

2026 ITRC Project Team Proposal

Environmental Topic: Sorption Technology

Project Title: Novel Adsorption Media for Remediation of PFAS in Water Systems

Project Deliverables:

This work will result in various deliverables in order to educate engineers, municipalities, etc. on the suite of options available or in development for per- and polyfluoroalkyl substance (PFAS) remediation. This will include the guidance document which will highlight strengths and weaknesses of novel media as was done for granular activated carbon (GAC) and anion exchange resins (AER) in the previous guidance document in order to create easy access resources for these lesser-known adsorbents. GAC and AER are strong tools for remediation, but other options are available that can close the gaps left by these sorbents. The goal of this work is to provide a deeper understanding of these novel adsorbents therefore strengthening the efforts of PFAS treatment across the United States.

It is hoped that ITRC will select one or more PFAS topic proposals as well as the Updating ITRC PFAS-1 proposal for the 2026-2027 project cycle. The team intends that any PFAS proposals selected by the Board would be implemented cooperatively by one PFAS Team.

Problem Statement:

Environmental contamination of PFAS has gained widespread recognition in the past decade due to the significant human and environmental health implications associated with the contaminant class. This has led to the implementation of several regulatory limits, both at the state and federal levels, including the United States Environmental Protection Agency (USEPA) PFAS drinking water maximum contaminant levels (MCL). Current requirements state that these MCLs must be met by drinking water providers by 2031, therefore creating a significant demand for water remediation techniques. Development of technology for water treatment and remediation of PFAS contamination is critical in order to meet USEPA PFAS MCLs by the deadline. Current treatment technologies typically include sorption-based remediation with GAC and AER. Though these sorbents are tried and true for PFAS removal, there remains a necessity for alternative sorbents which can efficiently remove PFAS from water in order to address the entirety of the problem. These adsorbents are commonly used because they have been demonstrated as strong tools for PFAS removal from water, but neither option is universally compatible with all water treatment designs. With this consideration, it is critical to also highlight novel adsorbents that can help to fill gaps and address the widespread issue of PFAS water contamination.

There are some drawbacks with GAC and AER for water treatment. Though the drawbacks are not universal issues that apply to all treatment facilities, there are several treatment plant designs that do not operate efficiently with these media. This can include, but is not limited to, plants that have small spatial footprint where GAC utilization is challenging, with high salt content or use of chlorination which is not compatible with AER. It is well known that GAC is widely impacted by organic co-contaminants and complex matrices in source water. This often leads to fouling of the media, clogging of the micropore structures that characterize GAC, as well as decreased bed life due to competitive sorption with the other contaminants in source water. Additionally, the sorption kinetics of GAC are slow therefore requiring long contact times, i.e. empty bed contact time, which

requires a significant volume of media and a large spatial footprint. Many treatment plants do not have the ability to expand the size of their facilities as they are in urban or densely populated areas, meaning they are often not conducive to GAC for PFAS remediation. Matrix impacts on AER can also have an impact on media performance. Source water with significant salt concentrations or co-contaminants such as nitrates face effects of competitive sorption which can reduce the bed life of the resins. In addition, the possibility of carcinogenic nitrosamines leaching from AER as a result of the production process or as a reaction product of chlorination disinfection processes, which poses a potential risk to consumers. Also, though AER is highly effective at PFAS removal from water, it is often a more expensive option compared to other adsorbents. The AWWA recently determined that the annual cost of treating PFAS to USEPA MCLs will cost between 2.7 to 3.5 billion dollars annually, of which the burden will fall primarily on the public. With this in mind, efforts to make water treatment processes as cost effective as possible are critical.

This proposal is for the development of a second sorption document which pivots the focus to novel adsorbents. Novel adsorbents were briefly discussed in the 2024 ITRC sorption technologies proposal, but the focus of the final document was decided to be on GAC, AER, and foam fractionation. This decision was made based on the proven readiness of the technologies. Since this time, novel sorbents including surface modified clay (FLUORO-SORB® Adsorbent), cyclodextrin based adsorbents (DEXSORB®), membrane reactors (NanoSORB™), etc. have been demonstrated as viable options for water treatment and can address some of the needs discussed earlier. The guidance produced from this proposal will highlight novel adsorbents that are on the market, discuss their capabilities and drawbacks, as well as discuss their technology readiness levels.

Proposal Supporters:

Rebecca Dickman, Ph.D., Technical Services Manager, CETCO, Rebecca.Dickman@mineralstech.com

Levi Hauptert, Ph.D., Physical Scientist, USEPA, hauptert.levi@epa.gov

Andrew Safulko, Brown and Caldwell, asafulko@brwnclad.com

References

1. Saeidi, Navid, Adelene Lai, Falk Harnisch, and Gabriel Sigmund. "A FAIR comparison of activated carbon, biochar, cyclodextrins, polymers, resins, and metal organic frameworks for the adsorption of per-and polyfluorinated substances." *Chemical Engineering Journal* 498 (2024): 155456.
2. Liu, Fuqiang, Joseph J. Pignatello, Runze Sun, Xiaohong Guan, and Feng Xiao. "A comprehensive review of novel adsorbents for per-and polyfluoroalkyl substances in water." *ACS ES&T Water* 4, no. 4 (2024): 1191-1205.
3. Burkhardt, Jonathan, Thomas F. Speth, Stanley Gorzelnik, Alexander S. Gorzalski, Orlando Coronell, Ahmed Rachid El-Khattabi, and Mohamed Ateia. "How Do Novel PFAS Sorbents Fit into Current Engineering Paradigm?." *ACS ES&T Engineering* 5, no. 4 (2025): 830-838.