

# MICROBIAL FUEL CELL FOR CHEMICAL ZONE WASTE WATER AMBERNATH

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**Abstract** - We investigated the simultaneous production of electrical power and wastewater sludge recycling by microbial fuel cells (MFC). The constructed MFC were comprised of two chambers, each with an approximate volume of 5 liters, which were connected by salt bridge. The graphitic anode was placed in one chamber, which was filled with wastewater sludge from a waste water treatment plants at BADLAPUR and DOMBIVALI; a ALUMINIUM cathode was placed in the other chamber and filled with an electrolyte. The most important parameters such as voltage and amperage were measured during 9 days; the maximum values obtained were 1944V and 1915mA. Glass wool was selected as the material for PEM. The fuel cell blocks were designed to accommodate a voltage increase.

cathode, the proton exchange membrane and the external circuit. The electrons are pulled out as released energy during the oxidation process and into the electron acceptor via an external circuit. The protons pass through the ion/proton exchange membrane and react with the electrons during the reduction process in the cathode thus completing the circuit. This simple process which is common and found in most fuel cells i.e. battery cells, hydrogen fuel cells can be optimised for an efficient current generation

## 2. Literature review

The microbial fuel cell is a bio-electrical system in which bacteria is used to convert organic material into electricity.

Andrew De Juan Etal (2013),etc. Stated comparative study on microbial fuel cell by using to convert organic material into electricity. The study is basically base on provided waste water treatment along with simultaneously renewable energy generation in the form of direct electricity. He research the latest technological advancements made in the areas of microbial fuel cell he study power densities and power output of the different substrates and associated bacteria suggested by the latest peer review research documents. He has suggested to obtain the relevant components and to build a small scale microbial fuel cell as the experimental model for testing and data collection. He has also produce electricity using different kinds of bacteria obtain from waste water, merine sediments and bacteria grown in laboratory.

Jessica Li. Etal(2013),etc. Studied the electricity generating capacity of microbial fuel cell. Her first goal was to examine the performance characteristics of MFCs in this application. Specifically she investigate the relationship between the percentage of organic matter in a sample and the electrical capacity of MFCs fueled by that sample. She observed that higher percentage of organic matter in sample results in higher electricity production of MFCs powered by that sample. She measure the thermal limits that dictate the temperature range in which MFCs can function and confirm that the upper thermal limit is 40°C. She observe that the

**Keywords:** Recycling, MFC, Wastewater, Electrolyte, Voltage,

## 1. INTRODUCTION

Our society is constantly in search of sustainable, renewable, and alternative energy sources. Often when people think about these energy sources, they think of solar cells or wind mills. Microbial fuel cells (MFCs) may also be part of the picture. A microbial fuel cell (MFC) is a bio-electrochemical system that harnesses the natural metabolisms of microbes to produce electrical power. Within the MFC, microbes consume the nutrients in their surrounding environment and release a portion of the energy contained in the food in the form of electricity. The idea of using MFCs for producing electricity dates back to 1911. Research on this subject and the creations of MFCs occurred sporadically throughout the rest of the 20th century. Recently the need of renewable and clean forms of energy and the need of wastewater treatment have triggered wide research interest in developing the MFC technology.

The microbial fuel cell is a bio-electrical system in which bacteria is used to convert organic material into electricity. The fuel cell itself is made up of four parts; the anode, the

electricity production of MFCs decreases almost linearly over a period of 10 days.

Her second goal is to determine conditions under which MFCs work most efficiently to generate electricity

Manaswini Behara Etal(2016)etc. Studied the power generation in an MFC is dependent upon many factors like reactor configuration, type and size of electrode materials and proton exchange membrane(PEM), and cathodic electron accept or other than operating parameters such as COD concentration, HRT, and pH. Therefore, modification in reactor configuration, selection of better electrode and PEM materials, and maintaining proper electrode surface area and PEM surface area to reactor volume ratio will enhance the power generation in the MFC operated under the optimum range of operating variables such as influent COD concentration ,HRT, and feed pH. However, the present optimization experiments established the trend of substrate degradation and power generation that could be obtained at different levels of operating variables studied.

Baikun Li Etal (2011)etc., tested anaerobic microbial fuel cell (MFC) treatment of domestic wastewater and produced sustainable electricity at the pilot scale. He and his collaborative team of HydroQual, Inc., Fuss &O'Neill, and the University of Connecticut developed a novel MFC system in a multiple anode/cathode granular activated carbon configuration; effectively integrating multiple MFCs into a single unit. The unique advantage of this novel configuration is increased power generation in a small footprint, which is beneficial when considering wastewater treatment plant applications. Four pilot-scale, 16-liter (L) were operated over a six-month period, with the primary focus on organic loading rate and hydraulic retention time (HRT). They achieved COD removal exceeding 80%, and effective power densities on the order of 300 mW/m<sup>3</sup> . In addition, a new, cost-effective catalyst, manganese dioxide (MnO<sub>2</sub>) was developed and tested at pilot-scale. The results show that the MnO<sub>2</sub> catalyst is capable of achieving similar power generation compared to the more costly platinum catalyst that has been used to date in other MFCs.

Zhuwei Du Etal(2007)etc. Are studied for application as biosensors such as sensors for biological oxygen demand monitoring power output and coulombic efficiency are significantly affected by the types of microbe in the anodic chamber of microbial fuel cell, configuration of microbial fuel cell and operating condition. Currently real world applications of microbial fuel cells are limited because of the low power density level of several thousands mW/m<sup>2</sup>. They found out microbial fuel cell can also used in waste water treatment facilities to break down organic matter.

Ease of Use

## 2.1 Transferring of Electrons

Many microorganisms possess the ability to transfer the electrons derived from the metabolism of organic matters to the anode. Marine sediment, soil, wastewater, fresh water sediments and activated sludge are all reach sources for this microorganisms.

## 2.2 Electricity Generation

MFCs are capable of converting the chemical energy stored in the chemical compounds in a biomass to electrical energy with the aid of microorganisms. Because chemical energy from the oxidation of fuel molecules is converted directly into electricity instead of heat, the Carnot cycle with a limited thermal efficiency is avoided and theoretically a much higher conversion efficiency can be achieved (N70%) just like conventional chemical fuel cells.

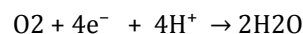
## 2.3 Equations

Typical electrode reactions are shown below using acetate as an example substrate.

Anodic reaction :



Cathodic reaction :



The overall reaction is the break down of the substrate to carbon dioxide and water with a concomitant production of electricity as a by-product. Based on the electrode reaction pair above, an MFC bioreactor can generate electricity from the electron flow from the anode to cathode in the external circuit.

## A. Material :

- The microbial fuel cell consists of simple yet vital components to effectively harness the energy are as follows:
- Electrodes – both in the anode and cathode chambers
- Proton Exchange Membrane – widely used Nafion as the least resistive membrane
- Substrate – any organic matter used as source of energy for microorganisms i.e. wastewater
- Bacteria – exoelectrogens, most suited for MFC applications
- Latest MFC developments focus on optimising each aspect in order to increase the overall efficiency of the electrochemical device.

### 3. Methodology

The MFC consisted of a double cylindrical plastic chambers (long by 6.5cmdiameter; empty bed volume of 388 mL) containing graphite rods (anode) each 6.15 mm in diameter and 150 mm placed in a concentric arrangement about a single cathode . The graphite rods were abraded by sand paper to enhance bacterial attachment. The salt bridge consists of jelly which is form by boiling of water, Agar-Agar powder and salt.

The PEM was then hot pressed directly into pipe of diameter 1” and it is then connected to both the chambers. Copper wire was used to connect the circuit containing a load unless stated otherwise.

Dombivali MIDC wastewater and Badlapur MIDC wastewater is collected. Wastewater was placed into the one chamber and used as the fuel without any modifications except for dilution of the wastewater with saline water in another chamber. Wastewater fed to the reactor had a pH ranging from 5.4 and 5.7 and a COD of 251 and 175 mg/L respectively.

All measurements were taken after the reactor had been operated for at least two hydraulic retention times, when power output was consistent. Measurements reported here are averages of triplicate measurementstaken over two consecutive retention times. The second control consisted of a same set of experiments using the with anopen circuit. All experiments were conducted in a temperature-controlled room set at 30 .

### Figures and Tables

TABLE 3.1: TEST PARAMETER WASTEWATER OF SAMPLE FROM DOMBIVALI MIDC

Sr. No.	Test Parameter	Result	Unit	Limit	Test Method
1.	Dissolved Oxygen	Absent	mg/L	...	IS:3025(P-38)1989
2.	Chemical Oxygen Demand	251	mg/L	...	IS:3025(P-58)2006
3.	BOD 3Days, 27°C	75	mg/L	...	IS:3025(P-44)1993

4.	pH	5.54	...	...	...
5.	TDS	96.5	mg/L	20	...
		94	mg/L	200	...

TABLE 3.2 : TEST PARAMTER WASTEWATER FROM SAMPLE OF BADLAPUR MIDC

Sr. No.	Test Parameter	Result	Unit	Limit	Test Method
1.	Dissolved Oxygen	Absent	Mg/L	...	IS:3025 (P-38)1989
2.	Chemical Oxygen Demand	175	Mg/L	...	IS:3025 (P-58)2006
3.	BOD 3 Days,27°C	49	Mg/L	...	IS:3025 (P-44)1993
4.	pH	5.70	...	...	...
5.	TDS	10.6	Mg/L	20	...
		11	Mg/L	200	...

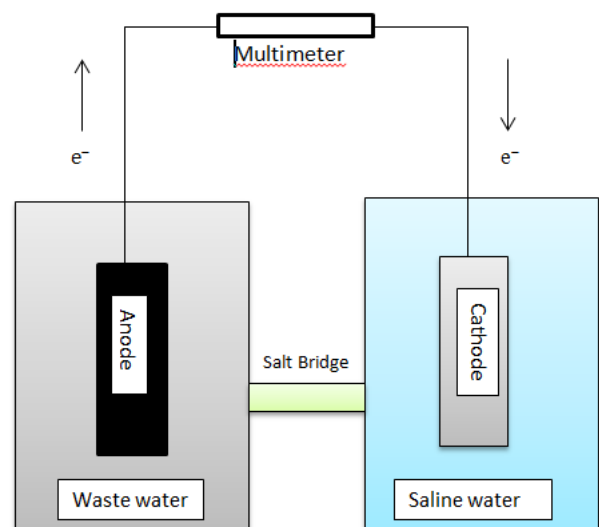


Fig. 3.1: Typical diagram of MFC



**Fig.3.2 Model of MFC**

**Results:-** Here are two results obtain from tests,

Wastewater Samples	Max. Voltage(mV)
Dombivali	1909
Badlapur	1944

#### 4. Conclusion

We concluded that if the chemical contamination in waste water is more then the Power generation in MFC increases. power generation in MFC is depend upon many factors like reactor configuration, type and size of electrode material acceptor other than operating parameter such as COD concentration and pH. However, the present optimization experiments established the trend of substrate degradation and power generation that could be obtained at different level of operating variable studied.

This study demonstrated the effect of operating variable as well as their interactive effects on the responses COD removal efficiency and power generation in a dual-chambered MFC. The COD removal efficiency increases with increases HRT; whereas increases in influent COD concentration and feed pH result in decreases in COD removal efficiency. Power generation in MFC increases with increases in COD concentration and feed pH. Validation experimental results confirmed that the measured optimum COD removal efficiency and power density were close to those estimated, which revealed the efficiency of this model. MFC operation in optimized anodic operating condition will facilitate proper growth of the electrogenic biofilm during start up and enhance the subsequent performance in long-term operation power output can be improve further by modification to reactor configuration, electrode material and cathodic electron acceptor, and by adjusting the distance between the electrodes while operating under optimal condition predicted by the model. This work clearly demonstrates that such an approach is useful to optimize the

MFC systems and could be useful to improve their performance.

#### 5. MFC future Scope:-

- It is likely that the MFC technology will co-exist with the methanogenic anaerobic digestion technology in the future.
- It is possible in the future that an optimized microbial consortium can be obtained to operate an MFC without extraneous mediators or biofilms while achieving superior mass transfer and electrode transfer rates.
- When used in wastewater treatment, a large surface area is needed for biofilm to build up on the anode. A breakthrough is needed in creating inexpensive electrodes that resist fouling. It is unrealistic to expect that the power density output from an MFC to match that of conventional chemical fuel cell such as a hydrogen-powered fuel cell.
- MFC technology contributes in generation electricity at low cost & it can be stored efficiently for future use.
- MFC also serves recycling purpose of the waste water.

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