease, soil and water-repellant properties
- Bioaccumulative in fish

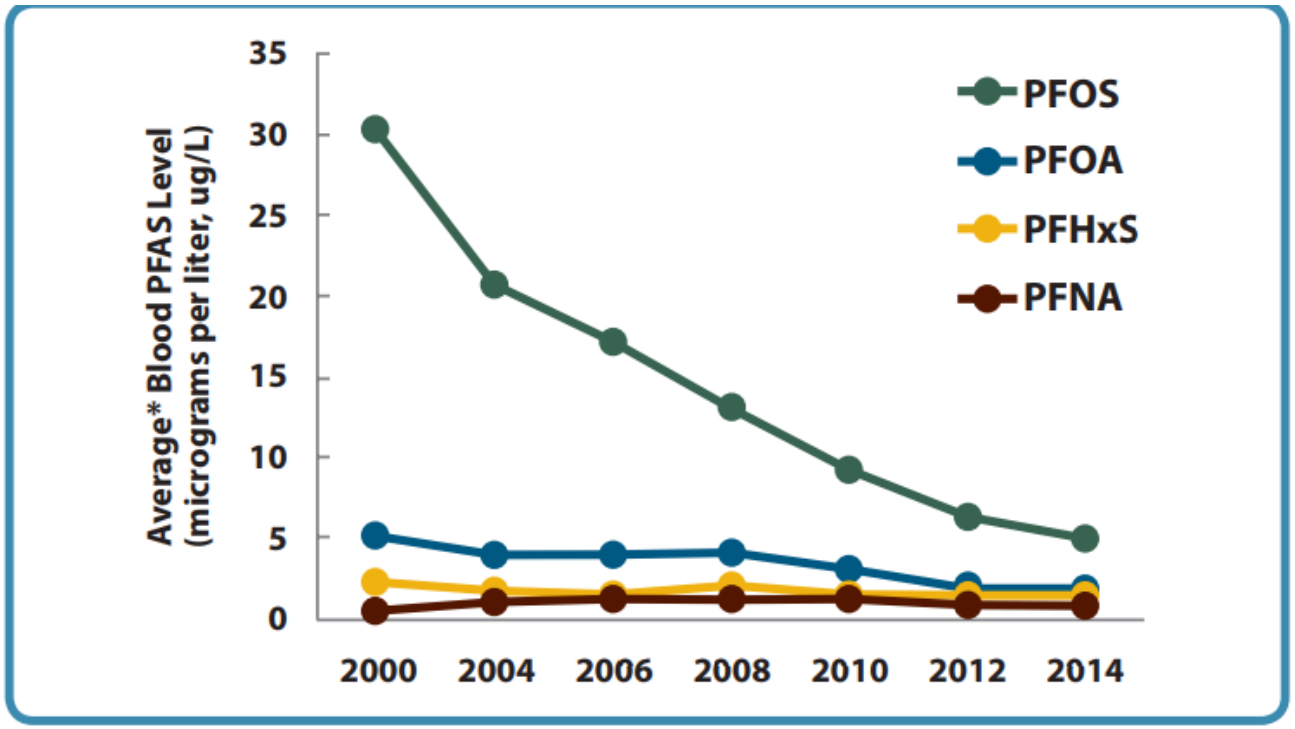


Sources

AMAZING NEW
CONCEPT IN
Cooking
FREE
SPATULA
WITH EACH
"HAPPY PAN"
NOTHING STICKS TO
"HAPPY PAN"
A cast iron skillet sealed with DuPont TEFLON®

24 9:21AM

PFAS
Sources
Shampoo
Non-stick
Cookware
Stain Resistance
Product
Photography
Firefighting
Foams
Fast Food
Packaging
Pesticides
Paints



* Average = geometric mean

Data Source: Centers for Disease Control and Prevention. Fourth Report on Human Exposure to Environmental Chemicals, Updated Tables, (January 2017). Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention.

Blood Levels of the Most Common PFAS in People in the U.S. from 2000-2014

Exposure to PFAS chemicals

- Drinking contaminated water
- Eating fish caught from water contaminated by PFAS
  - “Do Not Eat” Health Advisories
- Incidentally swallowing contaminated soil or dust
- Eating food packaged in materials containing PFAS
- Using some consumer products (i.e. non-stick cookware, treated fabrics)
- PFAS absorption through skin is negligible

Potential Associated Health Outcomes – PFOA and/or PFOS

Humans

- Lowering a woman's chance of getting pregnant
- Increasing the chance of high blood pressure in pregnant women
- Increasing the chance of thyroid disease
- Increasing cholesterol levels
- Changing immune response
- Increasing chance of cancer, especially kidney and testicular cancers

Animals

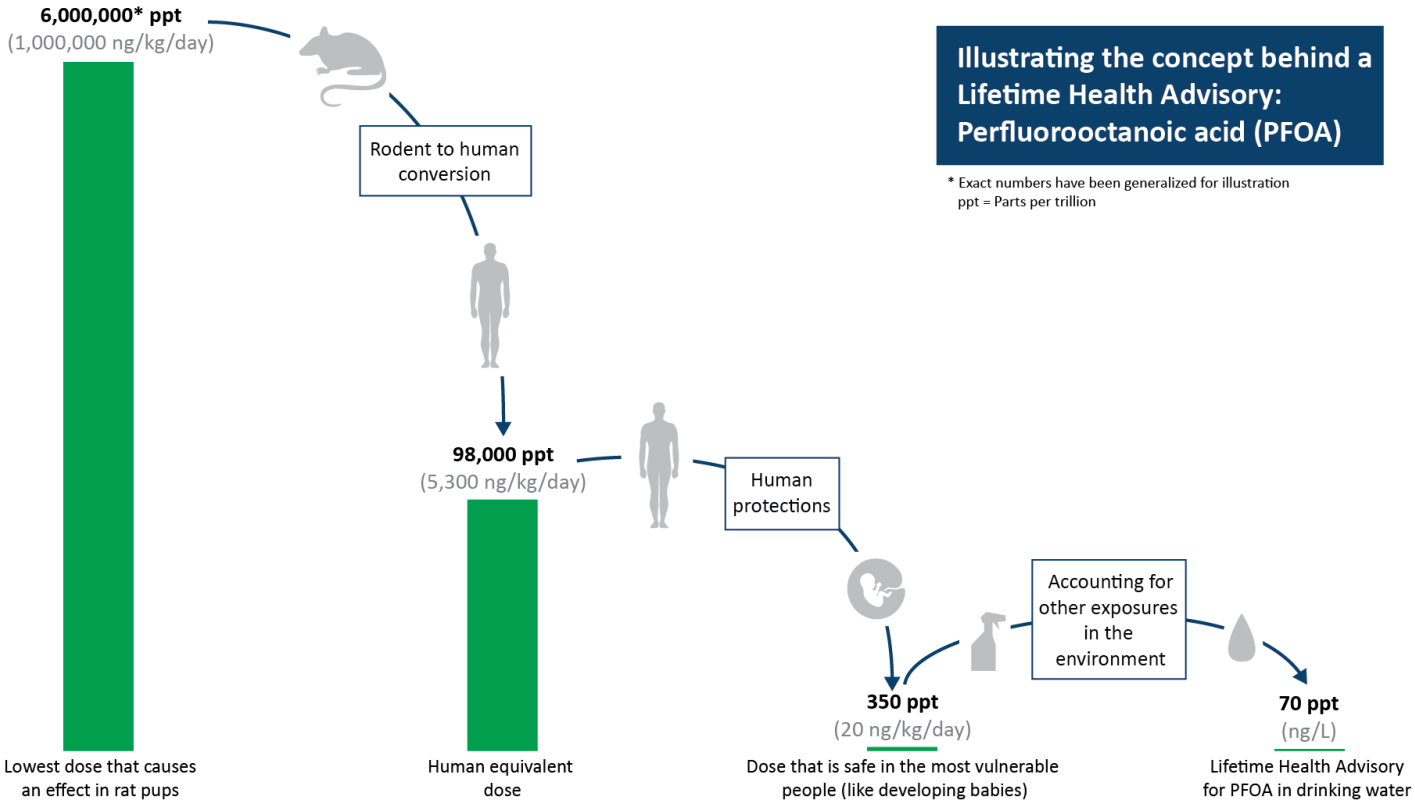
- Developmental effects
- Reproductive effects
- Liver effects
- Endocrine effects (thyroid)
- Immune effects
- Tumors (liver, testicular*, pancreatic)

* PFOA only

Health Advisories

- No federal regulations
- Health Advisories for Drinking Water
  - **EPA Provisional Health Advisory**, 2009
    Short-term adverse health effects
    PFOS: 200 ppt
    PFOA: 400 ppt
  - **EPA Lifetime Health Advisory**, 2016
    Long-term adverse health effects
    PFOS + PFOA: 70 ppt
- Protective of unborn baby against developmental effects
- Protective of all against non-cancer and cancer effects

USEPA's Lifetime Health Advisory



MDHHS
Public Health Drinking Water Screening Levels

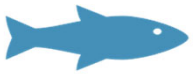
PFAS	Public Health Drinking Water Screening Level
PFOA	9 ppt (parts per trillion)
PFOS	8 ppt
PFHxS	84 ppt
PFNA	9 ppt
PFBS	1000 ppt

The Michigan Fish Consumption Advisory Program

Michigan Department of Health and Human Services

www.mi.gov/EatSafeFish.com

General Process For Consumption Guideline Development



Sampling & analysis

Planning

Fish collection (DNR/EGLE)

Fish processing (filets)

Analysis of filets (MDHHS Analytical Chemistry Laboratory)

Data evaluation

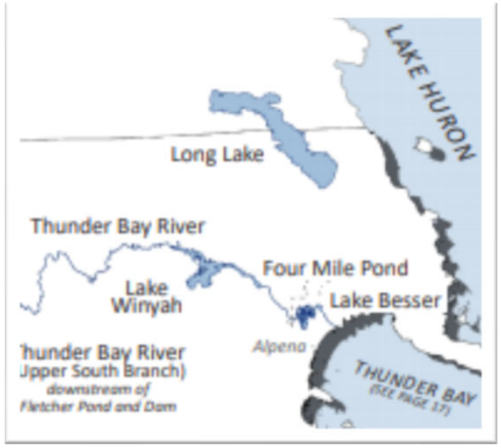
Comparing fish tissue chemical levels to screening levels

Additional considerations

Issuing a guideline

Outreach products – ESF Guides and others (statewide and site-specific)

Eat Safe Fish - Alpena



Lake Besser
Lake Winyah (aka Seven Mile pond)
Thunder Bay River (main branch)

Lake Besser

Type of Fish	Chemicals of Concern	Size of Fish (length in inches)	MI Servings per Month*
Bullhead	Mercury	Any	4
Carp	PCBs	Any	6 Per Year[2x]
Largemouth Bass	Mercury	Under 18"	2
		Over 18"	1
Rock Bass	Mercury	Under 8"	4
		Over 8"	2
Smallmouth Bass	Mercury	Under 18"	2
		Over 18"	1
Walleye	Mercury	Under 20"	1
		Over 20"	6 Per Year

Type of Fish	Chemical of Concern	Size of Fish (length in inches)	MI Servings per Month*
Black Crappie	Mercury	Any Size	4
Bluegill	Mercury	Any Size	8
Carp	PCBs	Any Size	2
Catfish	PCBs & Mercury	Any Size	4
Largemouth Bass	Mercury	Under 18"	2
		Over 18"	1
Muskellunge (Muskie)	Mercury	Any Size	1
Northern Pike	Mercury	Under 30"	2
		Over 30"	1
Rock Bass	Mercury	Any Size	4
Smallmouth Bass	Mercury	Under 18"	2
		Over 18"	1
Suckers	Mercury	Any Size	8
Sunfish	Mercury	Any Size	8
Walleye	Mercury	Under 20"	2
		Over 20"	1
White Crappie	Mercury	Any Size	4
Yellow Perch	Mercury	Any Size	4

Statewide Safe Fish Guidelines

- Based on typical amount of chemicals found in fish filets tested from around the state.
- Can be used for lakes, rivers, and fish species not included in the Eat Safe Fish Guide.

Eat Safe Wild Game - Alpena

- 20 deer were collected from near the Alpena sites
- Non-detect to very low levels of PFAS tested in deer meat
- Very little scientific information exists on whitetail deer and PFAS chemicals
- Additional testing and modeling studies to understand PFAS consumption in wildlife
- Baiting and feeding is banned in Alpena county
- www.michigan.gov/eatsafegame

Foam

Naturally occurring Foam

PFAS-containing Foam

Avoid Foam

- Foam may have high amounts of PFAS.
- Rinse off foam after contact. Rinsing in the lake or river is okay.
- Bathe or shower after the day's outdoor activities.
- Touching the **water** is *not a concern*. Enjoy swimming, boating, and fishing.
- Incidental swallowing of **foam** with high levels of PFAS is a *concern*.
- Do not allow pets to drink foamy water.
- Rinse pets with fresh water after contact with foam to avoid swallowing PFAS that may be on their fur.

Risk Assessment of Foam

- Foam-to-liquid conversion factor
- Incidental ingestion rate (~ 1 tsp of liquid from foam/day)
- Body weight
- Skin surface area
- Available skin permeability coefficient (ability of chemical to cross the skin)
- Oral (incidental ingestion) + Dermal (whole-body contact)
- 2hrs/day (for oral), 3hrs/day (for dermal)
  5days/week for 12 weeks (i.e. Summer) on the lake shore
- Total exposure dose decreases with increase in age
- Hazard Quotient (HQ) $= \frac{\text{Total } \mathbf{exposure\ dose}}{\mathbf{M}\text{inimal } \mathbf{R}\text{isk } \mathbf{L}\text{evel}}$

  HQ < 1: no risk of adverse health effects
  HQ > 1: Further evaluation of risk and PH actions such as advisories may be appropriate

SW/Foam Results

Sample Location	Sample Date	PFOA	PFOS	Total PFAS
9th Ave Culvert	4/24/2018	3.62	4.53	55.89
Island Bridge	4/24/2018	1.19	12.8	21.529
Island Bridge (right bank)	4/24/2018	0.863	ND	4.393
3rd Ave & Carter	4/25/2018	8.74	490	656.07
Island Bridge	4/5/2019	10.5	1060	1316

* Units in nanogram per liter (ng/L) or parts per trillion (ppt); 1 ng/L = 1 ppt

Additional Resources

- Michigan PFAS Action Response Team (MPART)
  www.michigan.gov/pfasresponse
- Environmental Protection Agency (EPA)
  www.epa.gov/pfas
- Agency for Toxic Substances and Disease Registry (ATSDR)
  https://www.atsdr.cdc.gov/pfas/

MDHHS – Toxicology and Response Section

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