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Hybrid filtration-reaction process for the removal of sulfamethazine from water

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Manufactured and organic compounds such as flame retardants, antibiotics, and other persisting pollutants have been detected in wastewater discharges. The current biological and physical processes in treatment plants failure to remove these non-biodegradables lead to accumulation and potentially adverse effects for humans and the environment. Advanced oxidative processes (AOPs) are being explored to remove these persisting contaminants. The hydroxyl radicals produced by AOPs are extremely reactive and useful for the degradation of organic pollutants. The objective of this work was to use an iron oxide coated ceramic membrane in a continuous flow system to catalyze a photo-Fenton reaction for degradation of sulfamethazine (SMZ), a common antibiotic in veterinary medicine. The membrane was fabricated in the lab, and X-ray diffraction (XRD) analysis confirmed the formation of hematite. A feed solution with a concentration of 5 ppm SMZ and dosed with 50 mM hydrogen peroxide (H2O2) was circulated through a custom-made membrane-module, at pH values of 2, 5, and 8. The SMZ concentration in the feed and permeate solutions was quantified at various times in each trial using UV-Vis as a preliminary measure and later high-pressure liquid chromatography (HPLC) to check. Control experiments in dark without addition of H_2O_2 did not show significant removal of SMZ with the membrane. Separation by size, adsorption, and photolysis, are not major mechanisms compared to the Fenton reaction in agreement with previous results obtained in batch reactors. The filtration experiments with the addition of hydrogen peroxide and light and suggest a promising reaction but the work is an ongoing process with data still being collected and analyzed. More research will be needed to optimize the process parameters and assess its effectiveness on other persisting contaminants. The observed Fenton reaction could be a cost-effective solution for the treatment of drinking water sources contaminated with recalcitrant contaminants.