PFAS

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Per- & Polyfluoroalkyl Substances (PFAS)

- complex family of 4,000+ manmade chemicals
- produced since late 1940s
- used to make products that resist heat, oil, stains, grease, and water
PFAS

[Diagram of PFAS molecule with labels for Carbon, Fluorine, Oxygen, and Hydrogen]
PFAS

- Widespread occurrence; persistent; bioaccumulative

- USEPA issued 2015 Lifetime Health Advisory [70 ng/L] for perfluorooctanoic acid (PFOA) & perfluorooctanoic sulfate (PFOS) [discrete and/or combined]

- these 2 have been phased out of production

- many other PFAS are still being used and are being studied for health effects
PFAS Products (Exposure)

- nonstick cookware
- food packaging (e.g., microwave popcorn bags, fast food wrappers, sliced cheese wrappers, pizza boxes)
- stain-resistant textiles; water-resistant clothes
- paints, varnishes and sealants
- cosmetics
- dental floss
- fire-fighting foams
- pesticide formulations
- medicines, arterial stints
Indicated Health Effects

• most studied are PFOA and PFOS
• some are indicated to affect:
  • developmental stages (growth, learning, behavior) of infants and older children
  • lower a woman’s chance of getting pregnant
  • disrupt the body’s hormones (PFOS)
  • increase cholesterol
  • increase cancer risk (PFOA)
PFAS Exposure

• Drinking Water
  - contaminated water supply
  - typically localized and associated with a specific facility……
    - PFAS manufacturer
    - landfills
    - firefighting training facilities
    - wastewater treatment facilities
PFAS DW Analytical

- Method 533 (December 2019) -- 26 PFAS

- Method 537.1 -- 19 PFAS

- Total coverage -- 30 PFAS

- ~4,000+ PFAS
Some Near - Term DW Data

• UCMR3 (2013 – 2015)

• CWSs that served greater than 10,000 persons and at some small systems randomly selected by the EPA

• 4,920 PWSs sampled for 6 PFASs (2013-2015)
Some Near-Term DW Data

- 4,920 PWSs sampled for 6 PFASs (2013-2015)
- Detection (>MRL) Occurrence:
  - PFOS (40 ng/L) – 1.9% [0.9% >70 ng/L LHA]
  - PFOA (20 ng/L) – 2.4% [0.3% >70 ng/L LHA]
  - PFNA (20 ng/L) – 0.3%
  - PFHxS (30 ng/L) – 1.1%
  - PFHpA (10 ng/L) – 1.7%
  - PFBS (90 ng/L) – 0.2%
Some Near-Term DW Data

- South Carolina
  - 82 PWS included
  - 498 samples collected and analyzed
  - one (1) sample from one (1) utility:
    - 12 ppt for PFHpA and 24 ppt for PFOA
  - three (3) follow-up sample events were conducted at that system; all follow-up results were non-detects.
USEPA PFAS Action Plan

Regulatory Determination

- December 2019
- at OMB
- MCL? (SDWA)
- More methods
- Hazardous substance? (CERCLA)
What Are We Doing About PFAS?

• Strategy for Drinking Water
• Issued January 30, 2020
• Vulnerability Approach
• CWS (80%) ~ Private Wells (20%)
• Ambient Surface Waters & Fisheries Strategy to follow in 3Q20
What Are We Doing About PFAS?

Ambient Surface Waters & Fisheries

• OCPSF
• Pulp and Paper
• Textiles
• Airports

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• DOD (BLWM)
What Are We Doing About PFAS?

• Does your facility use or manufacture perfluoro- and polyfluoroalkyl substances (PFAS)?

• Do you know or suspect that PFAS is present in your effluent?

• Indicate the specific PFAS compound present (or suspected to be present);
  • provide the outfall number
  • the reason the pollutant is believed present
  • analytical data (SW-846 8237)
Toxicology 101

The dose makes the poison (Paracelsus)

• Exposure – pathway, duration

• Dose – amount, potency

• Effect ~ Exposure x Dose
Toxicology 101

Effects

- Acute, chronic, sub-chronic
- Lethal, sub-lethal
- Carcinogenicity, mutagenicity, teratogenicity
- Bioconcentration, bioaccumulation, biomagnification
Toxicology 101

Confounding Considerations

- Species extrapolation
- Multi-analyte interaction
  - Additive
  - Synergistic
  - Antagonistic
  - None
# Toxicology 101

<table>
<thead>
<tr>
<th>Toxicity</th>
<th>High</th>
<th>Low</th>
<th>Dioxins</th>
<th>(oPO₄ pests)</th>
<th>(oCl pests)</th>
<th>Persistence</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>///</td>
<td>√</td>
<td></td>
<td></td>
<td></td>
<td>Low, High</td>
</tr>
</tbody>
</table>

This table illustrates the toxicity and persistence of different compounds.

- **High Toxicity** and **Persistence** correlate with **Dioxins**.
- **Low Toxicity** and **Persistence** correlate with **(oPO₄ pests)**.
- **(oCl pests)** do not have a specific toxicity classification in this context.
The Risk Cascade

• Risk Assessment
• Risk Management
• Risk Communication
Basic Risk Considerations

• $1 \times 10^{-6}$ or less….. Greenfield; no remedial action required
  (….. Acceptable Risk)

• $1 \times 10^{-4}$ or greater …. Remedial response required
  (….. Unacceptable Risk)

• $1 \times 10^{-6}$ to $1 \times 10^{-4}$…. Risk management range (……..acceptable risk)
Basic Risk Considerations

• FDA (1958) Delanney Clause (zero product residue in animals used for food [DES]; what is zero? Prove it?)→

• NCI (1961) essentially zero (what is safe?)
  • *de minimus non curat lex*

• FDA (1973) → Federal Register Notice
  • $1 \times 10^{-8}$ (1 in 100,000,000)
Basic Risk Considerations

- FDA (1977) → $1 \times 10^{-6}$

But…

- what is acceptable risk?
- who gets to decide that?
Risk Assessment

- Quantitative and Semi-Quantitative Estimate
- Carcinogenic Risk and Non-Carcinogenic Hazard (Chemical)

- it’s the numbers
Risk Management

• Decision-making process that applies data from Risk Assessment to...

• Establish a program for protection of human health and the environment (ecological) in the context of....
  • Available technical and economic resources
  • Regulatory requirements/constraints
  • Commercial…. Business (risk) tolerance
Risk Management

• Make a health-protective decision
  • Implementable
  • Robust
  • Dependable
  • Sustainable

• it’s the response decision
Risk Management

• Expert’s **concern** about risk driven by high levels of:
  • Morbidity/mortality
  • Disability
  • Property damage/loss
  • Financial loss
  • Political turmoil
Risk Management

- Public’s perception driven by:
  - Voluntary vs. forced
  - Controllable/by self vs. uncontrollable/by others
  - Familiar vs. unfamiliar
  - Fair vs. unfair
  - Chronic vs. acute; fatal vs. non-fatal
  - Diffuse vs. granular/focused temporally-spatially
Risk Management (Public Perception)

• Sub-conscious origin
• May (often) not be logical
• Culture -influenced
• Emotions -influenced
• Not always expressed verbally
Risk Communication

• Transfer of technical information regarding (chemical) risks in the environment from the assessor & manager to the User

• The User gets to decide, or at least have a strong say, in the acceptable risk level
Risk Communication
(the degree of difficulty)

• PFOA & PFOS—non-detect
• PFOA & PFOS—>70 ppt
• PFOA & PFOS—ND < x <70 ppt
• Other detections at whatever level
Risk Communication

- Create trust & credibility
- Public (User) education
- Involve public (User) in the decision-making process
Effective Risk Communication

- Engage/involve those affected
- Establish trust
- Be honest, transparent
- Be quickly responsive
- Be proactive
- Be empathetic (respectfully)
- Multi-enterprise partners
Effective Risk Communication

• Make message simple (understandable)
• Explain factors influencing the risk (exposure duration, frequency, etc.)
• Present & explain uncertainties
• User must have opportunity to ask questions, make comments
Blocks to Effective Risk Communication

• Complicated technical message
• Lack of messenger credibility
• Unrealistic expectation of User
• Difficulty in explaining the uncertainties inherent in RAs
Perception Conditions

UNCONCERN

Outrage

Health Education Stakeholder Relations

Outrage Management

Crisis Response

Precautionary Advocacy

Low

ACTUAL RISK

High

ENGAGEMENT

South Carolina Department of Health and Environmental Control
Successful Risk Cascade

• Data alone will not suffice
  • technical; experts
• Information alone will not suffice
  • comprehension
• Must be understandable, honest, transparent, committed & trusted
Crucial Balancing Elements

- **Risk Assessment**
  - Toxicology
  - Environmental Fate
  - Potential Exposures

- **Risk Management**
  - Engineering
  - Technical Limitations
  - Regulatory Constraints
  - Cost

- **Risk Communication**
  - Trust
  - Empathy
  - Knowledge

Options
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