

Using Bacteria in Microbial Fuel Cells

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ABSTRACT

Microbial fuel cell (MFC) has become one of the sustainable energy technologies for waste water treatment purposes in the recent years. It combines waste water treatment and electricity generation together to achieve energy balance. Four types of locally isolated bacteria (Escherichia coli, Pseudomonas aeruginosa, Bacillus sp, and Klipsella pneumonia) were tested for their ability to produce electricity. Two kinds of municipal wastewater were used; from aerobic and anaerobic treatment stages, while providing the system with nutrient glucose continuously. Results showed that the highest value of the voltage generated when using the bacteria Bacillus sp. It gave 0.6 Volt and lasted for two days at room temperature. The smallest value was recorded when aerobic treatment, and it was 0.3 Volt and lasted for three days at room temperature and pH of 8.6.

Key words: *Bacillus spp.; Microbial Fuel Cell and Wastewater*

INTRODUCTION

Microbial fuel cells are series of operations where chemical energy is converted to electrical energy through biomass¹. Which led to increase attention as a new technology for the treatment of sewage water and reduce the cost of energy². The infrastructure changes will be more extensive over time, so it need more energy though we will require changes not only to our infrastructure, but include our lifestyle, these changes affect everything from home heating, lighting, etc., for that using bacteria that have the ability to be decompose of organic materials are being developed to use in domestic and industrial wastewater treatment by removing organic matter from the water, while at the same time not have the ability to produce an electric potential^{3,4}. These cells may have other applications for the future as it can be used in biological treatment, and to remove nitrates (conversion to nitrite) can also be developed and used for the processing of energy in all the devices in the marine estuaries and distance site seas⁵. The water and energy of the most important topics face the world as a result of social developments and economic, where microbial energetical cells considered one of the newest ways to energy production and generate clean water through microorganisms to catalyze the oxidation of organic materials and inorganic^{6,7}. The research aims to use bacteria and wastewater for the production of electrical energy and effort teams used to generate an electric current in the microbial fuel cells.

MATERIALS AND METHODS

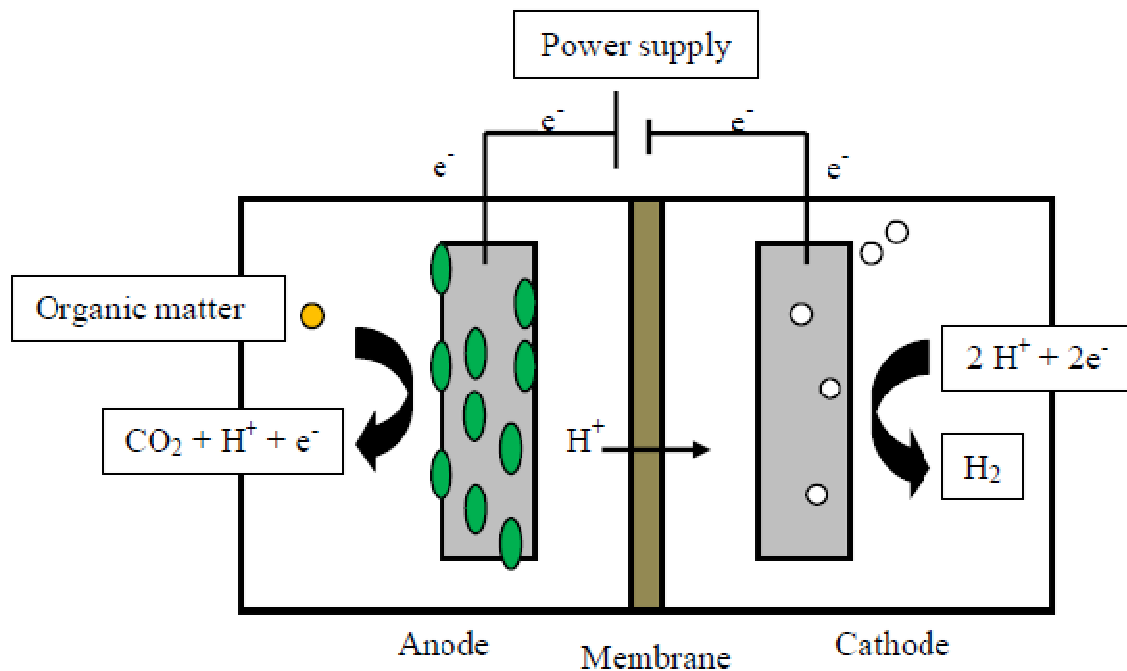
Microbial fuel cell (Microbial Fuel Cell, MFC)

Microbial fuel cell MFC consists of the following components according to Cao¹, *et al.*, and Qu⁸, *et al.*, Figure [1]:

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- Polar cell (anode and cathode)
- Bacteria and waste water (27 ml) the concentration of bacteria 10^8 cells / ml, compared with a tube McFarland (0.5).
- Substrate (nutrients)

Microbial fuel cell consists of a room of the anode and the cathode, where bacteria grow on the positive electrode (anode), and works on the oxidation of organic matter and inorganic where liberated electrons to the anode and the cathode when the protein intake and release Hydroxyl non ionic produce which produces the voltage generated between the poles teams ⁹.



The form of [1] scheme for microbial fuel cell [5]

Design microbial fuel cell

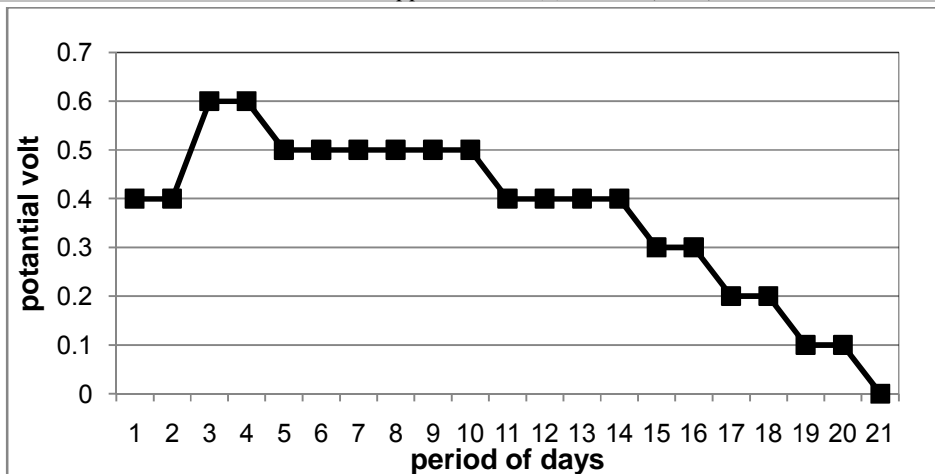
The fuel cell is formed on the cube-shaped plant material plastic. Anode consists brush of carbon rod Titanium diameter 5 mm treatment anode heat 30 minutes, at a temperature of 450 °) and wash brush carbon and penis for 48 hours in 1 M of hydrochloric acid and then rinsed with water to remove trace metals. As the cathode is a carbon texture of the surface area of 7 cm² is covered with platinum concentration of 0.35 mg / cm² were used wires of titanium metal electrodes to connect with the external circuit.

Isolate and diagnose of bacteria

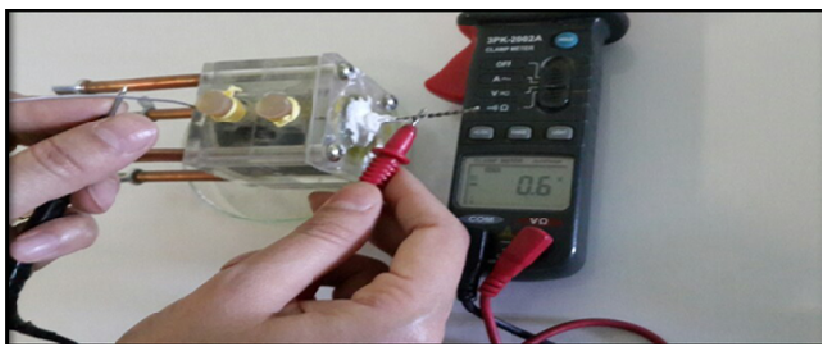
It isolated the bacteria from wastewater before must experiments, using among private bacterial growth, using among bacterial especially of bacterial growth was the diagnosis using biochemical tests according to ¹⁰.

RESULTS AND DISCUSSION

Resent results explain values of voltages of anaerobic wastewater treatment stage and aerobic wastewater treatment stage when compared with voltages generated by the bacteria *Bacillus* sp isolated from soil pollution with hydrocarbon, as well as, with the incubation period. The initial voltage reading recorded 0.4 volt sat first day and then highest value of voltage generated from the bacteria *Bacillus* sp. recorded 0.6 volts at the second day and continued for two days at room temperature at pH 8.5. It continued to produce voltages for a period of twenty-one day where it was generating voltages at the first day and started to come down gradually when the fourth day, as illustrated in Figure^{2,3}.

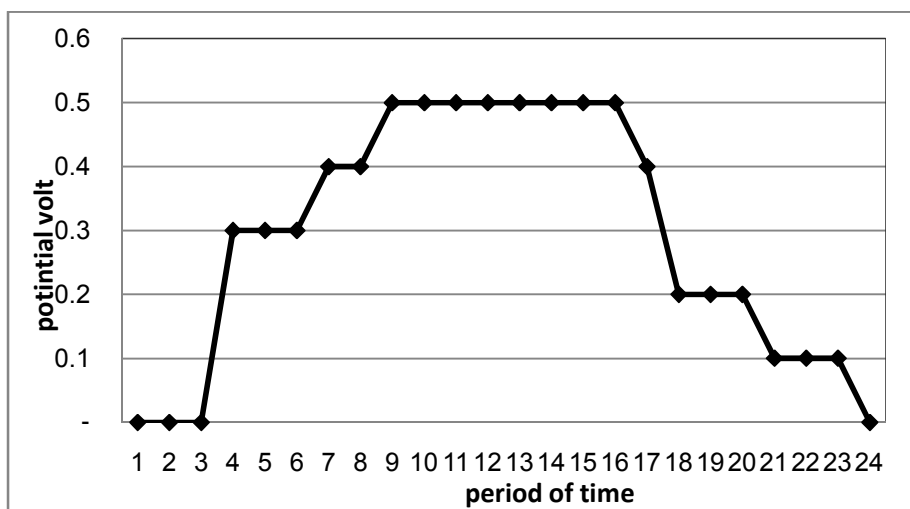


Form [2] the relationship between the production of cell voltages by MFC for *Bacillus* sp bacteria and time analysis



Form (3) measure voltages when a six-day period of application of the system

While the results showed the highest obtained values of the voltage of the treated wastewater an aerobically 0.5 volts when the eighth day and continued supporting for eight days at room temperature and pH 8.6 and isolated and diagnosis these bacterial species *Escherichia coli*, *Pseudomonas aeruginosa*, *Klitsella pneumonia*, from waste water an aerobically. Where it was generating voltages when the third day was 0.3 voltages and gradually began to land at the seventeenth day. The system continued to generate voltages for a period of twenty-four day as shown in Figure^{4,5}.



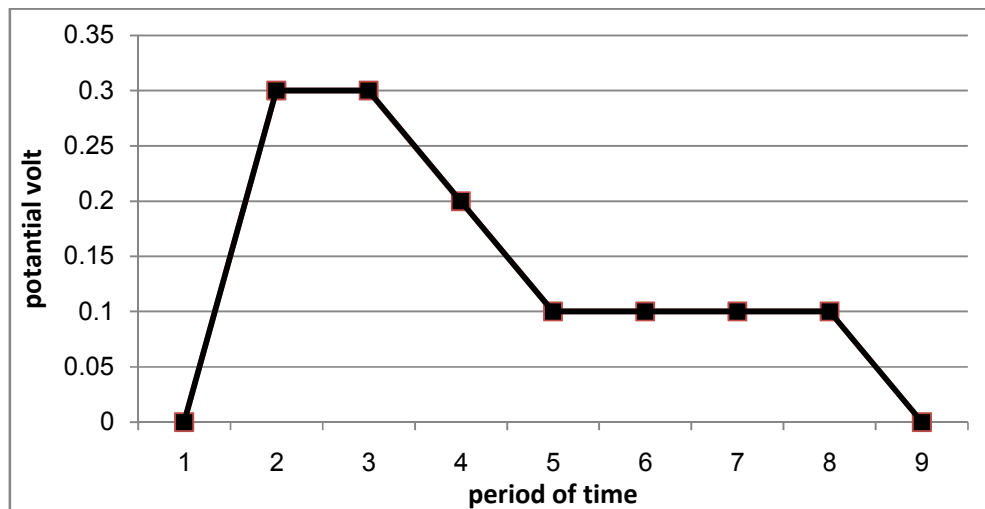
Form [4] the relationship between the production voltages and the time of decomposition wastewater treatment an aerobically in MFC



Form [5] measuring voltages when eight days of an MFC application system period

When compared anaerobic treated wastewater with contaminated water with bacteria *Bacillus* sp. and wastewater aerobic treatment stage, the highest results record for aerobic wastewater in the second day and record 0.3 volts and lasted for three days at room temperature and pH 8.6 and continued to generate voltages for nine days where it began in the generation of voltages when the second day and it began a gradual decline in the fourth day when, as shown in Figure⁶.

Where cultivation of these waters have been diagnosed with bacterial species *Escherichia coli*, and *Pseudomonas aruginosa*.



Form [6] the relationship between the production voltage sand the time of decomposition wastewater treatment aerobically in MFC

Logan¹¹ et al., found that this bacterial species is capable of producing electricity at levels that can be used to run small electrical appliances as the bacteria were fed glucose or organic waste has been able to produce energy. Some types of bacteria produce a very small electronic current during the vital activities as where it digest nutrients into molecules have the ability to generate protons and electrons generate electricity and running on the re-mixing and conversion of chemical energy into electrical energy, so the current production in the microbial fuel cell depending on several factors they necessary to understand the impact of various operational readings and improve the electricity production of the MFC and which nutrients type, temperature, pH and other variables¹². As results from findings of the Lsumaidaie¹³ et al.,. The bacterium *Bacillus* sp. gave a result of 0.4 volts after one day but this system has continued to rise and gave 0.6 volts after two days. While for anaerobic wastewater treatment when the eighth day was voltages of 0.6 volts higher voltages.

CONCLUSION

From the above we conclude that viable microbial cell design had economically effect and may be developed from small-scale this is an environmentally-friendly process for the purification of water derived from industrial processes. It also generates small amounts of electricity in practice enough to drive a small fan, a sensor or a light-emitting diode. In the future, the researchers hope to scale up this energy generation to enable the same energy to be used to power the water purification process that commonly consists of many stages often involving mechanical and energy-demanding decontamination steps at its outset.

The production of current in the MFC depends on several factors such as nutrient, PH. Further studies are necessary to understand the effect of different operational parameters and optimize the electricity production from the MFC.

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