MICROBIAL FUEL CELL: GREEN ELECTRICITY GENERATION AND WASTE WATER TREATMENT

A Mini Project Report

In Partial Fulfilment of the Requirement for Award of Degree of

Bachelor of Technology of the 2^{nd} Year in Chemical Engineering

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CERTIFICATE

Certified that the Mini Project Report entitled *"Microbial Fuel Cell: Green Electricity Generation and Waste Water Treatment""* submitted by JAYPRAKASH AND RUPESH KUMAR of B.Tech. 4th Semester, in partial fulfillment of the requirements for the award of degree in Bachelor of Technology (B. Tech) in Chemical Engineering, is according to the students their own investigation carried out by them in the Department of Chemical Engineering, School of Studies of Engineering & Technology, GGV, during the session 2024-25.

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Abstract

The environmental impact of fossil fuels and the global energy crisis have spurred the search for sustainable alternatives, such as microbial fuel cells (MFCs). MFCs harness the metabolic activity of electroactive microorganisms to generate electricity while also treating wastewater, making them an attractive bio electrochemical technology. This review provides a comprehensive overview of MFCs, ranging from types, substrates, and microbial communities to configuration designs and technological advancements. Studies have demonstrated that MFCs can achieve power densities up to 460 mW/m^2, reduce sludge generation by 52–82%, and demonstrate high chemical oxygen demand (COD) removal efficiency (>90%), particularly for low-COD wastewater. Furthermore, the selection of optimal microbes, electrode materials, and operating conditions significantly enhances power yield and coulombic efficiency. While MFCs are suitable for small-scale applications, large-scale operation is faced with challenges including costly materials, low buffering capacity of wastewater, and relatively low power generation. Comparative studies with traditional wastewater treatment processes validate the potential of MFCs in reducing energy consumption without sacrificing treatment efficiency. Further, the technology extends beyond electricity generation, finding applications in biosensors, degradation of toxic chemicals, and resource recovery. Further studies are warranted to streamline microbial interactions, electron transport mechanisms, and system configurations to upscale MFCs from laboratory-scale demonstrations to industrial practice. This review consolidates recent developments, identifies research gaps, and provides perspectives on the future advancement of MFC technology towards sustainable energy and environmental management.