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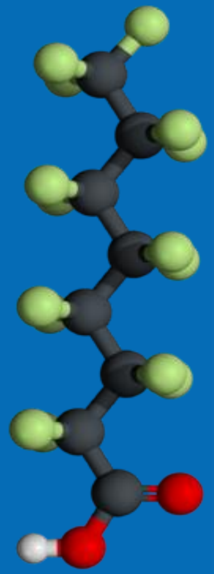
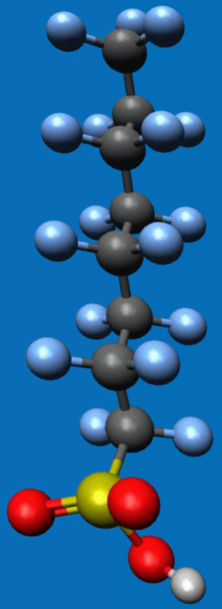


EPA PFAS INNOVATIVE TREATMENT TEAM (PITT) FINDINGS ON PFAS DESTRUCTION TECHNOLOGIES



Tim Watkins
Acting Director, Center for Public Health and Environmental Assessment
US EPA Office of Research and Development

BOSC Executive Committee Meeting
September 30, 2021

Outline

- Summary of the PFAS Innovative Treatment Team (PITT)
  - Concept
  - Goals
  - Approach
  - Results
- PITT Experiences Working in Communities

PFAS Innovative Treatment Team (PITT)

- Full-time team of multi-disciplined EPA research staff
- Focused efforts and expertise on a single problem: **how to remove, destroy, and test PFAS-contaminated media and waste**
- For 6 months, the PITT worked to achieve the following goals:
  - Assess current and emerging destruction methods being explored by EPA, universities, other research organizations and industry
  - Explore the efficacy of methods while considering byproducts to avoid creating new environmental hazards
  - Evaluate methods’ feasibility, performance and costs to validate potential solutions

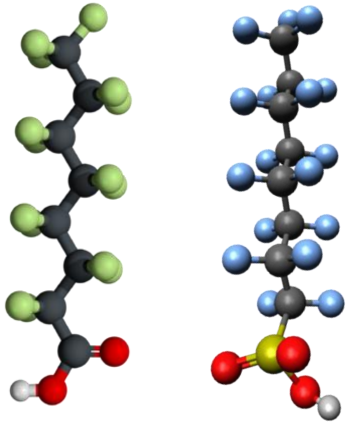
PITT Goals

- Develop a “Toolbox” of reviewed solution(s) for the destruction of PFAS in media and contaminated waste to meet the needs of EPA programs and regions, states and tribes, federal agencies, and industry
  - Traditional (combustion) destruction
    - Temperature and time conditions for C-F bond breakage
    - Performance of flue gas cleaning systems
    - Analysis of byproducts
  - Innovative (high risk), non-traditional approaches
    - Destruction performance
    - Byproducts

- Provide decision makers with state of the science data on incineration effectiveness enabling them to better manage end-of-life disposal of PFAS-containing materials

PFAS Sources Considered

- Biosolids, sludge
- Aqueous film forming foam (AFFF)-contaminated soils
- AFFF concentrate, spent AFFF
- Municipal Waste Combustors (MWCs), landfills, landfill leachate
- Spent granular activated carbon (GAC), anion exchange resins



Non-Combustion Technologies Selected

- Chemical
- Biological
- Plasma
- **Mechanochemical**
- Sonolysis
- Ebeam
- UV
- **Supercritical water oxidation**
- Deep well injection
- Sorption/stabilization
- **Electrochemical**
- Landfill
- Land application
- **Pyrolysis**

Technologies selected for further investigation

Assessment Factors:

- Technology readiness
- Applicability
- Cost
- Required development remaining
- Risk/reward of technology adoption

Assessment Methods:

- Subject matter expert discussions
- Literature reviews
- PITT discussions

PITT Introductory Paper on Four Innovative Technologies Studied

- PFAS problem
- 5 waste characteristics
- 4 innovative technologies
- Crosswalk of wastes and technologies
- Technology readiness level

Phase	TRL	Description
Research	1	Basic Principles observed
	2	Technology concept formulated
	3	Experimental proof of concept
Development	4	Technology validated in lab
	5	Technology validated in relevant environment
	6	Technology demonstrated in relevant environment
Deployment	7	System prototype demonstration in operational environment
	8	System complete and qualified
	9	Actual system proven in operational environment

https://www.twi-global.com/technical-knowledge/faqs/technology-readiness-levels

TRLs of Technology & PFAS Matrices

	Electrochemical Oxidation	SCWO	Mechanochemical degradation	Pyrolysis
Spent GAC / AEX	TRL 4[1] (GAC Only)	N/A [11]	TRL 2 [9,11]	TRL 1[11]
Soils	TRL 1[2]	N/A [11]	TRL 5/6[9]	TRL 1[11]
Biosolids / Sludges	N/A [11]	TRL 6[5]	TRL 1[11]	TRL 7[10]
Spent and unused AFFF	TRL 4/6[1, 3]	TRL 7[5-8]	TRL 3/4[9]	N/A [11]
Landfill Leachate	TRL 4[4]	TRL 4[7]	N/A [11]	N/A [11]

BASIS

[1] AECOM
[2] Skinn 2019
[3] Schaefer et al 2019
[4] Pierpaoli et al 2020
[5] 374Water
[6] General Atomics
[7] Aquarden
[8] Battelle
[9] EDL
[10] BioForceTech
[11] PITT

PITT Research Briefs

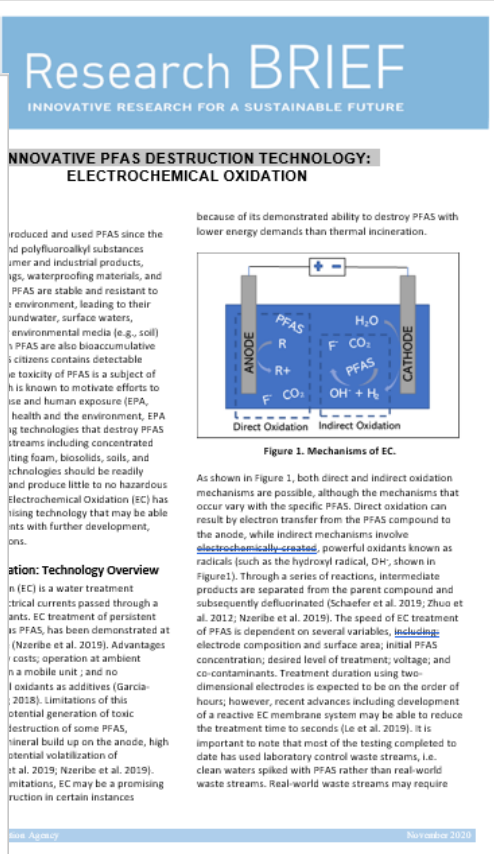
https://www.epa.gov/chemical-research/pfas-innovative-treatment-team-pitt

Research BRIEF

INNOVATIVE RESEARCH FOR A SUSTAINABLE FUTURE

INNOVATIVE PFAS DESTRUCTION TECHNOLOGY: SUPERCRITICAL WATER OXIDATION

SCWO

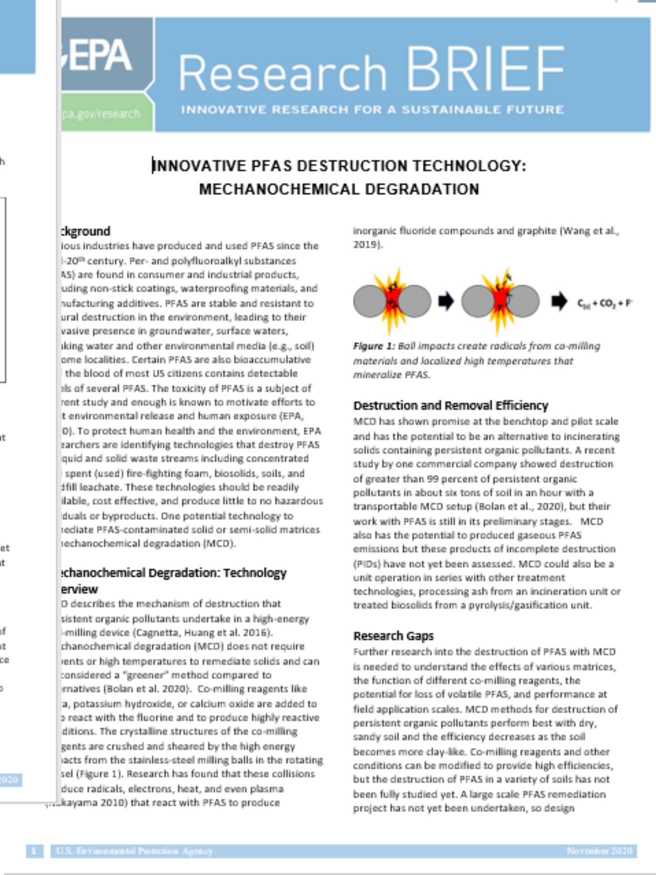


Research BRIEF

INNOVATIVE RESEARCH FOR A SUSTAINABLE FUTURE

INNOVATIVE PFAS DESTRUCTION TECHNOLOGY: ELECTROCHEMICAL OXIDATION

Electrochemical Oxidation



Research BRIEF

INNOVATIVE RESEARCH FOR A SUSTAINABLE FUTURE

INNOVATIVE PFAS DESTRUCTION TECHNOLOGY: MECHANOCHEMICAL DEGRADATION

Ball Milling

Research BRIEF

INNOVATIVE RESEARCH FOR A SUSTAINABLE FUTURE

INNOVATIVE PFAS DESTRUCTION TECHNOLOGY: PYROLYSIS AND GASIFICATION

Pyrolysis & Gasification

Summary of PITT Findings and Accomplishments

- The PITT was successful in significantly accelerating research to evaluate "traditional" thermal treatment of PFAS waste and catalyzing research to identify and evaluate potential innovative approaches for PFAS waste treatment.

- Preliminary results in laboratory and pilot-scale treatment systems demonstrate up to 99% loss of the initial PFAS compounds in the contaminated waste.
  - Still unknown, however, is what PFAS byproducts, if any, are formed.

- PITT efforts also drove the development of new PFAS measurement methods to be used to characterize air emissions sources and evaluate efficacy of PFAS destruction/removal technologies
  - Stationary source air emissions test method - Other Test Method 45 (OTM 45)

- PITT scientists contributed to recently released EPA "Interim Guidance on Destroying and Disposing of Certain PFAS and PFAS-Containing Materials That Are Not Consumer Products"
  - https://www.epa.gov/pfas/interim-guidance-destroying-and-disposing-certain-pfas-and-pfas-containing-materials-are-not

Building Upon the PITT

- Continue laboratory and pilot-scale research and development efforts on:
  - Non-combustion, innovative technologies
  - Thermal/combustion technologies
- Identify potential fluorinated byproducts formed during the application of these treatment approaches (non-target compound analyses)
- Exploring opportunities for field sampling at industrial and utility facilities
  - Wastewater Treatment/Sewage Sludge Incineration
  - Municipal Waste Combustion
  - Hazardous Waste Incineration

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PITT Experience with Working in Communities

United States Environmental Protection Agency

PITT Experiences with Working in Communities

- The PITT attempted two field studies to evaluate PFAS treatment/destruction technologies
  - Municipal Waste Combustor facility in Rahway NJ – cancelled due to community concerns
  - Pyrolysis Biosolids Treatment facility in Redwood City CA – completed but with reduced scope

- Communications and Community Engagement
  - Develop communications materials (Desk Statement, Background, Q&As) which were reviewed, edited and approved by ORD, EPA Regions, and Office of Public Affairs.
  - Focused communication on a few key stakeholders, but decision to not communicate widely in advance of testing

- Challenges
  - PITT initiated in April with a 6-month timeline – limited time for community engagement
  - Inaccurate or misinformed coverage from the press

PITT Experiences with Working in Communities

Lessons Learned

- Greater recognition to cumulative impacts in community
- Ensure sufficient time for community engagement and communications
- Consider proactive communications to control key messages
  - Purpose of the study
  - Post study plans and actions
- Strong partnerships are critical
  - EPA Region
  - State
  - Facility

Lessons Learned from PITT experience applied as ORD completed a field study in August at a wastewater treatment plant in Cedar Rapids, IA

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https://www.epa.gov/chemical-research/pfas-innovative-treatment-team-pitt