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Evaluation of a new sponge addition-microbial fuel cell system for removing nutrient from low C/N ratio wastewater

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Abstract

This study developed a new microbial fuel cell (MFC) system (Sponge-MFC), which consisted of a cathodic chamber with an added sponge and two anodic chambers, for low carbon/nitrogen (C/N) wastewater treatment. When operating in the closed-circuit state, the Sponge-MFC(C) demonstrated its superior electrochemical performance compared to the closed-circuit MFC. This superiority took the form of higher coulombic efficiencies, voltage outputs, current densities and power densities. Adding a sponge could reduce the cathode's charge transfer resistance and solution resistance, and improve its capacitance, thus increasing cathodic reaction rate and power outputs. Simultaneous nitrification denitrification (SND) and bioelectrochemical denitrification processes on the cathode coupled with the sponge's SND process were responsible for efficient removal of nitrogen from the Sponge-MFC(C). Fluorescent in situ hybridization (FISH) analysis revealed that nitrifying bacteria and highly diversified denitrifying bacteria were distributed at the cathode's outer layer and inner layer, respectively. Higher phosphorus removal efficiencies (82.06 ± 1.21%) in the Sponge-MFC(C) than that in the MFC(C) (53.97 ± 2.32%) could be ascribed to biological phosphorus removal and precipitation of phosphate salts on the cathode. These results suggested the Sponge-MFC(C) could accomplish better

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