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Simultaneous electricity production and Direct Red 80 degradation using a dual chamber microbial fuel cell

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ABSTRACT

Microbial fuel cells (MFCs) are gaining tremendous interests for achieving simultaneous power production and recalcitrant wastewaters treatment. In this study, simultaneous electricity generation and tetra-azo dye (Direct Red 80) decolorization was examined in a dual chamber MFC. In addition, glucose and various volatile fatty acids were separately examined as co-substrates for anaerobic dye degradation and bioelectricity generation. Maximum power of 477.8 and 455.7 mW/m^2 were attained with glucose (1,000 mg/L) as a sole carbon source and glucose (1,000 mg/L) coupled with dye (200 mg/L), respectively. At this glucose and dye initial concentration, 85.8% color and 74.9% COD removal were resulted in 48 h batch studies. Color removal without any co-substrate's addition was 23%, indicating dye was degraded mainly in the presence of carbon sources. There was no substantial negative effect in electricity generation was observed with the dye degradation. Dye removal was decreased with the increase in dye initial concentration (25–800 mg/L) and increases notably with the increase in initial glucose concentration between 0 and 1,000 mg/L, while afterward insignificant effect up to 2,000 mg/L was observed. Glucose was determined as better co-substrate followed by acetic, propionic, and lactic acid in terms of dye removal and maximum power production. Gas chromatography-mass spectrometry showed sodium 4-aminoazobenzene-4′-sulfonate to be the subsequent metabolites formed during the decolorization of dye. This work demonstrated that MFC could be applied to achieve electricity generation and simultaneous azo dye degradation using glucose as the preferred co-substrate.

Keywords: Microbial fuel cell; Direct Red 80; Dye degradation; Anaerobic; Power density

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