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Emerging Contaminants in Leachate – A Sticky Situation

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Emerging Contaminants

- Focus:
  - Perfluorinated compounds (PFCs)
  - 1,4-dioxane
- Background
- Issues
- Sampling and Analysis
- Properties
- Treatment

NYSDEC and Emerging Contaminants

- Part 363 Expanded Parameter List
  - Per- and polyfluoroalkyl substances
  - 1,4-dioxane
  - Required for existing water quality – first event
  - 363-4.6(f)9(i)(b)6 – potential off-site testing
- NYSDEC statewide PFC survey
- Why you should care

Perfluorinated Compounds (PFCs)

- Compounds that resist heat, oil, stains, grease, and water
- PFAS – Per and Polyfluorinated Alkyl Substance – General term
- Most widely known:
  - Perfluorooctanoic Acid (PFOA)
  - Perfluoroctane Sulfonic Acid (PFOS)
- Where will you find these?

Everywhere

- Fire-fighting foam
- Water repellent clothing
- Carpeting
- Furniture
- Adhesives
- Food packaging
- Paints and varnishes
- Non-stick cookware
- Personal care products
- Cleaning products

200+ Perfluorinated Alkyl Substances

PFC Contamination

- City of Newburgh, NY – PFOS from airport fire-fighting foam
- Village of Harriman, NY – PFOA/PFOS in groundwater supply
- Town of Petersburgh, NY – PFOA in water supply
- Hoosick Falls, NY – PFOA in water supply and private wells

PFCs in Landfill Leachate

- Closed Coakly Landfill, New Hampshire
- Closed Washington County Landfill, Minnesota
- Pine Bend Landfill, Minnesota
- Canadian Study – 28 Landfills, Almost all had PFCs
- Just scratching the surface

Testing – EPA Method 537

- N-ethyl perfluorooctanesulfonamidoacetic acid (NEtFOSAA)
- N-methyl perfluorooctanesulfonamidoacetic acid (NMeFOSAA)
- Perfluorobutanesulfonic acid (PFBS)
- Perfluorodecanoic acid (PFDA)
- Perfluorododecanoic acid (PFDoA)
- Perfluoroheptanoic acid (PFHpA)
- Perfluorohexanesulfonic acid (PFHxS)
- Perfluorohexanoic acid (PFHxA)
- Perfluorononanoic acid (PFNA)
- Perfluorooctanesulfonic acid (PFOS)
- Perfluorooctanoic acid (PFOA)
- Perfluorotetradecanoic acid (PFTA)
- Perfluorotridecanoic acid (PFTrDA)
- Perfluoroundecanoic acid (PFUnA)

Regulatory Status

- NY no water quality standards
- USEPA – 70 ppt lifetime health advisory level, combined PFOA and PFOS
- DWQI – 14 ppt PFOA MCL recommendation
- NJDEP – 10 ppt PFNA interim GWQS
- MN Guidance – 35 ppt PFOA
  27 ppt PFOS

Perspective on PPT Levels

- 10 PPT
- 1 oz by weight in 3,125,000 tons

Sampling - What to Avoid

- Teflon or other fluoropolymer tubing or pumps
- Passive diffusion bags
- Low density polyethylene
- Decon 90
- Chemical ice packs
- Waterproof paper or field books
- Plastic clipboards
- Sharpie markers
- Water resistant clothing
- Tyvek
- Fabric softener
- Sunscreen, cosmetics, etc.
- Aluminum foil
- Pre-packaged food

Properties

- Soluble – PFOS, 370 mg/L

  PFOA, 9,500 mg/L
- Partitioning varies – range: VOCs to PAHs
- Stable, breakdown slowly
- Breakdown products: PFOS and PFOA
- Bioaccumulate

PFCs Treatment

- Sorb to GAC
  - Conventional pump and treat
  - In-situ (e.g., PlumeStop®)
- Chemical Oxidation – strongly oxidizing only
- Biodegradation - resistant

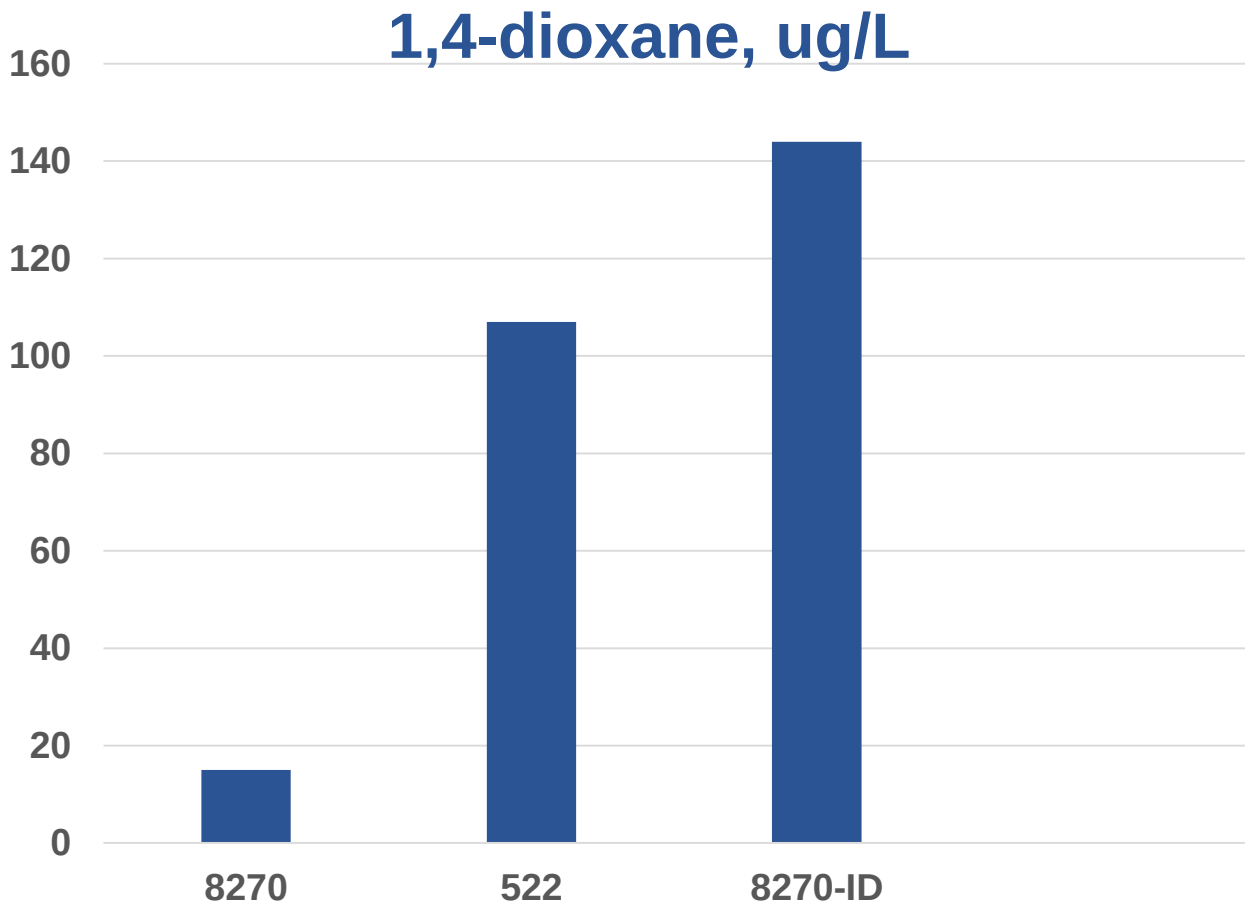
1,4-dioxane

- Commonly a stabilizer for chlorinated solvents
- Found in
  - Paint strippers
  - Dyes
  - Greases
  - Antifreeze
  - Deodorants
  - Shampoos
  - Cosmetics
- By-product of PET manufacture/recycle
- High probability of being in leachate

1,4-dioxane Chemical Analysis

- EPA Method 8260, volatiles
- EPA Method 8270, semi-volatiles
- EPA Method 522, drinking water
- EPA Method 8270 or 522
  - With isotope dilution

Analytical Method Results Vary



Recommend EPA Method 8270-SIM with Isotope Dilution

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1,4-dioxane Regulatory Status

- NY does not have water quality standards
- USEPA – 0.35 ug/L risk based level
- NJDEP – 0.4 ug/L groundwater standard
- MA – 0.3 ug/L drinking water guideline

1,4-dioxane Properties

- Miscible
- Not very volatile
- Not very biodegradable
- Difficulties with chemical analysis
  - Difficult to extract

Treatment

- Not Carbon
  - Typical adsorption – 5-70 ug/g
  - Compare, benzene – 7,800 ug/g
- Not Air Stripping
- Chemical Oxidation – High Oxidation Potential
  - Persulfate
  - Peroxide
  - Ozone
- Resin (Ambersorb 560®)
- Biodegradation

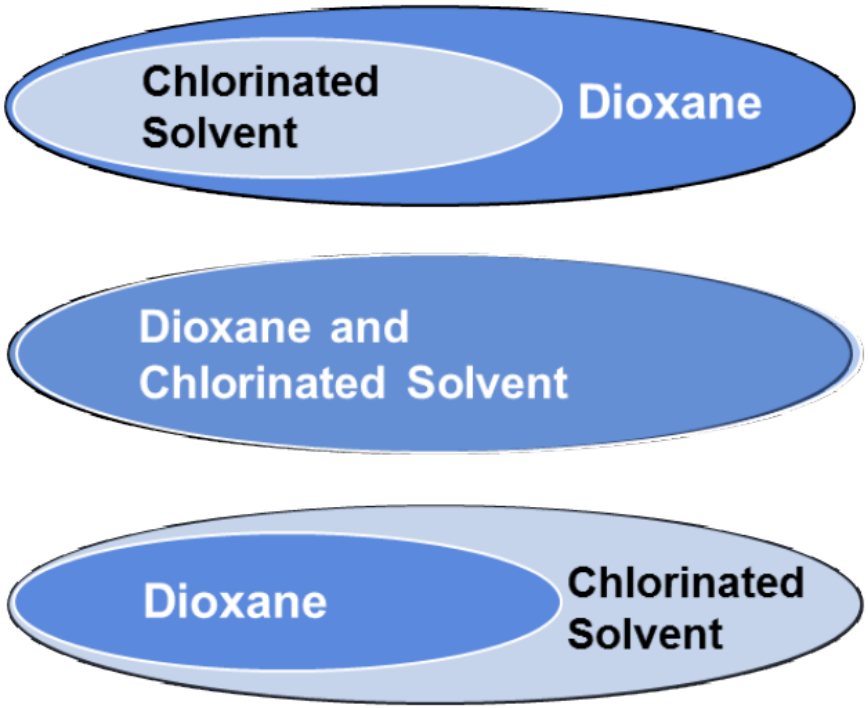
Treatment (continued)

- Biodegradation
  - Originally thought to not occur
  - Oxygen
  - Pseudonocardia dioxanivorans
  - Monooxygenase enzymes
  - Co-metabolism (e.g., tetrahydrofurans, propane)

1,4-dioxane Plumes

- Conventional thinking
  - 1,4-dioxane leading edge
  - Plumes are large and dilute
  - Solvents in the main part of a plume

California/US Air Force Study



Dioxane plume is longest = 21%

Dioxane plume is same length = 23%

Chlorinated solvent plume is longest = 56%

n = 105 sites where dioxane and chlorinated solvents co-occur

Source: SERDP ER-2307, May 2017

What does it all mean?

- PFCs and 1,4-dioxane are common
- Existing water quality testing – probable occurrence
- Off-site investigation potential
- Likely present in leachate
- Pretreatment requirements for leachate to POTW
- Testing and treatment for local discharge of leachate

Thank You and Questions

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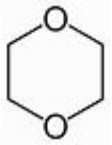

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