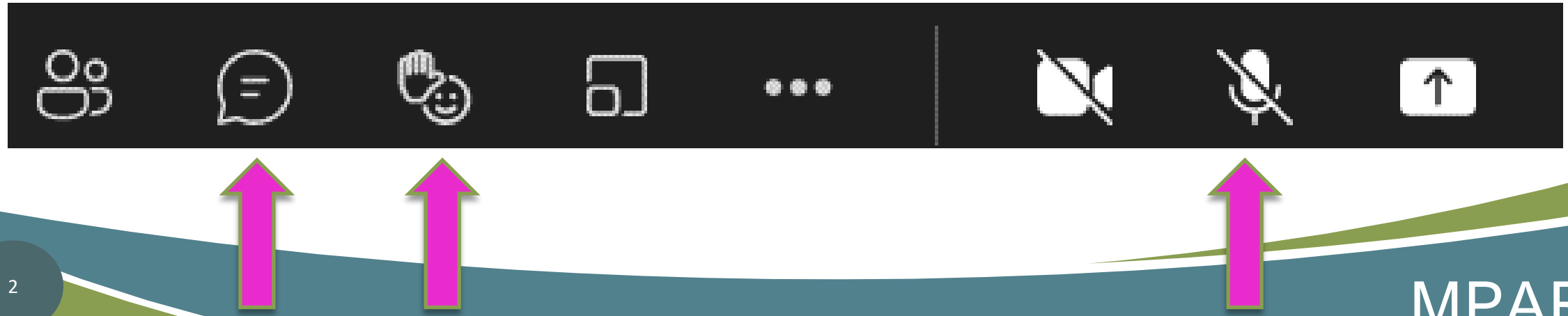
MPART Citizens Advisory Workgroup

June 13, 2023

MPART

Housekeeping

- Please keep your mic/phone muted unless speaking
- Only use the “raise hand” and/or “chat” function for questions or to request to speak
- Cameras are optional
- This meeting is being recorded



MPART

Agenda

- Roll Call – Community Updates
- Subcommittee Updates
- A.J. Birkbeck Memorial
- CAWG Survey Response
- PFAS Remediation Technologies
- MPART Updates
- Future Meeting / Topics

Roll Call and local updates/events/ sharing from communities

CAWG Subcommittee's

- Membership Subcommittee
- Website Review Subcommittee
- Preventative Measures Subcommittee
- Engaging the Public Subcommittee

Moment to Remember
AJ Birkbeck

- Memorial Bench Dedication

Celebrating the Life and Legacy of

AJ Birkbeck

Wednesday, May 31
3:00-5:00 PM
Downtown Rockford
Please see below for more event details

CAWG Member Survey Response

CAWG Member Responses to June, 2023 Survey

1. During recent meetings of the CAWG, MPART/EGLE have suggested that CAWG members do outreach on PFAS information to their communities and possibly neighboring communities. Would you be willing to participate in this type of activity? Is this a role you envision for CAWG members?

Yes –
- I would be willing to do this on a limited basis. It is role that is consistent with our charter, I believe. However, I do not think this should be the CAWG sole role or that the CAWG should abdicate from its advisory responsibilities.
- yes and yes
- Yes, I would be willing to reach out to my local community. I also believe that outreach/education is part of the CAWG mission.
- Yes, I live in Livingston County and I would like to help with outreach.
- Yes, most definitely.
- I have presented PFAS information, and distributed printed materials on PFAS from MDHHS, Ecology Center, EWG and Great Lakes PFAS Action Network to my community several times. I am willing to continue, and support other members also presenting if they choose. However, I find there are drawbacks such as when I am unable to answer questions, and when community members state that if it is that important why isn't the State of Michigan telling us? I am also concerned about how other areas throughout the State will be covered when there are so few CAWG members, and some are not active members.

NO –
- I do not excel at this type of thing – sorry! But others who do would be great if they could!
- This is not a main role. It takes training and a natural gift to communicate well. CAWG members could add their stories to such an effort, but they cannot be relied on for the infrastructure needs of educating and notifying the public. Too much is at stake.

2. Should the CAWG Engaging the Public Subcommittee work on developing the public relations campaign with EGLE/MPART/MDHHS for the community outreach?

Yes –

- There are many ways to engage the public and a PR campaign is one, and I am broadly supportive. However, I don't believe that the subcommittee should abdicate its advisory responsibilities and focus soley on a PR campaign. I do wonder if 'developing' is consistent with our advisory role; we certainly could advise the agencies in this regard.
-yes
-yes
-yes, the outreach would be best served with experts from EGLE/MDHHS and they do want to help.
-yes
-Engaging the Public Subcommittee members could add their perspectives. Without the help of city and municipal leaders, this will be hard to do. We must involve municipalities and media to get this important message out.

- I feel that the Engaging the Public Subcommittee should continue the discussion regarding this outreach campaign but this should be done in conjunction with all involved agency staff including MDHHS. Just as with some past actions that some CAWG members were requested to participate in, I would not want the CAWG to expend considerable time and energy in the process and then not have our input used.

No –
-not sure, no opinion

3. During the April CAWG meeting Daniel Brown suggested that the CAWG have a meeting on our own to free up agency staff while we discuss various topics. Charlie Schlinger also suggested the possibility of a CAWG member-only meeting during the May Engaging the Public Subcommittee meeting. A couple of other members have suggested such a meeting prior to this.
Would you attend a CAWG member-only meeting? Would you be more likely to express your opinion on CAWG issues or your community issues without agency staff present? Are there topics you would like to have discussed if this meeting is set? What would you want the CAWG to accomplish during the meeting? Sandy Wynn-Stelt has stated that she does not want to have a meeting just to have a meeting. What's the purpose? Please offer your thoughts.

Yes –

- I am supportive of the CAWG and subcommittees being able to meet on their own, without oversight or steering on the part of agency staffers. As I have said before, the agency folks are free to get together and discuss CAWG matters whenever they want, and we should be likewise free to do so. I would like for CAWG members to freely discuss what they want to accomplish in their CAWG work. I see objectives of such meetings (as compared to just one meeting) as identifying and discussing prospective agenda topics, discussing progress or the lack thereof on CAWG initiatives, and so on and so forth.
- yes to attending member-only meeting, no different on speaking up if agency staff is present or not, would like frank discussion and evaluate progress during such a meeting, and discuss proposals for EGLE to consider implementing.
- I think it would be a good opportunity for people to be able to speak their minds freely. I would like to have an agenda in place prior to the meeting, however, to ensure we are meeting with resolve and purpose.
- I think it would be invaluable to have CAWG member-only meetings. I do think others are more likely to participate. Building relationships and having a chance to discuss complex issues candidly are good things. We need to be able to think aloud as a member group.
- I agree to a member-only meeting because other active CAWG members have asked for it; and because if we are to continue as a member-led organization we should establish policies, set goals and decide criteria of measuring success.

NO –

- No, I wouldn't attend and it's a silly idea- as divisive as it is useless. "Would you be more likely to express your opinion on CAWG issues or your community issues without agency staff present?" No and I can't imagine anyone would be this cowardly.

- The CAWG doesn't exist without the participation of EGLE/MPART. It's my opinion that we should not be meeting behind closed doors and excluding MPART/EGLE staff from the discussion.
- I agree, unless there is a clear goal for the meeting, I wouldn't attend. I feel comfortable expressing my PFAS concerns around these folks listed above.

4. Concerns, comments, suggestions for future agenda items or presentations you feel would be beneficial to the CAWG or your understanding of PFAS?

- As far as presentations are concerned, a comprehensive review of known medical effects of PFAS on humans and other organisms would be useful, as would a comprehensive review of current known sources of human exposure to PFAS in our society and region (an exposure analysis, for lack of a better term.).
- Stay the course!
- Train CAWG members to get out in the field to take foam, surface water and drinking water samples. We need to find those many other places contaminated by PFAS that are not yet on the radar. We need to memorialize CAWG meetings with typed, transcribed minutes. Otherwise we go in circles. Also, a list of accomplishments. An archive of 'lessons learned'. Establish a Hospitality Committee to welcome and direct new members? Especially those for whom professional meeting is not an everyday occurrence. New members could be looking for emotional/practical support and then instead feel intimidated for those who have a professional background already. Thank you for doing the Survey!
- more updates and local news on Wolverine Worldwide's progress (?) in Rockford with the old tannery site and sole plant. Why doesn't State or regulators crack the whip more and force them to move things along ASAP?
- What current industry settlements mean for Michigan (i.e. dupont et al. just settled 1.2 Billion for impacts to public waters. What does MI get from settlement, etc.
- None currently. Thank you for providing this opportunity to comment.
- I am concerned with the number of CAWG members that never attend meetings, members that may attend but seldom share their thoughts during meetings, or members that may not offer any response to surveys. It is difficult to gauge member outlook on the CAWG or on the citizen-led process without members input.

THANK YOU TO THE MEMBERS THAT PARTICIPATED IN THIS SURVEY!
Members are welcome to continue to send in their survey responses to be added to these results to blanchmary@comcast.net.

Possible Zero Waste Solutions for the Remediation of PFAS

– Emerging Onsite Destruction Technologies

Presented By: Jason Lagowski, CPG

June 13, 2023

Objective of today's presentation

Present a high-level overview of emerging onsite PFAS destruction technologies and how they might be incorporated into a treatment train that results in a "**Zero Waste**" outcome for liquid wastes.

Agenda

- What are PFAS and why are they a problem (brief overview)
- Remediation Approaches (water)
- Emerging PFAS Destruction Technologies
  1. Thermal/Incineration
  2. Electrochemical Oxidation
  3. Super Critical Water Oxidation
  4. Other
- Case Study (treatment train with zero waste outcome)
- Q&A

PFAS - Sources

There are lots of industrial and commercial products that historically and/or currently contain PFAS.

AFFF as a source gets the most media coverage but generally accounts for < 10% of total PFAS source material

Manufacturing

- Aerospace
- Automotive
- Chemical
- Electronics
- Metal Coatings & Plating
- Textiles

Firefighting

- Airports and Aviation Facilities
- Military Bases and Training Centers
- Petroleum Refineries and Terminals
- Petrochemical Production Facilities

Non-industrial

- Waste Disposal Facilities
- Wastewater Treatment Plant Operations
- Biosolids Application for Agriculture

PFAS - Why are they a problem?

- PFAS comprises many thousands of compound from multiple sources
- PFAS have impacted drinking water worldwide, entered the food chain and likely found in most people's blood
- Some PFAS are classes as Persistent Organic Pollutants (POPs) and included in Stockholm Convention
- Media Focus “Forever Chemicals”
- Some but not all PFAS are regulated and have part per trillion cleanup/action criteria
- PFAS are persistent in the environment and don’t biodegrade.
- Some unregulated PFAS (precursors) may biotransform to daughter compounds that are regulated.
- Increasing regulatory concern (US EPA PFAS Strategic Roadmap, potential CERCLA listing)

PFAS - Chemistry

Poly- and Perfluoroalkyl Substances (PFASs)

Polyfluorinated compounds (est. 4,700 compounds)

More Commonly Regulated

Perfluorinated Compounds (PFCs) aka Perfluoroalkyl Acids (PFAAs)
~25 common individual compounds but ~100's compounds
PFOS ,PFOA, PFHxS, PFBA, GenX, Forever chemicals

Biotransformation

PFOS

PFAS - Challenge

MI Maximum Contaminant Levels (**MCLs**)–

- PFOS (16 ppt)
- PFOA (8 ppt)

Its like finding 16 or 8 individual dollar bills in this pile of cash!

Remediation Approaches

Liquid Wastes

Basic Approach to PFAS Containing Liquid Waste Treatment

- **Incineration** (currently prohibited)
- **Adsorption**
  - ❖ GAC, IX Resin, Polymeric Adsorbents and other Polymer products and media
- **Separation & Concentration**
  - ❖ Filtration (RO, NF/UF)
  - ❖ Fractionation (Air, Ozone, DAF)

Note:

Soil Washing produces a liquid waste stream that is likely treated by one of these approaches.

Waste Media Treatment and/or Disposal

- Spent Media (GAC/Resin/other adsorbents) - *Solid Waste*
- Regeneration fluids (for select IX resins)
- Reject Water (RO/UF/NF)
- Concentrate/Super Concentrate (Fractionation)

Note:

Liquid Waste tend to be low volume containing high concentrations of various PFAS compounds.

Fractionation will likely product 0.5% to 1% of input volume concentrate. This can be reprocessed to process a super concentrate (further 90% reduction)

RO typically produces 10% to 30% reject waste

Waste Challenge

- PFAS compounds are recalcitrant by nature and today's remediation technologies don't destroy/degrade PFAS, so waste is likely relocated to offsite treatment/disposal facilities.

- The Good News is that it is possible to break this cycle via new and emerging technologies that at bench and pilot scale have successfully achieved the destruction of PFAS!

Emerging Technologies

Onsite PFAS Destruction evaluated by USA EPA PFAS Innovative Treatment Team (PITT)

Reference Source

US EPA

In Spring 2020, the EPA established the PFAS Innovative Treatment Team (PITT). The PITT was a multi-disciplinary research team that worked full-time for 6-months on applying their scientific efforts and expertise to a single problem: disposal and/or destruction of PFAS contaminated media and waste.

While the PITT formally concluded in Fall 2020, the research efforts initiated under the PITT continue.

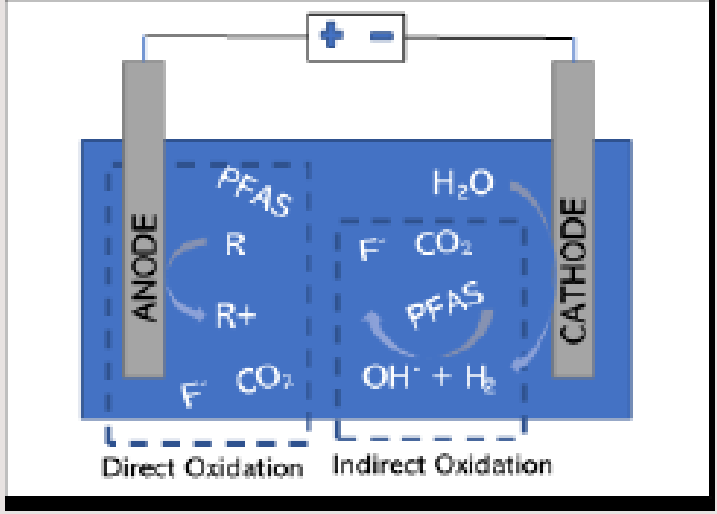
To protect human health and the environment, EPA researchers are **identifying technologies** that can **destroy PFAS** in liquid and solid waste streams, including concentrated and spent (used) fire-fighting foam, biosolids, soils, and landfill leachate. **These technologies should be readily available, cost effective, and produce little to no hazardous residuals or by-products.**

Incineration

A potential disposal method for PFAS waste is high temperature incineration.
Incineration has been used historically as a method of destroying other hazardous waste including PCBs and halogenated organic compounds where sufficient high temperatures and applicable residence times can achieve >99.99% destruction rates.

- Was a commercial technology, but currently prohibited/banned by DOD and some states
- The chemical stability of PFAS makes it difficult to degrade.
- PFAS compounds will likely require higher temperatures and longer residence time to achieve destruction in comparison to other organic pollutants.
- CF4, which is one of the more recalcitrant fluorinated compounds requires temperatures > 1400C.
- Potential for incomplete destruction and generation of shorter chain PFAS compounds.
- Emissions monitoring likely required, with downwind impacts from former incineration facilities identified
- Not mobile

ElectroChemical Oxidation (EC)



EC achieves degradation/destruction of PFAS in water by passing an electrical current through a solution to oxidize pollutants.

Advantages:

- Proven at bench and pilot scale
- Operates at ambient conditions
- No reagents need
- Mobile
- Lower energy demands in comparison to thermal options

Limitations:

- Potential generation of unwanted byproducts
- Incomplete destruction of some PFAS compounds
- Loss of efficiency over time due to mineral build up on anode
- High cost of electrodes and energy

De-Fluoro™

Large Scale Field Demonstration Project of EC in Australia

- Solved some of the limitation of EC
- Modular/scalable system
- Largely agnostic to input concentration
- 98% to100% of regulated PFAS mass reduction
- 90% to 100% Total PFAS Mass reduction
- US Pilot plant to incorporate electrochemical reduction into process

Trial / Sample #	Client Sector	Sample Description	Initial total PFAS concentration (µg/l)	% Mass Reduction (total PFAS) DE-FLUORO™	Initial 'regulated' PFAS concentration (µg/l)	% Mass Reduction (regulated PFAS) - DE-FLUORO™
1	New Zealand Government	Source area groundwater	27	84%	13	98%
2	Chemical Manufacturer	Industrial wastewater	354	100%	310	100%
3	Australian Government	Source area groundwater	455	99%	445	98%
4	Remediation Contractor	IX R – soft wash recipe	1,570	63.6%	54.9	100%
5	Aviation	Remediation derived wastewater	1,590	90%	1088	98%
6	Oil & Gas	Spent C6 AFFF solution	4,620	83%	6	71%
7	Remediation Contractor	Remediation derived wastewater	10,700	99%	6,572	100%
8	Oil & Gas	3M AFFF Concentrate / Product	6,380,000	57%	4,800,000	64%

Super Critical Water Oxidation (SCWO)

PFAS resists oxidization at standard temperatures and pressures.

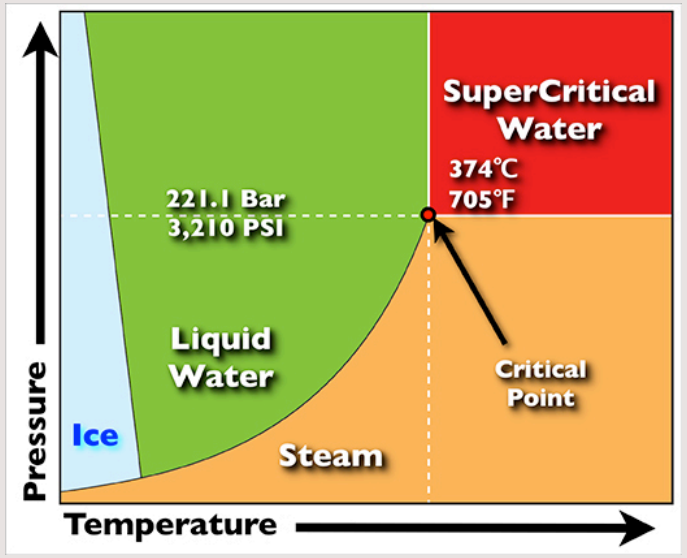
SCWO uses higher temperatures (approx. 705F) and higher pressures (approx. 221.1 bar) to achieve complete destruction of all PFAS compounds.

Above the critical point, organic compounds that are usually insoluble in water become highly soluble.

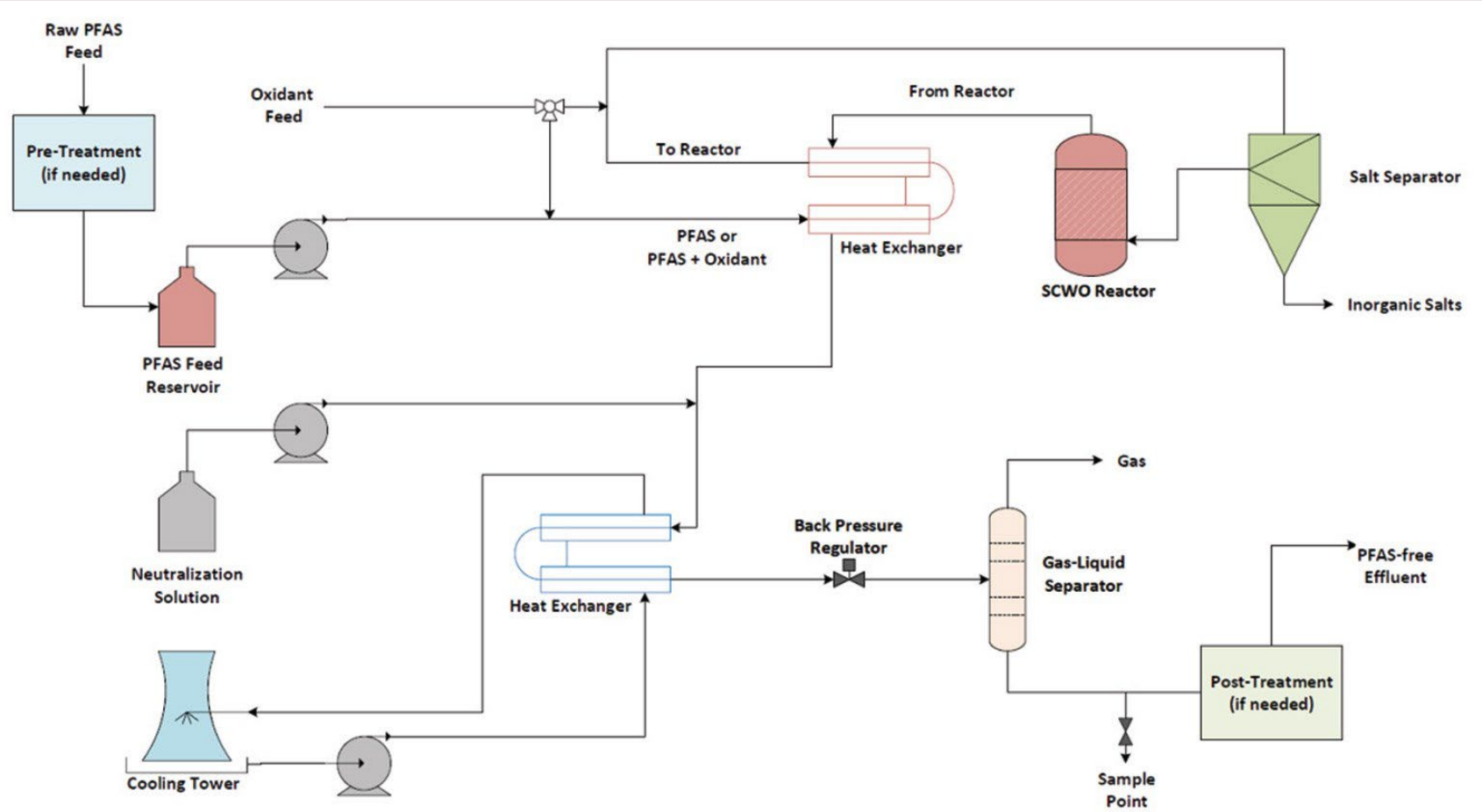
With the addition of an oxidizing agent such as oxygen, supercritical water dissolves and oxidizes PFAS.

Can achieve >99.99% destruction with treatment rates currently up to 500 gpd for mobile system.

Treatment takes seconds and produces inert salts.



SCWO - PFAS Annihilator™



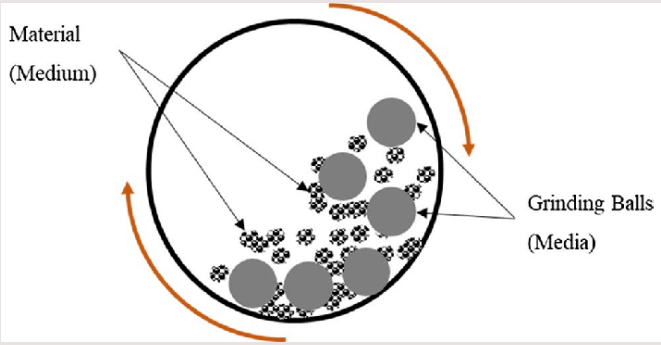
Capacity – Up To 500 gpd (with concentration 10x) for mobile system. Scalable

Closed Loop System

Can run on mains power or generator

Uses inexpensive oxidant and neutralization chemicals

Mechanochemical Degradation (MCD)



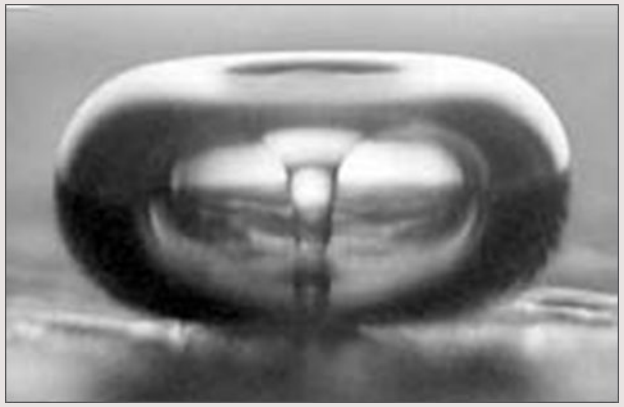
- High energy ball-milling
- MCD doesn't require solvents or heat
- Soils/solids application (potential biosolids?)
- Co-milling reagents (silica, potassium hydroxide, calcium oxide maybe added to react with fluorine
- Milling process produces radicals, electrons, heat and plasma that react with PFAS to produce inorganic fluoride compounds and graphite
- Proven technology at both bench and pilot scale with some POPs (PCBs) that achieved 99% destruction at a 6t/hr rate
- Evaluation of technology for treating PFAS is still in the preliminary stages
- Technology may produce gaseous PFAS emission that may require separate treatment step

Other Destruction Technologies

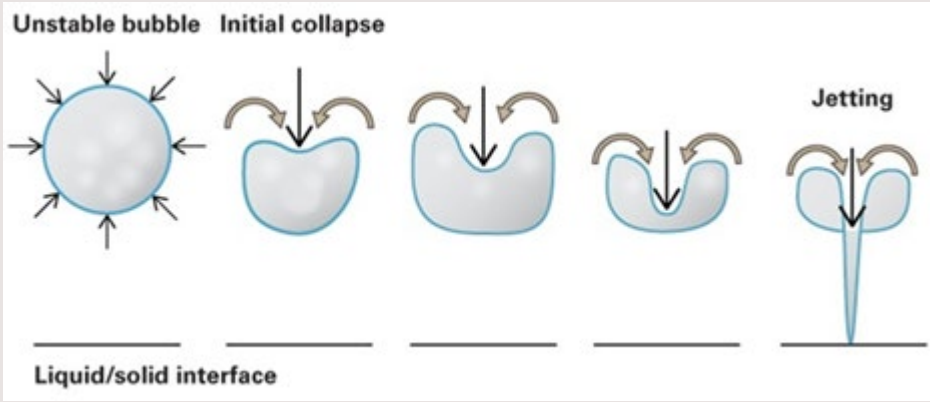
Includes technologies not evaluated by PITT but may have potential to meet mission statement and provide Zero Waste outcome.

Note: this isn't an exhaustive list

Sonolysis



- Use of high frequency sound (ultrasonic system) to break C-F bond
- Degradation is generally accepted to be high temperature pyrolysis at the bubble surface
- Still in research phase to fully understand degradation parameters (i.e., treatment frequency, treatment times/rates, etc.) but proven at bench scale
- Pending SERDP/ESTCP trial for In-situ application within horizontal well
- Bench scale results achieved 99% reduction with less energy required in comparison to other thermal or electrical options.



Electrical Discharge Plasma

- Energy is used to create a plasma which is a gaseous state of matter containing ions, atomic fragments and free electrons
- Plasmas can be considered thermal or non-thermal depending upon energy/temperature of the electrons relative to the background gas
- In aqueous applications, plasma is usually non-thermal which uses less energy
- Process both oxidizes and reduces organic molecules simultaneously
- Bench scale results achieved 90% reduction for some PFAS compounds at 1 gpm

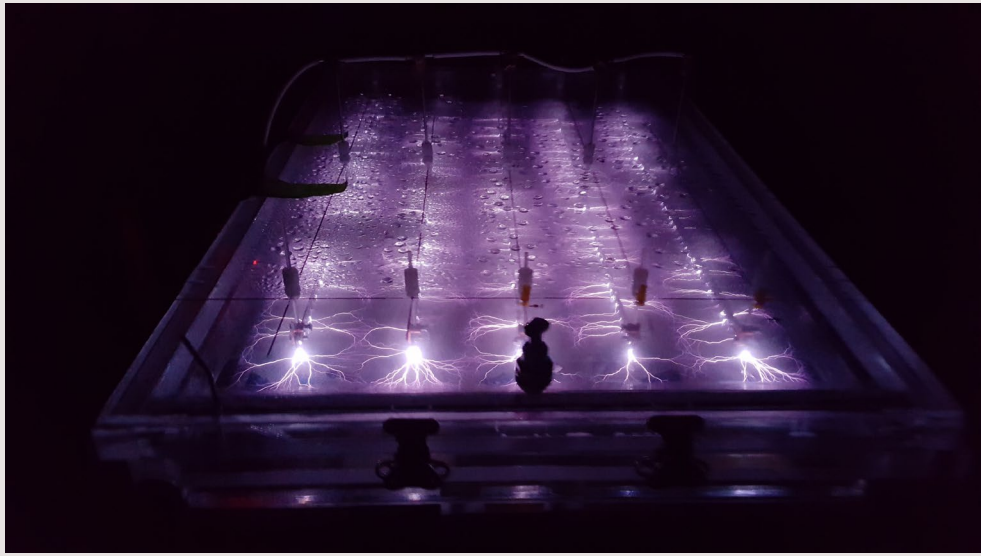
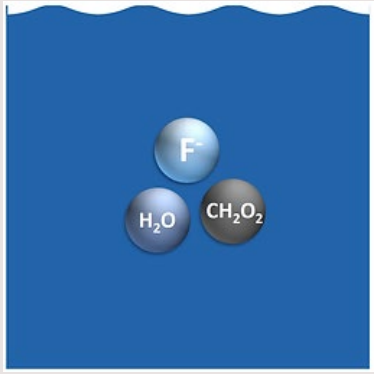


Photo Activated Reductive Defluorination (PRD)

- Technology uses proprietary chemistry and UV light to degrade PFAS in solution
- Surfactant added to PFAS solution to create micelle cage around PFAS molecule
- Proprietary non-toxic chemical added to solution that binds with the surface of the micelle cage
- When UV light is applied, hydrated electrons are created
- Hydrated Electrons is a type of solvated electron which is electrically neutral in liquid water and highly reactive
- Hydrated electrons have the energy needed to break the C-F bond.
- PRD process fully mineralizes the PFAS compounds and creates fluoride, clean water along with acetic and formic acid
- Evaluation of technology for treating PFAS is still in the preliminary stages
- MI – Based firm



Other Thermal Treatment Options

Pyrolysis is a treatment process that decomposes impacted solids at moderately high temperatures in an oxygen-free environment. **Gasification** is similar but introduces small quantities of oxygen. Gasification leverages the partial combustion process to provide additional heat to operate the process.

- Pyrolysis (no oxygen) and gasification (limited oxygen) makes the technologies differ from incineration.
- Potential application for biosolids
- Can be used to create biochar/soil amendment and syngas (alternate fuel source)
- Solids reduction of over 90%
- Emissions and incomplete destruction of PFAS needs additional evaluation.

Onsite Destruction Technology Considerations:

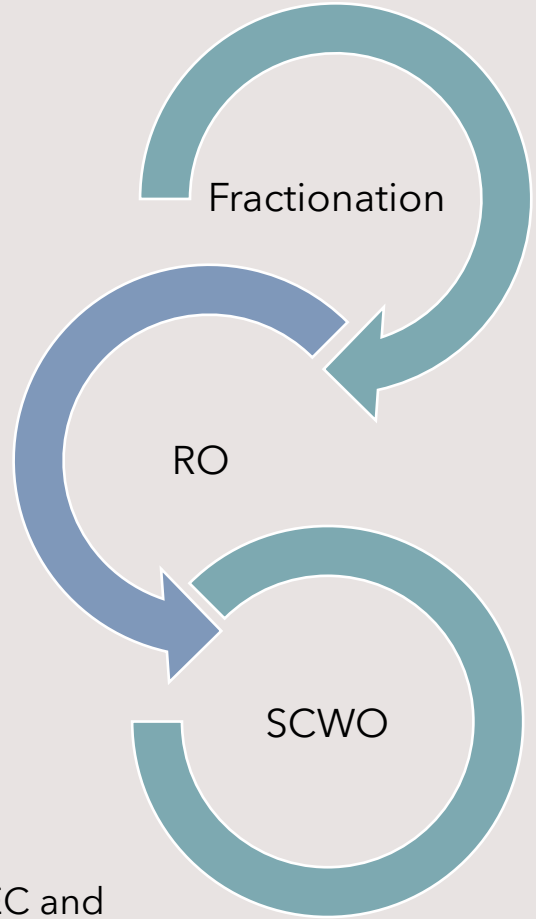
- Destruction/Life Cycle Cost (individual treatment costs were not readily available)
- Treatment cost likely driven by energy consumption and consumable (reagents, electrodes, etc.) prices
- Treatment rates (typically low) and unwanted byproducts
- Batch verses continual flow considerations
- Scalability (sweet spot is low volume, high concentration liquids)
  - ❖ Groundwater, surface water, wastewater, leachate, AFFF
- Commercialization (Pilot, bench, full scale)
- Stakeholder Acceptance (Client, Public, Regulator)

Case Study

Zero Waste Outcome

Treatment Train Concept – Water Treatment: Hypothetical Zero Waste Solution

Primary Treatment



Polishing Step – if required

Onsite Waste Destruction

Note: There are current commercial/large field scale trials of EC and SCWO, but trial results haven't been published yet

Waste Production Calcs:

- Fractionation plant should waste concentrate between 0.5% to 1% of input volume
- 50 gpm system produces 0.5 gpm of concentrate (720 gpd of waste) assuming 1% production rate
- Concentrate can be reprocessed with an est. 90% reduction (typical system uses dedicated fractionation column for waste reprocessing)
- **Primary treatment therefore would produce 72 gpd of Super Concentrate**
- Volume is well within capacity of mobile SCWO unit (500 gpd)
- RO, if required would contribute 14,400 gpd of reject assuming 20% reject rate of membranes.
- Reject would require some reprocessing to reduce volume.
- Reprocessing of reject could reduce volume by est. 90% (1,440 gpd)
- **Total water volume for SCWO would be approximately 1,512 gpd, which is within the capacity of the mobile SCWO plant at a 10x concentration**

ZERO WASTE

Actual Site/Commercial Application:

Patrick Center, WGVU /

- Wyoming, MI
- 4Never (Heritage Crystal Clean, Allonnia, EPOC and Revive Env.)
- Landfill Leachate application
- Leachate trucked in
- Foam Fractionation (SAFF) & SCWO (PFAS Annihilator)
- February 2023
- 150,000 gpd (+/-)
- Data?

Questions & Answers

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jjlagowski@gmail.com
1.517.304.3910

Member General Discussion on Open Topics

MPART Update

New MPART Sites / Areas of Interest

- 5312 11 Mile Road NE
  Rockford, Kent County
- Bofors Nobel
  Egelston Township, Muskegon County
- North Houghton County Water and Sewer Authority WWTP
  Calumet, Houghton County

Going Live Tomorrow:

- Roscommon Area Public Schools WWTP
  Roscommon, Roscommon County
- Kalkaska WWTP
  Kalkaska, Kalkaska County

MPART Update

- May 26, 2023 - Comments on Proposed PFAS National Primary Drinking Water Regulation
  - EPA Proposed Rules
- Meeting with Colorado

Foam Sampling

- PFAS Foam on Lakes and Streams

Waterbody	Location	Sample Collection Date	Media	PFOS
Van Etten Lake	RATLIFF PARK	2018-10-02	Foam	148000
Van Etten Lake	RATLIFF PARK	2018-10-02	Surface Water	35.6
Van Etten Lake	RATLIFF PARK	2018-10-01	Foam	86500
Van Etten Lake	RATLIFF PARK	2018-10-01	Surface Water	75.5
Van Etten Lake	RATLIFF PARK	2018-10-01	Foam	82300
Van Etten Lake	RATLIFF PARK	2018-10-01	Surface Water	50.3
Van Etten Lake	RATLIFF PARK	2018-10-02	Foam	134000
Van Etten Lake	RATLIFF PARK	2018-10-02	Surface Water	59.8
Van Etten Lake	RATLIFF PARK	2017-09-19	Foam	110000
Van Etten Lake	RATLIFF PARK	2017-07-27	Foam	12100
Van Etten Lake	RATLIFF PARK	2017-07-27	Surface Water	15.1
Van Etten Lake	RATLIFF PARK	2017-07-27	Foam	17200
Van Etten Lake	RATLIFF PARK	2017-07-27	Surface Water	93.9
Van Etten Lake	RATLIFF PARK	2017-07-27	Foam	48000
Van Etten Lake	RATLIFF PARK	2017-07-27	Surface Water	254
Van Etten Lake	RATLIFF PARK	2017-07-13	Foam	910

Future Topics?

Next Meeting:

July 11, 2023

Michigan PFAS Action Response Team (MPART)

www.Michigan.gov/PfasResponse

EGLE
MICHIGAN DEPARTMENT OF ENVIRONMENT, GREAT LAKES, AND ENERGY

Michigan Department of Agriculture & Rural Development

MDHHS
Michigan Department of Health & Human Services

MDOT
Michigan Department of Transportation

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