A PFAS Primer

Clean Water Summit Partners
State Water Board PFAS Order Compliance Webinar

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September 16, 2020
PFAS
(Per and Polyfluoroalkyl Substances)

Carbon-Fluorine bond strength:
- Leads to oil and water repellency
- “Forever chemicals” -- last for geologic time!

Courtesy: Dr. Jennifer Field
**3M Employee Bulletin**

**Date: 05/16/2000**

3M Phasing Out Some of its Specialty Materials

3M will phase out of the perfluorooctanyl chemistry in certain repellents and surfactant products by the end of this year. We thank the people in these business units for their hard work. They have consistently given the company and our customers their best efforts. For more information, below is a news release issued this morning:

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ST. PAUL, Minn -- May 16, 2000 -- 3M today announced it is phasing out of the perfluorooctanyl chemistry used to produce certain repellents and surfactant products.

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EPA says it pressured 3M over Scotchgard chemical
Ohio River Valley: West Virginia Manufacturing Plant

- PFOA used to manufacture Teflon
- Releases to water & air
- 70,000 + residents with contaminated drinking water
- C8 Health Study
Movie: Dark Waters

• The story of attorney Rob Bilott, who uncovered massive PFOA contamination from a DuPont factory in WV
Scientific publications on PFAS

Grandjean, Environ. Health. 2018
• Ubiquitous
• Long-range transport
UCMR3 Data

Hydrological units with detectable PFASs

EPA Lifetime Health Advisory Level of 70 ng/L PFOA + PFOS

Exposure Sources & Pathways

- Drinking water
- Diet (foodstuffs & food packaging)
- Dust
- Air
- Consumer Products

Sunderland et al., JESEE, 2018.
DOI: 10.1038/s41370-018-0094-1
Exposure Sources & Pathways

Scenario:
Contaminated drinking water

\[ [\text{PFOA}]_{\text{DW}} = 519 \text{ ng/L} \]

Vestergren & Cousins, ES&T, 2009. DOI: 10.1021/es900228k
Exposure Sources & Pathways

Scenario:
Background level in drinking water

[PFOA]_{DW} = 1.3 \text{ ng/L}

- Drinking water
- Consumer articles
- Precursors (FTOHs)
- House dust
- Diet

Vestergren & Cousins, ES&T, 2009. DOI: 10.1021/es900228k
PFASs exposure is a health concern

Exposure linked to health risks:
Cancer, elevated cholesterol, obesity, immune suppression, and endocrine disruption

(Ref: Lewis et al., 2015; Grandjean et al., 2012; Braun et al., 2016; Barry et al., 2013)

Courtesy, Cindy Hu, Harvard University
Drinking Water Health Guidelines (ng/L)

- DuPont PFOA: 5000
- DuPont PFOA: 1000
- U.S. EPA PFOA: 400
- U.S. EPA PFOA: 70
- New Jersey PFOA: 14
- New York PFOA: 10

PFAS

4730 in commerce (OECD, 2018)

240 in fire-fighting foam and contaminated ground water

29 measured by EPA Method 533 and 537.1

6 included in UCMR3

2 with federal Health Advisories
• Extreme persistence and potential toxicity make all PFAS suspect
• Not enough time to study them all
• Avoid their use when possible
Recent comments from CDC

Patrick Breysse, Director of the CDC’s National Center for Environmental Health:

The presence of perfluorinated chemicals in U.S. drinking water is “one of the most seminal public health challenges for the next decades.”

“...it won’t be too long before we think hundreds of millions of Americans will be drinking water with levels of these chemicals above levels of concern.”

- BNA News, Oct. 17, 2017
PFAS & Wastewater Treatment

• Are WWTPs sources of PFAS?
Sources of PFAS Emissions

• Industrial
  • Plants that produce PFAS
  • Plants that use PFAS

• Firefighting foam
  • Military bases, airports, etc.

• Landfills

• Consumer products* – carpets, apparel, food packaging, cosmetics, other

High input = high output. Industrial sources & firefighting foam are important.
Conventional treatment trains not effective

- Perfluoroalkyl acids (PFOA, PFOS, etc.) resistant to biodegradation
- Aerobic treatment oxidizes precursor compounds, generating more perfluoroalkyl acids
- Effluent > Influent
From WWTPs to the Environment: Biosolids

• Partitioning to biosolids
  • Long-chains > short-chains

• 2013 study: 10 out of 13 PFAS analyzed consistently detected in US municipal biosolids samples

• Potential for accumulation in agricultural soils & uptake to food crops

Venkatesan & Halden, J. Haz. Mat. 2013
Maine

- Paper mill sludge led to contamination of
  - Local municipal supply well
  - Milk at dairy

- Maine DEP:
  - All biosolids must now be tested for PFAS prior to use
  - Initial testing: nearly all biosolids exceed state screening levels for PFOS and/or PFOA (5.2 and 2.5 ng/g)

[theintercept.com/2019/06/07/pfas-chemicals-maine-sludge/](theintercept.com/2019/06/07/pfas-chemicals-maine-sludge/)
From WWTPs to the Environment: Effluent

• Problematic for downstream users, example: Orange County
  • OC has more wells with reportable PFAS than LA, Riverside, and San Bernardino counties combined
  • Suspected source: treated wastewater from Inland Empire entering groundwater through Santa Ana River
  • OCWD expects to shut down 1/3 of its 200 wells this year due to PFOA & PFOS

See Orange County Register, Jan. 17, 2020
PFAS Fate

Industrial or residential source -> WWTP

Effluent -> Ground water

Surface water -> DWTP

Drinking water
PFAS Treatment

Drinking Water:
- Granular activated carbon
- Ion exchange
- Reverse osmosis

Wastewater:
- Advanced treatment

Biosolids:
- Industrial pretreatment
Water Treatment Costs: North Carolina

Brunswick County: reverse osmosis filtration:
- $99M to build
- $2.9M to operate each year

Cape Fear Public Utility Authority activated carbon filtration:
- $46M to build
- $2.7M to operate each year

Wilmington Star News, May 9\(^{th}\) & 10\(^{th}\), 2018
Congressional PFAS Task Force

• Launched 1/24/19
• Goals
  • Educate
  • Elevate
  • Legislate
  • Appropriate

• Accomplishments
  • CDC Health Studies
  • USGS monitoring
  • Stop DoD and FAA use of PFAS firefighting foam
• May 2018: PFAS Summit
• Feb. 2019: PFAS Action Plan
  • Drinking water
  • Cleanup
  • Toxics
  • Monitoring
  • Research
  • Enforcement
  • Risk Communication
Drinking water: US states

Adopted or proposed standards & guidelines

- MN
- MI
- NJ
- VT
- CA
- NC
- NH
- NY
- PA
- WA

www.saferstates.com/toxic-chemicals/pfas/
Drinking water: California

August 2019: Notification levels dropped
• PFOS: 13 ppt → 6.5 ppt
• PFOA: 14 ppt → 5.1 ppt

Feb. 2020: Response levels dropped
• Formerly: (PFOA + PFOS) 70 ppt
• Now: PFOA 10 ppt, PFOS 40 ppt

OEHHA developing Public Health Goals
CA Water Board PFAS Investigation

Announced March 2019

• Phase 1: airports, landfills, and nearby drinking water wells
• Phase 2: Refineries, fuel terminals, fire training locations, urban wildfire areas
• Phase 3: Wastewater treatment plants

July 9, 2020:

• Investigative order to ~250 POTWs (> 1 mgd)
• 31 PFAS compounds
• Beginning Q4 2020, to last 1 year
PFAS are Problematic & Difficult to Clean Up

Prevention is preferable!
Only use when necessary
Moving away from PFAS
Thank you!

To learn more:
Sign up for our newsletter

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PFASCentral.org