QUARTERLY PROGRESS REPORT

[October 01, 2021 – December 31, 2021]

PROJECT TITLE: Per- and Polyfluoroalkyl Substances (PFAS) in Landfill Gas Emissions

PRINCIPAL INVESTIGATORS:

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PROJECT WEBSITE: https://web1.eng.famu.fsu.edu/~ytang/PFAS_in_gas.html

Project summary: While the knowledge on per and polyfluoroalkyl substances (PFAS) and their degradation products in landfill leachate has significantly increased in recently years, the knowledge on these compounds in the landfill gas emissions has been very limited. One of the major reasons is that the concentrations of these compounds in the landfill gas are usually below the detection limit. The first objective (i.e., preconcentration of gas-phase PFAS) of this proposal is to evaluate and compare three methods for preconcentrating PFAS and their degradation products in the gas phase. The second objective (i.e., measurement of PFAS in landfill gases) is to evaluate PFAS and their degradation products in the gas emission samples of three municipal solid waste (MSW) landfills, three construction & demolition (C&D) landfills, and three waste-to-energy facilities in Florida. The third objective (i.e., measurement of PFAS in lab-scale bottles) is to evaluate the fate of PFAS and their degradation products in the headspace of lab-scale bottles filled with various typical PFAS sources (i.e., carpet, building materials, and paper products), respectively. The project, if successful, will fill in the knowledge gap in the area of PFAS in the landfill gas emissions. It will also provide methods for measuring PFAS in the gas phase for the landfilling industry and the PFAS research community.

Work Accomplished during this Reporting Period:

The project has four tasks. We have completed ~25% of Objective 1, ~15% of Objective 2, and ~20% of Objective 3. The completed work in each task is described below:

Objective 1: Preconcentration of Gas-phase PFAS

The concentration of gas-phase PFAS in landfill gases is usually very low so that preconcentration of PFAS is needed. In this reporting period, we used a 7100 preconcentrator (Entech Instruments) to improve the detection limit of one gas-phase PFAS -- Octafluorocyclobutane (C_4F_8). Figure 1 shows the system that we used, including an autosampler, a preconcentrator and a gas chromatography - mass spectrometry (GC-MS) system. We made a standard curve for C_4F_8 (Figure 2). The detection limit of C_4F_8 was ~1 ppb. Without using the preconcentrator, the detection limit of C_4F_8 was 1 ppm.

Figure 1. The system in the lab for gas-phase PFAS identification and quantification

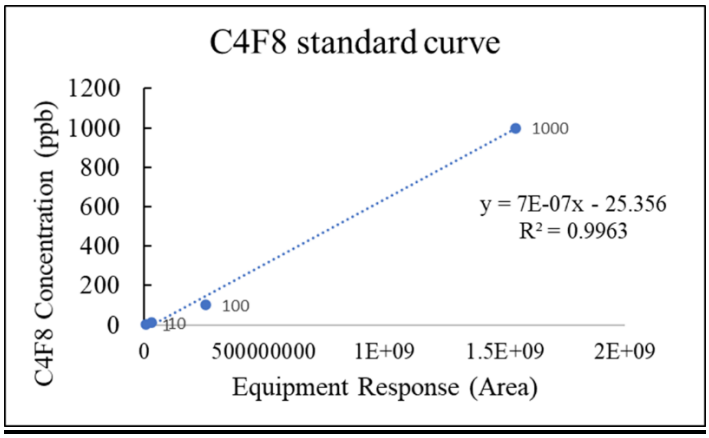

Figure 2. A standard curve generated by the gas chromatography – mass spectrometry system coupled with a 7100 preconcentrator for measurement of C_4F_8. The curve range is 1 – 100,000 ppb. The detection limit is ~1 ppb.

Objective#2: Measurement of PFAS in Landfill Gases

To sample gas emission from solid and hazardous waste facilities, we will use gas canisters and flow regulation systems to fill in the gas canisters. Figure 3 shows the connection of a gas canister and CS1200E (Entech Instruments) flow regulation system.

Figure 3. The canister and flow regulation system for collecting air samples

Objective #3: Measurement of PFAS in Lab-Scale Bottles

To evaluate the fate of PFAS, eighteen lab-scale bottles as shown in Figure 4 will set up. Details about the 18 bottles are summarized in Table 1.

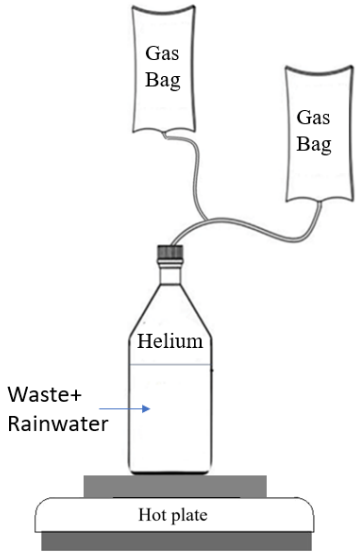

Figure 4. The schematic figure of bottles and gas bags

Table 1. The information of each bottle

Bottles	Materials	Description
1	140 gr Carpet+320 mL Rainwater	A mixture of carpet from five different manufactures (1/5 from each manufacturer in weight).
2	140 gr Carpet+320 mL Rainwater	
3	140 gr Carpet+320 mL Rainwater	
4	140 gr building materials+Rainwater	A mixture of building materials (including surface sealers, paints, wires) from five different manufactures (1/5 from each manufacturer in weight).
5	140 gr building materials+Rainwater	
6	140 gr building materials+Rainwater	
7	140 gr paper products+310 mL Rainwater	A mixture of paper products from five different manufactures (1/5 from each manufacturer in weight)
8	140 gr paper products+310 mL Rainwater	
9	140 gr paper products+310 mL Rainwater	
10	140 gr masks + 310 mL Rainwater	A mixture of masks from five different manufactures (1/5 from each manufacturer in weight)
11	140 gr masks + 310 mL Rainwater	
12	140 gr masks + 310 mL Rainwater	
13	140 gr no-PFAS waste + 310 mL Rainwater	
14	140 gr no-PFAS waste + 310 mL Rainwater	No-PFAS control: One type of plastic that does not contain PFAS
15	140 gr no-PFAS waste + 310 mL Rainwater	
16	Rainwater without wastes	No-waste control
17	Rainwater without wastes	
18	Rainwater without wastes	

TAG Meetings #1:

• Date of the meeting: 12/16/2021

• TAG members, recording of meeting, and meeting minutes are available at the project website: https://web1.eng.famu.fsu.edu/~ytang/PFAS_in_gas.html

Metrics:

1. List research publications resulting from THIS Hinkley Center project.

None in this reporting period.

2. List research presentations resulting from (or about) THIS Hinkley Center project.

None in this reporting period.

3. List who has referenced or cited your publications from this project.

None in this reporting period.

4. How have the research results from THIS Hinkley Center project been leveraged to secure additional research funding? What additional sources of funding are you seeking or have you sought?

We are preparing a PFAS proposal to DoD.

5. What new collaborations were initiated based on THIS Hinkley Center project?

None in this reporting period.

6. How have the results from THIS Hinkley Center funded project been used (not will be used) by the FDEP or other stakeholders?

None in this reporting period.

Pictures:

- Canister cleaning system