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Review

Microbial fuel cells for mineralization and decolorization of azo dyes: Recent advances in design and materials

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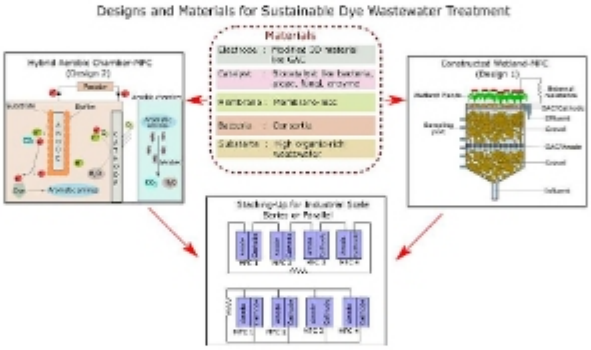
HIGHLIGHTS

- Microbial fuel cells can treat azo dyes & generate electricity but underutilized.
- Focus needed on fuel cell design, electrode & membrane for industrial application.
- Limited studies focused on complete mineralization of azo dyes using hybrid MFCs.
- Industry needs integration of fuel cell with aerobic reactors & constructed wetland.

GRAPHICAL ABSTRACT



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ABSTRACT

Microbial fuel cells (MFCs) exhibit tremendous potential in the sustainable management of dye wastewater via degrading azo dyes while generating electricity. The past decade has witnessed advances in MFC configurations and materials; however, comprehensive analyses of design and material and its association with dye degradation and electricity generation are required for their industrial application. MFC models with high efficiency of dye decolorization (96–100%) and a wide variation in power generation (29.4–940 mW/m^2) have been reported. However, only 28 out of 104 studies analyzed dye mineralization – a prerequisite to obviate dye toxicity. Consequently, the current review aims to provide an in-depth analysis of MFCs potential in dye degradation and mineralization and evaluates materials and designs as crucial factors. Also, structural and operation parameters critical to large-scale applicability and complete mineralization of azo dye were evaluated. Choice of materials, i.e., bacteria, anode, cathode, cathode catalyst, membrane, and substrate and their effects on power density and dye decolorization efficiency presented in review will help in economic feasibility and MFCs scalability to develop a self-sustainable solution for treating azo dye wastewater.

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