ELECTROCOAGULATION FOR TREATMENT OF DISINFECTION BYPRODUCTS, ORGANIC MATTER, AND PER-AND POLYFLUOROALYKL SUBSTANCES.

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Technologies are needed to treat contaminants such as disinfection byproducts (DBPs), trace organic compounds (TOrCs), and per- and polyfluoroalkyl substances (PFAS) in water to improve consumer safety and mitigate chronic risk. This dissertation focused on evaluating electrocoagulation (EC) and hydrogen peroxide (H_2O_2)-enhanced EC (peroxi-electrocoagulation; EC:H_2O_2) for treatment of these contaminants, the impacts of source water quality (such as natural organic matter [NOM]) on overall performance, and the non-destructive and destructive pathways involved in treatment.

The first objective focused on the performance of EC for mitigating the formation of regulated DBPs in water to better substantiate EC's performance relative to regulations and conventional treatment technologies. This objective was achieved by conducting a series of EC and conventional coagulation tests for multiple NOM sources and measuring the DBP formation potential following post-treatment chlorination. Overall, EC had similar performance to conventional coagulation, indicating that EC may be a competitive DBP mitigation technology in applied systems.

The second objective focused on enhancing the oxidizing capabilities of iron-EC by adding hydrogen peroxide to boost the oxidant yield via EC:H_2O_2. This process provided oxidative destruction of TOrCs in tandem with non-destructive separation pathways that can treat NOM as well as TOrCs. The energy inputs required for EC:H_2O_2 were favorable compared to other oxidative technologies, substantiating the case for EC:H_2O_2 as a combined destructive and non-destructive process for water treatment.

The third objective assessed EC:H_2O_2 for PFAS mitigation and the influence of six different NOM sources on treatment efficiency. PFAS removal was observed for systems with and without NOM. However, the PFAS treatment pathways were different in NOM-containing systems, where more non-destructive removal, such as floatation layer accumulation, occurred. This difference may be due to the interactions between low molecular weight NOM, iron, and PFAS that form complexes that are more susceptible to non-destructive treatment and inhibit destructive treatment. These findings showed that real-world waters can heavily influence PFAS mitigation processes relative to treatment in synthetic laboratory matrices without background NOM and shift removal pathways. Overall, this research shows that EC and EC:H_2O_2 may serve as effective water treatment technologies for real-world waters that contain NOM.