

Title: Antibiotic-contaminated wastewater treatment and remediation by electrochemical advanced oxidation processes (EAOPs)

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Abstract: Antibiotics are extensively used in health sectors, animal husbandry, and agriculture, which raises serious concerns nowadays due to their presence in surface water, groundwater, soil, sediment, and plants. Antibiotics in water can cause the accumulation and spread of antibiotic-resistant genes that have a serious impact on the environment. Moreover, due to the refractory and persistent nature of antibiotics, conventional wastewater treatment technologies including physio-chemical and biological treatments are inefficient for antibiotic wastewater treatment. In recent times, Electrochemical Advanced Oxidation Processes (EAOPs) have been reported to be effective in the treatment of antibiotic-contaminated wastewater. These specialized techniques produce very reactive and oxidizing intermediate $\bullet\text{OH}$ radicals which readily degrade the antibiotics. In this article three most important EAOPs, Electro Oxidation (EO), Photo Electro Catalytic Oxidation (PEC), and Electro Fenton (EF) are reviewed along with their classification, performance in different antibiotics, influencing factors e.g., anode-cathode materials, pH, current density, initial concentration, temperature, and supporting electrolytes. These processes offer eco-friendly, sustainable, cost-effective methods for treating antibiotics. Moreover, the feasibility of EAOPs in industrial wastewater treatment has not been properly established due to toxic intermediates, high cost, incapable to handle a large volume of wastewater, its performance only at ideal conditions, degrade only a few antibiotics, and mass transfer limitations. Consequently, combining membrane separation and conventional biological treatments as pre- or post-treatments of EAOPs can effectively address toxicity reduction and the handling of large volumes of wastewater. In addition, the energy consumption in a single EO process is higher than the combined processes. To constructively write this review, data have been collected from renowned publishers e.g., ScienceDirect, Springer, Willey, American Chemical Society Publications, etc. The possibilities, challenges, and future outlooks for the scale-up and commercialization of existing lab-based EAOPs have been discussed for the sustainable use of EAOPs in treating toxic and bio-persistent antibiotic compounds from wastewater. Furthermore, the research gaps mentioned in this paper can encourage future researchers to utilize the merits of EAOPs and combined processes for achieving high degradation efficiency of antibiotics at low cost and establishing it commercially.

Keywords : Antibiotics Electro advanced oxidation process Photo electro-catalytic oxidation Electro-fenton Combined-EAOP process Energy consumption.

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