Effect of Biofilm Formation On The Performance Of Microbial Fuel Cell for the Treatment Of Palm Oil Mill Effluent

E. Baranitharan[a], Maksudur R. Khan[a] , D. M. R. Prasad[a], Wee Fei Aaron Teo[b],Geok Yuan Annie Tan[b], Rajan Jose[c]

[a]Faculty of Chemical and Natural Resources Engineering, Universiti Malaysia Pahang
[b]Faculty of Science, Institute of Biological Sciences, University of Malaya
[c]Faculty of Science and Technology, Universiti Malaysia Pahang

ABSTRACT

Anode biofilm is a crucial component in microbial fuel cells (MFCs) for electrogenesis. Better knowledge about the biofilm development process on electrode surface is believed to improve MFC performance. In this study, double-chamber microbial fuel cell was operated with diluted POME (initial COD = 1,000 mg L−1) and polyacrylonitrile carbon felt was used as electrode. The maximum power density, COD removal efficiency and Coulombic efficiency were found as 22 mW m−2, 70 and 24 %, respectively. FTIR and TGA analysis confirmed the formation of biofilm on the electrode surface during MFC operation. The impact of anode biofilm on anodic polarization resistance was investigated using electrochemical impedance spectroscopy (EIS) and microbial community changes during MFC operation using denaturing gradient gel electrophoresis (DGGE). The EIS-simulated results showed the reduction of charge transfer resistance (R ct) by 16.9 % after 14 days of operation of the cell, which confirms that the development of the microbial biofilm on the anode decreases the R ct and therefore improves power generation. DGGE analysis showed the variation in the biofilm composition during the biofilm growth until it forms an initial stable microbial community, thereafter the change in the diversity would be less. The power density showed was directly dependent on the biofilm development and increased significantly during the initial biofilm development period. Furthermore, DGGE patterns obtained from 7th and 14th day suggest the presence of less diversity and probable functional redundancy within the anodic communities possibly responsible for the stable MFC performance in changing environmental conditions.

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