

Single Chamber Microbial Fuel Cell for Electricity Generation by Treating Organic Waste from Different Sources

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Abstract

Microbial Fuel Cell provides a new approach of harvesting electrical energy from the organic waste by treating wastewater without aeration. This research work was carried out in order to understand the working principle of MFC by designing and constructing a single chamber membrane-less MFC with a capacity of 15 Liter. The parameters such as electrode spacing, nature of substrate, electrode materials and operating temperature were analyzed and optimized so as to enhance the performance of MFC in terms of COD removal efficiency and power generation. Different experiments were carried out by varying the unit step distance between electrodes from 1 inch to 5 inch using canal river wastewater at an ambient temperature of 20 °C. Each experiment was run for six hours. It was observed that COD removal efficiency decreases with reducing the electrode spacing while the maximum average voltage of 105 mV is achieved with an electrode separation of 3 inch. Furthermore, to analyze the effect of temperature, canal water was treated in MFC for six hours at an electrode spacing of 3 inch for the temperature of 20, 30, 40 and 50 °C and it was investigated that highest average voltage generation of 150 mV is achieved at a temperature of 40 °C compared to 105mV, 129mV and 109mV at 20 °C, 30 °C and 50 °C respectively. To analyze the effect of waste on MFC’s performance, the wastewater from canal river and sugar industry was used as a substrate as described in this study. It was found that the industrial wastewater, rich in carbohydrates and organic matter produces higher power density as compared to canal river water. Maximum voltage of 265 mV and COD removal efficiency of 80% is achieved by treating the canal river water for 18 days while 707 mV and 95% COD removal efficiency were achieved by treating wastewater from sugar industry at a HRT of 18 days under the optimum operating conditions. Cell performance is also correlated in terms of operating parameters using multi-regression analyses. The model developed has a regression coefficient of 0.928 and is in good agreement with the experimental data.