DEVELOPMENT OF A COMPUTATIONAL MODEL FOR BIOFILM BASED MICROBIAL FUEL CELL

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Degree of Master of Science

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Abstract

Studies on Microbial Fuel Cells (MFC) as Power production units are of increasing interest, because it can convert a variety of bio-degradable organic compounds into electricity. In a MFC; biological, chemical and electro-chemical reactions take place resulting in a change of concentration of substrate, suspended solids and growth of a biofilm leading to a production of an electrical current. In this study a dynamic mathematical model is developed that represents the behavior of microbial fuel cell using set of derived equations those describe the consumption of substrate by microorganisms, production of oxidized mediators using reduced mediators, growth of microorganisms in the bulk liquid and the biofilm attached to the anode and production of current at the electrode surface. The system consists of a bulk liquid with suspended cells and the anode with an attached biofilm.

Performance of a MFC is evaluated by analyzing the variation of production of current with time, variation of concentration of components (microorganisms, substrate, oxidized mediator and reduced mediator) in the bulk liquid with time and variation of concentration of mediators at the electrode surface with time in various combinations of selected operating parameters (reaction rate, exchange current density and total cell resistance). It was found that, higher the reaction rate the production of current by the fuel cell is high. At the same time, reaching of maximum current production is rapid in the systems simulated with high reaction rates compared to that of the others. On the other hand, high exchange current density values give relatively low current production from the cell where the low exchange current densities give somewhat high current production. Variation of total cell resistance affects in a similar manner on current production. That is, when the cell is simulated with high cell resistance values, the production of current is low. But, the current production sustain for a rather long period.

Key words: Microbial Fuel Cell, biofilm, dynamic modeling

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Contents

List of Figures

List of Tables