

Electricity Production by Microorganisms

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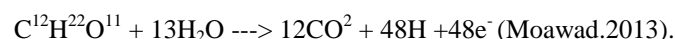
Abstract: Microbial fuel cells (MFCs) are alternative source of producing electricity, yet not commercialized but they shows production of electricity. The power produce by this experiment is limited but can be consider for future aspect. This research carried out by various samples which show positive result. , its due to metabolic activity which carried out in the anaerobic condition MFCs production of electricity is indirectly proportional to time. This can be seen in all samples. The experiment is carried out by construction of two-chamber, in which transfer of energy was carried out. The power production of the main mechanism in this experiment was by direct transfer of electrons to the electrode by bacteria growing on the electrode cyclic voltammeter. The attachment of bacteria on electrode was studied. The most bacteria which were isolated from the sample were *Klebsiella pneumonia*, *Escherichia coli*, *Pseudomonas aeruginosa*.

Keywords: Microbial fuel cell, power density, electric energy generation, Alternative energy, electron, proton.

I. INTRODUCTION

The forecast of the world's population reveals that by 2050 it will reach 9.4 billion and therefore there is an urgent need to increase energy production by that time. In past centuries, fossil fuels have been a key factor for industrial and economic development.(Vizhemehr *et al.*, 2012) A unique type of fuel cell holding a promise in the long term is the bio-fuel cell further work on cattle waste substrate for successful production of Bioelectricity by MFCs has been reported.(Tyagi *et al.*, 2012).Alternative source of power generation can be biological method.[1]

MFC is a device that converts chemical energy stored in the organic matter to electricity using microorganisms as the biocatalyst. The organic matter is oxidized with the help of microorganisms, producing energy, electrons and protons. The energy is stored by microorganisms and used for the growth. The electrons are brought to the anode from the inside of microorganisms by the mediator, and flow to the cathode through copper wire. The protons go through the proton exchange membrane (PEM) and enter the cathode chamber. They react with the oxygen and the electrons on the cathode, producing water. In this way, the organic matter is converted to electricity. (Zhen long Li *et al.*, 2007). The use of microorganisms in fuel cell as a catalyst for electricity generation was known 40 years ago. When microorganisms consume a substrate such as sugar in aerobic conditions they produce carbon dioxide and water. However when oxygen is not present, they produce carbon dioxide, protons and electrons



Our aim to analysis the power generation by MFCs using the bacterial culture from the waste sample. The study including construct microbial fuel cells using various sample, to derive mathematical models to express voltage generated from the cells as a continuous function of time. Evaluate the rate of change of the generated voltage with respect to time extrapolate how long the microbial fuel cells stay functioning .Observation of a mixture of bio wastes does actually result in high voltage.[1]Microbes in the anodic chamber of an MFC oxidize added substrates and generate electrons and protons in the process. Carbon dioxide is produced as an oxidation product. However, there is no net carbon emission because the carbon dioxide in the renewable biomass originally comes from the atmosphere in the photosynthesis process. Unlike in a direct combustion process, the electrons are absorbed by the anode and are transported to the cathode through an external circuit. After crossing a PEM or a salt bridge, the protons enter the cathodic chamber where they combine

with oxygen to form water. Microbes in the anodic chamber extract electrons and protons in the dissimilative process of oxidizing organic substrates (Rabaey and Verstraete, 2005)

Fig. 1 shows a schematic diagram of a typical MFC for producing electricity. It consists of anodic and cathodic chambers partitioned by a proton exchange membrane (PEM) (Wilkinson, 2000; Gil et al., 2003).

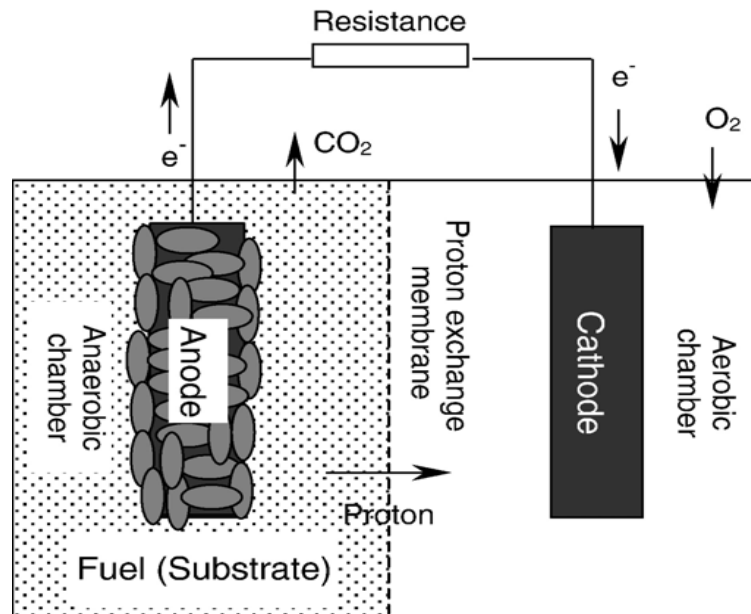


Fig. 1. Schematic diagram of a typical two-chamber microbial fuel cell

II. METHOD & MATERIAL

The sample collection were carried from different places sources each set of 5 like Drain water, Kitchen waste, Cow dung + slurry, Organic waste + slurry+vermicompos, Orange peels, fish. Construction of two-chambers and salt bridge were done. Incubation period of the sample was 5days, So that the metabolism of the bacteria takes place in anaerobic condition. A salt solution, NaCl1g was added to each of the bio waste samples to make the mixture electrically conductive. This mixture was placed in a sealed chamber to stop entering of oxygen, thus forcing the microorganism to use anaerobic respiration. An electrode which was placed in the solution was act as the anode. In the second chamber of the MFC was placed another sample solution and another electrode. This electrode, called the cathode was been positively charged and would be the equivalent of the oxygen sink at the end of the electron transport chain. Connected the two electrodes by a wire and completed the circuit and connected the two chambers by salt bridge. Preparation of salt bridges, a water solution contented concentrations of 3% NaCl and 1.6% agar was prepared to boil for nearly 3 minutes. The hot solution was poured into PVC pipe by sealing one end. The setup will thereafter allow cooling. The salt bridges were thus ready for use. To increase the overall stack voltage or current, the five individual MFCs (MFC 01–MFC 05) were respectively connect in series circuit. Variation in The voltage after stacking the MFCs in series circuit was being reported at regular time Intervals. After making MFCs incubation take place for 5days

III. RESULT & DISCUSSION

The voltage production was varying between the samples. Production of voltage increases by connecting in series. Electricity production was seen in 3phase Lag phase, stationary phase, and log phase. As the time was increases the nutrient value was decreasing from the sample due to utilization by the organism. In 2010, A. ter Heine et al. constructed a device capable of producing electricity and reducing Cu (II) (ion) to copper metal it was same result. We can say that energy is directly proportional to bacteria present in sample so that by use of biosensor we may able to increases the power generation. Kitchen waste gives significant result so we can say that organisms are getting high nutrition value from the sample.in mixture of cow dung and slurry, slurry contain high soil bacteria which are able to reproduce in anaerobic state so that it's able to give significant power.

TABLE I Qualitative analysis of samples for production of energy

Sr.	Sample	Energy Productivity
1	Drain water	+
2	Kitchen waste	++
3	Cow dung + slurry	++
4	slurry, Organic waste + slurry+vermicompos	+
5	Orange peels	+
6	Fish	-

Keys: + = Presence of electricity , - = Absence of electricity

a. **Graphs:** Samples incubated for 5 days showed electricity generation and its voltage was measured at different interval of time. Its graphical representation is presented in fig .2, fig .3

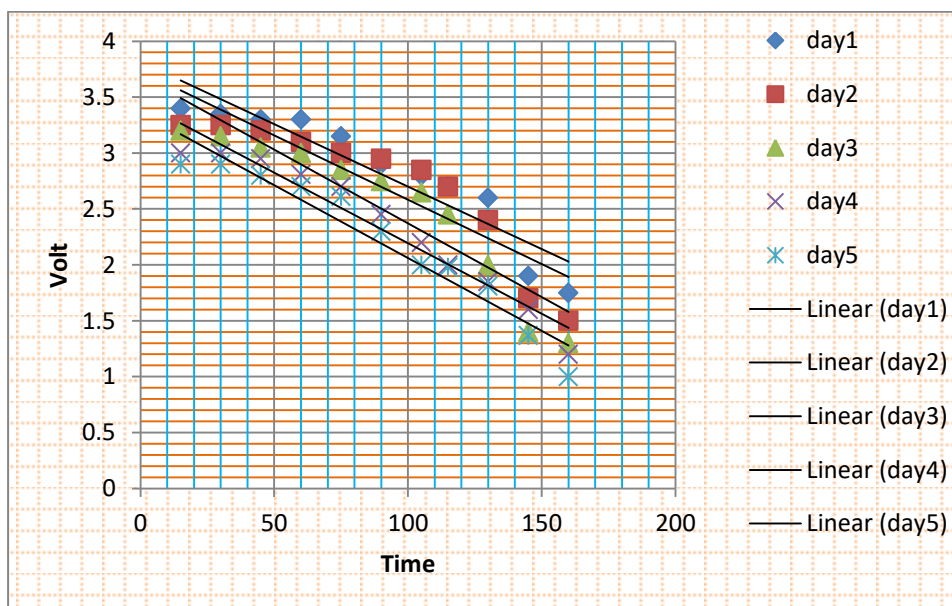


Fig 2: Electricity generated by kitchen waste sample

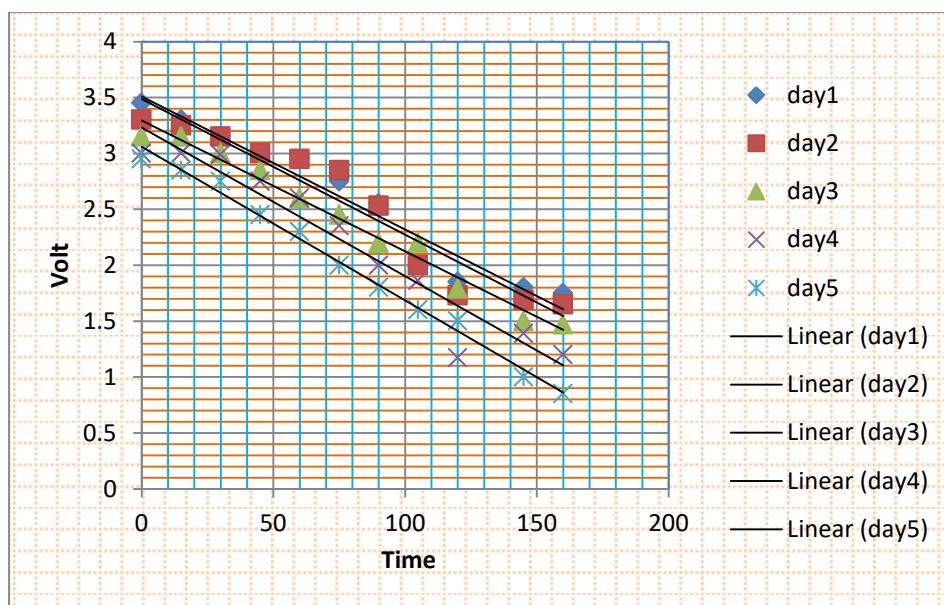


Fig 3: Electricity generated by cow dung + slurry sample

b. Conclusion acknowledgement:

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IV. CONCLUSION

Electricity generation not seen in high protein contained sample like fish Sample. Significantly electricity generation was higher seen in kitchen>cow dung and slurry>orange peel>drain water>.□In all sample electricity production was more significantly on 1st day of sample voltage measurement. Electricity production was decreases as increase in day

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