Environmental Engineering and Management Journal *August 2015, Vol.14, No. 8, 1821-1828*
http://omicron.ch.tuiasi.ro/EEMJ/

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DYNAMICS ANALYSIS OF A MICROBIAL FUEL CELL SYSTEM AND PID CONTROL OF ITS POWER AND CURRENT BASED ON THE CRITICAL PROPORTION DEGREE METHOD

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Abstract

In this paper, the structure and working principles of a microbial fuel cell (MFC) are analysed, and a mathematical simulation model of MFCs is established based on the electrochemical equation, kinetic equation and material balance equation of a MFC. A simulation analysis and discussions are conducted in a MATLAB environment to investigate the effect of acetate concentration, influent flow and external resistance on the performance of a MFC system. The simulation model is demonstrated to be reasonable and feasible by a comparison with actual system testing data results. To solve the problems of unstable power output in the initial operation stage and the long adjustment time during the operation of a MFC, a proportional-integral-derivative (PID) control strategy that is based on the proportion degree method is proposed to effectively adjust the output power and current of a MFC under random influent flow at constant external resistance and acetate concentration. The simulation results show that the proposed method can accurately track the set value, shorten the power adjustment time, and reduce the response fluctuations. Therefore, the proposed scheme is feasible and effective for the control of the power and current output of a MFC.

Key words: critical proportion degree method, mathematical simulation model, microbial fuel cell, output power, PID control

Received: November, 2014; Revised final: July, 2015; Accepted: July, 2015

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