Technical Awareness Group (TAG) Meeting No. 1

Monday, December 16, 2024, 11:00 – 12:00 noon Eastern Time
Meeting location: Microsoft Team

Project Title: Zero waste of PFAS destruction in landfill leachate by foam fractionation concentration, selective biochar adsorption and hydrothermal treatment

TAG Members:
Dr. Natalia Soares Quinete, Assistant Professor, Department of Chemistry & Biochemistry, Florida International University
Dr. Yelena Katsenovich, Sr. Research Scientist, Applied Research Center, Florida International University
Dr. Hari Parthasarathy, Ph.D., P.E. (SC), Principal Engineer, Geosyntec consultants
Mr. Joe Dertien, P.E., Division of Waste Management, Florida Department of Environmental Protection
Mr. Danny M. Gallagher, E.I., Project Manager of Sustainability & Disposal Operations, Solid Waste Management Department, Hillsborough County
Ms. Shanin T. Speas-Frost, P.E., MBA, Professional Engineer III, Oil & Gas Program, Division of Water Resource Management, Florida Department of Environmental Protection
Dr. Luke A. Mulford, Ph.D., P.E., Senior Professional Engineer, Water Resources Department, Hillsborough County

In Attendance:
Joe Dertien, Yelena Katsenovich, Gang Chen, Daniel Gallagher, Hari Parthasarathy, Lin Qi, Sidney McConnell, Luke A. Mulford, Natalia Soares Quinete, Hannah Sackles, Yudi Wu, Alise Darsch, Liana Nazario, Leith Dessureault, Alise Darsch

Project Presentation
Dr. Wu introduced the project team and TAG members.

Dr. Wu then presented the background, project plan, and timeline and tasks.

Dr. Wu first presented the results of Task 1.1 Foam Fractionation. In this section, she showed the results using a PFAS mixture of six types of PFASs with different C-F chain lengths and functional groups (i.e., carboxylic and sulfonic functional groups). These PFASs included PFBA, PFHxA, PFOA, PFBS, PFHxS and PFOS and the initial concentration was 100 ppb for each of these PFAS compounds.

Four surfactants including anionic (sodium dodecyl sulphate (SDS)), non-ionic (Triton X-100), zwitterionic (Lauryl sulfobetaine (SB3-12)), and cationic (cetyltrimethylammonium bromide (CTAB)), were used to determine their comparative behavior for PFAS concentrating. Air was purging at a rate of 0.5 L/min and the liquid samples were extracted from the column at three different heights (bottom height = 5 cm, middle height = 20 cm, and top height = 35 cm) at 0 minutes, 7.5 minutes, 15 minutes, 22.5 minutes, and 30 minutes throughout the experiment.

During the foam fractionation experiment, PFAS adsorbed to the bubbles, migrate to the top of the column and finally accumulate at the produced foam. The introduction of surfactants led to differential removal efficiencies for PFAS in liquid phase, which were reflected in the transfer of PFAS into the generated foams. Anionic surfactant SDS effectively removed long-chain PFASs such as PFOA and PFOS but showed negligible removal for PFHxS and short-chain PFASs like PFBS, PFHxA, and PFBA. Non-Ionic surfactant Triton X-100 demonstrated good removal efficiency for long-chain PFASs, including PFHxS, PFOA, and PFOS, but was less effective for short-chain PFASs (PFBA, PFBS, and PFHxA). Zwitterionic surfactant SB3-12 exhibited excellent removal of most PFASs, except for PFBA, which remained in the liquid phase. Cationic surfactant CTAB achieved effective removal of all six tested PFAS, demonstrating the highest overall efficiency among the surfactants.

Dr. Wu then presented the results of Task 1.2 Surface Tension Measurement. Based on the surface tension measurements, the CMCs of the surfactant were determined, 11.53 mM for SDS, 1.02 mM for CTAB, 1.43 mM for Triton X-100, and 3.24 mM for SB3-12.

Dr. Wu also briefed Task 2. Biosolids Biochar Synthesis. The biosolids biochar has been synthesized and sent to external lab for further analysis.

Group Discussion

Dr. Yelena Katsenovich was concerned about the remaining PFASs in biochar after hydrothermal treatment. Dr. Wu explained the PFAS destruction after hydrothermal destruction and potential reuse of the recovered biochar. A mass balance of PFASs in different phases will be conducted to ensure PFASs are not released to the environment.

Dr. Yelena Katsenovich also wondered about the role of biosolids-based biochar. Dr. Wu showed the results of her prior research which demonstrated that biosolids-based biochar had the best efficiency in adsorbing PFASs among the different feedstocks of biochar.

Dr. Wu also explained the sampling locations along the length of the column and sampling methods.

Joe Dertien would like to know more details of the hydrothermal theory and Dr. Wu explained in detail how hydrothermal reactions can destroy the PFAS compounds.

Dr. Luke Mulford asked for the experimental design of foam removal, and the research team explained the column assembly and related foam separation with biochar.

Dr. Hari Parthasarathy discussed with the research team the surfactant uses for real leachate and the limitation of the use of simulated leachate. He also wondered whether the foam can be treated directly without biochar adsorption. Dr. Wu acknowledged the limitation of the use of simulated leachate and discussed the plans to overcome the limitation.

Dr. Natalia Soares Quinete suggested the investigation of the biochar destruction in the hydrothermal reaction and the research team considered the inclusion in the research.

The meeting was adjourned at 12:00 noon, minutes taken and submitted by Gang Chen.