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Electrooxidation treatment for removal of emerging pollutants in wastewater sludge



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HIGHLIGHTS

• Electrooxidation removed emerging pollutants in industrial wastewater sludge.

• Sorption of emerging pollutants to solids limit electrooxidation efficiency.

• 90% of the organic matter is associated to sludge solids.

• Process performance is mass transfer limited and requires good mixing conditions.

• Degradation of selected emerging pollutants reached 73-89%.

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Management of wastewater sludge continues to pose a challenge as its generation is rising as a result of an increase in wastewater treatment and because its quality varies widely. Lately, emerging pollutants have gained importance based on their persistence and potential risk once they enter the environment. Different treatment processes have been proposed to reduce their concentration, such as electrooxidation. Electrooxidation using boron doped diamond electrodes has properties that make them suitable for a wide variety of applications, including wastewater and sludge. Electrooxidation was applied to sludge from a wastewater treatment plant receiving industrial discharges located in Toluca, México. Different pH and current densities were tested at the laboratory and, based on soluble chemical oxygen demand (sCOD) reduction, operating conditions were set at a pH of 3 and a current density of 40 mA cm⁻² during 1 h. Oxidation of organic matter was limited by the concentration of solids during treatment as phased separation (flotation) occurred due to gas generation and additional tests were performed to overcome this situation. 4,4'-(Propane-2,2-diyl)diphenol, Nonylphenol, and 5-chloro-2-(2,4-dichloro-phenoxy)phenol were removed by 73%, 89%, and 82% under improved test conditions. Sludge volatile solids were degraded 23% and total COD 27%. Overall, the proposed process represents a promising technology to reduce emerging pollutants in wastewater sludge.

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1. Introduction

As a result of improvements in global sanitation, the amount of sludge that must be managed will increase [1]. Growing concerns about sludge management arise not only because of the costs

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associated to its treatment and disposal (up to 60% of operation and maintenance costs; [2]), but also based on the presence of harmful pathogens and a new kind of contaminants, namely, emerging pollutants [3].

Emerging pollutants, or micropollutants, include tensoactive substances, personal care products, pharmaceuticals, hormones, phthalates, and flame retardants. These pollutants reflect the diversity of products that society is using and the careless way in which people abuse and discharge them into sewage system. Moreover, these pollutants represent an environmental risk as some of them may have harmful effects on aquatic environments as well as on animal fertility [4].





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Abbreviations: BDD, boron doped diamond (electrodes); BPA, 4,4'-(propane-2,2diyl)diphenol; COD, chemical oxygen demand; NP, Nonylphenol; TCS, 5-chloro-2-(2,4-dichlorophenoxy)phenol.

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