Industrial and Aviation Contamination – Looking Upstream to Prevent PFAS from Contaminating Municipal Wastewater

Montrose Environmental Group

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Presentation Outline

- **Tracking PFAS as it moves through wastewater**
- **Focused Discussion on Removing PFAS from Challenging water**
- **Industrial wastewater**
  - **Opportunity, challenge, solution**
- **Deicing Fluid**
  - **Opportunity, challenge, solution**
- **Conclusion**

PFAS In Municipal Wastewater

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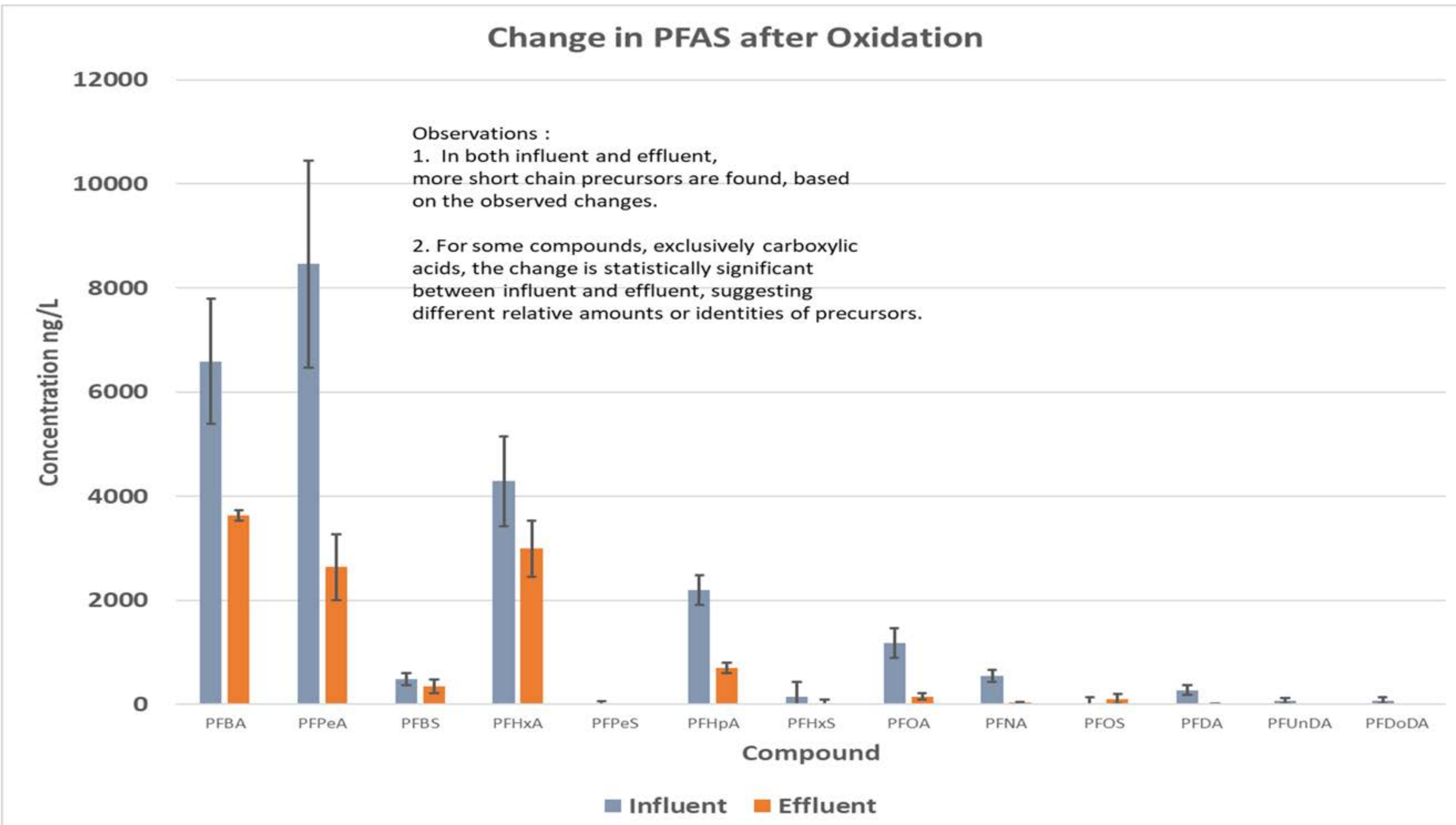
A case study in North Carolina

Background Conditions

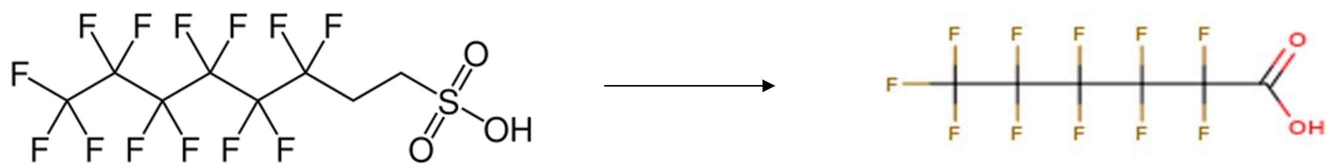
- **Study**
  - Collected Influent and Effluent samples in which we wanted to compare the magnitude of PFAS precursors
  - Samples were collected from the same WWTP at the same time points.
  - A 24 hr lag time was given for effluent collection as to be more representative of the corresponding influent sampled



Change in PFAS after Oxidation
12000
10000
8000
6000
4000
2000
0
Concentration ng/L
Observations :
1. In both influent and effluent,
more short chain precursors are found, based
on the observed changes.
2. For some compounds, exclusively carboxylic
acids, the change is statistically significant
between influent and effluent, suggesting
different relative amounts or identities of precursors.
PFBA
PFPeA
PFBS
PFHxA
PFPeS
PFHpA
PFHxS
PFOA
PFNA
PFOS
PFDA
PFUnDA
PFDoDA
Compound
Influent
Effluent

Degradation Products

Common in Waste Water & Chemically Rich Environments



6:2 FTS (C8)

Liver and Kidney Toxicity
Skin Irritation

Compounds	Influent	Effluent	Δ
6:2 FTS	1840 ppt	105 ppt	- 1735
PFHxA	19.9 ppt	70.8 ppt	+ 50.9

Mass Balance….Where did it go?

https://nasf.org/wp-content/uploads/2019/04/Summary-of-Toxicology-Studies-on-6-2-FTS-and-Detailed-Technical-Support-Documents.pdf

What does this mean?

- **What does this mean for the industry?**
  - **PFAS bio-transforms as it moves through conventional POTW treatment**
  - **Removing PFAS from effluent discharge will be expensive**
  - **Research should be done about removing PFAS sources upstream**

AIRPORT PFAS TREATMENT

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Opportunity

- **Opportunity**
  - 1+ million gallons of deicing fluid generated every winter season
  - Legacy PFAS impact on the soil and groundwater in the area
  - Deicing fluid picks up PFAS as it moves through the stormwater collection system
  - 500,000 gallons of capacity in storage lagoons prior to discharge to sanitary sewer
  - Lagoons storage allows for sampling/analytical to control discharge rate to POTW

Challenge

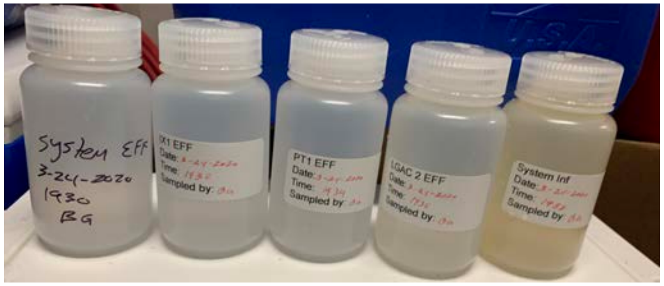
- **Challenge**
  - De-icing fluid is a difficult matrix to remove PFAS from – **fatty acids, high glycol** and **COD**
  - Lagoons had plenty of **iron, bacteria,** and **biofouling agents** present
  - Storm precipitation varied, leading to **fluctuating dilution/background chemistry**
  - Freezing temperatures – Difficult to pump ice!
  - Nearby PFAS mitigation systems unaffiliated with this property
  - Remote location - electricity and potable water not easily accessible on site

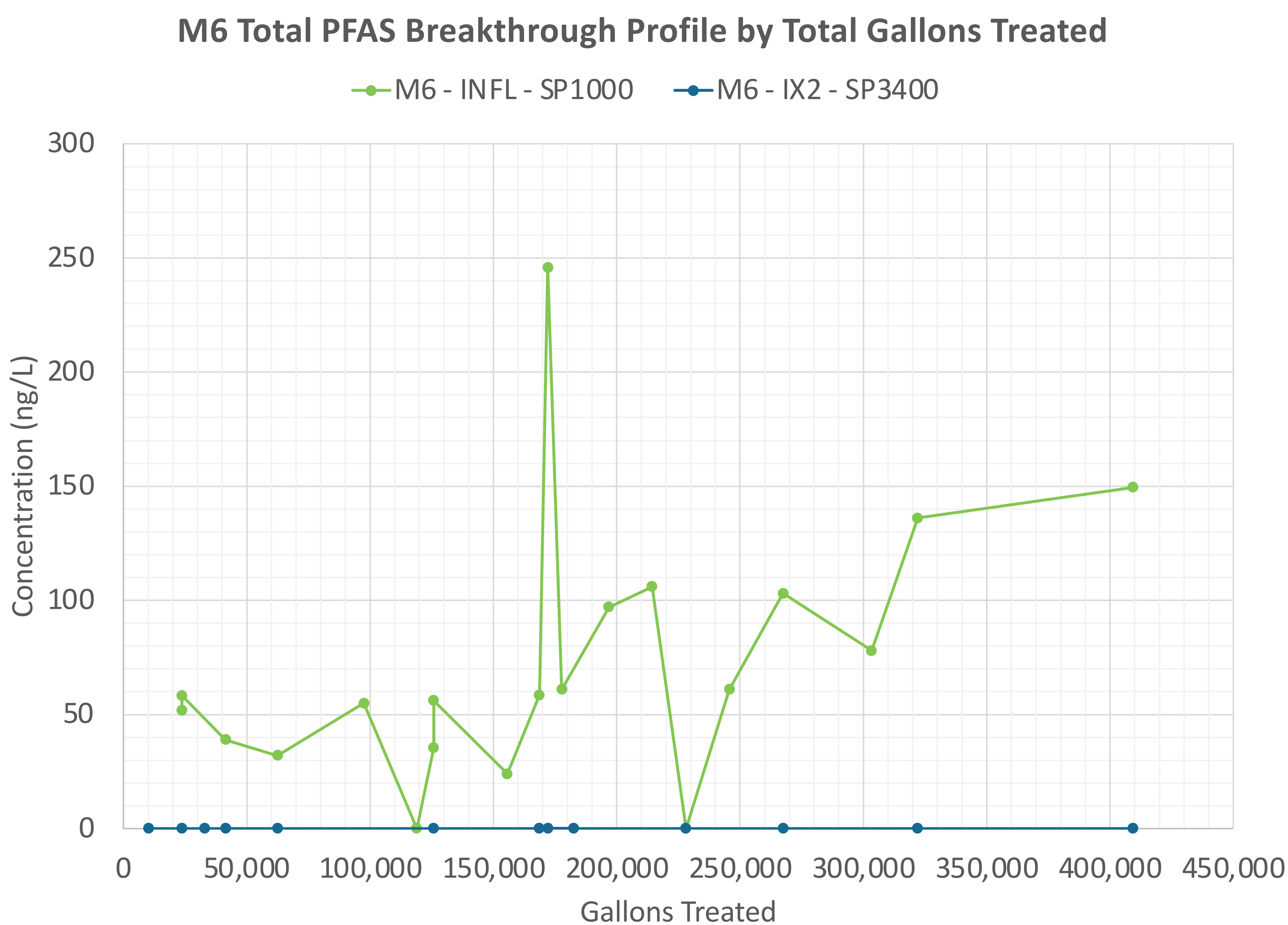
Solution

- **Solution**
  - SORBIX M6 – 25 GPM Mobile Treatment Unit
  - Rapid Construction and Deployment – PO to treated water on site in 30 days
  - Pilot system running ahead of the full scale system – help forecast any biological or pressure challenges
  - Innovative treatment approach to prevent variables from impacting performance
  - 24/7 remote access to operations – ensuring success on site

Onsite Pilot

- **Challenges + Process Forecasting**
  - Pilot system running ahead of the full scale system – help **forecast** any **biological** or **chemical** challenges
  - Pressure Build
    - Organic Dispersant developed that was both **safe for IX resin and the wastewater treatment plant**
  - Rapid turnaround on PFAS Samples from lab partner to allow for on-the-fly changes
  - Major impact from **Iron** in water




M6 Total PFAS Breakthrough Profile by Total Gallons Treated
M6 - INFL - SP1000
M6 - IX2 - SP3400
Concentration (ng/L)
300
250
200
150
100
50
0
0
50,000
100,000
150,000
200,000
250,000
300,000
350,000
400,000
450,000
Gallons Treated

Data + Lessons Learned

- **Data + Results**
  - 23 compounds analyzed – non of which were detected above 2 ppt in treated water
  - Pretreatment step performed well – no issues with biological interference
  - Minimal waste produced due to innovative treatment approach

- **Lessons from the field**
  - Pretreatment extremely important
    - Biogrowth is a challenge – learnings from the pilot study and previous experience to protect the system
    - Variability in water chemistry can lead to challenges – utilize upfront storage (lagoons)

SORBIX^{TM} PURE Full Scale System – Challenging Water

Airport Deicing Fluid

PFAS Source:	Legacy AFFF Impact	
Source Water:	Deicing Fluid Lagoons, Surface Water	
System Flow Rate:	12 GPM Average Flow	Capable of 24/7 unmanned operation
Maximum Influent PFAS Level:	PFHpA = 36 PPT PFHxS = 13 PPT PFOA = 47 PPT	PFHxA = 57 PPT PFOS = 55 PPT
Target Effluent:	Non-detect for all PFAS Compounds	

Industrial Process Water PFAS Treatment

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PFAS is used in the manufacturing process, how do we keep it out of the wastewater?

Opportunity

- **Opportunity**
  - PFAS used to manufacture a product
  - Total PFAS concentrations in the wastewater present at 500 ppb to 1 ppm
  - Daily flow varied between 30,000 gallons and 288,000 gallons of wastewater, depending on the process taking place that day

Challenge

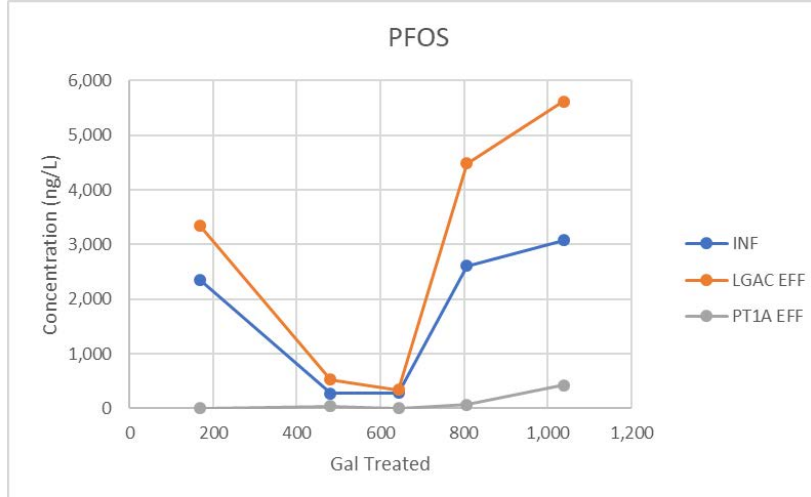
- **Challenge**
  - Extremely challenging water matrix for PFAS removal
  - Batch production resulted in variable water chemistry
    - High variability in solids generation lead to increased need for pretreatment
    - Up to 20,000 mg/l in TDS
    - Up to 8,000 mg/l in TOC

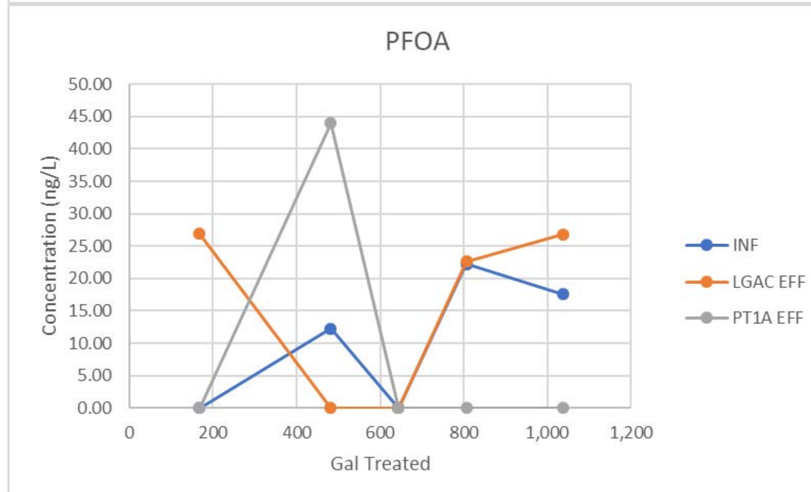
Solution

- **Pilot Setup**
  - GAC
  - Single Use Resin
    - Pretreatment followed by IX
  - Foam Fractionation

Phase I Pilot Results

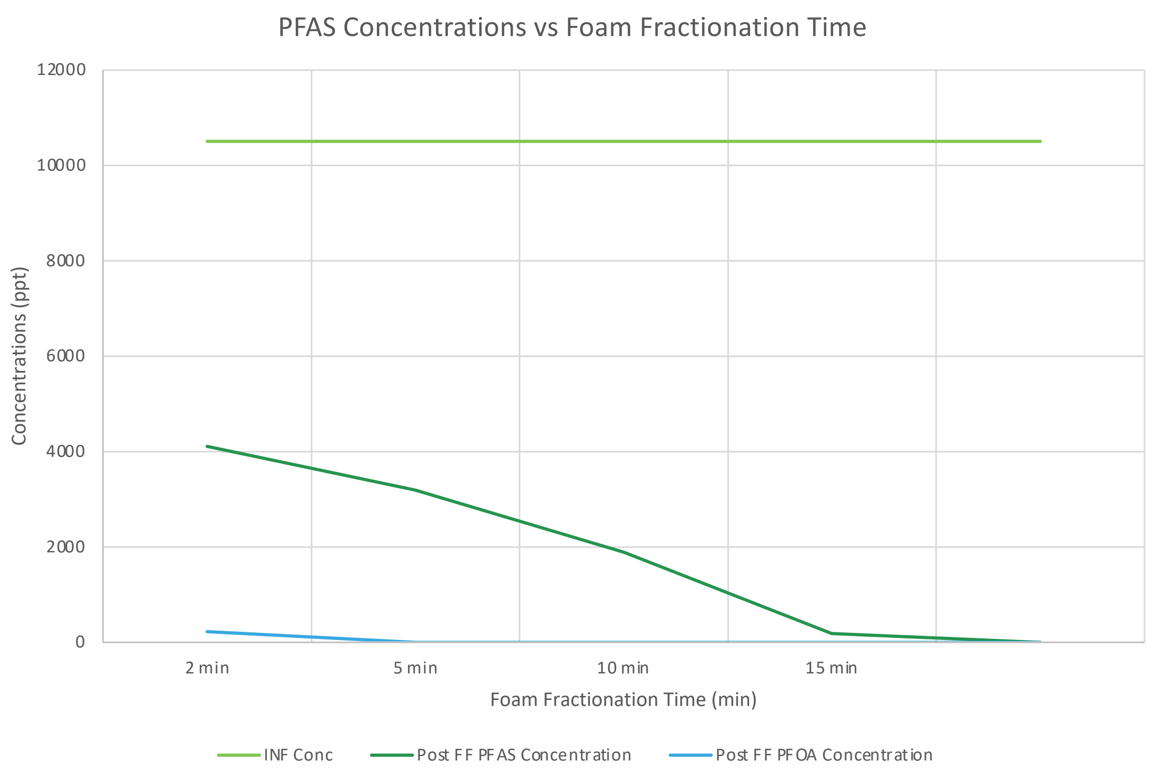
- **Results**
  - No clear winner
  - High variability in the water lead to interesting performance data
  - Immediate issues with pressure creep and TDS forced us to make a change





Phase II Pilot Study

- **Foam Fractionation**
  - Foam Fractionation
  - Works by using bubbles to “attract” PFAS molecules and float them out of solution
    - Tested with dwell times of 5, 10, 15 minutes
  - Initial influent above 9 ppb, after FF final PFAS < 80 ppt


PFAS Concentrations vs Foam Fractionation Time
12000
10000
8000
6000
4000
2000
0
Concentrations (ppt)
2 min
5 min
10 min
15 min
Foam Fractionation Time (min)
INF Conc
Post FF PFAS Concentration
Post FF PFOA Concentration

Results

- **Solution**
  - For this industrial case
    - Foam Fractionation pilot phase beginning in the next couple weeks
    - Initial fractionation will get enough PFAS removal for facility to meet permit
    - GAC or IX will be utilized to then treat foammate before discharge
    - Eventual goal is to couple with destruction technology

Data + Lessons Learned

- **Data + Results**
  - PFAS treatment at the source can be more effective, and less expensive, than treating PFAS in municipal wastewater
  - More data is needed to continue understanding of PFAS impact on POTW
    - “Background level” data needs to be agreed upon by the industry
  - Not every industrial source is the same – tailored solutions will be required
  - Some

Thank you!

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