EBC Solid Waste Management Webinar: Update on PFAS in the Solid Waste Industry
Welcome

Jackson Bailey

Marketing & Program Manager

Environmental Business Council of New England
Thank you to our Sponsor
Program Introduction

Stephen Sakakeeny

Program Co-Chair and Moderator

Principal, SAK Environmental LLC
PFAS Air Impacts at Landfills and WWTPs

Stephen Zemba

Project Director
Sanborn, Head & Associates, Inc.
PFAS Emissions to Air from Landfills

Stephen Zemba, PhD, PE
EBC Solid Waste Management Webinar: Update on PFAS in the Solid Waste Industry
July 14, 2020
Why Worry About PFAS Air Emissions at Landfills?

- Elevated PFAS levels found in air near landfills
- Some PFAS have significant volatility
- Heightening focus on background exposures to PFAS
- EPA-funded research to measure PFAS in landfill gas
Research on PFAS in Landfill Gas

Characterization and Quantification of per- and polyfluoroalkyl substances in landfill gas and estimate of emissions from U.S. Landfills

- **EPA Grant Number:** RD839600
- **Title:** Characterization and Quantification of per- and polyfluoroalkyl substances in landfill gas and estimate of emissions from U.S. Landfills
- **Investigators:** Barlaz, Morton A., Field, Jennifer, Simonich, Staci
- **Institution:** North Carolina State University at Raleigh, Oregon State University
- **EPA Project Officer:** Hahn, IntaeK
- **Project Period:** September 1, 2019 through August 31, 2022
- **Project Amount:** $900,000

- **$900K grant**
- **Commitments from 400 landfills**
- **PFAS in landfill gas and soil attenuation**
Available Relevant PFAS Data / Air Emissions

- Ambient air measurements collected near landfills in:
  - Canada (Ahrens et al., 2011)
  - Germany (Weinberg et al. 2011)
  - China (Tian et al., 2019)

- Landfill gas measurements collected from landfills in:
  - Minnesota (MPCA, 2010)
PFAS Measurements in Air Near Landfills (Canada)

- Excess FtOHs
  - 2,000 – 25,000 pg/m³

- Excess Me/Et FOSA/FOSE
  - 20 – 70 pg/m³

PFAS Measurements in Air Near Landfills (Canada)

- ~ Doubling of PFCAs – excess of 100-200 pg/m³
- PFBA highest, other PFCAs “on site”
- Background 50-100 pg/m³


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PFAS Measurements in Air Near Landfills (Germany)

- Excess FtOHSs
  - 50 – 500 pg/m³

- Background FtOHSs
  - 50 – 100 pg/m³

- Doubling of Me/Et FOSA/E (for “C”)
  - Background 10 pg/m³

PFAS Measurements in Air Near Landfills (China)

- **Excess PFAS (Central v. Reference Locations)**
  - FtOHs – 400 – 2,000 pg/m³
  - PFCs – 400 – 500 pg/m³
  - Me/Et FOSA/FOSE ~ 10 – 20 pg/m³

- **Background PFAS**
  - FtOHs -- ~ 100 pg/m³
  - PFCs -- ~ 200 pg/m³
  - Me/Et FOSA/FOSE ~ 10 pg/m³

2007 Landfill Gas Sampling in Minnesota

- Actual Landfill Gas, not Ambient Air
- Pine Bend LF accepted industrial PFAS waste, maybe post-PFOS mfg
- PFOA > PFBA maybe era-specific & might reflect aerosols in LFG

FtOHs in LFG Emissions – Does it Make Sense?

- Fluorotelomer alcohols appear to have high volatility
PFAS Emissions from Landfills – Unknown Territory

- To date, almost no published PFAS data for LFG – this will change in the next few years
- PFAS use has evolved dramatically in the past 20 years
  - What PFAS will be found in landfills of different ages?
  - Do PFAS concentrations in LFG change with time?
- Do soils and landfill cover attenuate PFAS in fugitive LFG emissions?
- Do flares/IC engines destroy PFAS – or maybe convert them?
Do levels of PFAS measured near landfills indicate significant contributions to PFAS exposure?

- Drinking water is often the largest source of PFAS exposure when it is found in public/private water supplies
- In the absence of drinking water exposure, other pathways contribute to “background” exposure
  - Diet, e.g., from transfer from food packaging
  - Air, e.g., from household dust from wear of PFAS-containing coatings

Compared with background exposure, how large might exposure to air emissions from landfills be?
PFAS Background Exposure Estimates

### Geo Mean PFAS Levels in Blood (National Data)

Error bars = 95% confidence interval

<table>
<thead>
<tr>
<th>PFAS</th>
<th>Daily Adult Exposure Estimate (ng/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFHxS</td>
<td>12</td>
</tr>
<tr>
<td>PFOA</td>
<td>19</td>
</tr>
<tr>
<td>PFOS</td>
<td>43</td>
</tr>
<tr>
<td>PFNA</td>
<td>5</td>
</tr>
</tbody>
</table>

\[
\frac{d}{dt}(C_b V_d) = D_{back} - k_e C_b V_d
\]

\[
k_e = \frac{\ln(2)}{\tau_{1/2}}
\]

where the terms are:

- \(C_b\): Arithmetic average concentration of PFAS in serum (blood) (ng/l);
- \(V_d\): Apparent volume of PFAS distribution (l/kg);
- \(D_{back}\): Background exposure to PFAS (ng/kg-d);
- \(k_e\): PFAS elimination constant (d\(^{-1}\)); and
- \(\tau_{1/2}\): PFAS half-life in the body (d).

Source: Draft Toxicological Profile for Perfluoroalkyls, U.S. Department of Health and Human Services, 2018

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What PFAS Levels in Air Are Important?

- Assume 100 ng/d of incremental PFAS exposure – somewhat larger than background estimates
- “Standard” breathing rate – 20 m³/d
- PFAS level of concern
  
  \[
  100 \text{ ng/d} \div 20 \text{ m}^3/\text{d} = 5 \text{ ng/m}^3 = 5,000 \text{ pg/m}^3
  \]
- 5 ng/m³ is in the range of measurements near landfills
- But also ... does it matter which PFAS?
### PFAS Toxicity – Data Available from EPA

<table>
<thead>
<tr>
<th>PFAS</th>
<th>Reference Dose (ng/kg-d)</th>
<th>Date and Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>PFOA + PFOA</td>
<td>20</td>
<td>2016 – Health Assessment Document</td>
</tr>
<tr>
<td>GenX</td>
<td>80</td>
<td>2018 – Draft Toxicity Assessment</td>
</tr>
<tr>
<td>PFBS</td>
<td>20,000</td>
<td>2014 – Provisional Toxicity Value</td>
</tr>
<tr>
<td>PFBS</td>
<td>10,000</td>
<td>2018 – Draft Toxicity Assessment</td>
</tr>
</tbody>
</table>

- Reference doses based on non-cancer effects
- Long-chain v. Short-chain difference?
PFAS Toxicity – an FtOH Wrinkle?

- Potential exposure to FtOH is likely the highest for PFAS air emissions from landfills
- Theoretically, FtOHs are less toxic than PFCAs
- But ... FtOHs can degrade into PFCAs
- How fast, and where, can the degradation occur?
What is Likely to Result from LFG Research?

- **Data**
  - PFAS are likely to be found in LFG, but which ones, and at what concentrations?
  - Will elevated temperatures in landfills be important?
  - Sampling techniques may be important

- **Publicity**
  - Landfills are currently facing many questions regarding PFAS in leachate
  - “Discovery” of air emissions could create another focal point
  - Questions on PFAS destruction in LFG combustion may arise
Relative Concentrations: Landfill Gas to Air

- Both dispersion modeling and empirical data suggest dilution ratios of the order of 1,000,000 between H$_2$S concentrations in landfill gas and ambient air
  - H$_2$S in LFG often ~1,000 ppm
  - Odor thresholds ~1 ppb = 0.001 ppm
- Implications for PFAS in LFG?
  - 1,000 pg/m$^3$ in air => 1 mg/m$^3$ in LFG
  - Levels should be readily measurable!

Conclusions / Recommendations

- PFAS in landfill gas will soon be measured and characterized
- PFAS such as FtOHs will likely be found
- Concentrations of PFAS in LFG could be viewed as significant, especially if interpreted out of context
- Dilution / exposure / potential risks are topics worthy of anticipatory consideration
Thank you!

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ITRC Technical Resources for PFAS
https://www.itrcweb.org/Team/Public?teamID=78

- Fact sheets
- Web-based Technical and Regulatory Guidance Document
- On-line Training Materials
PFAS: Water and Wastewater Utility Approaches and Challenges

Rebecca Weidman

Director, Toxic Reduction and Control (TRAC)
Massachusetts Water Resources Authority (MWRA)
PFAS: Water and Wastewater Utility Approaches and Challenges

July 14, 2020
Presentation Overview

• Importance of Human Health Protection
• State and Federal Regulatory Approaches
• Potential Implications of New Limits
  – Drinking Water
  – Wastewater/Biosolids
    • Beneficial Reuse
    • Alternative Disposal
• MWRA’s Approach
Human Health Exposure and Effects

- PFOA and PFOS can cause reproductive and developmental, liver and kidney, and immunological effects in laboratory animals.

- Because they are ubiquitous, most people have been and continue to be exposed to these chemicals through their wide commercial usages (Teflon pans, food packaging, fabric and carpeting coatings, personal care products).

- Some drinking water supplies have been contaminated from industrial and commercial use.
State and Federal Regulatory Approaches

- State agencies have various regulatory approaches
  - Clean up levels
  - Drinking water standards and rulemaking
  - Restrictions on sale of fire fighting foam
  - Testing of biosolids and screening levels
- Federal agencies have various regulatory approaches
  - Health advisories
  - EPA Action Plan
  - Laws
    - SDWA, CWA, CERCLA, RCRA
Massachusetts’ PFAS Efforts

• Proposed drinking water MCL
  – Proposed MCL is 20 ng/L (ppt) for sum of PFOA, PFOS, PFHxS, PFHpA, PFNA, PFDA
  – Published December 2019, comment period ended February 2020

• Updated MCP regulations

• Fire fighting foam take back

• Grant funding for DW treatment

• Biosolids Sampling
  – Approval of Suitability
  – Quarterly Sampling
  – Threshold/Screening Levels in the Future
Potential Implications

• Drinking Water
  – Treatment Systems
  – Alternative Sources
  – Public Trust/Reliance on bottle water

• Wastewater Reuse/Biosolids
  – Alternative disposal methods (landfills, incineration)
  – Lost environmental benefits
• Drinking Water
  – UCMR3 (2014 – 2016): 180 samples all non-detect
  – 2019 voluntary sampling – trace amounts too low to quantify
  – DEP’s MCL will result is regular sampling and reporting
  – MWRA will continue to perform testing and closely monitor developments in the science around this issue.
  – Public outreach and technical assistance to communities

• Wastewater
  – PFAS expected to be present in wastewater.
  – MWRA is participating in 3 studies related to wastewater treatment
    • SBNMS sampling of effluent and MassBay
    • WRF 5031 - Occurrence Of PFAS Compounds In US Wastewater Treatment Plants
    • WRF 5032 - Assessing Poly- and Perfluoroalkyl Substance Release from Finished Biosolids
• Biosolids
  – Bay State Fertilizer sold in Massachusetts and several other states
  – Beneficial Reuse
  – MassDEP Approvals of Suitability
    • 5-year renewal
    • Quarterly sampling
    • 9 PFAS Compounds
  – Screening levels currently in Maine and expected in Massachusetts
  – Limited alternatives to land application
• Biosolids
  – Bay State Fertilizer sold in Massachusetts and several other states
  – Beneficial Reuse
  – MassDEP Approvals of Suitability
    • 5-year renewal
    • Quarterly sampling
    • 9 PFAS Compounds
  – Screening levels currently in Maine and expected in Massachusetts
  – Limited alternatives to land application.
• Landfills
  – MWRA receives leachate from several landfills
  – Clinton WWTP Sludge landfill leachate is recycled back to the plant for treatment
  – Currently no EPA approved method for analyzing PFAS in wastewater or leachate
• Following the science
• Collecting data and participating in research
• Working closely with EPA and DEP
• Providing technical assistance to our communities
• Sharing information with the public
PFAS Disposal Update

Pete Long

Strategic Account Manager
Heritage Environmental Services, Inc.
Virtual Presentation: Disposal of PFAS Impacted Waste
PFAS Impacted Waste

- What we will discuss:
  1. What types of PFAS containing waste we receive from the market.
  2. PFAS Soil and Water Thermal Destruction
  3. Heritage Research Group
Examples of PFAS Impacted Waste currently handled

- Bulk AFFF soil
- Bulk PFAS derived water
- Virgin product
- Spent remediation system carbon
- IDW Drums
PFAS Disposal

Thermal Destruction takeaways

- Heritage does not landfill PFAS waste.
- Heritage Thermal Services (HTS) facility in East Liverpool Ohio
- Material is shipped as non-hazardous and accepted “case by case”
Preparing to Dispose PFAS

Requirements by the facility:

• Analytical requirements that Demonstrate the waste is non-hazardous
• 1-quart sample prior to bulk approval
• Prepare a Wastestream Survey Form (Profile)
The Heritage Research Group PFAS Initiatives

• The Heritage Group owns and operates a private Research Group in Indianapolis.

• Recognizing incineration is a temporary solution, one of the studies is focused on the removal of PFAS at the site level immobilization.
The Heritage Research Group PFAS Initiatives

• Research is currently underway for Immobilization and Stabilization technologies for soil

• www.thgrp.com
Questions?

Pete Long
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Thank you for your time!
PFAS Reporting Under TRI and Toxics Use Reduction Efforts

Heather Tenney

TURA Program Manager
Massachusetts Toxic Use Reduction Institute
PFAS Chemicals, Uses, and Compliance Obligations

Environmental Business Conference
July 14, 2020

Heather Tenney – Toxics Use Reduction Institute
TURA

Toxics Use Reduction Act passed in 1989

Requires *certain facilities* using *certain chemicals* to report their chemical use, byproduct, and emissions and plan to reduce them.
Certain Chemicals and Facilities

- TURA chemical list originally started with TRI and CERCLA
- NAICS codes are primarily manufacturing with some additions
- Ten employee threshold
- Thresholds generally 25,000 lbs for Manufactured and Processed, 10,000 for otherwise used, unless HHS or PBT
Goals of TURA

1. **Statewide goal of reducing toxic waste generated by fifty percent (50%) by the year 1997**

2. Sustain, safeguard and promote the competitive advantage of Massachusetts businesses

3. Promote reductions in the production and use of toxic and hazardous substances

4. Enhance and strengthen the enforcement of existing environmental laws

5. Establish TUR as the preferred means for achieving compliance with any federal or state law or regulation pertaining to toxics

6. Promote coordination and cooperation between all state departments and agencies administering toxics-related programs.
TURA Filers, Individual Chemical Reports, and Different Chemicals Reported (1990-2018)
New TRI PFAS Reporting requirements

• Section 7321 of the National Defense Authorization Act for Fiscal Year 2020 (P.L. 116-92) (NDAA) added 172 Per- and Polyfluoroalkyl Substances (PFAS) to the Toxics Release Inventory (TRI) list.

• These chemicals are subject to TRI reporting requirements for Reporting Year 2020, with **TRI reporting forms due by July 1, 2021.**
Reporting threshold for each substance = 100 lbs

<table>
<thead>
<tr>
<th>CASRN</th>
<th>TRI Chemical Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>307-35-7</td>
<td>Perfluorooctylsulfonil fluoride</td>
</tr>
<tr>
<td>307-55-1</td>
<td>Perfluorododecanoic acid</td>
</tr>
<tr>
<td>335-66-0</td>
<td>Octanoyl fluoride, pentadecafluoro-</td>
</tr>
<tr>
<td>335-67-1</td>
<td>Perfluorooctanoic acid</td>
</tr>
<tr>
<td>335-71-7</td>
<td>1-Heptanesulfonil fluoride, 1,1,2,2,3,3,4,4,5,5,6,6,7,7-pentadecafluoro-</td>
</tr>
<tr>
<td>335-76-2</td>
<td>Perfluorodecanoic acid</td>
</tr>
<tr>
<td>335-95-5</td>
<td>Sodium perfluoroctanoate</td>
</tr>
<tr>
<td>355-46-4</td>
<td>Perfluorohexanesulfonic acid</td>
</tr>
<tr>
<td>375-95-1</td>
<td>Perfluorononanoic acid</td>
</tr>
<tr>
<td>376-06-7</td>
<td>Perfluorotetradecanoic acid</td>
</tr>
<tr>
<td>376-14-7</td>
<td>2-[Ethyl[[heptadecafluoroctyl]sulfonil]amino]ethyl methacrylate</td>
</tr>
<tr>
<td>376-27-2</td>
<td>Methyl perfluoroctanoate</td>
</tr>
<tr>
<td>383-07-3</td>
<td>2-[Butyl[[heptadecafluoroctyl]sulfonil]amino]ethyl acrylate</td>
</tr>
<tr>
<td>423-82-5</td>
<td>2-[Ethyl[[heptadecafluoroctyl]sulfonil]amino]ethyl acrylate</td>
</tr>
</tbody>
</table>
NDAA - TRI:
Chemicals that met two criteria:

They were subject to a significant new use rule at either 40 CFR 721.9582 or 721.10536 on or before December 20, 2019; and

They were identified as active in commerce on the Toxic Substances Control Act (TSCA) Inventory that was published in February 2019.
NDAA-TRI
Chemicals specifically identified

- PFOA (335–67–1) and salts (3825–26–1, 335–95–5, and 68141–02–6)
  - Note: PFOA has de minimis of 0.1%, all others are 1.0%
- HFPO-DA “GenX” (13252–13–6) and salt (62037-80-3)
- PFNA (375-95-1)
- PFHxS (335-46-4)
Additional Substances and Provisions

- Provisions for EPA to evaluate several other ethers and shorter chain substances within 2 years
- All CBI claims must be re-substantiated (2 years)
- Revisit thresholds within 5 years
Reporting threshold and de minimis

- Reporting thresholds are 100 lbs
- De minimis is 0.1% for PFOA
- De minimis is 1% for all others
Industrial Codes Covered under TRI

• Solid Waste Landfills and Solid Waste Combustors and Incinerators covered only for facilities regulated under RCRA Subtitle C

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TRI PFAS **SHALL** Be Added to TURA

• TRI PFAS will be reportable under TURA the year after TURA regulations are finalized – no earlier than reporting year 2021

• How to determine reporting obligations
  – Best engineering estimates
  – Emission and ash analytical sampling
  – Conditions for full destruction in incinerators is under study
    • Preliminary data: Effective destruct at Incinerator temps ~1000°C with ≥ 2 sec residence time (Yamada, 2005, Taylor 2014)
What products use these substances?

• Water and stain resistant fabrics and textiles
• Water and stain resistant paper, food contact paper and paperboard
• Fire fighting foam
  – municipal fire departments, airports and military bases
• Metal finishing
  – mist suppressants
• Lubricants
• Plastics, coatings
What is the TURA Program doing about PFAS?

- SAB reviewed since 2016
- Draft Policy Analysis presented to Advisory Committee and Administrative Council
- Provided training for companies on where to look for PFAS
- Connecting grants and academic research where possible
- OTA is working with POTWs in support of EPA and DEP efforts to protect drinking water supplies and identify potential sources of PFAS in those supplies
- Participate in interstate Biosolids efforts
Science Advisory Board Recommendation

• Recommendation for listing a category of chemicals defined as “those PFAS that contain a perfluoroalkyl moiety with three or more carbons (e.g., $-C_nF_{2n}-$, $n \geq 3$; or $CF_3-C_nF_{2n}-$, $n\geq2$) or a perfluoroalkylether moiety with two or more carbons (e.g., $-C_nF_{2n}OC_mF_{2m}-$ or $-C_nF_{2n}OC_mF_m-$, $n$ and $m \geq 1$)”.

• The definition was crafted based on SAB’s:
  – Review and recommendation to list individual PFAAs and their salts (PFNA, PFOA, PFHpA, PFHxA, PFBA, PFOS, PFHxS, PFBS, GenX, and PFPAs and PFPiAs),
  – Review of OECD methodology and PFAS list, and
  – Evaluation of the degradation/transformation of precursors to PFAAs.
Process after SAB’s Recommendation

Policy Analysis

Advisory Committee

Administrative Council

Regulatory package for public review
Big Picture
Thank you

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Toxics Use Reduction Institute
University of Massachusetts Lowell
Moderated Discussion

Moderator: Gretchen Carey

Program Co-Chair

Recycling & Organic Coordinator, Republic Services