CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
Anna T. Rioux

Project Number
J0218

Project Title
Improving Energy Production of a Microbial Fuel Cell: Testing Surface-to-Area Ratio Variations

Abstract

Objectives/Goals
The purpose of this experiment was to improve the energy production of a Microbial Fuel Cell (M.F.C.). I did this by testing the energy output of different surface-to-area ratios of electrodes and chambers, to use the best combination design in a series connected circuit for application and scale use on a dairy. I hypothesized the large electrode/small chamber (21 cm per 1L ratio) combination would produce the most usable energy.

Methods/Materials
I designed and built four mediator-less M.F.C. combinations: sml electrode/sml chambers (9.5 cm/1L); lrg electrode/sml chamber (21 cm/1L); sml electrode/lrg chamber (2 cm/1L); lrg electrode/lrg chamber (4.5 cm/1L). Twice daily voltage and amperage reading were taken to calculate wattage. Plastic storage containers (3.785 L & 17.98 L) were used as anode/cathode chambers. Carbon cloth sized 6x6 cm and 9x9 cm, and copper wire were used as electrodes. An agar solution, cording and compression fitting were used for the salt bridge, and an air pump was used to aerate the cathode. Cow manure was used as the waste material for the fuel cells.
Then the fuel cells were connected in series to test for further increase in electrical output.

Results
The results showed that the sml electrode/sml chamber produced 525 mV; 232 mA, and a usable energy of the 0.056 watts. The lrg electrode/sml chamber produced 669 mV; 200 mA, and had the second best usable energy output of 0.066 watts. The sml electrode/lrg chamber produced 105 mV; 28 mA and had the least usable energy output of 0.001. The lrg electrode/lrg chamber had 545 mV; 272 mA, and the greatest usable energy output of 0.071 watts. Distilled water (control) did not produce any usable electricity.

Conclusions/Discussion
My hypothesis was proven incorrect. The lrg electrode/lrg chamber with a 4.5 cm/L ratio had the best performance. However, the lrg electrode/sml chamber had the best voltage output. These results indicate that the electrode size is as important as the size of the container to increase the output of the fuel cell. Continuing testing is being conducted by connecting the lrg electrode/lrg chamber fuel cells in a series circuit to further improve electrical output of the fuel cell. Initial result of this series testing is promising, with the goal of transferring the energy produced from the series to a rechargable battery for future use, and eventually for application to power a dairy.

Summary Statement
This project looks to improve the energy production of a microbial fuel cell by testing the energy output of different surface-to-area ratios of electrodes and chambers, to use the best combination design in a series connected circuit.

Help Received
My dad helped me drill holes in the chambers, my mom helped with editing my paper, and technical electrical advice was provided by Dr. Zhao, of West Hills Community College.