

Tri-Hybrid Electricity Generation Method by using Microbial Fuel Cell, Solar and Wind Energy

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Abstract: *This paper reviews Microbial Fuel cell. First objective is to discuss microbial fuel cell. Second objective is to put forth various experiments done by me in generating electricity through microbial fuel cell. Till now majority of Microbial Fuel cell are using graphite as anode and cathode separated by Proton exchange membrane. I have used Graphite and Magnesium as electrodes for generating electricity in single chamber without any membrane. This MFC can be used for various applications. Also a new concept of generating electricity with solar panels and using the area beneath it for generating energy with MFCs, while at the same time a small wind turbine while be used as a third hybrid electricity generating partner. This technology can revolutionize the current energy production method. Also the reason behind bringing this technology into light is to show that it is green, free, hazard free, flexible, compact and unending availability. One can generate electricity at home for own consumption. Microbial cell is a very easy and simple method to get energy from soil. This battery generates voltage of 1.5 to 1.8 volts. It is totally green and renewable. This energy can be used to turn on led lights, buzzers, calculators, digital watches etc. Tomorrow we may see this energy being used in many Gadgets (as energy requirement for electronics devices getting reduced day by day). This paper is a result of 5 years of research and development, trial and error and infinite ideas..*

Keywords: Microbial fuel cell, Renewable energy, Free energy, perpetual energy, non-conventional energy.

I. INTRODUCTION

Today we face three major problems in the world first is availability of fresh water, Second is how to eliminate / reduce pollution and third is energy generation required to operate various equipment. On earth energy is available everywhere in the form of thermal, wind, sunlight, chemical, hydro etc. But as we have developed equipment which requires electricity to work, we have to convert this energy available in various forms into electricity.

At present I have carried out various experiments for generating electricity with microbial fuel cell from soil, which can provide sufficient energy to lit up LED lamp, charge mobile phone batteries or switch on sensors. Microbial cell uses earth soil / mud (dirty) to produce energy along with clean water and also treats waste. Soil is available everywhere and microbes are present in all soils / mud. This Microbial fuel cell does not generate any hazardous waste, gives out clean water and clean energy.

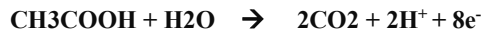
Generally Microbial Fuel cell consists of Anode and Cathode separated by a membrane. Container of Microbial Fuel cell is of polycarbonate/ glass. Anode and Cathode are from Graphite, but other materials are also used. Anode and Cathode are separated by Proton exchange membrane. Microbes in anode chamber react with organic material and produce electrons, protons and carbon dioxide. Electrons produced are transported from Cathode to anode through external circuit and light up the LED connected to it in the circuit. MFC can be single chamber or double chamber. While protons transported through PEM (Proton exchange membrane) to cathode. In my experiments I have used Graphite and Magnesium with soil as substrate in single chamber MFC.

II. WORKING PRINCIPLE OF MICROBIAL FUEL CELL

Reactions at Electrodes

Considering Acetate as substrate, reactions taking place will be as per following

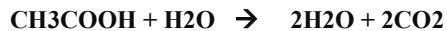
Microbes Reaction at Anode:



Microbes Reaction at cathode:



Microbes Total reaction:



Thus in MFC carbon di oxide is evolved at Anode and Water is produced at Cathode.

2.1 Schematic Diagram of MFC

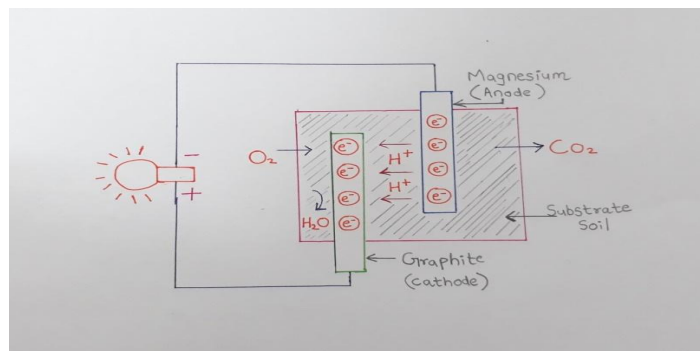


Figure 1: MFC Working and construction

2.2 Developments in Microbial Fuel Cell

First microbial fuel cell was developed by Mr Potter in year 1911 which showed that electricity can be produced through organic material. In year 1931 Cohen further developed this MFC by producing around 35V. Different types of substrate, electrode materials, microbes have been tried over the period. Lot of research has being done to convert human waste for generating electricity during long flights (Cohen 1963),

2.3 Applications

Over the period due technological developments many devices have been developed which consume very less energy when it is compared to around 50 years back. For example LED lamps and mobile phones when compared to filament bulb and radios working on valves. Considering this we can use this electricity to power small electronic devices such as LED lamps / torches, charging mobile phone batteries, sensors in remote areas or spaceships.

MFC can be used for waste water treatments. MFC can convert biomass into electricity by metabolism activity of microbes. This serves the dual purpose generating electricity and waste water treatment.

MFC can be used for production of hydrogen through microbial electrolysis.

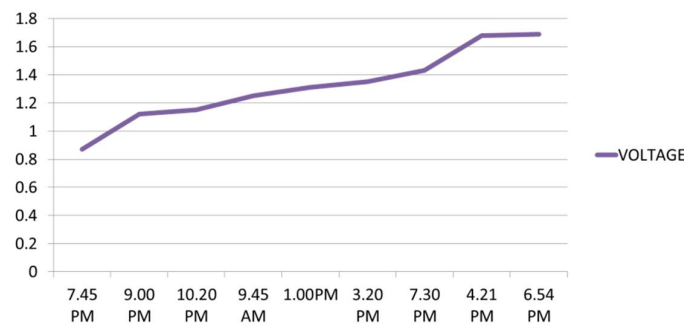
2.4 Results of Experiments Carried Out

I had prepared. Single Chamber MFC by using soil, Electrodes are of Magnesium & graphite. Container is of polycarbonate.



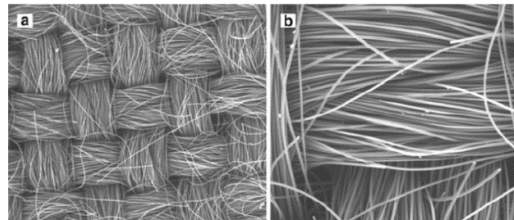
1. Around 1.8V produced with MFC. Photograph also shows moisture being produced during electricity
2. Around 3.75V produced with 2 MFC connected in series.
3. LED lighted with two MFC joined in series.
4. Charging AA battery
Before charging (0.22 volts)
5. After charging for 8 to 9 minutes (0.90 volts)
6. Charging of batteries.

BATTERY CHARGING USING 1 CELL



III. FUTURE AREA OF RESEARCH

1. Using carbon/graphite and magnesium plate instead of rods. Because according to my observations, as the surface area increase the current is improved. So for getting a larger amount of current plates must be used. And maybe if Carbon cloth is used then it is possible that much larger current shall be obtained.
2. Various types of carbon materials such as carbon fibre, carbon paper, carbon nanotubes, Carbon cloth etc are available in laboratories.
3. The most suitable for the fuel cell shall be Carbon cloth, as CC has many advantages over Carbon fibre.

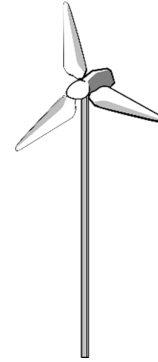


Carbon cloth at 200x (a) and 400x (b)

4. Carbon cloth is more thicker, flexible and more electrically conductive.
5. Our next plan is merging solar power, wind power and MFC energy and creating a plan where in daytime solar shall give power to the house, while microbial fuel cells and wind power shall charge a battery in day time and power up the house at night. Solar and wind will generate depending upon the climate, while MFC will give constant output independent of climatic changes.

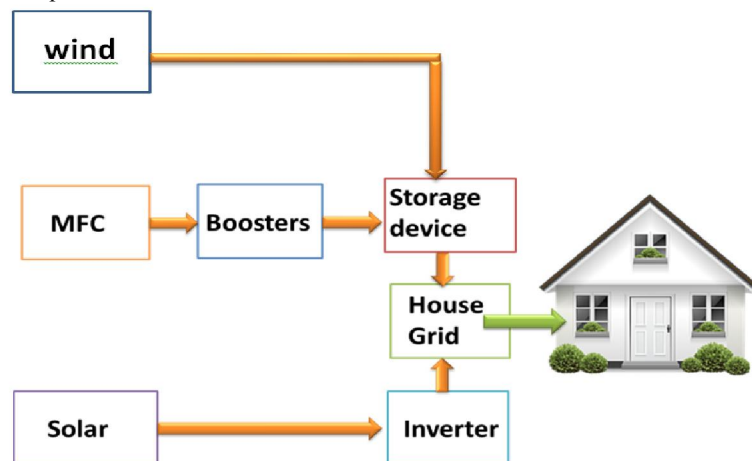


Unused area under and around solar panels



Wind Turbine

6. Recently Elon musk has created 100MW storage batteries Named under Tesla’s Power wall. As our battery storage capacity is increasing similarly Battery charging speed is also increasing while referring to Super Capacitors. Powerwall can power a house for 7 days when grid power is off. When grid power is OFF, a house is powered using solar power and Powerwall and at the night time house will be powered completely through Powerwall
7. Microbial fuel cells shall Charge these tremendous batteries in day time with solar and wing power and at the night time this battery shall be charged through MFC and wind. The combination of these cells shall be in series or parallel as per the requirement.



8. Idea behind merging solar, wind turbine and MFC is that in solar farms or at commercial buildings, whenever solar panels are installed, these panels are fixed at a particular angle, making the area under it useless. To make use out of this area we shall do some vegetation and in that will be our hidden technology of future “MFC”.
9. Not only the area can be used for vegetation but also for composts and power generation.
10. I am thinking to combine Microbial cells and solar power in my future projects. Also at the top of commercial and residential buildings, there is enough wind flow to rotate a small wind turbine which will also charge the battery with solar and MFC.

IV. CONCLUSION

MFC is a very ideal source for generating electricity. Lot of researches are being done in this field. Cross functional team from Electrical engineering, Chemical engineering, material science should come together and work in this area to come out with a solution to develop a MFC which will be at low cost, easy to handle, maintenance free and generate sufficient voltage and current to successfully power the devices. At present real problem is the low current density and power. Presently this technology is at very infant stage, but research is being done and soon solution will be available due to which it can be commercialized and made available to use for everybody.

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