NOVEL SORBENTS FOR PFAS WATER REMEDIATION

Christian Chung¹ (chrichu@email.unc.edu), Haley Macdonald¹, Guan Pin Nick Chew¹, Orlando Coronell¹ (coronell@email.unc.edu), Irene Manning², Frank Leibfarth² (frank@email.unc.edu)
(1) Department of Environmental Sciences and Engineering, Gillings School of Public Health, (2) Department of Chemistry, University of North Carolina at Chapel Hill

BACKGROUND

Per- and polyfluorinated alkyl substances (PFAS) are a broad class of synthetic organic compounds, possessing desirable chemical properties that enable a broad range of applications and contribute to their environmental persistence in groundwater, surface water, and finished drinking water systems. Water contamination is the most common pathway for human exposure, giving way to adverse health effects such as altered liver function, elevated cholesterol, and some cancers.¹ Mini-rapid small-scale column tests (RSSCT), loaded with ionic fluorogel (IF) resin, demonstrated an effective approach for PFAS removal from water systems via selective fluorophilic sorption and targeted ion exchange mechanisms.

MOTIVATION

PFAS, the “forever chemicals,” are heavily integrated into the daily lives of consumers. These chemicals are used as surfactants, possessing hydrophobic and oleophobic properties, making them useful in water/stain resistant products such as aqueous film forming foams, water and stain resistant fabrics, and more.² Because of widespread application, PFAS are increasingly disposed and detected in environmental compartments, including clean water systems. PFAS possess chemically stable carbon-fluorine bonds, consequently making them resistant to biodegradation and permitting their long-term ecological presence.³ Current EPA regulations have phased out and set water health advisories of 70 parts per trillion for legacy, long-chain PFAS such as perfluorooctanoic acid (PFOA) and perfluoro-1-ocanesulfonic acid (PFOS).⁴ However, these regulatory efforts have influenced manufacturers to create alternative, emerging, short-chain PFAS such as GenX to replace legacy compounds. These shorter chain compounds are harder to remove from water, creating a need for technology that better addresses the changing profile of PFAS.³

IONIC FLUOROGENE SORPTION & MINI-RSSCTS TREATMENT

SYNERGISTIC MECHANISM FOR SORPTION

Fluorous-Fluorous Interaction + Ion Exchange

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\text{IF} \rightarrow \text{PFAS} \rightarrow \text{NOM}
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SELECTIVE REMOVAL THROUGH MINI-RSSCTS

Local water treatment plants have provided settled conventional water samples for sorption testing. Settled water is collected from the point in the treatment process before filtration and after sedimentation. Utilizing settled water in mini-RSSCTs models water matrixes in treatment plants, where PFAS remediation technologies, like ionic fluorogels, would be implemented.⁴

RESULTS

• The synergistic mechanisms of fluorous-fluorous interactions and ion exchange within ionic fluorogels result in the rapid, efficient, high-capacity, selective removal of a variety of PFAS under laboratory tests mimicking environmentally relevant conditions.²
• IF resins removed short-chain PFAS more efficiently than commercial IX resin.
• Ionic fluorogels are being further developed and evaluated at bench-scale towards identifying an improved material formulation for pilot-testing in several NC sites.

CONCLUSIONS & FUTURE WORK

References


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