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Investigating the effects of operational parameters on the electrochemical treatment of water containing p-nitrophenol

Fatemeh Ajam,*[,a] Farhad Qaderi[b]

[a,b]*Department of Civil & Environmental Engineering, Faculty of Civil Engineering, Babol Noshirvani University of Technology, Babol, Iran*

* E-mail: *fatemehajam96@gmail.com*

Nitrophenols are widely used in the production of various chemical products but can pose significant threats to ecosystems and human health when released into the environment. The United States Environmental Protection Agency recognizes nitrophenols as priority organic pollutants due to their high toxicity, persistence, and bioaccumulation[1-2]. Electrochemical methods have shown high efficiency in mineralizing organic pollutants, with electrolysis being the most common and cost-effective technique for decomposing these pollutants in wastewater. Electrolysis is an advanced oxidation process facilitated by the hydroxyl radical, a strong oxidizer that helps remove organic molecules from water. Organic pollutants can be eliminated during electrolysis through direct electron transfer to the anode (direct electrolysis) or by reacting with oxidants produced through electromagnetic reactions, such as the hydroxyl radical (OH) generated during water discharge at the anode (indirect electrolysis) [3].

This study aims to provide an efficient technology for wastewater treatment and investigate the key parameters of the electrolysis process. The research findings reveal that the reaction flow directly impacts the removal efficiency of p-nitrophenol (PNP), while the initial concentration of the pollutant and the pH of the solution have opposite effects. PNP decomposition is more efficient in an acidic environment compared to alkaline and neutral conditions. The increased efficiency in acidic conditions can be attributed to the enhanced production of H+ ions, resulting in the formation of H2SO4, a strong acid that improves pollutant decomposition. Conversely, at higher pH levels, the formation of polymer intermediate products hampers PNP degradation due to interactions with the hydroxyl group.

In conclusion, this study highlights the potential of electrolysis as an efficient technology for wastewater treatment. The findings contribute to a better understanding of nitrophenol removal and offer insights for the development of optimized treatment systems.

Keywords: Electrolysis, Graphit, p-nitrophenol

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