INFLUENCE OF ELECTRODES SPACING ON THE MAXIMUM POWER OF A SOIL MICROBIAL FUEL CELL BASED ON STAINLESS-STEEL-NANOCARBON COMPOSITE ELECTRODES

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The electrical output of microbial fuel cells (MFCs) is unstable due to the natural activities of the electroactive bacteria involved. To sustain the maximum performance of MFCs, an optimization of the architectural aspect is necessary with special consideration of electrode materials, electrode spacing and substrate availability. This study was conducted with three single-chamber soil MFCs having different electrode spacings (2, 5 and 8 cm) and electrodes made of stainless-steel mesh with activated carbon catalyst layers to investigate the influence of the electrode spacings on the sustainability of the Maximum Power Point (MPP) of a soil MFC with synthetic urine medium (SUM) as substrate. The MFCs using mud from active soil were polarized every three days until the MPP was reached and then refueled with SUM every 6 days during a 90-day operating period. During the initial treatments, the maximum power was inversely proportional to the anode-cathode distance. However, this trend could not be maintained during continuous treatments, as the optimum performance was achieved with an electrode spacing of 5 cm. At 2 cm, 5 cm and 8 cm electrode spacing, the maximum power and the open-circuit voltage were 695.67 ± 36.0041 µW and 779.71 ±13.698 mV for 18 days, 517.66 ± 30.4 µW and 804.8 ±12.01 mV for 66 days and 474.9 ± 45.3 µW and 757.49 ±11.488 mV for 54 days respectively. During continuous treatment, the internal resistances of the MFCs decreased by 34.30, 28.2 and 41.87 % respectively due to an increase in electrolyte conductivity. Electrochemical impedance spectroscopy of the MFCs showed that the treatment had a more significant effect on electrolyte resistance than charge transfer resistance. These results showed that optimal cathode-anode spacing ensures substrate availability at the electrodes to maintain bacterial metabolism, resulting in stable performance of an MFC over a reasonably long period of time.