A STUDY ON MICROBIAL FUEL CELL (MFC) TO POWER UNDERWATER MONITORING DEVICE

By

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APPROVAL

A STUDY ON MICROBIAL FUEL CELL (MFC) TO POWER UNDERWATER MONITORING DEVICE

by

saravan a/l ravichanthiran

A project dissertation submitted to the Faculty of Engineering and Quantity Surveying INTI INTERNATIONAL UNIVERSITY in partial fulfilment of the requirement for the Bachelor of Engineering (Hons) in Mechanical Engineering

Approved:

DR. MUHAMMAD IZZAT NOR MA’AROF
Project Supervisor

INTI INTERNATIONAL UNIVERSITY
NILAI, NEGERI SEMBILAN

April 2018
DECLARATION

I, the undersigned, hereby declare that this report is my own independent work except as specified in the references and acknowledgements. I have not committed plagiarism in the accomplishment of this work, nor have I falsified and/or invented the data in my work. I am aware of the University regulations on Plagiarism. I accept the academic penalties that may be imposed for any violation.

Signature .................................................................

Name ................................................................. Saravanan A/L Ravichandiran

Matrix No. ................................................................. 114005634

Date ................................................................. 28 May 2018
ABSTRACT

A “Microbial Fuel Cell” also known as biological fuel cell impersonates the way bacteria behave in nature to generate current. A Microbial Fuel Cell converts the chemical energy through a catalytic reaction to electrical energy. A Microbial Fuel Cell consists of two different compartments namely an anode and cathode respectively. This project is done by using two compartments which are divided by a cation specific membrane which contains positively charged ions. In the anode, protons and electrons are produced as a result if the fuel oxidization by microorganisms. While the protons are moved to the anode via the membrane, the electrons are then moved to the cathode via an external circuit. In the cathode, both protons and electrons are used up to make a combination with oxygen in order to produce water. Malaysia has access to various renewable resources such as wind, ocean, biomass, solar and small hydro. Malaysia therefore has the potential to achieve sustainable energy. Several energy policies have been put in place to promote energy efficiency, quality of service and environmental safeguarding. However, there is still no proper collaboration between the government and the general public regarding the use of renewable resources at a faster rate. Therefore, the objective of this project is to study and analyse the requirements of a Microbial Fuel Cell to generate electricity, design and implement a Microbial Fuel Cell, validate and quantify the amount of bio-waste required to generate electricity and to validate and generate electricity using the Microbial Fuel Cell. Therefore, a system was fabricated following a proper methodology and several experiments was tested our using different kinds of electrodes and resistor. These experiments are mainly to determine the voltages and power density to do further analysis and discussion. The system must able to power an underwater monitoring device that was replace with an LED as less voltage needed to power up those sensors. There is limitation associated to Microbial Fuel Cell which is their low power density. To have a better understanding of the different parameters and to optimize the production of electricity, more in depth studies are required. The operating and production costs can be reduced while the power generation can be increased with ongoing improvements. Before Biological Fuel Cells can actually be produced and commercialized, a huge amount of improvement is required.
ACKNOWLEDGEMENTS

I would like to thank and express my gratitude to my supervisor, Dr. Muhammad Izzat Nor Ma’rof as he has given me support and advices regarding the project since the beginning. Other than that, I would like to show my appreciation to my fellow friend Rishan Murali who was there for me and providing me his place to do my project whether it is indoor and outdoor and slept late due to my data collection at night. Both of us did our project since the 1st day of Final Year Project in stage 1 and he did provide me a lot of good advices throughout the FYP period. Then, I would like to thank to our respected examiner which are Dr. Amir and Dr. Lim as they been listening to my presentation and able to support with my own project. Finally, I would like to thank my friend and family who are been my helping hand to be with me from my project. I would like to take opportunity to say that this project in learning about Microbial Fuel Cell is definitely a game changing experience for me. As we are living in this era full of renewable energy such as solar energy, wind energy and solar energy, there are many more renewable energies can be found throughout years ahead where technologies are transitioning fast and vastly in this world. Gaining the fundamental and those skills that acquired throughout the project is a blessing for me as it would be beneficial in my future undertaking in this engineering field.
DEDICATION

Author would like to dedicate this project to the people that help me get this far, without them author wouldn’t be able to complete this project nor make this project happen. Firstly, author wants to dedicate this projects to author’s friends that provided author with the recourse and the transportation to obtain materials to compose this project. Secondly, author wants to dedicate this project to author’s own family whom have supported author throughout the journey in building and creating this project, without their help author wouldn’t have been able to have such a great opportunity to develop this assignment. Lastly, author would like to dedicate this project to author’s own life partner whom have supported me mentally and physically motivating author to not give up but to keep moving forward to complete this project.
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<td>MFC</td>
<td>Microbial Fuel Cell</td>
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<tr>
<td>CEM</td>
<td>Cation Exchange Membrane</td>
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<tr>
<td>PEM</td>
<td>Proton exchange membrane</td>
</tr>
<tr>
<td>ATP</td>
<td>Adenosine Triphosphate</td>
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<tr>
<td>NADH</td>
<td>Nicotinamide Adenine Dinucleotide</td>
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<tr>
<td>EMF</td>
<td>Electromotive Force</td>
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<td>OVC</td>
<td>Open Circuit Voltage</td>
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<tr>
<td>COD</td>
<td>Chemical Oxygen Demand</td>
</tr>
<tr>
<td>DO</td>
<td>Dissolved Oxygen</td>
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<tr>
<td>ERC</td>
<td>Energy Regulation Commission</td>
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<tr>
<td>PH</td>
<td>Hydrogen potential</td>
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<td>NEMA</td>
<td>National Environment Management Authority</td>
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<td>GOK</td>
<td>Government of Kenya</td>
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<td>E.coli</td>
<td>Escherichia coli</td>
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<tr>
<td>$\Delta G^0$</td>
<td>Gibbs free energy</td>
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<tr>
<td>n</td>
<td>Amount of electrons per reaction mole of the substrate</td>
</tr>
<tr>
<td>T</td>
<td>Absolute temperature</td>
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<tr>
<td>$\Delta E$</td>
<td>Potential Difference</td>
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