Options for Managing Per and Polyfluorinated Substances (PFAS) in Landfill Leachate, Fire Water and other Wastewaters

AWMA Southern Section

Callaway Gardens, Pine Mountain, GA

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Presented by Frank Marine, Texas Molecular

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Background

- PFAS is and has been used in a wide variety of applications based on the superior physical and chemical properties.
- PFAS is a generic name for hundreds of individual fluorinated compounds including subgroups such as PFOS, PFOA, Gen-X and others.
- Some of their advantages of these compounds were their major drawback. They do not degrade and they accumulate in the tissue of living animals. Some level of PFOS and PFOA have been found in almost all people tested.
- PFAS have potential for lingering problems due to the extremely low thresholds for regulation (parts per trillion).
- It is valuable to review the various strategies and options for compliant and cost effective management of residual PFAS from process and site legacy

Glossary of Terms

- HA, Health Advisory
- MCL, Maximum Concentration Levels
- UCMR, Unregulated Contaminant Monitoring Rule
- PFAS. Thousands of Per- and Polyfluorinated Alkyl Substances. Common PFAS in regulatory discussion:
  - PFOA, Perfluorooctanic Acid
  - PFOS, Perfluorooctanesulfonic Acid
  - PFNA, Perfluoroonanoic Acid
  - PFHpA, Perfluoroheptanoic Acid
  - PFHxS, Perfluorohexanesulfonic Acid
  - PFBS, Perfluorobutanesulfonic Acid
  - Gen X, Hexafluoropropylene Oxide Dimer Acid and its Ammonium Salt

Agenda

- Uses of PFAS
- Major Sources of Wastewater with PFAS
- Current Regulatory Situation
- Options to Manage PFAS
- Options to Manage PFAS Treatment Residuals
- Considerations for Selecting an Option
- References
- Questions

Uses Of PFAS

- Coatings on fabrics, paper, wood – non-stick, moisture, stain, chemical barrier
  - » Carpets
  - » Outdoor goods
  - » Clothing
  - » Specialty coatings
  - » Food packaging
- Lubricants –chemical and heat resistance
- Cookware – non-stick, heat resistance
- Fire Fighting Foams – film forming, heat stability, chemical resistance
- Chrome plating – mist suppression, chemical resistance

Sources of Wastewater with PFAS

- Chemical plants using PFAS in production of their product
- Users of fire fighting foams containing PFAS
  - Military
  - Airports
  - Chemical Plants and Refineries
- Plating companies. Legacy from use of PFOA and PFOS for mist suppression in Chromic Acid plating. PFOA and PFOS mist suppression were completely banned in 2015 after several years of voluntary action. **Note: These compounds were recommended by EPA in 1995.**
- Landfill Leachate

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Current Regulatory Situation

- Regulatory situation is not established, but direction is moving toward strict regulations.
- PFAS found in, or threatening drinking water is driving regulations
- EPA is in the process of setting discharge and water quality standards, e.g. Maximum Contaminant Level (MCL). Final standards may be a few years away.
- EPA has set a non-enforceable health advisory of 70 ppt for PFOS and PFOA.
- Unregulated Contaminant Monitoring Rule (UCMR) is expected to add more PFAS compounds when updated.
- There are concerns that some PFAS have a link to a whole host of diseases, cancers, and other conditions. Additional studies are underway for additional PFAS.
- States are setting their own standards for drinking water. States with regulations under development with less than 70 ppt include VT, RI, NJ, CA, NH, and NY, and MI.
- Congressional Action: Proposed legislation making PFAS as a Hazardous Substance under CERCLA, bans on cookware and food packaging, and testing of surface and groundwaters for PFAS. These bills have bipartisan sponsorship and support.
- Potential for regulation as a state or even Federal Hazardous Waste (not likely anytime soon).

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Options to Manage PFAS Liquids

- Ion Exchange Resin (IX)
- Granular Activated Carbon (GAC).
- Reverse Osmosis (RO)
- Incineration
- Deepwell Injection
- Landfills
- Other Technologies

Options to Manage PFAS Liquids
Ion Exchange Resin

Advantages

- Fully demonstrated technology with targeted resins for PFAS
- Generally higher adsorption capacity than GAC
- Scalable, capable of managing large water volumes.
- Can be used in combination with GAC.

Disadvantages

- Regeneration fluid or single use requires off-site disposal or incineration.
- Multiple species of contaminents can reduce efficiency.
- May not remove all PFAS compounds

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Options to Manage PFAS Liquids Granular Activated Carbon (GAC)

Advantages

- Demonstrated option for PFAS removal
- Better for PFAS with greater than 6 carbon atoms
- Scalable, can manage large volumes of water.
- Source of GAC is important
- Can be used with other technologies

Disadvantages

- Break through risk.
- Requires regeneration or incineration of spent GAC
- Multiple species can reduce efficiency of GAC

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Options to Manage PFAS Liquids
Reverse Osmosis (RO)

Advantages

- A partially developed technology to remove PFAS from water.
- Scalable, can manage large volumes of water.
- May be better for 6 carbon chain PFAS.

Disadvantages

- High concentration RO reject stream may require off-site treatment.
- Non-target compounds may increase corrosivity.

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Options to Manage PFAS Liquids Incineration

- Advantages
  - Best for solids, sludges, and wastes not amenable to other technologies
  - Provides destruction of PFAS at elevated temperatures
- Disadvantages
  - Risk of incomplete combustion. May require high temperatures found in RCRA incinerators
  - Limited capacity for liquids
  - Cost vs. other options

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Options to Manage PFAS Liquids Hazardous Underground Injection

Advantages

- No discharges to water
- Meet potential regulation as a hazardous waste or hazardous substance today.
- Constituent level and variety are generally not an issue.
- Large capacity
- No CAPEX
- Lower cost vs. incineration

Disadvantages

- Transportation cost to disposal site.
- Potentially cost effective in up to 5 to 10 million gallons per year.

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Options to Manage PFAS Liquids Landfill

Advantages

- Locations near generating sites could result in overall lower off-site cost.

Disadvantages

- Risk to PFAS in landfill leachate.
- Limits on volume of water waste.
- Risk of future regulation
- Adds to risk of PFAS in leachate

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Options to Manage PFAS Liquids
Other Options

- Biochar. Partially demonstrated technology.
- Other absorption technologies. Partially developed.
- Precipitation, Flocculation, Coagulation. Lab/bench scale testing.
- Nanofiltration. Partially developed.
- Redox Manipulation. Lab/bench scale testing.

Options to Manage PFAS Liquids Treatment Residues

- Ion Exchange Resins
  - Single Use. Incineration in RCRA Incinerator
  - Liquid Regeneration Residue. Incineration in a RCRA Incinerator or injection in a Hazardous Waste Underground Injection facility
- Granular Activated Carbon
  - Regeneration
  - Single Use. Incineration in a RCRA Incinerator
- Reverse Osmosis
  - RO Reject Stream. Incineration in RCRA incinerator or injection in an Underground Injection facility.

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Considerations for Selecting an Option (General)

- Volumes:
  - > 5 million gallons/year generally favor on-site options.
  - < 5 million gallons/year. Off-site options may become competitive
- Distance to off-site options.
- Concentrations:
  - High concentrations. Adds to cost for on-site options.
- Segregate sources of high PFAS
- Contaminents:
  - Multiple contaminents add to cost of on-site options.
  - Technology may not be effective all PFAS
- Future Regulations.
  - Does the technology meet potential future regulations?
- Discharge Risk:
  - Off-site options are considered on a cost/benefit basis.

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References

- Interstate Technology Regulatory Council, ITRC. https://www.itrcweb.org/wp-content/uploads/2018/03/pfas_fact_sheet_remediation_3_13_18.pdf
- National Association for Surface Finishing, NASF. https://nasf.org/pfas/pfas-in-surface-finishing/
- **USEPA. EPA's Per- and Polyfluorinated Substances (PFAS) Action Plan, EPA 823R18004, February 2019.**
- **Association of State Drinking Water Administrators (ASDWA). www.asdwa.org/PFAS**

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Questions

Thank You!

Frank Marine, President, Texas Molecular

281-222-6641

fmarine@texasmolecular.com,

www.texasmolecular.com

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