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Research Article

URINE BRIGHTNESS

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ABSTRACT

Method of adding wastewater such as urine to the list of renewable energy sources

INTRODUCTION

Due to the constant increase of the energy demand and the consequential environmental problems, the exploration of clean, sustainable energy sources have been receiving considerable attention. The world's supply of fossil fuels is being depleted, and there is increasing pressure to develop new renewable sources of energy such as wind, solar, and hydropower. Bioenergy is one such source, and microbial fuel cells can produce it. Microbial fuel cells (MFCs) provide a method of adding wastewater such as urine to the list of renewable energy sources. MFCs are attractive for wastewater treatment, because they could allow for harvesting energy from wastewater for producing electricity. A new kind of microbial fuel cell that can turn urine into electricity could revolutionize the way we produce bioenergy, particularly in developing countries such as India, Bangladesh, particularly in impoverished and rural areas. Microbial fuel cells have real potential to produce renewable bioenergy out of waste matter like urine. The world produces huge volumes of urine and if we can harness the potential power of that waste using microbial fuel cells, we could revolutionize the way we make electricity.

Microbial fuel cell (MFC) is the type of fuel cell that is used for the production of bioelectricity by using microorganism as a biocatalyst in an anaerobic anode compartment. For the biodegradation of waste to generate the electricity bacteria as microorganism can be used. The MFC is a true green technology that operates within the immediate carbon cycle and does not rely on fossil fuels. The MFC is in effect a system which taps a portion of that biochemical energy used for microbial growth, and converts that directly into electricity- what we are calling urine-tricity or pee power. There are other ways of producing bioenergy, including anaerobic digestion, fermentation and gasification. But microbial fuel cells have the advantage of working at room temperature and pressure. They're efficient due to the direct conversion of the fuel energy into electricity, relatively cheap to run because of the type of fuel it uses, produce less waste than the other methods, as well as the ability to use a great diversity of organic compounds depending on the metabolic abilities of the organisms being used. Thus devices like this that can produce electricity from urine could make a real difference by producing sustainable energy from waste.

The overall aim of our present work is to investigate the performance of novel small scale MFCs assembled in different configuration, fed with artificial / natural urine and demonstrate their practical implementation by directly powering LED. The stack will be configured in a cascade manner, where all MFC units were hydraulically linked, in an attempt to sequentially treat the urine fuel at different added carbon energy concentrations and thus better utilise the organic contents. Several other key parameters will be investigated for improving the energy output.

Review of Literature

The first concept of MFC was came in to 1910 given by Potter. Platinum electrodes and living cultures of Escherichia coli and Saccharomyces was used for the production of electricity. The power density was very less in the first MFC, due to that

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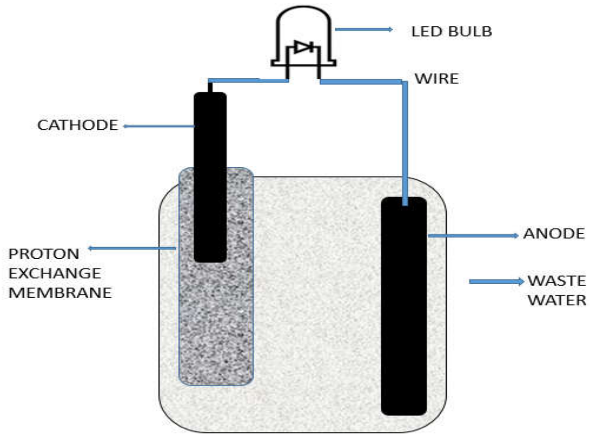
scientist did not show much interest in MFC concept till 1980s. A great breakthrough was reported when some microorganisms were found to transfer the electrons directly to the anode. These microbes were very stable and yielded a high current and power density, Shewanella putrefaciens, Geobacteraceae sulfurreducens, Geobacter metallireducens and Rhodoferax ferrireducens are the few of bio electrochemically active microorganism which can form a biofilm on the anode surface and transfer electrons directly by conductance through the membrane.

Microbial Fuel Cells (MFCs) are unique bio-electrochemical transducers that convert wet organic waste directly into electricity, through the metabolism (waste treatment) of constituent microorganisms. One such global and abundant waste product is human or animal urine, which has already been demonstrated to be an efficient fuel for direct electricity production via single MFCs with >50% efficiency (Ieropoulos *et al*., 2012). The MFC is a true green technology that operates within the immediate carbon cycle and does not rely on fossil fuels, but it also carries the added advantage of low cost in manufacture and maintenance. MFCs may therefore provide a solution for delivering a sustainable energy source for the future, whilst concomitantly providing clean water production, advantageous for developed and developing countries (Ieropoulos *et al*., 2012).

Improved energy outputs and scale-up of the technology are most likely to be achieved through miniaturisation and multiplication of MFC units and thus careful fine tuning of the key parameters governing the performance of stacks of miniaturised MFCs, is critical (Ieropoulos *et al*., 2008; Ieropoulos *et al*., 2010a; Qian& Morse, 2011; Fangzhou *et al*., 2011). Some of the parameters that have already been considered include the inoculum source and community mix (Zhang *et al*., 2012; Ieropoulos, Winfield &Greenman, 2010a); substrate (Futamata *et al*., 2012; Yu *et al*., 2012); catholyte (Zhang *et al*., 2012a; Harnisch & Schröder, 2010); MFC structural material (Ieropoulos *et al*., 2010a); flow rate (Winfield *et al*., 2012; Ledezma *et al*., 2012; Ieropoulos *et al*., 2010c); anode material (Liu *et al*., 2012; He *et al*., 2012); anode chamber volume to electrode surface area (Ieropoulos, 2006) and the type of proton exchange membrane (Ieropoulos *et al*., 2010a)

The effect of electrode material in performance of microbial fuel cells (MFC), which utilize urea in urine at the anode chamber and plain water at the cathode chamber have been demonstrated using different size for metal electrode and also different volume for urine sample. The combination of magnesium and copper produce a promising result which can be used for hardware development. The highest output power, voltage load and current are respectively 0.9 mW, 1.11 V and 0.89 mA. The output voltage of hardware will produce more than 3volts in series connection of 3 cells of the MFC. The output voltage of hardware at no load condition was producing 4.3 V in series connection of 3 cells of the MFC. The current flow with using a red LED as a load is 0.63 mA. These result demonstrate the type of electrode have important role on the efficiency of biological fuel cell.



Diagram

The alkaline nature of urine acts as a good electrolyte liquid. The system works like a conventional battery system. However, a discharged battery needs to recharge by electricity in order to reactivate it. On the other hand, urine based system needs only to replace old urine by fresh urine to activate the system again. As no electricity is required for charging the system, the daily available fresh urine from a dairy farm could be a possible source of renewable energy. Human or animal excretion is not a waste, but an energy source. If an adult human produces 1.5 L of urine containing 2 % urea, it would produce 11 kg of urea each year which is equivalent to the energy in 18 kg of liquid hydrogen that can be used to drive a car for 2700 km powered by a urea fuel cell.

Objectives

To understand the concept of single chambered microbial fuel cell ,Development of SCMFC , Effectively miniaturize the MFC and scale-up power production by generating compact batteries of multiple miniature units, Optimization of multichannel MFC units ,Field trail/ laboratory trail of compact multiple MFC unit battery.

PLAN OF WORK AND METHODOLOGY

Materials required:-•Sample: Human urine

- Electrode: cathode and anode
- Proton exchange membrane(PEM)- jelly like solution (like agar-agar)
- Plastic containers or chambers or pipes
- Multimeter
- Resister and capacitor
- Welding and drilling instrument
- Copper wires
- Hollow pipes
- LED bulbs
- Charger , convertor
- Other auxiliary materials

METHODOLOGY

Sample Collection

Sample – urine will be collected from Government Medical College Chandigarh. Sample will be collected from Patient in beaker. Microbes will be present in urine sample.

MFCs Components

- Plastic chambers (with air tight cap) or pipes
- Anode
- Cathode
- PEM (Agar agar)
- LED bulbs and charger

MFCs Construction (Single chamber Microbial fuel cell)

- It will be constructed with the help of a plastic container, which will be served as cathode as well as anodic compartment or pipes with multiple electrodes.
- The container or pipe will contain the sample (urine) and the anode.
- A similar electrode which has been used as anode will be served as cathode.
- A salt bridge (PEM) will be prepared with the help of 10% agar-agar + 2M NaCl.
- The salt bridge (PEM) responsible for the transfer of protons.
- The cathode will be immersed in the salt bridge when it will be in molten stage to ensure complete surface contact.
- 50% cathode surface will be exposed to atmospheric air.
- The external circuit will be completed by connecting a resistor between the two leads of the electrodes (cathode and anode).

MFCs operation

Sample (urine) will be added in the chamber or pipe of constructed MFCs. The chamber will be sealed to maintain anaerobic condition. The copper wires will be connected at anode and cathode. With the help of these wires we will check the lightning of LED bulb. In result, we will ensure the production of electricity.

Designing of Multi-Chamber MFCs.

- Development of multiple cell single chambered MFCs
- All the MFCs will be placed in a cabinet.
- Three platform will be constructed for placing multiple MFC units.
- Connect the MFC units with pipes for transferring the sample between different units.
- Led bulb, charger or millimetre connected to check the production of electricity

Optimization of Multi-Chamber MFCs

- MFCs will be connected in series as well as in parallel combination to increase the quantity of current and voltage respectively.
- Capacitors will be used for the storage of charge and maintaining constant current.
  Mini-transformer will be used to increase the production of electricity.
- Various other factors like electrode material, size, area, distance will be optimized for maximum output

Significance:-•A battery powered by urine could be environmentally-friendly power source

- •Fuel cell generates power by using bacteria to turn organic matter into electricity
- (Waste water treated)
- Urine microbial fuel cell especially designed to create energy for

*Household purpose
 *	Hospital public toilets
 *	Mall, cinema halls, bus stops and railway stations.

Microbial fuel cells can play an important role in addressing the three fold challenge of finding solutions that support secure, affordable and environmentally sensitive energy. By harnessing the potential power of human waste, we could revolutionise how electricity is generated. According to the International Energy Agency, around 1.2 billion people in the world don't have access to electricity. By developing cheap and simple ways of generating electricity, such as microbial fuel cells, people in poor and developing or rural areas could also be helped. The device is also carbon-neutral , which means no additional carbon dioxide is released into the atmosphere. when it operates the technology has the potential of addressing the poor sanitation in developing countries and remote areas while generating electricity. In the near future this device could provide a means of generating much needed electricity to remote areas at very little cost.. With growing global pressures to reduce reliance on fossil fuels and the associated greenhouse gas emissions, microbial fuel cells could be an exciting alternative .In these MFC in practice , urine will pass for the reaction to happen. From here, electricity is generated by the bacteria which can then be stored or used to directly power electrical devices. The ultimate purpose is to get electricity to light the toilets, and possibly also the outside area, in impoverished regions. The system reduces chemical oxygen demand (COD); in other words, it also serves to treat the urine.

Proton Exchange Membrane

Characteristics of PEM

1. Cost effective
2. Increased proton conductivity
3. Good segregational properties
4. Increased mechanical strength
5. Endurance against heat and chemicals
6. Electronically resistive

PEM that has been used in MFC include Nafion 117, Nafion 112, SPEEK, and Ultrex. Nafion is a sulfonatedtetrafluroethylene copolymer.

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