INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X
Impact Factor: 6.078

(Volume 7, Issue 4 - V7I4-1369)
Available online at: https://www.ijariit.com

An overview on bio battery unveiling potential

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ABSTRACT

In the modern age there are so many power sources but one of the more efficient power sources in our Villages are the Bio-Battery, which is an alternate sources of energy. using wastewater- which is a major problem in rural India, Handy source of power generation. Further we can stored energy in the form of Carbohydrates, found in the waste biomass ,contains Microbial Fuel Cells. We can produce electricity in an MFC (Microbial Fuel Cells) from domestic wastewater and at the same time accomplish biological wastewater treatment. So Bioreactors based on power generation in MFCs are a new approach to waste treatment and power generation.

Keywords: *Waste Water , MFC, Bio-reactors and Carbohydrates, Bacteria.*

INTRODUCTION

In the modern age, there are so many power resources but on of the different type power sources are Bio-Battery,we can produce electricity in an MFC from domestic wastewater and at the same time accomplish biological wastewater treatment. the Bioreactors are based on power generation in MFCs are a new approach to waste treatment and power generation. Further we can telling about the working of MFC. In an MFC the **bacteria** present in the wastewater ferments the carbohydrates.

$$C_6H_{12}O_6 + 6\ H_2O \rightarrow 6\ CO_2 + 24\ H^+ + 24\ e^-$$

Now Electrons are transferred from the bacteria to the anode and to the cathode through the circuit to combine with protons and oxygen to form water. The difference in potential coupled to the flow of electrons produces electricity in the MFC. A **bio-battery** is an energy storing device that is powered by organic compounds, usually being glucose, such as the glucose in human blood. Therefore, by using enzymes to break down glucose, **bio-batteries** directly receive energy from glucose. ... Then these **batteries** store this energy for later use.

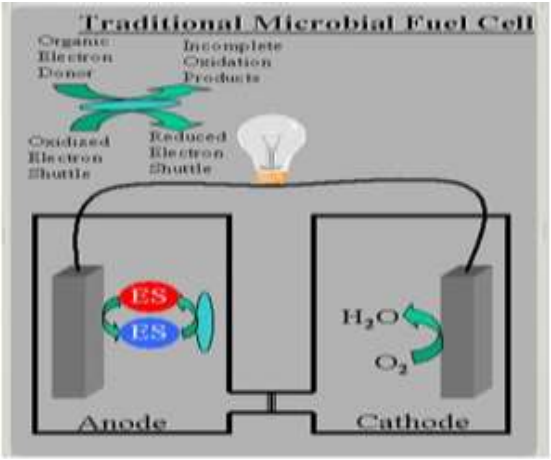


Fig. (1) Traditional Microbial Fuel Cells

WORKING OF BIO-BATTERIES

Like any battery, bio-batteries consist of: an anode, cathode, separator and electrolyte with each component layered on top of another. Anodes and cathodes are the positive and negative areas on a battery that allow electrons to flow in and out. The anode is located at the top of the battery and the cathode is located at the bottom of the battery. Anodes allow current to flow in from outside the battery, whereas cathodes allow current to flow out from the battery.

Between the anode and the cathode lies the electrolyte which contains a separator. The main function of the separator is to keep the cathode and anode separated, to avoid electrical short circuits. This system as a whole, allows for a flow of protons ($\mathbf{H^+}$) and electrons ($\mathbf{e^-}$) which ultimately generates electricity.[1]

At the anode, the sugar is oxidized, producing both electrons and protons.

$$\text{Glucose} \rightarrow \underline{\text{Gluconolactone}} + 2H^+ + 2e^-$$

These electrons and protons now play an important role in the release of stored chemical energy. The electrons travel from the surface of the anode through an external circuit to get to the cathode. On the other hand, the protons are transferred via the electrolyte through the separator to the cathode side of the battery.[1]

The cathode then carries out a reduction half-reaction, combining the protons and electrons with the addition of oxygen gas to produce water.

$$O_2 + 4H^+ + 4e^- \rightarrow 2H_2O$$

ADVANTAGES

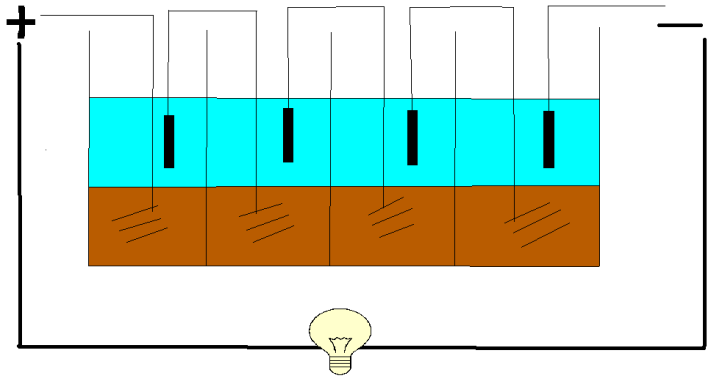
A significant advantage that bio-batteries have in comparison to other batteries is their ability to allow an instant recharge.[2] In other words, through a constant supply of sugar, or glucose, bio batteries are able to continuously keep themselves charged without an external power supply. Bio batteries are also a source of non-flammable, and non-toxic fuel. This provides a clean alternative renewable power source.[2]

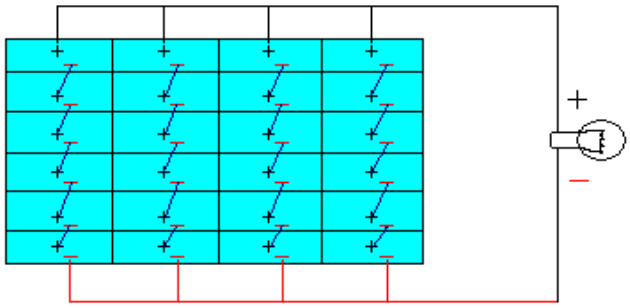
DISADVANTAGES

Compared to conventional batteries, such as lithium batteries, bio-batteries are less likely to retain most of their energy.[3] This causes a problem when it comes to long term usage and storage of energy for these batteries. However, researchers are continuing to develop the battery in order to make it a more practical replacement for current batteries and sources of energy.[3]

APPLICATIONS

OUT LINE OF OUR MFC





\+ Carbon anode

− Zinc cathode

RESULTS AND DISCUSSIONS

Power generated in various types of MFCs systems vary widely as a function of the inoculum, substrate, and reactor. The power generation can be increased by

- modifying the tank design
- making more compartments
- increasing the surface of the electrodes
- using pure bacterial cultures
- maintaining strict anaerobic conditions
- maintaining a continuous flow of wastewater

Optimization:

- Number and surface area of electrodes
- Quality of wastewater used – household and industrial wastewater
- Compartmentalization of the tank – more number of compartments
- Continuous flow system

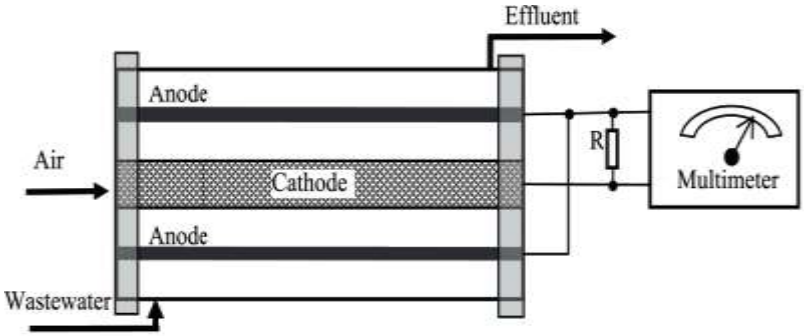
TANK WITHOUT COMPARTMENTS

TANK WITH COMPARTMENTS

RESULTS FROM TANK WITH C OMPARTMENTS

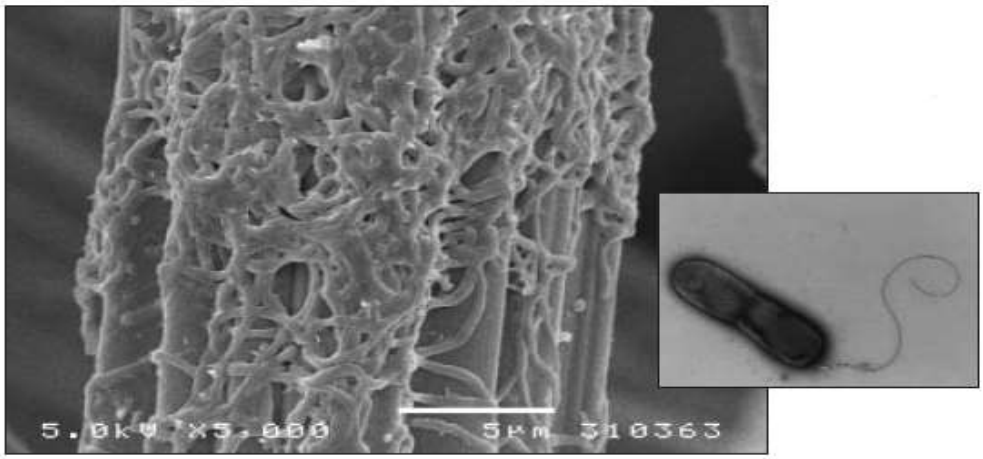
IMPROVEMENTS IN THE MODE

Now after results and discussion we can improve it to a model. For our future life. Which is shown in following figure.



USE OF PURE CULTURES

- Rhodoferax ferrireducens and Geobacter metallireducens have adapted to survive under anaerobic conditions.
- These bacteria utilize iron as their food source and give their excess electrons thus producing electricity.



FEASIBILITY AND COST

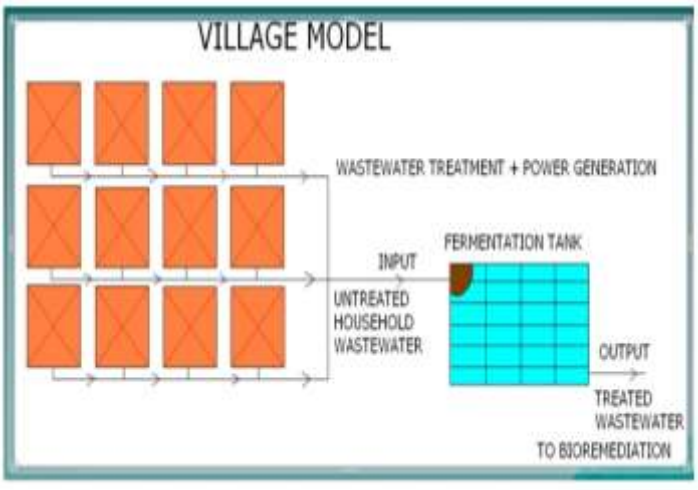
This model is very much feasible and can be sustained with a continuous flow of wastewater.
The cost for the setup is also very less and can be done with a few thousand rupees on a large scale.

SUITABILITY TO INDIAN SCENARIO:

About 10000 million liters of wastewater is generated in India every day and the cost of treatment is also high.
Therefore this method of treating wastewater and obtaining power at the same time will be a very useful one for rural India as well as urban areas which generate lot of wastewater.

IMPLEMENTATION IN RURAL INDIA:

- Many parts in rural India do not have regular power supply and the bio-battery can be a useful device for the people and can be used to power low power consuming devices like a small radio.
- The bio-battery can be a continuous source of power supply as long as there is sufficient amount of the substrate i.e. carbohydrates.

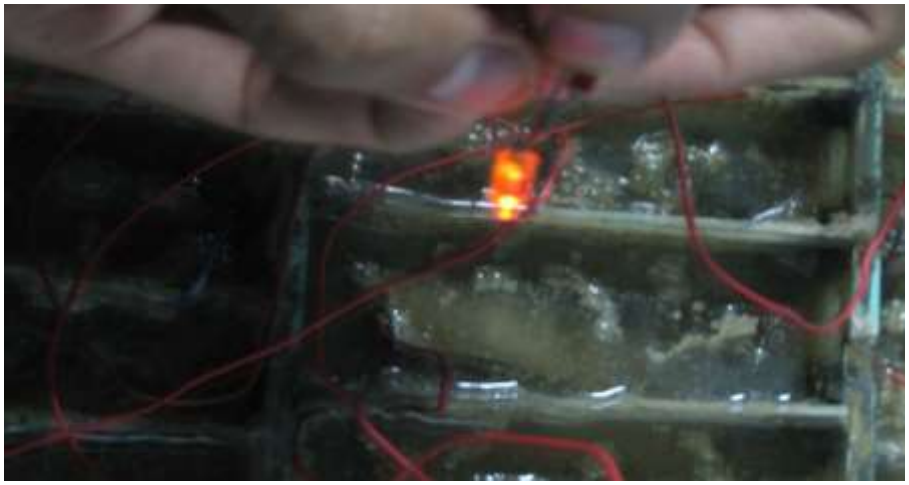


APPLICATIONS

Although bio-batteries are not ready for commercial sale, several research teams and engineers are working to further advance the development of these batteries.[2] Sony has created a bio battery that gives an output power of 50 mW (milli watts). This output is enough to power approximately one MP3 player.[1] In the coming years, Sony plans to take bio batteries to market, starting with toys and devices that require a small amount of energy.[3] Several other research facilities, such as Stanford and North eastern, are also in the process of researching and experimenting with bio batteries as an alternative source of energy. Since there is glucose in human blood, some research facilities are also looking towards the medical benefits of bio-batteries and their possible functions in human bodies. Although this has yet to be further tested, research continues on the subject surrounding both the material/device and medical usage of bio-batteries.

- This device can be used to power small/low power consuming devices consistently over a long period like calculators, and robotic devices in remote areas and underwater sensors.
- Powering a digital calculator

- POWERING AN LED:



BACTERIA

There has been an interest in using bacteria to generate and store electricity. In 2013, researchers found that E.coli is a good candidate for a living bio-battery because its metabolism may sufficiently convert glucose into energy thus produce electricity.[4] Through the combination of differing genes it is possible to optimise efficient electrical production of the organism. Bacterial bio-batteries have great potential in that they can generate electricity rather than just storing it and also that they may contain less toxic or corrosive substances than hydrochloric acid, and sulfuric acid.

Another bacteria of interest is a newly discovered bacterium, Shewanella oneidensis, dubbed "Electric Bacteria" which can reduce toxic manganese ions and turn them into food.[5] In the process it also generates electrical current, and this current is carried along tiny wires made of bacterial appendages called bacterial nano-wires. This network of bacteria and interconnected wires creates a vast bacterial biocircuit unlike anything previously known to science. Besides generating electricity it also has the ability to store electric charge.[6]

Scientists showed that bacteria could load electrons onto and discharge electrons from microscopic particles of magnetite. Researchers had new experiments with purple bacteria, Rhodopseudomonas palustris, by controlling the amount of light the bacteria was exposed to. This bacteria was able to pull electrons from its surrounding environment. The team changed the light conditions. During the day-time, phototrophic iron-oxidizing bacteria were able to remove electrons from the magnetite discharging it. During the night-time, the bacteria were able to put electrons back onto the magnetite recharging it.[7] During this process, researchers found out that this magnetite could be used to clean up toxic metals. Magnetite can reduce the toxic form of chromium, chromium VI, to the less toxic chromium (III).[7]

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