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A SHORT REVIEW ON BIOFUEL CELL AND ITS IMPORTANCE IN THE SUSTAINABLE DEVELOPMENT

Palash Manoj Thakre
Assistant Prof. Dept. of Biochemistry,
Kamla Nehru Mahavidyalaya Nagpur.

Abstract: Electricity generated from water and coal may make human life easier but on the other hand it causes great harm to the environment. Coal-fired power plants have been linked to different hazardous effect which may include developmental defect in infants. Water power in its various forms is a renewable energy resource and there are no fuel costs, perhaps the largest disadvantage of hydroelectric energy is the impact it can have on the environment. Dams can damage or otherwise impact the environment both upstream and downstream through their construction process during the formation of the dam. Even though it is necessary to do all this for the progress of human beings, but it is the responsibility of all of us to protect the environment. All this can be possible only when we make a good invention by using all the waste things and make them useful to fulfill our need. It is possible today that we can produce electrical energy from chemical energy by using biocatalyst and the device which use in this process called as biofuel cell. In fact *biomass* utilization is expected to play a crucial role in sustainable development. This review article includes overview of biofuel cell which eludes the balance of environment with the recycling of waste product.

Key words: Electricity, biomas, biofuel cell, sustainable development.

Introduction:

For speed up the biochemical reaction resides in the living organism a substance plays an important role called as biocatalyst which includes enzyme or hormones (Palmore and Whitesides et al., 1994). Microorganisms plays important role in both fermentation as well as decomposition. Fermentation is a metabolic process that converts sugar to acids, gases, or alcohol (Chojnacka, K. (2010). Decomposition includes dead organic substances which are broken down into simpler organic or inorganic matter (Rao, C. R.et all., 1979). Both processes includes released of electrons during biochemical reaction. These electrons are used to generate electricity. The biological fuel cells are devices competent of directly transforming chemical to electrical energy via electrochemical reactions by involving biochemical pathways.

The more profitable thing in biofuel is that they have ability to convert chemical energy of biological process into electrical current for generating electricity. The source of energy is organic material like glucose. The

most important thing is that the waste product of environment can be recycled properly and became generate electricity from it. For constructing the biofuel cell there is a substance necessary for the activation and speed up biochemical reaction is called as biocatalyst, which is responsible for conversion of chemical energy to electrical current (Chem et al., 2001).

The important approach of biofuel cell is to generate electric current from bounteous organic substance which is useless for human beings but many useful things can be made from it. One of the approaches includes the use of microorganism as well as enforce the fermentation of sketchy material furl product (Tsujimura et al., 2001). Second approach based on the behavior of microorganism which act as a catalyst and able to converts chemical energy to electrical one (Ketz et al., 1999).

It is claimed that the principle is based on authentic enzyme that catalyzes redox reaction for persuading oxidation and reduction of distinct fuel and oxidizing substance on the electrode support and generation of electrical current production is more (Arunas Ramanavecius et al.,2004). It is noted that biocatalyst are tempting choice to transient metal catalysts due to fallowing reason.

- These are renewable
- These are found extensively
- They can survive by using cheap fuel cell components (Tayhas et al., 1999).

For the creation of electrical communication an enzyme plays an important role for performing oxidation reaction. These enzymes may be oxidase or dehydrogenase (Hambermuller et al., 2000). It is stated that energy source are allotted into three batches i.e., fossil fuel, renewable source and nuclear source (F. Akdeniz et al., 2002), which have non renewable source energy comprising a large proportion of the energy; these are aligned into two major classification these are nuclear and fossil fuel (M.Rahimnejad et al., 2009).

Fossil fuel negatively affects nature by releasing carbon dioxide. It surely follows from what has been said that the expenditures of fossil fuels have seriously endangered human life through its drastic consequence such as global warming and pollution (M. Rahimnejad et al., 2012).

Types of Biofuel cell:

On the basis of use of metal as a catalyst to oxidize the fuel the biofuel cell is of two type's i.e. microbial fuel cell and enzymatic biofuel cell.

Microbial fuel cell:

Microbial fuel cell is a bioelectrochemical fuel cell (Logon et al., 2006) that produced electric current by targeting electrons released from the oxidation of reduced donor molecules done by microorganism. These

electrons are destined to anode to oxidize the compounds which are electron acceptor located on the cathode through an external electric circuit (Badwal et al., 2014).

A microbial fuel cell is an instrument that transforming chemical energy into electricity via catalytic activities of microorganism. Although microbial fuel cell have a great potential as alternative energy source innovative waste water treatment processes and biosensor for oxygen and pollutant extensive adaptation is needed to harness the maximum microbial potential(Kim et al.,2007).

Recently the microbial fuel cell is the device that makes it come closer to the environment by conserving its ethic. For halting the diversification of environment the microbial fuel cell have started to find the commercial use in waste water treatment. For initiating the process of generating current the substance which neglecting the conflict in between the reactant called as mediator. On the pursuance of mediator the biofuel cell is of two types i.e. mediator microbial cell and mediator less microbial fuel cell.

It is studied that, the majority of microbial cell are electrochemically dormant, hence for shifting the electron from microbial cell to electrode i.e. electrical conductor. It needs the facilitation. The comfortless is produced by mediator like thionine methyl viologon, methyl blue, humic acid (Delney et al., 2008).

Mediator less microbial cell is also known as mediated free microbial fuel cell. This fuel cell can run on wastewater and generates energy diversity from certain plant and oxygen. Hence this assortment is known as plant microbial fuel cell. The possible plant includes cordgrass, rice, algae (Rasierapparte et al., 2021).

Working of Microbial fuel cell:

The method was under the mediator microbial fuel cell. An instrument was contained different component mainly anode chamber, which should be in anaerobic condition in which sewage water can be kept, cathode chamber having fresh water and should be in aerobic condition and proton exchange membrane which allow only H^+ ion to cross through it. Anode and cathode were connected with a wire for generating the electric current due to the transformation of electron from anode chamber to cathode chamber. When the waste placed in an anode chamber the microorganism exist in the waste water naturally having a characteristic to consuming organic matter and turn it into CO2, H^+ and e^-.These electrons flows through circuit from anode to cathode. The H^+ ions flow from anode chamber to cathode chamber by the function of exchange membrane. Electrons moves through circuit and CO2 get evolved. The exchange of H^+ ions into cathode chamber can also from fresh molecule of water due the reaction takes place in between oxygen present in the cathode chamber and H^+ ions coming from anode chamber (Logon et al., 2006).

Enzymatic Biofuel cell:

The biofuel cell which includes the enzymes that acts on the substrate produced electrons by oxidizing it. The approach is based on the energy released during the reaction takes place in between enzyme substrate. It is

proven that the most abundant molecules present in the environment are glucose. Due to its low volatility, nontoxic nature it has been widely used as fuel in the biofuel cell. The prospective thing is that the efficient use of a glucose as a substrate is the ability to oxidize glucose to carbon dioxide and convert more efficiently the chemical energy released upon redox reaction to electrical current. It is proven that the enzymatic cascade bioanode containing pyrroloquinoline quinine dependent enzyme oxidized glucose to carbon dioxide through a synthetic minimal metabolic pathway. In the study it is also proven that the bioanode was able to performing direct electron transfer to carbon electrode surfaces and eliminates the need of mediators (Shuai Xu et al 2020).

It is mentioned that enzymatic biofuel cell serves at comprehensive temperature and pH. This cell utilizes vegetables and animal fluids as a biofuel to produces electrical energy. The glucose is the main source of fuel for producing energy. The elemental part of glucose biofuel cell was two bioelectrode by their surface utilizes as an enzyme immobilized site. The enzyme glucose oxidase and dehydrogenase were placed on bioanode and oxidize glucose while oxygen diminished in biocathode using immobilized laccase or billirubin oxidase in order to generate sufficient power (Arman Amani Babadi et al., 2016).

It is studied that the glycerol is used as a fuel, perhaps it is an a very large scale in our environment but most highlighted thing is that it is a byproduct of biodiesel production. Due to the quality of non toxicity, low vapor pressure low flammability and high energy density mark glycerol is a seductive as an energy stream. It can be used as source fuel for generating the electric current due to the flashy properties. It has described that the use of glycerol for a fuel in the enzymatic biofuel cell that harness three enzymes cascade on the anode that can possess the complete oxidation of glycerol. The bioanode which was developed include PQQ-ADH, PQQ-AldDH, and oxalate oxidase immobilized within tetrabutylammonium improved Nafion membrane With the addition of oxalate oxidase the glycerol/air biofuel cell had yield power densities of up to 1.32 $mWcm^{-1}$ and able to operate high fuel concentration (R L Arechederra et al.,2009).

It is reported that grapheme sheets as a feasible probationer can be used for constructing biofuel cell. Preliminary grapheme sheets were chemically synthesized and marked out by surface characterization method. Subsequently, grapheme was used to make the anode and cathode in the biofuel cell. The anode of the bifuel cell containing a gold electrode which was coated by grapheme glucose oxidase by using silica sol-gel matrix. These biofuel cell exhibits a maximum power density of about 24.3 ± 4 µW (Chang Liu et al., 2010).

Importance of biofuel cell in sustainable development:

Growing progress makes human life simple and less complicated. Although human life has been greatly benefited by the development of science and technology but this positive change is on the verge of being negative for the environment. The thermal power station pollutes the atmosphere due to the production of large amount of smoke and fumes. Beside the heated water comes from thermal power plant has adverse

effect on the creature lives in the water and disturbs the ecology The transportation of fuel is one of the major difficulties for the plants located away from coal field. The fuel is used in the thermal power station is non renewable resource means producing energy by using it may be limited in future. Sustainable development means the development occurs without damaging the environment. Producing the electric energy by using biofuel cell we can reduce the problem cause to environment to some extent.

Conclusion:

Biofuel cells offer several advantages over conventional batteries, including the use of renewable and non-toxic components, reaction selectivity, fuel flexibility, and the ability to operate at low temperatures and near neutral pH. It creates no harmful emissions, eliminating the costs associated with handling and storing toxic substances such as battery acid or diesel fuel. Biomass energy comes from various raw material sources like waste material of farm, sewage water, and other organic waste material. It can prove to be a very cheap process to generate electricity which does not harm the environment. Keeping in mind the character of microorganisms, it is a very commendable thing to make full use of those things in human life which cannot be used by them in nature

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