OPTIMIZATION OF MICROBIAL FUEL CELL FOR ENERGY GENERATION

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ABSTRACT- Many studies have investigated the effect of electrode size/material, polymer exchange membrane (PEM) performance and organic substrate choice in microbial fuel cells (MFCs) separately. Optimization of the MFC for energy generation involves the manipulation of the latter architectural components in terms of cost, performance, availability and reliability. This paper aims to investigate the voltage generated by five individual dual chamber MFCs, each chamber of capacity 150ml, and thus determine the optimal electrode and membrane configuration, and additionally the best organic substrate for electricity generation. Five duel chamber MFCs were setup, each with varying electrode sizes and materials such as platinum-boron (Pt-B), platinum-carbon (Pt-C) and aluminum (Al). Three types of wastewater samples (from residential area, farm and swamp) were used to provide the organic substrate. Testing was carried out by recording the output voltage of each cell hourly over a period of three days. This was done for two membranes (Nafion 117 and 115) per sample. From testing (both membranes), it was observed that the electrode assembly of 8x4 Al: 2x2 Pt-B and 8x4 Al: 2x2 Pt-C produced the highest voltages. The electrode assembly of 2x2 Pt-B: 2x2 Pt-C produced the most stable results whereas the Al: Al electrode assemblies produced inconsistent but fair voltages. The MFC with Nafion 117 provided better results as compared to Nafion 115. The residential sample produced the most stable results throughout the testing compared to the other samples. From the analysis of data obtained during this study, it was found that the electrode assembly of 2x2 Pt-B: 2x2 Pt-C with Nafion 117 membrane and residential sample is optimum MFC configuration for energy generation.

Keywords- Energy Generation and Optimization, Polymer Exchange Membrane, Microbial Fuel Cell, Wastewater.

INTRODUCTION

A microbial fuel cell (MFC) is a device which utilizes microorganisms present in organic substrates as the biocatalysts to convert the chemical energy in organic compounds to generate electricity (Kumar, Singh, and Zularisam 2017). In its simplest form (dual chamber), a MFC consists of an anode and cathode placed in different chambers, separated by a polymer exchange membrane (PEM), with the organic substrate placed in the closed anode chamber (Scott and Yu 2016). A simplified illustration of basic components od a dual chamber MFC is as shown in Figure 1.

The operation of the MFC begins when the microorganisms (present in the organic substrate) located in the anode chamber (closed chamber) oxidises the organic matter producing electrons and protons (Robinson 2017). The protons are transferred through the PEM while the electrons flow through the external circuit (Figure 1), generating a voltage. The protons transferred to the cathode (open chamber), react with air to form water which is a by-product. Apart from the dual chamber, there are other common MFCs which include the single chamber, stacked and up-flow variations, each suited to specialized applications (Singh and Kalia 2017). The potential applications of MFCs include but are not limited to, energy generation, wastewater treatment, pollution monitoring and analysis, water desalination, hydrogen and methane production and powering of underwater devices (Logan and Regan 2006).

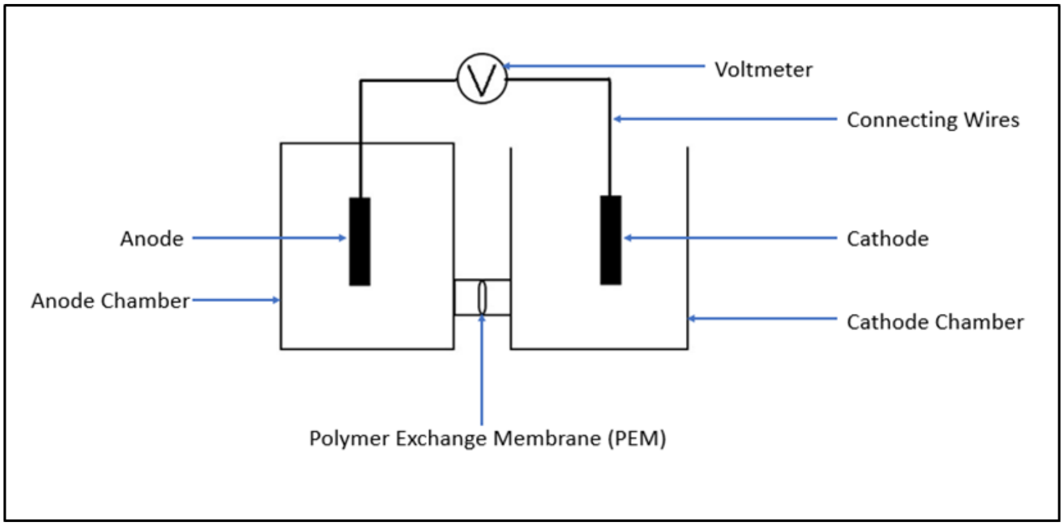


Figure 1 Basic Components of a Dual Chamber MFC

A challenge of setting up a MFC is to identify materials and configurations or architectures of the latter components to maximize power generation and Columbic efficiency, while minimizing cost and creating scalable architectures (Logan 2008). For an economically feasible MFC device, its energy generation prowess and cost must be able to rival that of other renewable energy sources and eventually fossil fuel sources. As a result, research has been focused on the optimization of MFC architecture to design low cost, high performance devices which produce a reliable current flow. Testing involving the variation of each of the major components provides data whereby scientists can discern the ideal configuration (based on the factors mentioned) of the MFC for energy generation as done in this study.

Electrodes of MFCs are anodes and cathodes. These components must possess various properties to make them an ideal choice for use in a MFC. These properties include biocompatibility, high conductivity, porous, low cost, recyclable, scalable, high specific surface area, corrosion resistance, and high mechanical strength (Logan 2008). Numerous materials have been tested for use as electrodes in MFCs. According to Logan (2008), the same materials used for anodes can be used for cathodes although cathodes sometimes, but not always, require a catalyst. Electrodes can be categorized on whether they are carbon based or metal based (Scott and Yu 2016). Scott and Yu (2016) go on to state that carbon felt, paper, cloth and brushes are the most common carbon-based electrodes while metal based include stainless steel, aluminum and platinum. Each material has a specific efficiency based on data collected from studies. For example, among the carbon-based electrodes mentioned, carbon brushes have the highest efficiency while in the metal based electrodes stated, platinum has the highest efficiency (Scott and Yu 2016). Additionally, choice of electrode influences certain undesirable properties of MFCs. These include, over-potentials, Ohmic losses, activation losses, concentration polarization losses, bacteria attachment and substrate oxidation (Rabaey and Verstraete 2005). Furthermore, several studies have shown significant correlation between electrode size and power output and as such the variation of electrode size and material allows for the investigation of the impact of these additional parameters in MFC design (Villarreal-Martínez et al. 2017) (Li et al. 2010).

PEMs are utilized in dual chamber microbial fuel cells to keep the anode and cathode chambers separate. Logan (2008) notes that membranes need to be permeable so that protons produced at the anode can migrate to the cathode. Membranes in MFCs are costly and are known to decrease system performance by increasing internal resistance of the cell (Logan 2008). Membranes can be removed, however, this leads to increased oxygen diffusion and therefore lower Columbic efficiency (Moon, Kondaveeti, and Min 2014). Important parameters which determine the quality of a membrane are its porosity, pore size, ion exchange capability, chemical inertness and mechanical strength (Scott and Yu 2016). Perfluorosulphonic acid (PFSA) polymers are the most common types of membranes used in fuel cells. These range of polymers include the Flemion, Aquivon and Nafion family of membranes, the latter the most popular brand utilized in fuel cell applications (Scott and Yu 2016). Examples of common Nafion membranes are the Nafion 117, 115, 212 and XL. Membrane cost is an inherent flaw in MFCs that utilize this material and as a result many studies investigate alternatives. Nafion 117 is a common membrane used in research. Scott and Yu (2016, 164) noted that thickness is an important factor in membrane choice as thinner membranes have less mechanical strength and higher reactant crossover. Thicker membranes reduce reactant crossover but as a consequence there is higher resistance and therefore lower power density and efficiency of the cell (Scott and Yu 2016). Scott and Yu (2016, 164) go on to argue that thinner membranes decrease fuel utilization, causes some electrode polarization and can lead to material corrosion. Thicker reinforced membranes are good candidates for use in scaled up MFC systems while thinner membranes are suitable for smaller setups. Nafion 117 is a good choice for smaller setups as the membrane is not too thin but thick enough to offer stability to small-scale MFC systems.

A substrate serves as a source of food, energy and support for certain organisms (Dictionary.com 2017). The use of organic substrates in MFCs depend on the efficiency and economic viability of the substrate in converting waste to bioenergy (Pant et al. 2010). Substrates in MFCs influence not only bacterial composition but performance factors as well including power density and Columbic efficiency (Chae et al. 2009). There is great variety in the types of substrates that can be used in MFCs from pure compounds to complex mixtures of organic matter present in wastewater (Pant et al. 2010). One of the most common substrates is wastewater due to the variety in types and bacteria content when obtained from different sources as well as being rich in complex organic substrates, nutrients and energy, ideal for use as an MFC (Chae et al. 2009). Common wastewater substrates used in studies include brewery wastewater, food processing wastewater, swine wastewater and synthetic wastewater, each with varying composition/bacteria content and hence different MFC performance (Pant et al. 2010).

The focus of this study was to investigate the voltage generated by five individual dual chamber MFCs when the wastewater sample, electrode size/material and polymer exchange membrane were varied. Based on these findings, the optimum architecture for energy generation in a MFC was deduced based on data obtained for optimum wastewater sample, electrode size/material and PEM.

EXPERIMENTAL DETAILS

The five MFCs, used in the experiment, were setup according to the configurations as shown in Table 1.

Table 1 MFC Configurations Used in Experiment

Cell	Anode Material	Cathode Material	Ratio*
1	Aluminium	Platinum-Boron	8x4 Al: 2x2 Pt-B
2	Aluminium	Platinum-Carbon	8x4 Al: 2x2 Pt-C
3	Aluminium	Aluminium	8x4 Al: 4x4 Al
4	Platinum-Boron	Platinum- Carbon	2x2 Pt-B: 2x2 Pt-C
5	Aluminium	Aluminium	10x5 Al: 4x4 Al

* Ratios are taken as Length x Width (In Centimeters)

System Specifications:

Figure 2 shows the setup of one of the dual chamber MFCs used in the present study.

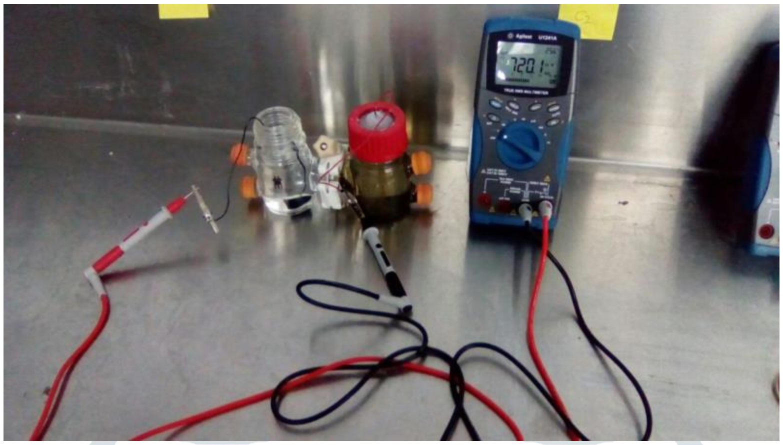


Figure 2 Experimental Setup for a Microbial Fuel Cell

Glass Chambers:
- Adams and Chittenden Scientific Glassware
- 150 ml

Anode and Cathode Material:
- Aluminium mesh
- Platinum-Boron (Pt-B) 40% cloth
- Platinum-Carbon (Pt-C) 40% cloth

Polymer Exchange Membranes (PEMs):
- Nafion 117
- Nafion 115

Samples:
- Residential Sample from College Road, Curepe, Trinidad.
- Cow Sample from UWI Field Station Mt. Hope, Trinidad.
- Swamp Sample from Caroni Swamp, Trinidad.

Experimental Procedure:

Figure 3 shows the flow diagram of experimental steps followed during present study, which are further explained below:

1) Experimental Setup:

Five MFCs were setup as shown in Figure 2 based on the configurations stated in Table 1. Connecting wires were soldered to the aluminum mesh in the configurations where it was used as anode and/or cathode. Where Pt-B or Pt-C was used, the connecting wires were fixed to the surfaces of the cloths using a glue gun. All anode chambers were kept covered and the two ports at the side of each glass chamber plugged using the rubber seals. A hole was pierced into the cover of the anode chambers through which the connecting wires passed. After the connecting wire was pulled through the pierced hole at each one of the cells, silicon adhesive was used to seal the top of the cover which kept the wire fixed in all cells.

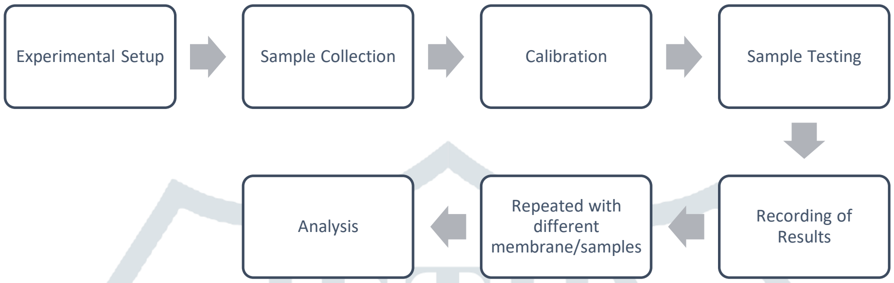


Figure 3 General Outline of Experimental Procedure

The pieces of the connecting wire that remained outside the anode chambers were fixed with crocodile clips and attached to the multimeter probes. The cathode chambers were kept open and the connecting wires emerging from all the cathode chambers were fixed with crocodile clips which were then fixed directly to the multimeter. Finally, the membrane to be used was cut in a square shape to cover the entire diameter of the port at the centre of both chambers. The flange seal was fixed to the port in one chamber and the membrane positioned on top the seal. The wide port of the other chamber was then pushed against the chamber with the flange seal and membrane ensuring a snug and precise fit. Any excess pieces of the membrane sticking out of the point of contact were trimmed. While keeping a small pressure on the both chambers, the knuckle clamp was fastened around where the ports of both chambers met. The setup was then inspected for any leaks using distilled water poured in the chambers. This procedure was done in setting up all 5 cells. Before the start of any new period of testing, all glass chambers and electrodes were properly washed and cleaned before use.

2) Sample Collection:

Samples were collected with as little time as possible between collection and testing as could be achieved. Typically, samples were collected at the sites, the evening of the day before testing was scheduled to begin and stored in plastic bottles until the testing period commenced.

3) Calibration:

Distilled water was used for calibration purposes. The distilled water was poured into the anode and cathode chambers of all the five cells and an initial voltage readings were taken for each cell. This was done 12 hours (at 7 p.m. previous day) before the sample was tested. A final calibration reading was taken just before sample testing was scheduled to begin. This calibration procedure was done for each 3-day round of testing done.

4) Sample Testing/Recording of Results/Repetition with Different Membranes and Samples :

- Sample was poured into anode chamber of each cell after which it was covered tightly, and distilled water placed in cathode chambers of each (left open).

- One sample was tested for 3 days with one membrane.
- Voltage was recorded at 1-hour intervals for 13 hours in each of the 3 days.
- At the end of the 3 days, the sample and used membrane were removed from each cell and the components of the setups (glass chamber, electrodes), washed and cleaned. A different membrane was then fixed to each setup. Distilled water was then poured into both chambers of the 5 cells and an initial calibration value taken.
- A new sample from the same site was obtained.
- Before testing the next day, the final calibration value was taken from each cell. The new sample was then poured into the anode chambers of the 5 cells and distilled water in the cathode chambers.
- The sample was then tested for 3 days with voltage readings taken at 1 hour intervals for 13 hours each day.

All the previous steps stated under sample testing were repeated for the remaining two samples which totalled eighteen (18) days of sample testing.

5) Analysis:

All results obtained were then analyzed. (calibration values obtained were subtracted from actual voltmeter readings and the new readings used)

RESULTS AND DISCUSSION

This work aimed to determine the optimum configuration for energy generation in microbial fuel cells. This was achieved by varying the parameters of polymer exchange membrane, substrate and anode/cathode ratio and material. Three types of wastewater substrates were utilized, two types of membranes and five different cells with various anode/cathode ratios and materials. Literature has shown that varying power outputs are obtained when these parameters are manipulated. This underscores the need to explore scalable architectures that are efficient in terms of cost and power output.

Samples for this study were chosen from three sites, each representative of a different type of wastewater. The first sample, a residential sample, was obtained from College Road, Curepe, Trinidad. The College Road is directly opposite the University of the West Indies (UWI) St Augustine Campus' South Entrance and as a result, there are many apartment buildings in the short stretch of road that it is, housing hundreds of students. Additionally, there is a popular food restaurant and grocery on the junction of the road. The latter in addition to the quantity of students occupying large scale apartment buildings, all utilize one drain in College Road through which the runoff from the entire road passes. At the end of the road, all the water runs into a grassy area between the road and the highway where in some areas it is left stagnant. The sample was collected at the stagnant areas. This sample was chosen to be tested due to probability of it being high in bacteria and other microorganisms as well as being near the university. Additionally, residential wastewater and food processing wastewater are popular substrates used in MFCs. The cow sample was obtained through the University of the West Indies (UWI) Field Station located at Mt. Hope. Literature suggests animal wastewater as being high in organic matter and a potential solution to offset costs of commercial treatment by utilization in MFCs (Min et al. 2005). While many studies focus on swine wastewater, not as much data exists for wastewater produced by cows. As a result, cow wastewater was used as it was assumed to be high in organic matter and ideal for use in MFCs. The final sample was obtained in Caroni Swamp. From studies reviewed, there was no literature showing any investigation into Swamp samples as a potential substrate for use in MFCs. However, based on research, swamps are known to be rich in microorganisms, bacteria, algae and fungi (AFM 2008). The Armand-Frappier Museum (2008) goes on to state that the floor of these water bodies is rich in microorganisms due to primarily droppings from larger aquatic animals. As a result, a swamp sample was proven to be an interesting and warranted choice for investigation. The close proximity of these three sample sites enabled testing to commence without having to store samples for any long period of time.

Wastewater is a common choice for substrate in MFCs. Table 2 shows some common wastewater substrates used in MFCs and their respective current densities. Animal wastewater is widely used due to its high organic matter content (Scott and Yu 2016). In several studies, swine wastewater in particular has emerged as the leading animal wastewater substrate (Ichihashi, Yamamoto, and Hirooka 2012) (Min et al. 2005) (Ma et al. 2016). Brewery wastewater has also been utilized in studies and has produced results rivaling that of domestic wastewater (Vijayaraghavan, Ahmad, and Lesa 2006) (Feng et al. 2008). Non-wastewater substrates such as acetate has also been widely explored for use in MFCs and has shown positive results (Liu, Cheng, and Logan 2005) (Sun, Thygesen, and Meyer 2015)

Table 2 Common Organic Substrates Used in MFCs (Pant et al 2010)

Type of Substrate	**Type of MFC Used**	**Current Density/mAcm^{-2}**
Acetate	Single chamber	0.8
Brewery wastewater	Single Chamber	0.2
Domestic wastewater	Dual Chamber	0.06
Food processing wastewater	Dual Chamber	0.05
Swine wastewater	Single Chamber	0.015

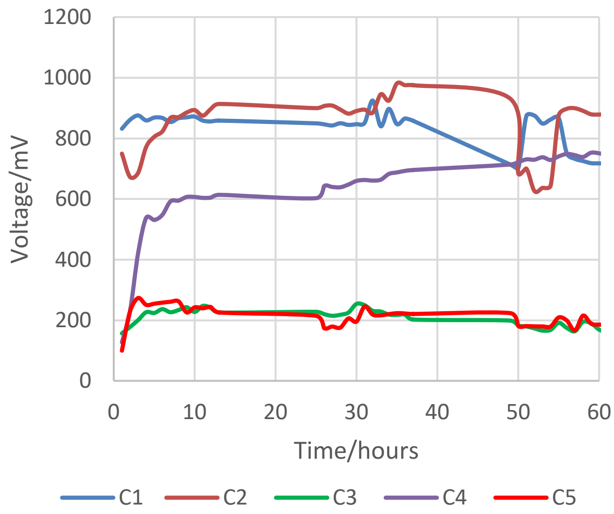
The choice of membranes for use in this study was challenging as various problems were initially encountered. The Nafion 212 and XL membranes were initially chosen as the membranes to be used in this study. However, upon various weeks of trials with the latter, no significant results were obtained as the multimeter was not registering any readings. Several fixes were tried but to no avail, but upon doing research into the XL and 212 the problem was solved. Scott and Yu (2016) noted that thicker membranes reduce reactant crossover but there is higher internal resistance and therefore lower power density and efficiency of the cell. Thicker membranes are suitable for use in scaled up MFC setups while thinner membranes are suitable for smaller MFCs. Nafion 212 has a thickness of 50.8 µm while XL is a reinforced membrane with a thickness of 27.5 µm (FCS 2017). The thickness of other common Nafion membranes as well as other properties are shown in Table 3.

Table 3 Characteristics of Common PEMs Used in MFCs. (The Fuel Cell Store, 2017)

Membrane	Thickness/µm	Conductivity/Scm^{-1}	Percent Water Uptake
Nafion 115	127	0.10	38%
Nafion 117	183	0.10	38%
Nafion 212	50.8	0.13	50±5%
Nafion XL	27.5	In Plane: >0.072 Through plane: >0.0505	50±5%

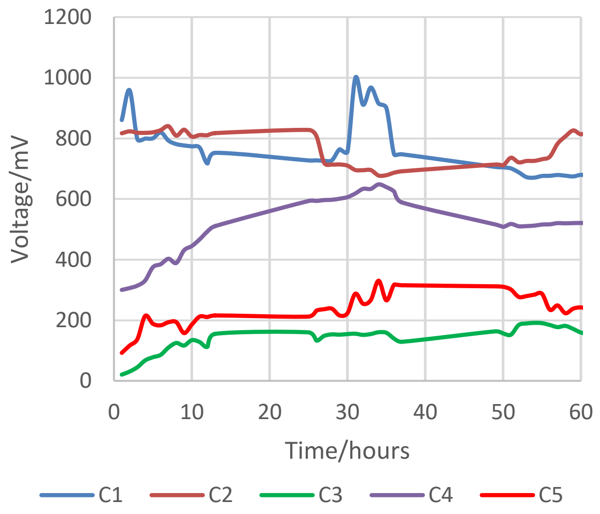
The materials used for electrodes in the experiment were aluminum mesh, platinum-boron 40% cloth and platinum-carbon 40% cloth. Ratios of these materials were chosen based on the limited size of the glass chambers as well as factoring into account the high cost of the latter cloths. Since high surface area is correlated with an increase in power output, aluminum ratios were adjusted so that maximum surface area was exposed to solution (Villarreal-Martínez et al. 2017) (Logan 2008). Where Pt-B and Pt-C were used, 2x2 ratios were chosen due to the high cost associated with these materials.

Graphs were plotted with the data obtained. Figures 4-9 show the results for each sample per membrane used.



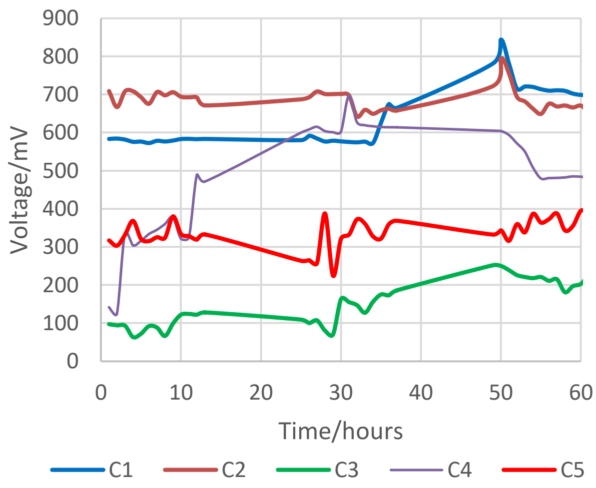
Highest voltage produced = Cell 2 with 981.9 mV
Highest, steadiest voltage = Cell 4 (max. 752.5 V)

Figure 4 Residential Sample with Nafion 117



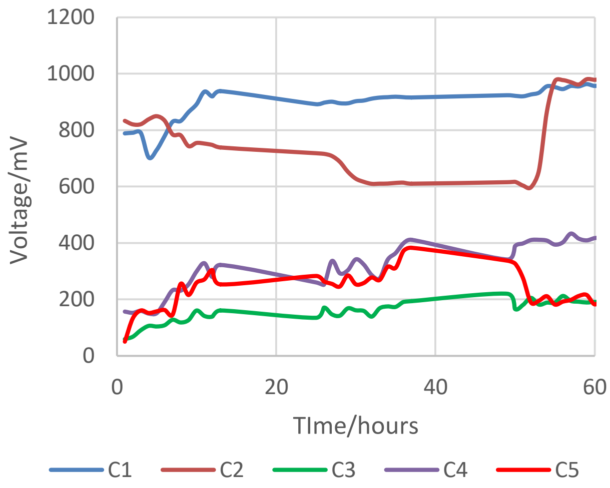
Highest voltage produced = Cell 1 with 999 mV
Highest steadiest voltage = Cell 2 (max. 840.5 mV)

Figure 5 Cow Sample with Nafion 117



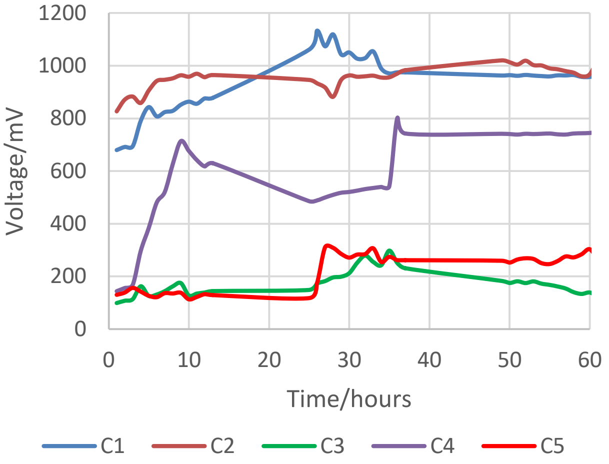
Highest voltage = Cell 1 with 843.9 mV
Highest steadiest voltage = Cell 2 (maximum 794.7)

Figure 6 Swamp Sample with Nafion 117



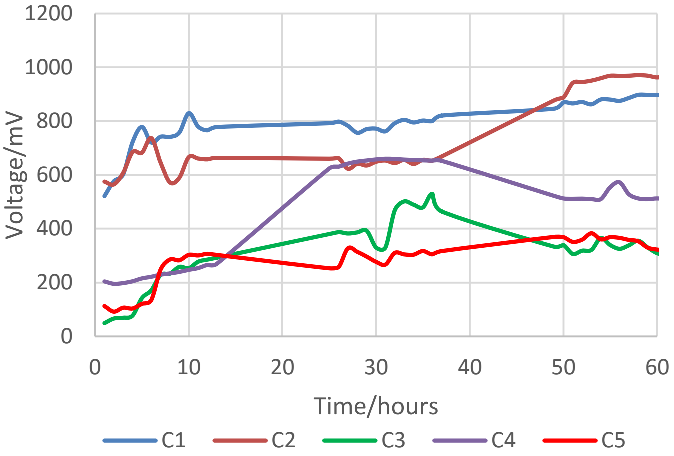
Highest voltage produced = Cell 2 with 981 mV
Highest steadiest voltage = Cell 1 (maximum 963.5mV)

Figure 7 Residential Sample with Nafion 115



Highest voltage produced = Cell 1 with 1133.6 mV
Highest steadiest voltage = Cell 2 (max. 1022.2mV)

Figure 8 Cow Sample with Nafion 115

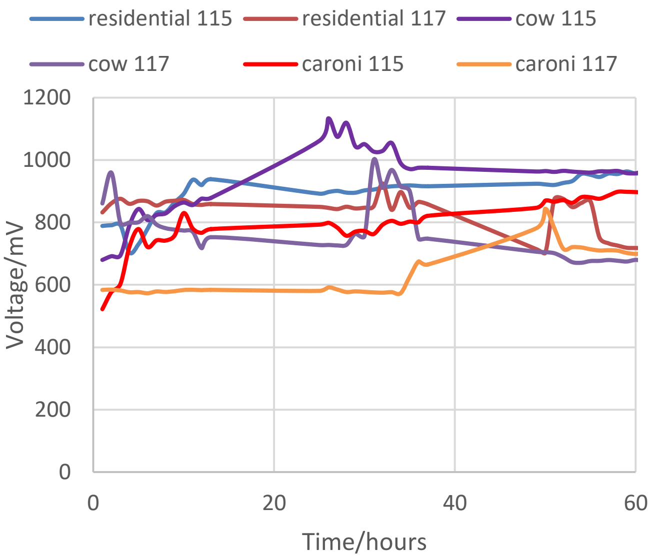


Highest voltage produced = Cell 2 with 970.3 mV
Highest steadiest voltage = Cell 1 (max. 897.6 mV)

Figure 9 Swamp Sample with Nafion 115

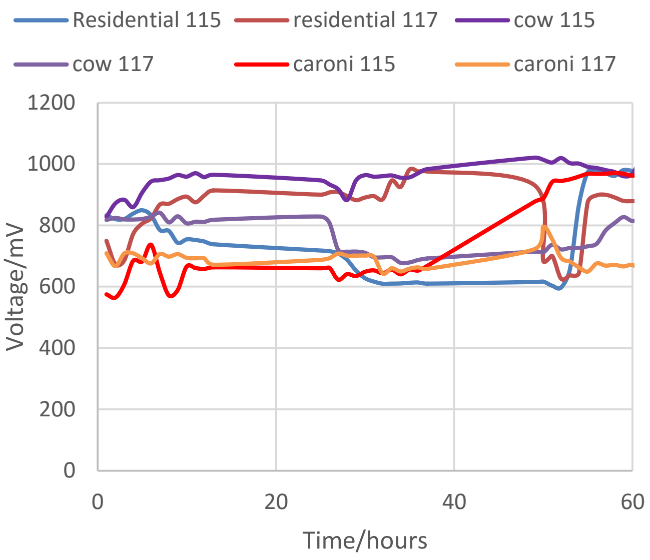
Based on the underlying phenomena in which renewable sources of energy like MFCs derive their power, fluctuations and unpredictability in this power generation is a major concern when analysing these systems (Leavy and Hild 2012). As a result, stability is factored in as a major parameter when analysing the power output of any renewable energy system. If these renewable energy sources are to be integrated into the power grid of any country reliable supply of power is of paramount importance. Therefore, when choosing optimum substrate, membrane and anode/cathode configuration, stability of the voltage output in addition to the peak voltage values were the major factors taken into consideration as well as external factors such as cost and availability.

The residential sample obtained from College Road was chosen as the optimum wastewater substrate based on the results obtained considering the factors stated previously. The cow sample most likely had high voltages due to the difference in the type of bacteria and microorganisms from the other sources. However, the results obtained with the cow sample were quite unsteady. Based on Figures 10, 12, and 13, the residential sample recorded the highest and steadiest results. It was shown that only in Cell 2 this sample did not register the best results. As a result, it was chosen as the optimum wastewater substrate used. The residential sample generated the second highest voltage reading of 981.9 mV based on Table 4 and Figure 4, a high figure for a residential sample but testament to the level of bacteria activity in the concentrated wastewater of College Road.



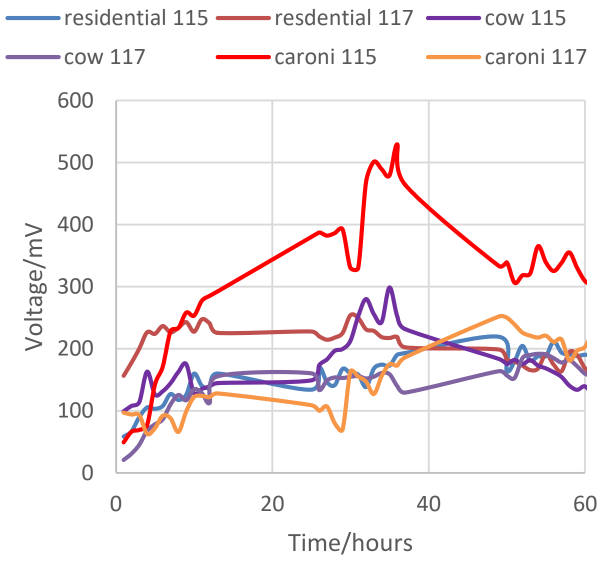
Highest voltage produced = Cow Sample with Nafion 115
Highest steadiest voltage = Residential Sample with Nafion

Figure 10 Performance of Cell #1



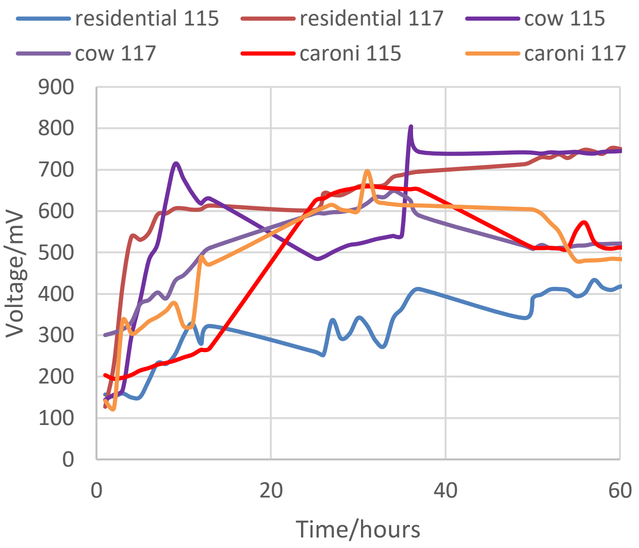
Highest voltage produced = Cow Sample with Nafion 115
Highest steadiest voltage = Cow Sample with Nafion 117

Figure 11 Performance of Cell #2



Highest voltage produced = Caroni Swamp Sample with Nafion 115
Highest steadiest voltage = Residential Sample with Nafion 117

Figure 12 Performance of Cell #3



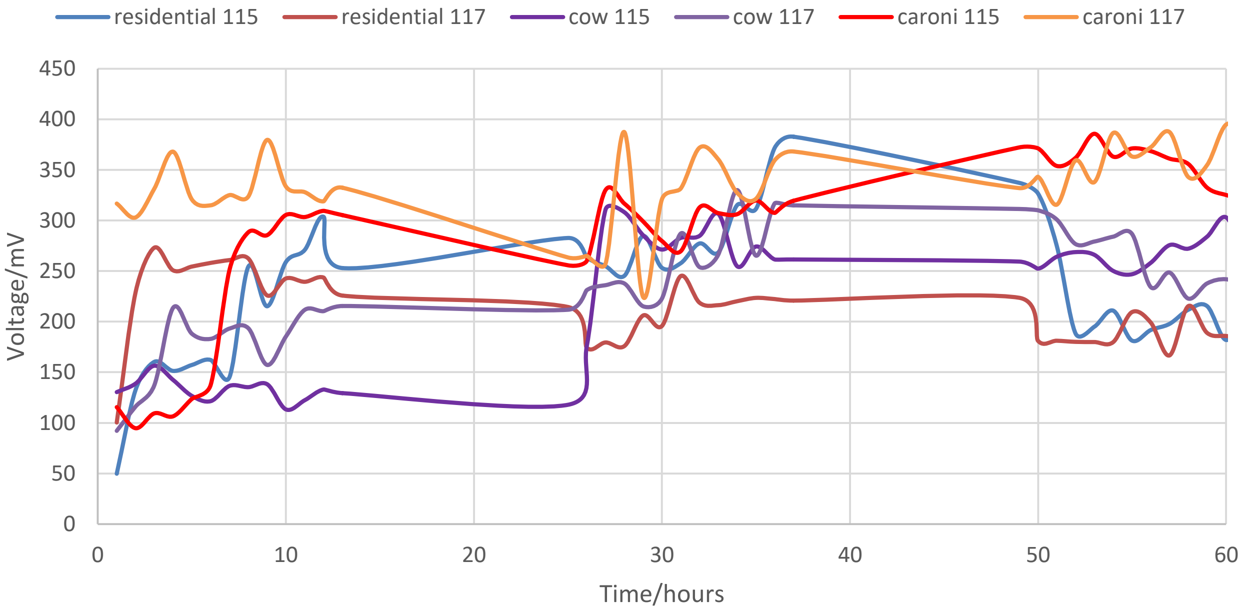
Highest voltage produced = Cow Sample with Nafion 115
Highest steadiest voltage = Residential Sample with Nafion 117

Figure 13 Performance of Cell #4

Table 4 Highest Voltage for Each Sample

Sample	Highest Voltage/mV
Residential	981.9
Cow	1133.6
Swamp	970.3

The Nafion 117 was chosen as the optimum membrane for energy generation in a MFC based on the results of this study. In Figures 11, 12, 13 and 14, the Nafion 117 membrane displayed the highest and steadiest results. The highest voltage was also recorded in Figure 12 for the 117. Only in cell 2, did the 117 not record a high nor steady voltage. Table 5 shows that the 115 had the highest voltages in four out of the five cells and based on the graphs and Table 4 it can be seen that Nafion 115 had the highest voltage of 1133.6 mV while the 117 had a high of 999 mV. This can be explained based on Nafion 115 being the thinner membrane. As a result of the latter, the 115 would naturally have a higher reactant crossover than the 117, but this also leads to the 115 having less mechanical strength, more polarization losses and higher chance of causing corrosion of the electrodes (Scott and Yu 2016). Also considered was the erratic nature and fluctuations associated with the 115. Hence, the Nafion 117 was chosen as the optimum membrane due to it having the highest and steadiest results as stated. Literature shows as well that when comparing novel membranes, Nafion 117 is used as the benchmark by which the results of the newer/novel membranes are compared (Hernández-Flores et al. 2015) (Hernández-Flores, Poggi-Varaldo, and Solorza-Feria 2016) (Li et al. 2011) (Moon, Kondaveeti, and Min 2014) (Mayahi et al. 2015). Incidentally, it is one of the most popular PEMs used in MFCs.



Highest voltage produced = Caroni Swamp Sample with Nafion 117
Highest steadiest voltage = Residential Sample with Nafion 117

Figure 14 Performance of Cell #5

Table 5 Highest Voltages Recorded Based on PEM Used

Polymer Exchange Membrane	Highest Voltage/mV
Nafion 117	999.0
Nafion 115	1133.6

The best anode/cathode configuration chosen was the 2x2 Pt-B to 2x2 Pt-C which indicated cell 4 of the setup. Table 6 shows that cell 4 registers the third highest voltage in comparison to the other cells. It can be argued also that in Figures 4 to 9, cell 4 only recorded the highest and steadiest voltage once as shown in graph 1. The other graphs (2 to 6) all show either cell 1 or cell 2 as the cells with the highest and most steady results. However, a major consideration must be made. The anode/cathode ratios of the cell 1 was 8x4 Al to 2x2 Pt-B and cell 2, 8x4 Al to 2x2 Pt-C. The ratio of Pt-B to Pt-C in cell 4 was 2x2 to 2x2. Hence, in the anode chamber, cell 1 and cell 2 had more than double the surface area of the 2x2 area cell 4 had in its anode chamber. Additionally, Table 6 shows that the highest voltage recorded by cell 4 was 801 mV, a 332.6 mV difference in cell 1's highest and a 221.2 mV difference in cell 2's. Taking into account Logan

(2008) and Villarreal-Martínez et al (2017) whose studies indicate that increasing surface area of electrodes results in a direct increase in power output, if cell 4's anode was scaled up to the size of cell 1 and cell 2 the resulting power output would surpass cell 1 and cell 2 significantly. Coupled with the fact that cell 4's readings were steady and the choice of cell 4 as the optimum ratio and material is justified. The only argument against the latter is the significant cost associated with the Pt-B and Pt-C cloth. Studies have compared the efficiency of platinum as an electrode to aluminum among other electrodes, with the former having a value of 78 mW/m^{-2} and the latter 0.004 mW/m^{-2} (Scott and Yu 2016). Therefore, such high values for the voltage of cell 4 due to its small size is warranted. Al-Al configurations produced unsteady and unreliable results throughout the experimental period as shown in Figures 12 and 14. The latter graphs show huge spikes and drops throughout at low voltages, thereby characterizing these configurations as less than ideal.

Table 6 Cell Numbers and Highest Voltage with their Respective Samples and Membranes

Cell Number	Highest Voltage/mV	Membrane	Sample
1	1133.6	Nafion 115	Cow
2	1022.2	Nafion 115	Cow
3	298.6	Nafion 115	Cow
4	801	Nafion 115	Cow
5	394.8	Nafion 117	Swamp

CONCLUSION

Major goal of MFCs is to design cells that are economical based on capital and operational costs in conventional setups where the cost is still very high. Ultimately MFCs can potentially be used as a method for renewable energy production. For developing countries, the prospect of MFCs provide a prime opportunity for investment as dwindling oil and gas reserves globally beckon governments each year to invest in renewable sources of energy. MFCs not only offer a source of energy generation in the country but also, provide an opportunity to reduce water pollution and increase water security. With operational costs decreasing every year based on new research, MFCs will soon breakthrough as a cost-effective source of renewable sustainable energy, thereby abolishing its major weakness. The benefits of these devices permeate globally as the superpowers seek to invest heavily in bright prospects for the future of energy generation such as MFCs. In the present study, we tried to optimized the electricity generation capability of a dual chamber MFC using different electrode material of different size, different membranes and different organic substrate. The optimum MFC configuration reveled in this study for energy generation was, electrode combination of 2x2 Pt-B : 2x2 Pt-C with a Nafion 117 polymer exchange membrane and Residential sample.

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