Title: Electrocoagulation-based wastewater treatment process and significance of anode materials for the overall improvement of the process: A critical review

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Abstract: The electrocoagulation (EC) technique has been thoroughly investigated over the last decade in several reviews. The selection and modification of anode materials play a crucial role in enhancing the efficiency and effectiveness of the EC process. This paper sheds light on an overview of the EC process, its principle, mechanism, and applications in wastewater treatment, mainly based on different anode materials and their applicability in various industries. It then discusses the importance of anode material selection and modification, emphasizing surface modification techniques such as conducting polymer and nanopolymer composite coating. These techniques aim to improve the anode's electrochemical properties and performance in wastewater treatment. Furthermore, this review conducts a comprehensive cost analysis of the EC process, considering equipment, energy consumption, maintenance, and chemical requirements along with different electrode materials. Cost-effective strategies for implementing EC-based wastewater treatment systems are discussed, highlighting the importance of considering long-term operational costs and environmental impacts. The review also provides future perspective recommendations for advancing the field of EC-based wastewater treatment. It suggests areas for further research, such as developing novel anode materials, optimizing surface modification techniques, and integrating EC with other treatment processes, such as wireless EC and nano-filtration, for improved efficiency.

Keywords: Electrocoagulation; Wastewater treatment; Anode materials; Electrode surface modification; Conducting polymer coatings; Nanopolymer composites; Cost analysis; Energy consumption; Hybrid electrocoagulation systems; Future perspectives

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