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Ex Situ Treatments of Aqueous Film-Forming Foam Impacted Water

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Background/Objectives. Per- and Polyfluoroalkyl Substances (PFASs) are surfactants, polymers and other substances that are widely distributed across the higher trophic levels and are found in air, soil and groundwater at sites across the U.S. Surfactant applications used heavily in the military include aqueous film–forming foams (AFFFs) used to extinguish fires involving highly flammable liquids. The toxicity, mobility and bioaccumulation potential of PFASs pose potential adverse effects for the environment and human health.
PFASs are fluorinated organic compounds in which the hydrogen atoms of the hydrocarbon skeleton are substituted fully or partially by fluorine atoms. In view of the strong covalent bond between the fluorine and the carbon atoms, these compounds are considered non-degradable and they persist in the environment.

Practitioners have difficulty remediating these compounds at a reasonable cost because PFASs are extremely resistant to thermal, chemical and biological degradation processes. Literature shows that PFOS (potassium salt) is substantially non-volatile. They do not favorably partition into the vapor phase, and they do not adsorb well to granular activated carbon (GAC). To date, adsorption on activated carbon was the only technically feasible method to treat PFAS-contaminated water. The presentation will provide updates on a novel treatment train approach to address ex situ treatment of AFFF impacted water.

Approach/Activities. In the pretreatment phase, PFASs are precipitated by metering a liquid surface-active reagent into a stirring tank. The amount of reagent must be adjusted to adequate concentrations. The precipitation products are separated from the water as micro-flocks by simple processes such as sedimentation and filtration. The precipitants can be concentrated to a very high degree, which allows for very economical disposal as compared to GAC. Post-treatment of the remaining residual contaminants is performed by a downstream activated carbon and activated carbon / aluminum hydroxide / Kaolin clay filter. Due to the significant reduction in the PFAS-contaminated water in the initial precipitation stage (up to 90%), the PFAS contaminant load reaching the absorbent filter(s) is lowered, which leads to a significant extension of the adsorbant's lifetime, which in turn further lowers operating costs.
The presentation will also provide results of the effectiveness of a stand-alone activated carbon / aluminum hydroxide / Kaolin mixture to treat PFASs. Studies have concluded that the adsorption capacity of the mixture for the smaller chain fluorinated substances PFBA and PFBS is vastly superior to that of GAC. This is likely due to the presence of the non-carbon components within the mixture that create unique physico-chemical interactions with the smaller chain PFAS compounds.

Results/Lessons Learned. The presentation will include results and lessons learned from the latest laboratory and field implementation for the treatment of PFAS impacted water.