Fabrication and Electrochemical Analysis of a Bio-Slurry Based Microbial Fuel Cell at Cryo-Mesophilic Temperatures

George Ochieng'[1], Aloys Osano[2] & Bakari Chaka[3]
[1,2,3]Department of Mathematics and Physical Sciences, Maasai Mara University
P.O Box 861-20500, Narok, Kenya
Tel: +254 742 811226
Email: georgeawuor20@gmail.com

Abstract
Currently there is increasing dependence on energy with advancement of science and technology. The objective of the study was to investigate the performance of the MFC with different resistors at ambient conditions using bioslurry as the bio-anode. Microbial fuel cells (MFC) are electrochemical devices that convert the chemical energy contained in organic matter into electricity by means of the catalytic (metabolic) activity of living micro-organisms. One of the most important significance of MFCs is to produce electricity from wastewater, providing a new way to simultaneously treat wastewater while obtaining a source of clean and renewable energy. A H-type mediator-less MFC of capacity 4,000 cm^3 using porous graphite electrodes and bio-slurry as the bio-anode was studied over 12-day retention period. The results showed an exponential increase in OCV up to the sixth day followed by its gradual reduction. Ohmic behavior was observed in the current and power densities with varying resistors. A multimeter was used to monitor voltage output in presence of several resistors, in series with the multimeter. Open-circuit voltage, current, power densities and energy balance were then monitored over duration of 12 days with varying Ohmic behavior. In the experiments with a frit membrane separator, an OCV maxima value of 1.143 V for 8 h was attained while that with a nafion separator a maxima OCV value of 1.128 V for 32 h was attained. In the determination of power density, the highest value was obtained in the 1,000 Ω. An optimal OCV value of approximately 1.0 V was achieved on the sixth retention day. The optimal power densities (on the sixth day) obtained by each of the resistors were 0.054, 0.018, 0.004 and 0.0005 mW/cm^3 for the 1,000, 2,500, 5,000 and 16,000 Ω MFC resistors respectively further illustrating ohmic behavior of the MFCs. The study shows great potential and conformity to electricity principles by MFCs utilizing naturally occurring and untreated bio-electrodes and thus exhibiting more applicability of MFCs.

Key words: microbial fuel cells, bio-slurry, cryo-mesophillic temperatures