Desalination and Water Treatment
www.deswater.com

doi: 10.1080/19443994.2014.931535

53 (2015) 2740–2745
March

Taylor & Francis
Taylor & Francis Group

Simultaneous bioelectricity generation and biodegradability improvement of refinery wastewater using microbial fuel cell technology

Xuan Guo, Yali Zhan*, Chunmao Chen, Suxiu Sun, Lijie Zhao, Shaohui Guo*

Key Lab of Oil and Gas Pollution Prevention and Control, China University of Petroleum, 18 Fuxue Road, Changping, Beijing 102249, China, Tel. +86 10 8973 3335; Fax: +86 10 6074 3667; email: guo.xuan@126.com (X. Guo), Tel. +86 10 8973 3094, Fax: +86 10 6074 3667; email: wylzhan@cup.edu.cn (Y. Zhan), Tel. +86 10 8973 3335; Fax: +86 10 6074 3667; emails: chunmaochan@163.com (C. Chen), sunsuxiu110@163.com (S. Sun), hi.zbao@163.com (L. Zhao), Tel./Fax: +86 10 8973 2278; email: shguo@cup.edu.cn (S. Guo)

Received 16 July 2013; Accepted 17 November 2013

ABSTRACT

Wastewater contains abundant chemical bond energy that can be recovered by microbial fuel cell (MFC), so the aim of this study was to explore the feasibility of using MFC technology to dispose refinery wastewater and generate electricity simultaneously by recycling the chemical energy in wastewater. The energy recovery rate together with the wastewater treatment performance of MFCs with different structures was studied, respectively. Results indicate that both the single- and double-chambered MFC could be successfully started up to generate electricity, using refinery wastewater as fuel, the highest voltage output of two-chambered MFC was 305 mV, and the relevant maximum power density output was 310.08 mW/m^3. Meanwhile, the maximum coulombic efficiency of refinery wastewater was 3.0%. Refinery wastewater treatment efficiency of MFCs was higher than that of traditional anaerobic biological treatment process. The oil pollutant removal rate of double-chambered MFC could reach to as high as 83.60%. In refinery wastewater MFC, the petroleum pollutants could be degraded through microbial metabolism, generating plenty of phthalic acid esters and alcohols metabolites; the removal rate of aromatic hydrocarbons was higher than volatile phenol, and that of short-chain fatty hydrocarbon was higher than long-chain fatty hydrocarbon. In addition, when refinery wastewater was treated by MFC, toxic effects on living beings would be reduced obviously, resulting in the sufficient improvement of degradability.

Keywords: Refinery wastewater; Microbial fuel cell; Electricity generation; Microbial degradation rules; Biodegradability improvement

*Corresponding authors.

Presented at 2013 International Environmental Engineering Conference and Annual Meeting of the Korean Society of Environmental Engineers (IEEC 2013), Seoul, Korea, 11–13 June 2013