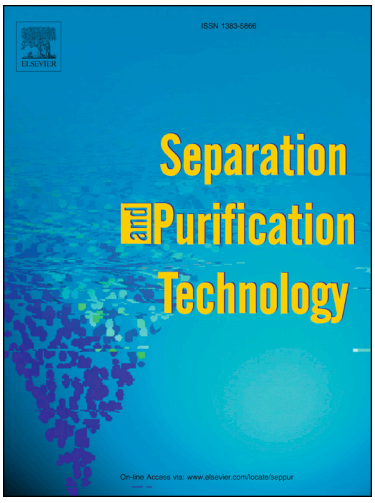

Simultaneous sulfide removal, nitrification, denitrification and electricity generation in three-chamber microbial fuel cells

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Simultaneous sulfide removal, nitrification, denitrification and electricity generation in three-chamber microbial fuel cells

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Abstract: Sulfide and ammonium in some industrial wastewaters need abolishing. The three-chamber microbial fuel cell (MFC), consisting of an oxic-cathode and an anoxic-cathode sharing same anode, was explored to accomplish simultaneous sulfide removal, nitrification, denitrification and electricity generation. It provided a promise of recovering electricity from wastewater containing sulfide and ammonium. The three-chamber MFC run with separate sulfide feeding and ammonium feeding showed preferable nitrogen removal and electricity generation performance as compared to that with a mixed sulfide/ammonium feeding. The desirable feeding sulfide concentration for this MFC was deemed as 193.6 ± 0.8 mg S L^{-1} considering both pollutant removal and electricity generation performance. Temperature rise favored both pollutants removal and electricity generation but hampered elemental sulfur recovery. The suitable temperature for this MFC was found to be 30 ºC, achieving a total nitrogen removal rate of 10.0 ± 1.3 g N m^{-3} d^{-1}, a sulfide removal rate of 206.5 ± 1.9 g S m^{-3} d^{-1}, a sulfur recovery efficiency of 28.9%, and an electricity generation of 428.0 ± 26.2 C/batch cycle. The distribution of coulombs to both cathodes affected the performance of nitrogen removal and electricity generation.

Keywords: microbial fuel cell; sulfide removal; nitrogen removal; electricity generation

1. Introduction

Currently, environmental pollution and energy shortage become major concerns worldwide. Microbial fuel cell (MFC), intergrating electricity generation with wastewater treatment, provides a promise of recovering energy from wastewater [1, 2]. To date, the applications of MFC to remove various pollutants such as organic, sulfurous and nitrogenous pollutants from wastewater coupled with power recovery have been widely reported [3-6]. Sulfide, a toxic and corrosive species of sulfurous pollutants in wastewater, could be removed in the anode chamber of MFC as the electron donor [7]. As for nitrogenous pollutants removal, previous studies mostly focused on removal of nitrate/nitrite in the anoxic-cathode chamber of denitrifying MFC, during which nitrate/nitrite was used as the electron acceptor [5, 8].

In most cases, the sulfide removal or nitrogen removal was performed individually in separate MFCs [4, 5, 7, 8]. Only several research groups applied a single MFC to remove both sulfide and nitrate in the anode chamber, but weak electricity generation was obtained in the presence of nitrate in the anode chamber [9, 10]. Because nitrate outcompeted the anode as the electron acceptor of sulfide oxidation, hindering electricity generation [9]. Recently we explored a novel denitrifying sulfide removal MFC to accomplish sulfide removal in the anode chamber and nitrate removal in the anoxic-cathode chamber

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