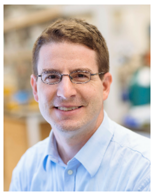
RESEARCH BRIEF
Start Date: Feb 2, 2022 | Duration: 36 months

NAWI National Alliance for Water Innovation

Tailored Reductants for Selenium Removal in Iron Electrocoagulation



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Challenge

The selenium (Se) concentration in industrial wastewaters ranges from about 10 µg/L in landfill leachates, to more than 1,000 µg/L in flue gas desulfurization wastewaters. Current Se discharge limits are as low as 5 µg/L,[1] requiring treatment processes that decrease Se concentrations by orders of magnitude. Reverse osmosis does not effectively remove Se and commercially available Se removal systems are largely biologically based,[1] but these systems can become unstable, are less effective in cold regions, and generates organo-selenium species, which are more toxic than Se itself.[1] There is a strong need for non-biological-based technologies that can selectively remove Se without generating toxic by-products and that are resilient to variable feedwater.

Research Approach

Mixed valence iron-containing solids are promising reductants for the precision separation of Se and have been shown to effectively remove Se from water through adsorption and chemical reduction.[2] Green rust, a mixed valence iron solid, is an especially potent reductant of the most soluble form of Se[3], selenate, and can be generated by iron electrocoagulation (EC) at specific pH and dissolved oxygen conditions.[4] This project will advance the ability of iron EC to remove Se from water through tailored generation of solids with targeted adsorption and reduction properties. The approach will test several representative challenge waters using batch and laboratory-scale continuous flow regimes; investigate Se-immobilization mechanisms and assess the stability of immobilized Se in the residual solids; develop a reaction-based model for predicting performance and; develop a technoeconomic assessment tool, assess economic viability, and prioritize future applied research.

Impact

Successful completion of this research plan will lead to the development of a modular and electrified treatment system for the precision removal of Se. Furthermore, information obtained throughout the life of this project will be used to inform two other NAWI-funded EC projects: one investigating EC for virus removal and the other using EC for removing silica and hardness. It is anticipated that the information gained from these three projects, collectively, will be greater than the sum of the parts and dramatically improve our understanding of EC and how EC can be used as a platform technology for treatment before or after RO.

RESEARCH PARTNERS

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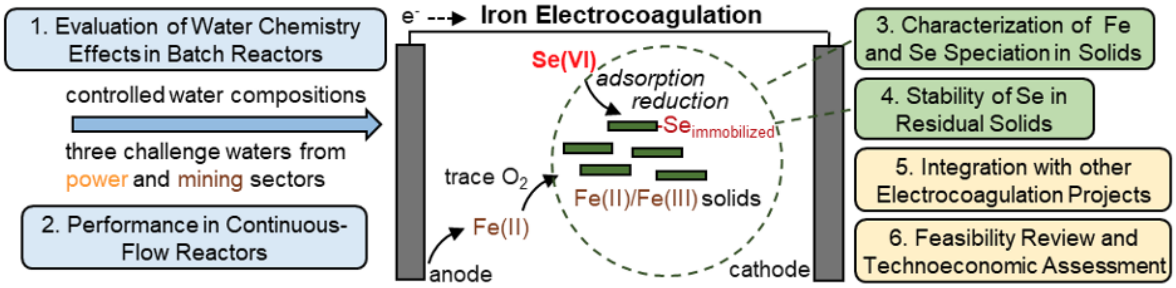

Figure 1. Research approach for advancing the precision separation of Se using electrocoagulation.

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