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Bio-Batteries

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***Abstract* - This paper provides the brief study about bio-battery. These bio- batteries are the upcoming battery technology. Bio batteries usually use the mechanisms that take place in the human organisms or the human body. Such a battery is not only eco friendly in nature but also it is an excellent source of an electrical energy. They basically use enzymes. These enzymes are used for breaking down the glucose, by this bio battery are able to receive the energy that is produced from glucose. This battery then stores this energy for the later use. This process is identical to both plants & animals how they obtain the energy. Still such bio battery technology is under research and many testing are being done before they are commercially sold in markets. Many research teams and many engineers are working for the development of these batteries.**

Keywords: Bio-Battery, Enzymatic bio-battery, Microbial fuel bio-battery, Electrical Energy, Energy Sources.

I. INTRODUCTION

A bio- battery is a battery that stores the energy which is powered by the organic compounds. Such organic compounds include glucose such as glucose present inside the human blood. The enzymes present inside the human body break down the glucose , then this breaks down into several electrons and protons are released. The carbohydrates and oxygen is produced in plants by photosynthesis process from carbon dioxide and water. Animals use these carbohydrates and oxygen. They utilize them as an energy source. They release carbon dioxide and water. The cycle is continued again and again. As carbon dioxide will be recycled in the system the carbon dioxide will not increase in atmosphere. One bowl of rice for about 100 grams is equivalent to 160 kilo calorie, this corresponds to 64 AA alkaline dry cells. The bio batteries are used for energy activity that is ATP and thermal energy that is used in the living organism. This can be obtained from the electron exchange and the proton exchange through these 2 enzymatic type of reactions. To have an advantage of such a living organism mechanism, the energy must be removed from inside that organism for the activity outside the organism as an electrical energy. It is the process when the electrons and protons are moving from one enzyme to another enzyme, it is very much necessary to extract the electrons and divert their path separately in a different direction. The principles of the bio batteries are based on the conversion of energy mechanism in the living beings. However there is a need to create several Technologies for development of the bio battery. These include enzyme immobilization which is normally incompatible which metal electrodes, carbon, electrodes structures and many electrolytes. The processes used in the living bodies are not only eco friendly in nature but they can be even practically used as an energy source also.

II. PROBLEM STATEMENT

Many types of conventional batteries like lithium ion batteries, several types of carbon batteries, zinc batteries etc are not at all eco- friendly as they contain high amount of concentration of chemical and they are hazardous due to their leakages. Many times, there is a possibility of malfunctioning of original equipment also.

So, by the usage of bio battery we can definitely avoid hazards that take place in the present environment. They are environment friendly as we use the organic materials like plants and many microorganisms also that are abundantly available in nature. There is no possibility of explosions as that doesn't require any type of recharge unlike other batteries. There are no leakage is in such a battery. This bio battery is a non flammable and or non toxic fuel also. It provides a very clean renewable power source as an alternative and has the instant recharge capability.

a) What is bio-battery?

A Bio battery is a device in which the substrate material, or else in organic material is converted into electrical energy. This conversion will take place with the help of various biochemical agents and biological agents like enzymes or microorganisms. The substrate is broken down into protons and then electrons are released.

It breaks down in the presence of the agents. The circulation of protons and electrons continuously and periodically within the bio battery generates electricity. Bio battery generates electricity by utilizing the energy sources such as carbohydrates, proteins, amino acid and fats digesting enzymes.

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III.HISTORY

An electrical signal can induce biological reaction, the reverse is also true for most of the cases and in this way the biological processes is used for generation of electricity. The electrical generated can be used for powering of electrical equipments. The first microbial 'bio fuel cell' that is BFC was initially demonstrated in 1912. The first enzyme based bio fuel cell was reported in 1964. This used glucose oxidize (GOx) as the anodic catalyst & glucose as the bio –fuel.

a) Need of Bio-Battery

As we know that energy conservation is the major issue, the bio-battery is one of the energy conservation method. In the field of electricity, a battery is a device that converts chemical energy to electrical energy. Different types of batteries are used in various electronic devices.

However, these batteries contain certain chemicals such as, of lead and mercury, which are highly toxic in nature. Also, all types of chemical batteries are prone to explosions, leakages, etc.

These problems that are not seen in the case of bio-batteries. Therefore, bio-batteries have a great potential to be used as suitable alternatives or even replacements for chemical batteries in the future. Bio-batteries are the alternative for clean renewable energy power source.

b) Types of bio-battery

i. Enzymatic bio-battery: Enzymes are involved in breakdown of glucose.
ii. Microbial bio-battery: Micro-organisms like Escherichia Coli, Electric bacteria etc are involved in breaking of glucose. The manufacturing technique reduces fabrication time & costs , & the design could revolutionize the use of bio-battery as a paper source in remote dangerous as well as resource-limited areas in bacteria powered battery on paper.

Depending on the type of agents involved in the breakdown of the substrate .The circulation of these protons and electrons within the bio-battery generates the conduction of electricity. Other types of bio-batteries developed include cellulose-based bio-batteries, body based bio-batteries, etc.

Even mitochondria (sourced from a suitable biological cell be used in a bio-battery, since they are regarded as the "energy powerhouses" of the biological cell.

c) Construction of enzymatic bio-battery

Bio-batteries contain an anode, cathode, separator & electrolyte. Main function of the separator is to avoid short circuits. Anodes allow electrons to flow in from outside battery, whereas cathode allow current to flow out from battery.

d) Working of enzymatic bio-battery

Glucose is broken at anode. Protons are transferred to cathode via separator. Electrons are transported to cathode by mediator. Cathode uses enzymes for reduction reaction. The reaction generates electrical energy.

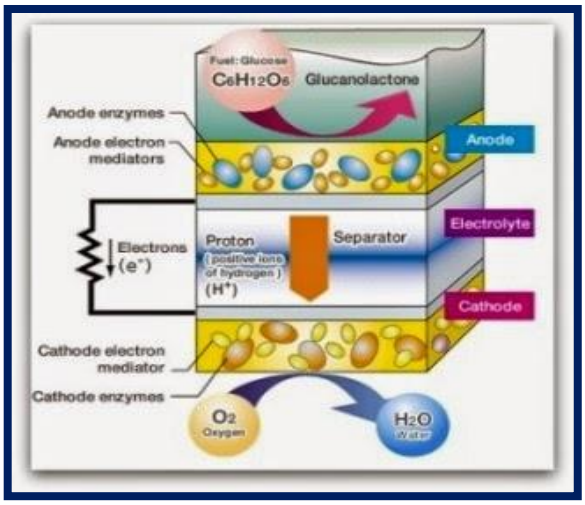

Figure 1: Working of Enzymatic bio-battery

e) Reaction of Enzymatic bio-battery

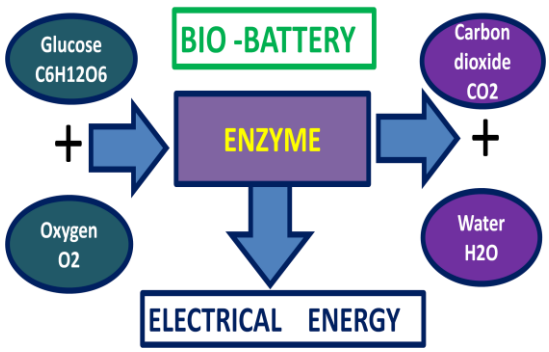

Figure 2: Reaction of Enzymatic bio-battery

f) Construction of Microbial bio-battery

Soil acts as nutrient – rich anodic media & proton-exchange membrane (PEM). Anode is placed at a certain depth within soil. Cathode rests at the top of soil & is exposed to air (oxygen i.e . O2). Soil has microbes & electrogenic microbes which are needed for MFC's which are full of

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complex sugars & other nutrients. Aerobic microbes act as oxygen filters &that causes the redox-potential of soil to decrease with greater depth.

g) Working of Microbial bio-battery

The bacteria live at anode & convert reactants like glucose, acetate & waste water into carbon – dioxide (CO2), protons & electrons. Under aerobic conditions, bacteria use oxygen/nitrate as electron acceptor to produce water. In absence of oxygen, bacteria switch from electron acceptor to an insoluble acceptor. Electron transfer take place via membrane.

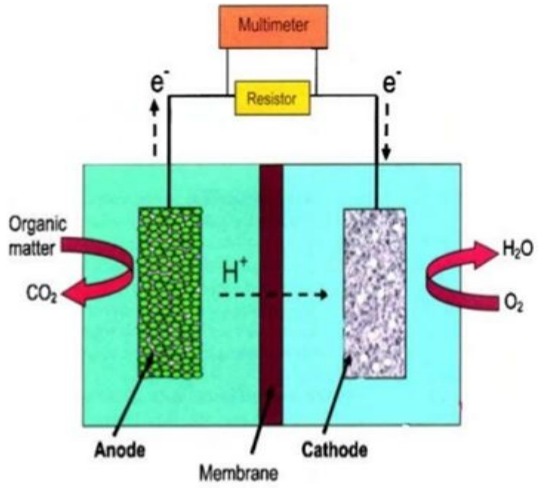

Figure 3: Principle of Microbial Bio-Battery

h) Reaction of Microbial bio-battery

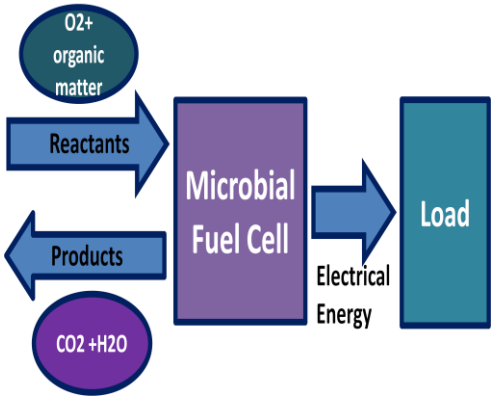

Figure 4: Reaction of Microbial bio-battery

IV. APPLICATIONS OF BIO-BATTERIES

a) Electronic Devices: Laptop & Cell phones
b) Military: Surveillance & Spying devices
c) Toys: Toy batteries
d) Medical Implants: Insulin pumps

V. ADVANTAGES OF BIO-BATTERY

a) Eco-friendly
b) Raw materials are easily available
c) Non-Explosive
d) Biodegradable
e) Safe batteries

VI. DRAWBACKS OF BIO-BATTERY

The bio-batteries are less likely to retain most of the energy during long term usage.

VII. FUTURE SCOPE

Bio-batteries have a very bright future ahead, as they serve a new form of energy that is proving to be environmental friendly, as well as successful, in producing and reserving energy.

VIII. CONCLUSIONS

The conventional batteries, such as lithium batteries, bio-batteries are less likely to retain most of their energy. 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. The bio-batteries are environmentally friendly as they do not use harmful chemicals or metals. . With that in mind, scientists seem to be exploring every possible option in bio-battery and fuel-cell technology. They serve as a new form of energy that is proving to be environmentally friendly, as well as successful, in producing and preserving energy. Although the batteries are still being tested before being commercially sold, several research teams and engineers are working to further advance the development of these batteries.

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