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Wastewater Treatment using Microbial Fuel Cells

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Abstract: *Microbial fuel cells (MFCs) are emerging as an innovative bioelectrochemical technology for sustainable wastewater treatment, offering the dual benefit of degrading organic pollutants while simultaneously generating electricity. By harnessing the metabolic processes of electroactive microbes, MFCs convert biodegradable substrates into electrical energy through oxidation reactions. This approach presents an attractive alternative to traditional wastewater treatment methods, which often rely on energy-intensive operations and contribute substantially to greenhouse gas emissions. Recent progress in MFC technology—including advancements in electrode materials, reactor design optimization, and improved microbial communities—has led to enhanced power output and higher efficiencies in removing chemical oxygen demand (COD). Beyond the elimination of organic contaminants, MFCs also hold promise for the remediation of nutrients and heavy metals, increasing their environmental utility. Life cycle assessments and energy recovery analyses reveal that MFCs can function with minimal external power, making them suitable for decentralized wastewater treatment in both urban and rural environments. The incorporation of separated waste streams and hybrid systems further improves their operational adaptability. Although challenges remain in scaling up, reducing costs, and ensuring long-term performance, MFCs support circular economy principles and offer a sustainable route to energy-positive wastewater treatment.*

Keywords: *Microbial fuel cells*

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