Converting PFAS-Impacted Landfill Leachate Waste from a Liquid to a Solid: Using Full-Scale Foam Fractionation and Media Superloading to Minimize Waste and Reduce Risk

Background/Objectives. Permitted landfills have been challenged to retain outlets for their leachate in the wake of increasing scrutiny on PFAS. To maintain the ability to discharge to local publicly owned treatment works (POTWs), landfills in certain jurisdictions have been required to pre-treat for PFAS. Because landfill leachate is a complex media with high levels of organic carbon and total dissolved solids, treatment for PFAS with adsorptive media has a high exhaustion rate at empty bed contact times typical of granular activated carbon and ion exchange treatment. To assist a landfill in the cost-effective treatment of PFAS, ECT2 designed a combined system of foam fractionation on the landfill leachate to remove PFAS and Superloading adsorptive media treatment on the concentrated liquid waste (foamate), thereby converting the foam fractionate liquid to a solid waste. The marriage of these two treatment technologies allows effective PFAS treatment combined with a high degree of waste minimization in a difficult to treat matrix.

Approach/Activities. ECT2 progressed its foam fractionation and Superloading test design from the pilot scale to a full-scale design and installation, with 1.5 years of full-scale operational data at the end of 2025. The system operates with lead-lag Foam X-3000 foam fractionators, which were first designed and implemented for this site. Treatment goals include removal of 75% of PFAS mass, with the proportion of PFAS being <45% short chain. During the commissioning period, ECT2 evaluated and optimized the use of multiple chemical reagents to manage solids formation and achieve the desired PFAS treatment goals. Under continuous operation, the foam fractionation system treats approximately 100 gallons per minute. The resulting foamate is treated in successive adsorptive media beds and then re-blended into the foam fractionation system influent. The adsorptive media is then returned with sequestered PFAS to the landfill, which is a simple waste management strategy that can be employed at similar facilities.

Results/Lessons Learned. Operating the foam fractionation system at scale continuously resulted in the implementation of long-term chemical dosing strategies to maintain smooth operations in the fractionators. Periodic changes in the leachate composition were able to be managed while maintaining performance. The foamate Superloading process resulted in up to an additional 500-fold of waste concentration into a solid media format, with changeouts timed to coincide with preventing re-blended foamate impacting foam fractionation treatment objectives. Overall, a waste concentration factor of approximately 1000 to 2000-fold was able to be achieved at this landfill. The landfill operator was able to maintain their disposal outlet for their leachate by implementing this system. This presentation will present operational lessons learned and performance data demonstrating the removal of PFAS in both primary system components.

Paul Newman
ECT2

Paul Newman is a Professional Geologist and the Defence Market Sector Leader for Emerging Compounds Treatment Technologies, Inc. Paul's focus is currently on supporting the DND and DoD (US) in generating and analyzing data to support PFAS treatment efficacy and cost evaluations, including Remedial Options Analyses, Feasibility Studes, and Engineering Evaluations/Cost Analyses. Data sources include ECT2's Rapid Small-Scale Column Tests, column and isotherm tests, in conjunction with field pilot studies using single use and regenerable anion exchange media, and foam fractionation treatment. These studies have facilitated the design and installation of full-scale treatment systems, and the pairing of treatment/ concentration technologies with destruction technologies. Paul received his Bachelor's Degree in Geology from the University of Windsor and his Master's Degree in Mineral Exploration Geology from McGill University.