Phytoremediation for Management of a Firefighter Training Site Waste Stream

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Background/Objectives. Firefighter training sites present a complex waste stream challenge. The effluent includes a combination of petroleum fuels and fire suppression agents that cannot be discharged to municipal wastewater treatment facilities. In addition, past and present use of poly-perfluoroalkyl substance (PFAS)-based firefighting foams create additional burden due to tightening regulations. An effective and economical strategy is in development to manage waste streams at military and civilian training sites. The present work explored and assessed using wetland plants to mediate treatment of effluent from closed-loop holding ponds used for firefighter training at Tyndall AFB, Florida.

The intent is to develop sustainable methods to reduce risk and expense of waste disposal. Phytoevaporation was examined as means to reduce waste volume by taking up wastewater, adsorbing contaminants (like PFAS) in tissues, and releasing clean water to environment through transpiration. The tests used the authentic waste stream at an operational training site to maintain plant test beds. Accordingly, the plants were exposed to a range (concentrations and constituents) of wastewater feedstocks and were representative for similar training facilities. Tyndall AFB is near the Gulf of Mexico and has a humid subtropical climate (hot, humid summers and mild winters); seasonal changes that will effectively challenge plant vigor.

Approach/Activities. A long-term, pilot-scale, field study was done. Wetland plants were cultivated in raised tanks (5 ft ×7.5 ft ×1 ft) containing expanded clay pellets for bedding material. The effluent from firefighter test and training pits was continuously trickled through the beds and bell siphon drains were used to maintain recycling exchange. Plant tissue and water samples were periodically collected to assess water quality and determine concentration of selected PFAS molecules in the feed stock and plant tissues.

The preliminary study was designed to address whether the phytoremediation concept is feasible for the application— i) can typical wetland plants survive irrigation with the raw effluent from training site?, ii) does resiliency differ among the tested plants?, which plant is best suited for environment?, iii) are PFAS concentrated in plant tissues?, iv) are uptake and transpiration rates sufficient to warrant phytoremediation as viable management strategy.

Results/Lessons Learned. The test beds were maintained for approximately four years in the open environment; the plants survived and showed typical seasonal growth behavior. Analysis of plant materials focused on the duck potato (*Sagittaria lancifolia*) plant tissue. The PFAS accumulated in plant tissues compared to background (i.e., the source water) concentrations. The analytical process and instrumentation have been refined and will better resolve the extent of accumulation in plant tissues. Additional scaling and design of test system are in development. The changes will provide data to determine applicability and support more rigorous experiments including determining extent the waste stream content affects plant transpiration.