Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.27144

Decomposition of sulfamethoxazole using persulfate oxidation with varied Fe^0 particle size and mixing rate

SOYEONG PARK[1] AND CHEOLYONG KIM[2]

[1]Incheon National University
[2]Incheon national university

The oxidation treatment of residual pharmaceuticals in contaminated groundwater using persulfate (PS) and Fe^0 has been widely studied. Persulfate is activated by Fe (II) generated from the corrosion of Fe^0, producing highly reactive sulfate radicals (SO_4^{-}) with strong oxidation potential. When this process is applied to commercial scale, the corrosion behavior of Fe^0 can be influenced by the mixing rate and particle size, ultimately affecting pollutant removal efficiency. This study aims to compare the effects of mixing rate and Fe^0 particle size on the removal efficiency of sulfamethoxazole (SMX), a representative residual pharmaceutical.

Sodium persulfate ($Na_2S_2O_8$, ≥98%, Sigma-Aldrich) was used as the oxidant, and two types of Fe^0 were employed for persulfate activation: granular Fe^0 (99.98%, 1–2 mm, Alfa Aesar) and iron powder (100%, Duksan Reagents). SMX (98%, Alfa Aesar) was selected as the target contaminant and prepared at a concentration of 50 μM in 200 mL solutions. Oxidation experiments were conducted in 250 mL flasks. After adding Fe^0 to the SMX solution, persulfate (0.5 mM) was introduced to initiate the reaction. Depending on the particle size, different concentrations of granular Fe^0 (10 g/L) or iron powder (1 g/L) were used. Batch experiments were performed by varying the mixing rate (50–200 rpm) to evaluate the effect of mixing intensity on pollutant removal efficiency.

When granular Fe^0 was used, SMX removal efficiencies after 24 hours were 68% at 50 rpm and 80% at 100 rpm. At 150 rpm and 200 rpm, SMX concentrations decreased by 71% and 67%, respectively, after 200 minutes. In contrast, with iron powder, SMX removal efficiencies after 24 hours reached 77% at 50 rpm and 92% at 100 rpm, while both 150 rpm and 200 rpm conditions resulted in 73% removal after 200 minutes. Overall, increasing the mixing rate enhanced SMX removal efficiency, likely due to improved mass transfer and corrosion dynamics of Fe^0. Furthermore, iron powder exhibited higher removal efficiency than granular Fe^0, despite being applied at one-tenth the dosage. This can be attributed to the significantly higher surface area of iron powder, which facilitates persulfate activation and enhances pollutant degradation.