Sustainable Production of Bioelectricity from Coovum River Using MFC Method

[1]S. Laxmipriya,[2] Ragavi,[3] Girija,[4] Rekha
[1]Asst. Professor,[2,3,4]*student*
Department of Civil Engineering,
Panimalar Engineering College.

Abstract : **Microbial fuel cells (MFC's) have recently gained the mode of conversion of organic Matter into electricity. In such a way that, the bioelectricity is generated by microbial fuel cell. There are many organic wastes that have been used such as rice bran, oil cake, leaf mould etc. The highest voltage of cellophane valued around 350mV. Microbial fuel cell is a bioreactor that converts the chemical energy in chemical bonds in organic compounds to electrical energy through catalytic reaction under anaerobic condition. Graphite fibre brush is good for anode material; whereas carbon fibre is good for cathode material for optimization of power generated. MFC's produce electricity using different compounds including acetate, lactate and glucose. It is also possible to produce electricity from domestic waste water accomplishing removal of chemical oxygen demand. Different material and methods are been adopted to construct MFC's, which are technique used to analyse system, performance and recommendation.**

KEYWORDS: ***MFC'S, Bio-electricity, Microbial fuel, Graphite fibre.***

INTRODUCTION

1.1 What is MFC

A microbial fuel cell is a bioreactor for the conversion of chemical energy in chemical bonds in organic compounds to electrical energy through catalytic reaction of microorganisms under anaerobic condition. It can be used for the treatment of waste water to breakdown organic matter.

1.2 FACTORS AFFECTING MFC

1.2.1 ELECTRODE MATERIAL

Performance of electrode material will always result in improvement of MFC because different anode material results in different activation polarization. For both anode and cathode construction graphite fill and carbon cloth can be used resulting in increase of cost. The platinum Red carbon cloth anode .

1.1.1 History

The attempts of producing electricity using microbial cells are first conceived in early 20th century by M. Potter to perform work in year 1911. The subject came with a study of hydrogen produced by fermentation of glucose by clostridium. Due to unstable nature of hydrogen producing microorganisms it finds to be unstable. Later this issue was resolved by karube in year 1976 for proposing current design concept of MFC. The university of Queensland, Australia complete its prototype in the year 2007 as cooperative effort with foster brewing company.

1.2.2 PH buffer and electrolyte

The difference in PH between anodic and cathodic chamber, theoretically say that there will be no PH shift when reaction rate of protons, electrons and oxygen at cathode equals. There is a possibility that the buffer compensated the slow proton transport and improvement in proton availability for cathodic reaction. The ionic strength can be increased by adding NaCl to MFC for improvement of power output. The fact that NACL enhanced the conductivity of both anolyte and catholyte.

1.2.3 Proton exchange system

The internal resistance can be affected by the proton exchange system in MFC and in turn influence power output of MFC. Nafion is most popular due to its high selective permeability of protons. The transport of cation is unavoidable during MFC. According to sense of charge its usage is better between anodic and cathodic chamber. The internal resistance in MFC decreases with increase of PEM over relatively large range.

1.2.4 Operating condition in anaerobic chamber

The important factors that impact the performance of MFC is the substrate type, concentration and feed rate. There is a variation in power density with different substrate using same a given microbe or microbial consortium. The dependency of electricity generation with substrate concentration both in batch and continuous flow mode. The current level with lactate was reported by park and zeikus was increased until it was in excess at 200mM. The growing of microbes along the electrodes as a biofilm, where the flora is affected by increased feed rate.

1.3 Why MFC

Due to the ability to generate power from organic or inorganic compounds it gained an attention in the microbial fuel cell. The technology of generating electricity through bacteria was found hundred of years ago, butthe attention was not gained. The MFC has many potential applications such as electricity generation, bio hydrogen production, biosensor in the ability of conversion of chemical energy to electrical energy. Till the year 1990s, there was an increase in number of studies on MFC. The electron shuttling was facilitated by mediators so that the power output can be increased significantly. But there was a limitation in development of MFC in the case of potassium ferricyanide because of

their toxicity to microorganisms and cost. A microbial fuel cell employed by the mediators has not been commercialized as most of the mediators are expensive and toxic**.**

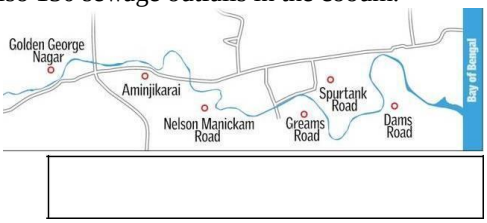
1.4 MFC in future

The mature methanogenic anaerobic digestion technology was yet to be competed by MFC technology as it has seen wide commercial applications because they can utilise the same biomass in many cases for energy production. At the temperature of 20°c, MFCs are capable of converting biomass. The reliance on biofilms for mediators less electron transport causes the major disadvantage of MFC,while anaerobic digester such as up flow anaerobic sludge blanket reactors eliminate this need by effectively reusing the microbial consortium without cell immobilization. There will be an existence between MFC technology with methanogenic anaerobic digestion technology in future. The new anadophilic microbes that vastly improve the electron transport rate from the biofilm for the improvement of power density output.

2.STUDY AREA

2.1 PRESENT CONDITION OF COOUM RIVER:

In order to find out the problems in Cooum basin has been analysed from multiple points of view. In Cooum River the primary rural areas serves as the upper catchment and before draining into the Bay of Bengal the river is constrained. The problems in water quality get increased due to increase in waste disposal. Due to chemicalised water it spoils the health of human and leads to ground water pollution. The main cause for sewage outfalls in Cooum River is from households where sewage lines are connected to storm water drains .Based on survey of Chennai Corporation 16000 buildings sewages get into the Cooum River and also 150 sewage outfalls in the cooum.



Map shows where Cooum River falls on the metro city areas.

2.1.2 PHYSIOGRAPHY:

In Tamil Nadu there are 17 major river basins and separated into 34 river basin. In Chennai there are four river basin they are Araniyar, Kosathalayar, Cooum and Adyar. In Chennai city the Cooum River serves as water drainage system and it is affected by sewage waste and industrial waste. The river originates in Thiruvallur district which is 70Km away from Chennai flowing through poonamallee. It enters into Chennai district through Arumbakkam. Some of the areas where the river flows are Chollaimedu, Chetpet, Egmore and Chintadripet.The water from Northern part and Southern parts gets joined near Napier bridge. The length of the river flow is 40Km in Chennai city. The river covers the total area of about 400Km^2 and width of the bed is 40m to 120m. The flood discharge is around 22,000m^3/sec and the river holds the capacity of 19500m^3/sec. Nearer to Chepauck the river gets drained into Bay Of Bengal This river flows nearer to Triplicane so it is called Triplicane river.

2.2 SAMPLING METHOD:

As per standards method which was prescribed by APHA the sample water is preserved and the container is washed with Procelyne acid.

3. METHODOLOGY:

3.1 MATERIALS USED:

3.1.1 SUBSTRATE COLLECTION:

MFC uses the substrate of sewage sludge(1000ml) which was collected from MUET Jamshoro, Pakistan.

3.1.2 SALT BRIDGE:

The salt bridge is made up of PVC pipe which is employed with 5M of nacl and 10% of Agar. The anodic chamber is completely sealed by epoxy and wax.

3.1.3CATHODIC AND ANODIC CHAMBER:

There are two plastic bottles each carries 1000ml.The bottles is washed with distilled water and filled by sample-methylene blue (10ml),sewage sludge(2L).In additional saccharomytes cerevisiae (44g) is added.

3.1.4 ELECTRICAL PARAMETERS:

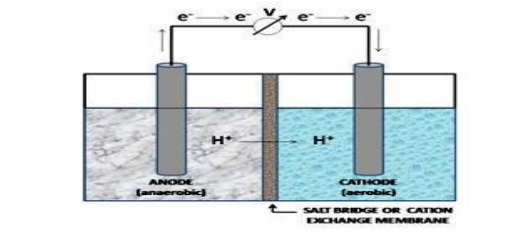
To measure the voltage digital mulitimeter is used. The readings where noted after 20 minutes for at least 200 minutes.

3.2 EXPERIMENTAL SETUP:

The setup consists of anode and cathode chamber where anode chamber contains bacteria, organic matter and cathode chamber contains saltwater solution. Salt bridge used to separate the anode and cathode chamber. Through cathode chamber electors gets generated and the solution is pulled out in the anode. The molten stage of salt water contain cathode where it is exposed to 50% to atmospheric air. Bacteria containing soil is packed which is used to generate electricity.

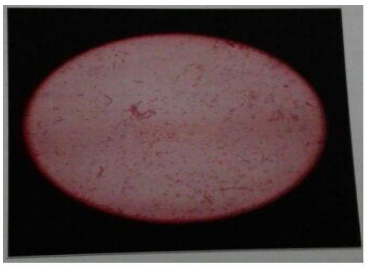
3.3 PROCESS:

The microbial fuel cell has capacity to clean and generate renewable electricity from bacteria-laden soil. The upcoming source for generating electricity is MFC. The function of MFC involves microbes to generate the electricity. The anode is buried down in the soil bacteria, the bacteria multiplies and covers electrode forming as a bio film. Lot of electrons are supplied by the process of breaking down of organic or inorganic substrates in soil. Simultaneously cathode is placed at top of soil leaving one side completely exposed to air. Anode produces electron which travels up a wire to cathode and they react with the oxygen from atmospheric air and protons made by digestion process of nutrients in soil to create water.



3.4MICROBES PRESENT IN THE COOUM RIVER:

The sample from cooum is tested in Annamalai University to identify the microbes present in the water. As per the result, pseudomonas fluorescence and Bacillus. These bacteria have capacity to conduct electricity as they are anaerobic in nature.



Microbes present in Cooum River.

4. RESULT AND CONCLUSION

MFC is the developing technology to generate renewable electricity by means of microorganism metabolism. There are lot of developments have occurred till now, but still there are many scope for developments. This review contains both pros and cons. During this review we have dealt with major wastes and chemicals like hexavalent chromium , agro waste , nitrates and azo dyes. Hexavalent chromium has great effect causing lung cancer in humans whereas azo dyes and agro wastes are toxic for both humans and aquatic organisms.MFC not only produces electricity but also transforms harmful chemicals and wastes into less toxic metabolies. This less toxic metabolies finds application in waste management and pollution control. The advantages of MFC are it is eco friendly, easier installation, and low maintanence. The disavantanges are low generation of electricity and scaling of electrodes also decreases the power output. Due to this disadvantage the process has not yet commercialised and it has to be improved much more to become effective , efficient, applicable and widely acceptable one. The total current produced by this method is determined by multimeter is 192 volts.

5. REFERENCE

[1] Andrew, D.E, Clescenri, L.S, Breenberg,AE,1995.Standard method for the examination of water and waste water,19th ed. APHA,AWW,WEF,Washington,DC,USA, pp-5-14.
[2] Park DH & ZEIKUS JG,Electricity generation in microbial fuel cells using neutral rod as an election iphone,Appl Environ Micron,66(2000) 1292-1297.
[3] Wrighton KC &Coates JD, Microbial fuel cells;plug-in and power-on microbiology,microbes,4(2009)281-287.
[4] Watanabe K,recent development in microbial fuel cells technologies for sustainable bioenergy,J Bioscience Bioengineering,106(2008)528-536.
[5] Ahmed Ebrahim Abu EI-Maaty Beauty(2012), Evaluation of steel slag and crushed limestone, mixtures,as subbase material in flexible pavement,Ain Shames Engineering Journal Issue 12,volume 3,pp.887-889.
[6] Oh SE & Logan BE,Hydrogen and electricity production from a food processing waste water using fermentation and microbial fuel cells technologies,water Res,39(2005)4673-4682.
[7] Montgomery D.G and Wang.G(1992),Instant-Chilled steel slag aggregate,cement and concert research.vol 22,pp.755-760.
[8] M.C.Potter“Electrical Effects Accompanying the De-Composition of organic compound”,Royal society B,Vol.84,No.571,1911,pp.260276, doi:10.1098/rspb.1911.0073.
[9] Tweed, ”Fuel Cell Treats Wastewater And Harvest Energy”, Scientific American,2012.
[10] Oh ST.Kim JR,Premier GC,Lee TH,Kim C,et al(2010)Sustainable Wastewater Treatment:how might microbial fuel cells contribute Biotechnol Adv 28:871-881.
[11] You SJ(2005) Identification of denitrifying bacteria diversity in an activated sludge system by using nitrite reductse genes.Biotechnol Lett 27:1477-1482.
[12] Ragauskas AJ,Williams CK,Davision BH,Britovsek.G,Cairney J,et al,(2006). The path forward for biofuels and biomaterials,science 311:484-489.