



# FAMU-FSU Engineering

FAMU - FSU COLLEGE OF ENGINEERING  
DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING

## Technical Awareness Group (TAG) Meeting No. 3

Tuesday, January 25, 2022, 3:00 – 4:00 pm Eastern Time

Meeting location: Zoom

**Project Title:** Non-Thermal Plasma Degradation of Per- and Polyfluoroalkyl Substances (PFAS) from Landfill Leachate

**TAG Members:** Bruce Marvin (Geosyntec Consultants), Chao Zhou (Geosyntec Consultants), Claudia Mack (Geosyntec Consultants), Kevin Warner (Geosyntec Consultants), Stephanie Sanchez (Geosyntec Consultants), Terry Johnson (Waste Management Inc.), Sterling Carroll (Florida Rural Water Association), Joseph Dertien (Florida Department of Environmental Protection), Kerry Tate (Florida Department of Environmental Protection), Lauren J. Coleman (Florida Department of Environmental Protection), Owete S. Owete (Florida Department of Environmental Protection), Ryan Barker (Florida Department of Environmental Protection), Shanin Speas-Frost (Florida Department of Environmental Protection), Walsta Jean-Baptiste (Florida Department of Environmental Protection)

**Principle Investigators:** Youneng Tang, Tarek Abichou, Bruce R. Locke, Huan Chen

**In Attendance:** Bruce Locke, Chao Zhou, Huan Chen, John Schert, Joseph Dertien, Karam Eeso, Lauren J. Coleman, Mojtaba Nouri Goukeh, Narasamma Nippatlapalli, Rachel Gallen Radha Bulusu, Stephanie Sanchez, Walsta Jean-Babtiste, Youneng Tang,

### Project Presentation

The meeting was called to order by Dr. Tang at 3:00 PM. Dr. Tang began by introducing the gas-liquid flowing film reactor. He explained that the reactor was able to mineralize different PFASs. He stated that two real-world landfill leachates were treated by the reactor and 30 PFASs were measured by FDEP. Then, Dr. Tang classified these PFASs into 4 categories. The removal percentages of PFASs were shown, and the degradation percentages of PFASs depended on the chain length. The effects of inorganic substances (represented by NaCl), simple organic substances (represented by the acetate), complex organic substances (represented by humic substances), pH, and surfactants on PFOA removal were discussed. He explained that these leachate components did not have a big impact on PFOA mineralization. Eventually, he described the acute toxicity measurement and concluded that PFOA (50 ppm) and its byproducts did not cause acute toxicity. Major research findings are summarized as follows:

- The reactor mineralized all of the five tested perfluorinated substances, including PFHxS, PFHpA, PFOA, PFNA, and one GenX product (undecafluoro-2-methyl-3-oxahexanoic acid, C<sub>6</sub>H<sub>9</sub>F<sub>11</sub>O<sub>3</sub>), but did not mineralize the tested polyfluorinated substance (Fomblin® Y, LVAC 16/6 average molecular weight: 2700 g/mol, CF<sub>3</sub>O[-CF(CF<sub>3</sub>)CF<sub>2</sub>O-]<sub>x</sub>(-CF<sub>2</sub>O-)<sub>y</sub>CF<sub>3</sub>).
- Two different leachates were treated by plasma, and most of the 30 measured PFASs were degraded at various percentages. For example, the degradation percentage of PFOA (C<sub>8</sub>)

for leachate 1 and leachate 2 was 76% and 65%, respectively. Four of the measured PFASs had increased concentrations after plasma treatment due to being produced as daughter products.

- The highest mineralization occurred when the acetate concentration was very high (> 10,000 ppm as C), the humic acids concentration was low (< 30 ppm as C), the pH was neutral, and an anionic surfactant (sodium dodecyl sulfate, SDS) was present. Compared to the DI water control, none of the tested conditions changed the PFOA mineralization by more than 30%.
- PFHpA (C7), PFHxA (C6), PFPeA (C5), and PFBA (C4) were identified as the intermediates of PFOA degradation.
- Microtox bioassay revealed no acute toxicity of PFOA (at 50 ppm) and their intermediates.

### **Group Discussion**

Major comments and suggestions from the TAG and responses from the research team:

- Question: How can this technology be used by landfill managers?  
Answer: The research team commented on the real-world application of the plasma reactor. They explained the steps that are needed before commercializing the plasma reactor for treatment of landfill leachate. Due to the modular nature of the reactor, it can be easily scaled up.
- Question: What are the other research projects that the research teams are doing?  
Answer: Dr. Tang and Dr. Locke mentioned their other projects that are funded by NIH, NSF, Geosyntec, FSU, and Redhill Scientific.
- A TAG member and the research team discussed the influence of acetate, humic acids, and surfactants on PFASs mineralization. More research is needed to understand the mechanisms.

The meeting was adjourned at 4:00 PM, minutes taken and submitted by Mojtaba Nouri Goukeh.