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GENERATION OF BIOELECTRICITY USING WASTE WATER

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ABSTRACT

The need for new and alternate sources of energy is increasing day by day. In the upcoming days the alternative sources of energy will be applied everywhere. The Microbial fuel cell technology represents a alternative form of energy wherein wastewater and industrial effluents are used for electricity generation. In this technology we have used sewage water and other industrial effluents and successfully generated a power of 0.9 -1.5 V , which is sufficient to light a LED. In this process the wastewater was primarily treated which was confirmed by the COD tests which showed reduction of COD. It is a very cost effective and a alternative source of energy which will be adopted for the future. We are also successful in isolating the electrogenic bacteria which include bacillus species and pseudomonas species. The main objective being the generation of required bioelectricity sufficient to run an industry.

Keywords : Bioelectricity, Anode, Cathode, Agar Salt Bridge

[1] INTRODUCTION

New approaches for electricity generation and waste water treatment, which not only reduce cost but also produce useful side-products, have recently received increasing attention. The microbial fuel cell (MFC) technology offers a valuable alternative to energy generation as well as waste water treatment. Microbial Fuel Cell is a device to treat waste water and generate electricity at the same time. We thought of adapting a technology which is a biotechnological solution for the power cuts and in the due course we discovered that MFC technology serves the purpose. A variety of readily degradable compounds such as glucose and acetate, and various types of waste water such as domestic, starching and paper recycling plant waste water, have operated successfully as substrate in MFC. Most could achieve a considerable chemical oxygen demand (COD) removal efficiency accompanied with electricity generation [1] [2].

According to the Logan Group of Pennsylvania State University (PSU), this technology can use bacterium already present in waste water as catalysts in generating electricity while simultaneously treating waste water [3]. Some of the newest advances and future challenges are reviewed here with respect to practical applications of these MFCs for renewable energy production and other applications [4]. Microorganisms have proven to be promising agents for electricity generation. [5].

[2] MATERIALS AND METHODS

2.1 Anode :

A Plastic anaerobic container of 1.5 litre capacity was used. It was holed to insert a Salt bridge. The chamber(container) was filled with different samples such as sewage water, cow's urine, industrial effluent(Agro waste, Diary waste). Carbohydrates (glucose, sucrose, cellulose, starch), volatile fatty acids (Formate, acetate, butyrate), alcohols (ethanol, methanol), amino acids, proteins and even inorganic components such as sulfides or acid mine drainages [6] & [7], can be used as substrate. The type of substrate fed to a MFC potentially has an impact on the structure and composition of the microbial community. In our apparatus, we have used sucrose, dextrose in concentration of 1gm/1.5litre solution.The following electrodes were used Carbon Rods of length 15cm and Diameter 1.5cm.Zinc Rods of length 15cm and Diameter 1cm.

2.2 Cathode :

A Plastic aerobic container of 1.5 litre capacity was used. It was holed at the side to insert a Salt bridge. The chamber was filled with electrolytic solution(saturated salt solution). The electrolytic solution was exposed to air for reduction reaction to occur. The Oxygen combined with protons which passed through salt bridge and the reduction occured at the point where oxygen, electrons and proton meet. Water is formed due to this reduction reaction. Electrodes were used as same as that of Anode

2.3 Agar Salt Bridge as Membrane

Composition: Sodium chloride 15g; agar 2%; water 150 ml.The purpose of an agar salt bridge is to provide an electrical connection to the solution while minimizing the transfer of ions or solute from the electrical environment. With a salt bridge, the desired cation (Positive ions) is isolated in one chamber. As electrons leave one half of a cell and flow to the other, a difference in charge is established. If no salt bridge is used, this charge difference will prevent further flow of electrons. A salt bridge allows the flow of ions to maintain a balance in charge between the two chambers while keeping the contents of each separate.

2.4 Construction of Microbial Fuel Cell

Different samples were collected from various sources, such as

Sample 1- Sewage water.
Sample 2- Cow's urine.
Sample 3- Agro waste.
Sample 4 - Diary waste.

2.5 Operation of MFC

The nutrients such as Sucrose, Dextrose were added to the anode chamber by unscrewing the top. L Cysteine was added at a concentration of 0.5gm/litre of sample solution to maintain the anaerobic conditions as it scavenges Oxygen present in closed anode container. The internal wiring of anode and cathode was connected to a multimeter to complete the circuit. The entire set up was left for 30min for stabilization and the deflection in the multimeter was noted down every hour.

[3] RESULTS

The maximum voltage and current was generated using the cows urine and dairy waste. Using mediator in MFC showed the good result as compared with mediatorless one. When optimization was done by varying the salt bridge size, it was analysed that if the salt bridge is smaller, the movement of protons is faster and voltage and current generated is more.

FIG 1. BIOELECTRICITY GENERATED FROM SEWAGE WATER CONTAINING MEDIATOR

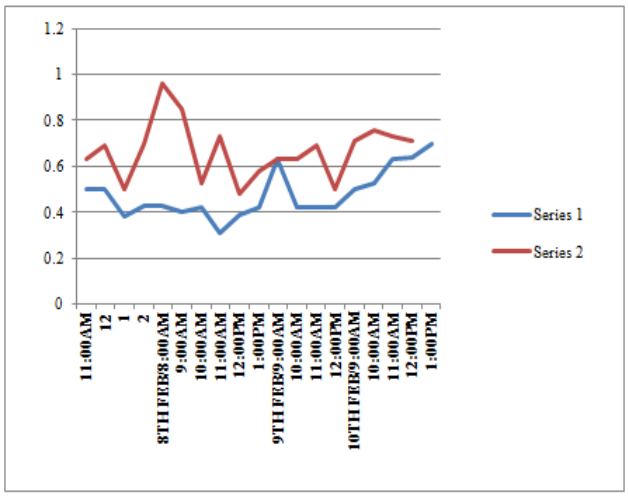


FIG 2. -BIOELECTIRICTY GENERATED FROM SEWAGE WATER WITHOUT MEDIATOR

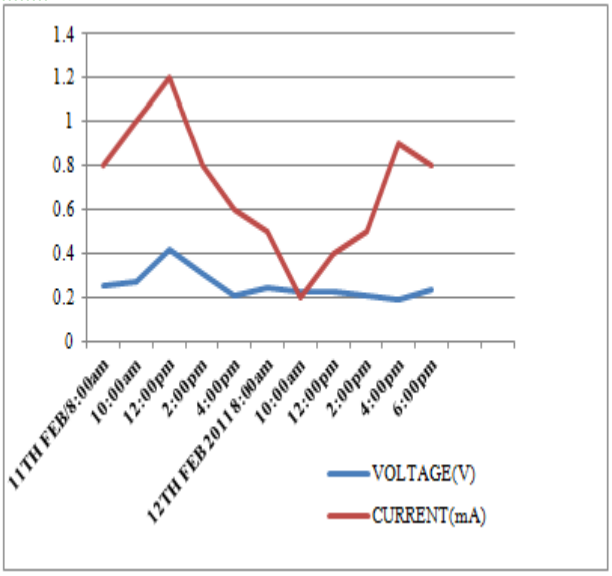
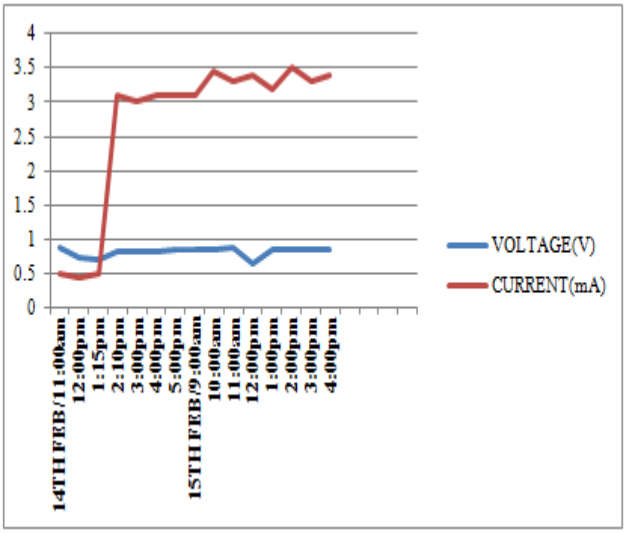


FIG 3. BIOELECTRICTY GENERATED FROM COWS URINE WITH SALT BRIDGE



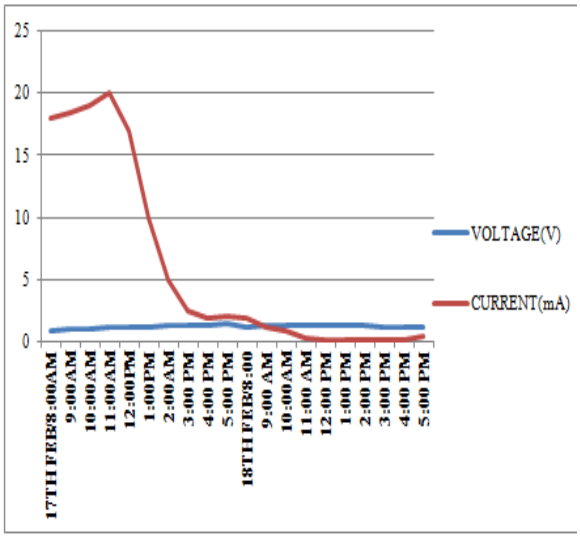
[4] DISCUSSION

A MFC generates electricity directly from electron donors through the microbial activity. Many researchers, however, have successfully generated electricity biologically in a single step process.

The MFCs can be readily modified to generate hydrogen instead of electricity using an anaerobic cathode and a small applied voltage to reduce protons in the cathode chamber. Recently discovered that hydrogen can be produced from a fermentation end product (acetate) by modifying a MFC by applying a small potential to that generated by the bacteria [8].

In the future the amount of low-power devices implanted in the human body will significantly expand. These devices need long term, stable power provision. To provide this power, a MFC can be used. Two possibilities exist, enzymatic and microbial fuel cells.

FIG 4. BIOELECTRICTY GENERATED FROM COWS URINE WITHOUT SALT BRIDGE



In enzymatic fuel cells the potential difference is created by the use of two electrodes with different enzymatic reactions creating a potential difference based on the reaction redox potential[9].

Bacteria show lower metabolic activity when inhibited by toxic compounds. This will cause a lower electron transfer towards an electrode. Bio-sensors could be constructed, in which bacteria are immobilized onto an electrode and protected behind a membrane. If a toxic component diffuses through the membrane, this can be measured by the change in potential over the sensor. Such sensors could be extremely useful as indicators of toxicants in rivers, at the entrance of wastewater treatment plants, to detect pollution or illegal dumping, or to perform research on polluted sites [10]

[5] CONCLUSION

MFCs are a promising technology for the generation of electricity from organic material

and wastes. Microbial fuel cells do hold promise towards sustainable energy generation in the near future. In addition to having very high fuel efficiency, microbial fuel cells produce very little pollution. They are inexpensive compared to a full metal combustion engine and they pose no explosion hazards such as the hydrogen fuel cell systems. The microbial fuel cell needs no charging, but operates within a very short time after substrate supplement, unless the starvation period is too long to sustain active biomass. Whereas the conventional battery requires charging for several hours before being operational

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