Field-Scale Thermal Treatment

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Destruction & Disposal

Data Gap: Knowledge regarding end-of-life management and ultimate disposal of PFAS-containing materials

Actions:

- Characterize end-of-life PFAS disposal streams (e.g., municipal, industrial, manufacturing, recycled waste streams)
- Evaluate efficacy of disposal/destruction technologies (e.g., landfilling, incineration, *in situ* stabilization) to manage end-of-life disposal
- Evaluate possibility of products of incomplete combustion/destruction

Research Products:

- PFAS presence in different types of landfills and leachates
- PFAS behavior in incineration environments
- Thermal treatment of PFAS-contaminated biosolids

Impact: Responsible officials will be able to effectively manage end-of-life disposal of PFAS-containing materials

Treatment Types

- Incineration
  - Sewage sludge
  - Municipal waste
  - Hazardous waste
- Pyrolysis/gasification
- Granular activated carbon (GAC) reactivation
- Thermal desorption
  - soil

Sewage Sludge Incineration

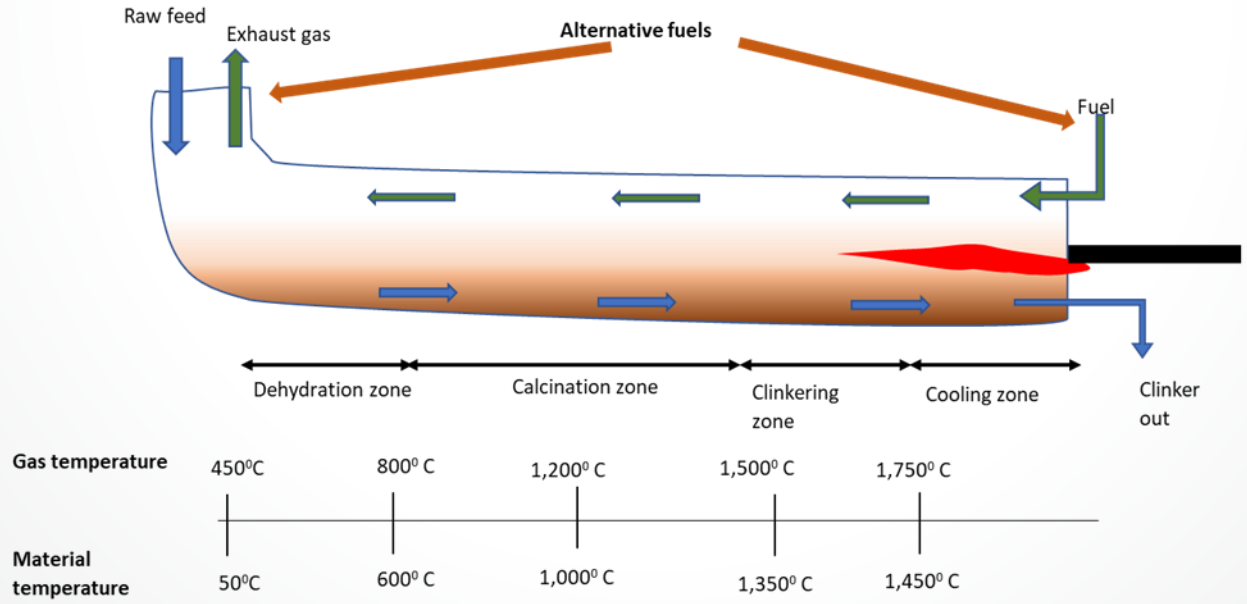
- **Currently 17% of wastewater treatment residuals are incinerated, but % may grow due to public concern & regulation**
- Site: R7 wastewater treatment plant (WWTP)
  - Full-scale sludge incinerator (details on next slide)
- Site: Hazen Research Inc.
  - Private lab with large-scale incinerators
  - Sampling event in Nov ‘21 to evaluate PFAS fate in sewage sludge incineration
- Site: R3 WWTPs
  - Preliminary screening at 5 facilities for 2022 large-scale sampling events

Site: R7 WWTP

- **Goal:** determine PFAS fate during wastewater treatment and sewage sludge incineration
- **Action:** Sampling event in Aug ‘21 to sample solids/liquids along treatment process and gas-phase emissions from sludge incineration
  - Targeted analysis for most common PFAS compounds
  - Non-targeted analysis for products of incomplete combustion (PICs)
  - Further develop sampling methods
- **Impact:** waiting on analytical results, serves as a model for future studies

Municipal & Hazardous Waste Incineration

- Critical area for thermal treatment of PFAS
- Currently contacting and building connections with full-scale facilities
- Sampling plan would be similar to sewage sludge incinerator

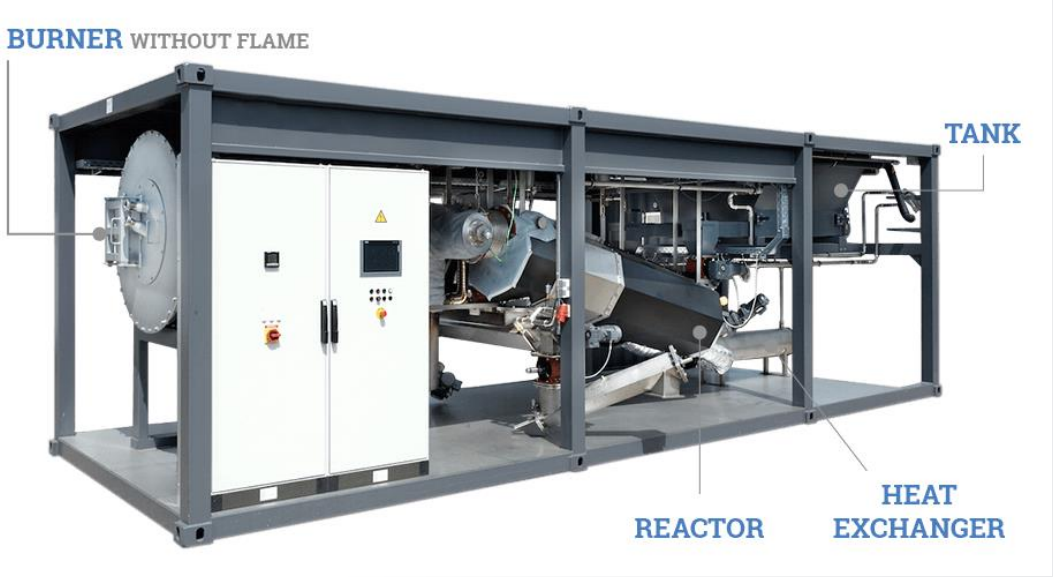


Pyrolysis/Gasification

- **Treatment at a range of temperatures in the absence of oxygen**
  - Typically produces material for beneficial reuse, such as biochar or syngas
- Site: BioForceTech gasification plant in Redwood City, California
  - Preliminary sampling as part of the PFAS Innovative Treatment Team (PITT)
  - Planning for a larger sampling event
- Searching for additional facilities

Pyrolysis of Biosolids

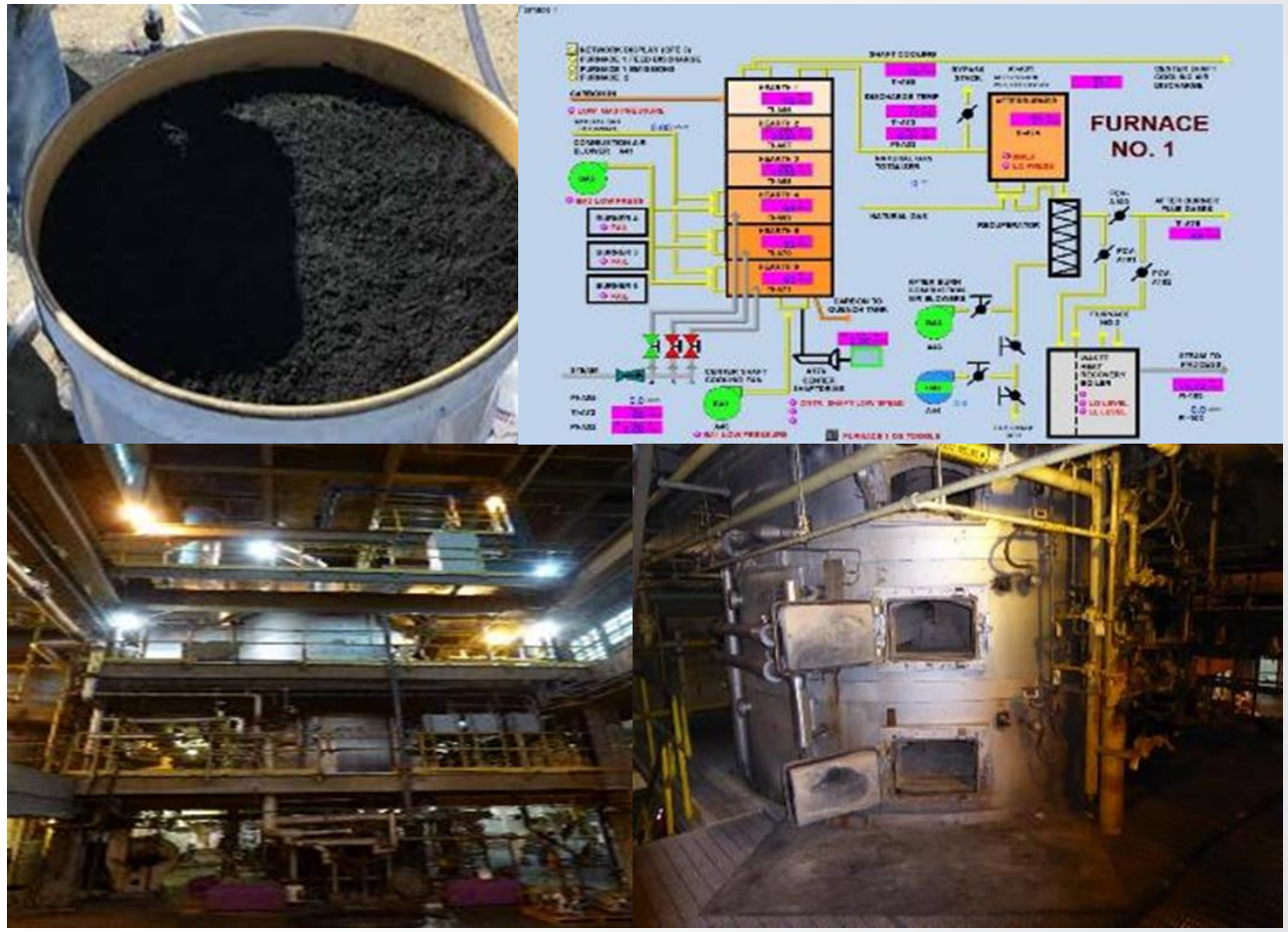
- San Francisco, CA field study with BioForceTech conducted in 2020
- Facility not known to be impacted by PFAS (chosen for operating tech)
- FTIR analysis for fluorine in gas-phase (no tracer used)
- Analyzed PFAS in influent (biosolids) and effluent (biochar)
- Manuscript accepted at Journal of Air & Waste Management's EM (2021)



Source: https://www.bioforcetech.com/

Granular Activated Carbon (GAC) Reactivation

- **GAC used in drinking water treatment for PFAS removal, then either incinerated or reactivated for repeated use**
- Site: Hazen Research Inc.
  - Private lab with large-scale thermal systems
  - Sampling event in Nov ‘21 to evaluate PFAS fate during GAC reactivation
- Searching for additional facilities (ideally on-site GAC reactivation at a drinking water treatment plant)



Thermal Desorption (soil)

- **Low temperature treatment to remove volatile species while limiting destruction to the sample matrix**
- Site: Moose Creek, AK
  - Develop OTM-45 method for collecting PFAS from gas-phase emissions

Contributors

- Sewage sludge incineration (R7): CESER, CEMM
- Sludge incineration/GAC reactivation: CESER, CEMM, Hazen Research Inc.
- Pyrolysis: CESER, CEMM, BioForceTech

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