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Simultaneous wastewater treatment and power generation with innovative design of an upflow membrane-less microbial fuel cell

Abstract

The objective of this study was to evaluate the performance of an upflow membrane-less microbial fuel cell (UFML MFC) with various types of carbon material as cathodes in power output and chemical oxygen demand (COD) reduction. The UFML MFC was designed with carbon felt as anode material, and the bioreactor was filled with 0.6-cm diameter of gravel at the anode region. Carbon flake, Pt-loaded carbon paper, and carbon felt were used as cathode electrodes. The voltage output (power density) for the carbon flake cathode and Pt-loaded carbon paper cathode was 384 ± 16 mV (44.4 ± 2.5 mW/m^2) and 399 ± 9 mV (44.1 ± 3 mW/m^2), respectively. The percentage of COD reduction at the anode region and effluent was above 75 and 85 %, respectively, for all cathode materials. The coulombic efficiency was 15.95, 6.09, and 15.32 % for Pt-loaded carbon paper, carbon felt, and carbon flake, respectively. The result suggests that power generation and COD reduction were influenced by the cathode material. Carbon flake can be considered as a cost-effective cathode material in UFML MFC for future application in real biological wastewater treatment process.

Keywords

MFC, Upflow, Membrane-less, COD, Cathode material, Carbon flake