Analysis of Bench Scale Dual-Chambered Microbial Fuel Cell

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EXTENDED ABSTRACT

The objective of this project was to design and construct a dual-chambered Microbial Fuel Cell (MFC) which will allow the observation of electrical output potentials and influent degradation rates based on variable influent characteristics.

A microbial fuel cell is a device that takes advantage of the natural metabolic processes of microorganisms to simultaneously generate electrical current and treat wastewater. For a dual-chambered MFC, a batch reactor scenario is employed to process wastewater. This wastewater contains microorganisms, as well as the organic matter, which serves as the microbial substrate. Microorganisms metabolize the organic substrate and release electrons. These electrons are conducted through an anode/cathode circuit, producing electrical current. As the wastewater is degraded, hydrogen ions are released and travel through a semi-permeable material to the air cathode chamber. Within this chamber, the hydrogen ions combine with ambient oxygen to produce pure water. The anodes were composed of three reticulated vitreous carbon (RVC) panels. A single graphite rod served as the cathode, and a 5 µm pore size polyethylene tube served as the semi-permeable material surrounding the cathode. As a result of preliminary lab research, an influent consisting of two liters of mixed liquor suspended solids and four liters of nutrient broth was used in the batch reactor.

Various standard water testing methods were employed to assess the treatment efficiency of the proposed MFC design. These testing methods include: chemical oxygen demand, biochemical oxygen demand (BOD), and solids analyses. In addition, electrical output was continuously monitored through the use of a Campbell Scientific CR23X data logger. Data from the digital analyzer will allow electrical voltage to be plotted over time.

Over the testing period, soluble chemical oxygen demand (SCOD) and BOD were reduced by 53.6 % and 60.6 %, respectively. Output voltages peaked at 433 mV and closely resembled the microbial growth curve.