

INVESTIGATION OF THE UV/PERSULFATE PROCESS FOR THE ELIMINATION OF TRIMETHOPRIM ANTIBIOTIC – THE EFFECT OF MATRIX AND INORGANIC IONS

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Antimicrobial resistance is one of the most emerging health crises due to the release of antibiotics into the environment. The WHO declared in 2019 that antibiotic resistance is among the ten most serious environmental risks. Nevertheless, antibiotic use increased sharply during the COVID-19 pandemic, as more than half of those infected with the coronavirus received antibiotics to prevent bacterial infection. These antibiotics and their biologically active metabolites are present in domestic and hospital wastewater effluents. Various UV-based advanced oxidation methods can be used in the degradation of pharmaceuticals due to the generation of reactive hydroxyl radicals. Besides these processes, sulfate radical ($\text{SO}_4^{\bullet-}$) based techniques have become widely investigated in recent years.

This study investigated UV photolysis combined with peroxydisulfate ion (PDS) to eliminate trimethoprim, a widely used and hardly biodegradable antibiotic from aqueous solutions. The low-pressure mercury-vapor lamp emits 254 nm UV light as a light source. The direct UV photolysis is negligible for trimethoprim elimination, and the addition of PDS enhanced the transformation and mineralization rate due to the formation of reactive $\text{SO}_4^{\bullet-}$ via direct photolysis.

The effect of inorganic ions, such as Cl^- and HCO_3^- and biologically treated domestic wastewater as a matrix were also investigated. Biologically treated domestic wastewater diminished the transformation and mineralization efficiency. Using 1.0×10^{-4} M trimethoprim and 1.0×10^{-3} M PDS concentration, the transformation stopped after 3 minutes, and no more than 30% degradation was reached. Using doubled PDS concentration, the negative matrix effect was moderated. Since both Cl^- and HCO_3^- react with $\text{SO}_4^{\bullet-}$, their influence was studied separately and together. The degree of inhibition was far below the value expected based on their radical scavenging capacity. The formed secondary radicals, Cl^\bullet and $\text{CO}_3^{\bullet-}$ can react with trimethoprim or initiate the formation of other reactive species, such as $^\bullet\text{OH}$. The formation of chlorinated products proved the contribution of Cl^\bullet to the transformation. The presence of HCO_3^- diminished the formation of chlorinated products, most likely due to the reaction between Cl^\bullet and HCO_3^- resulting in Cl^- and $\text{CO}_3^{\bullet-}$. However, the reactions between inorganic ions and $\text{SO}_4^{\bullet-}$ require further investigation due to the complexity of the multi-component solutions containing various reactive species.

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