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Generation of Electricity from Anaerobic Waste Water Treatment in Microbial Fuel Cell

Kalange AE and Sathe SJ

Tuljaram Chaturchand College, Baramati Dist-Pune MS, India

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ABSTRACT

Microbial fuel cells (MFCs) are a promising technology for sustainable wastewater treatment. Microbial fuel cells (MFCs) are devices that use bacteria as the catalysts to oxidize organic and inorganic matter and generate current. In the present work, we constructed a Microbial fuel cell and a different type of anode material is used. Waste water Sample collected from, dairy, sugarcane industry, domestic waste etc**.** During the treatment of waste water electricity generation and other parameters were measured. The obtained results are presented in this paper.

Keywords: Microbial fuel cells (MFCs), Microbial fuel cell, waste water electricity generation.

INTRODUCTION

Microbial fuel cells (MFCs) are devices that use bacteria as the catalysts to oxidize organic and inorganic matter and generate current. Electrons produced by the bacteria from these substrates are transferred to the anode (negative terminal) and flow to the cathode (positive terminal) linked by a conductive material containing a resistor, or operated under a load (i.e., producing electricity that runs a device)

Microbial fuel cells (MFCs) are a promising technology for sustainable wastewater treatment. In an MFC, biochemical reactions are carried out by electrogenic bacteria in an anaerobic anode chamber generating electrons & protons through the degration of the organic substrates embedded in wastewater, concurrently,

Electrochemical reactions occur in the aerobic cathode chamber, whereby electrons& protons are accepted through an oxygen reduction reaction (ORR).

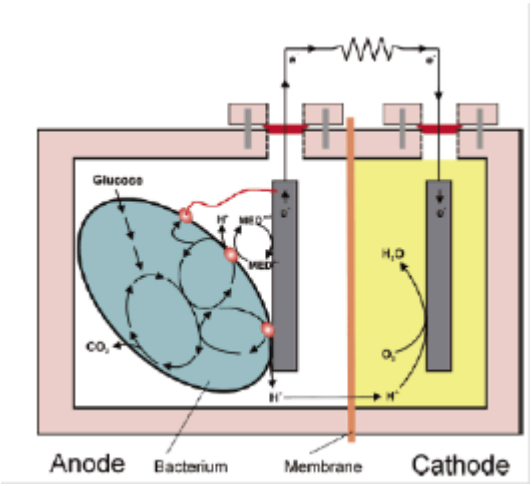


Fig.1: Microbial fuel cells

Anaerobic treatment of wastewater is substantially low energy intensive than aerobic treatment, however is taken longer to accomplish due to the inherently slow growth process of anaerobic microorganisms. Because of these, there has been little interest in applying anaerobic processes to dilute wastewater (e.g. domestic wastewater).

A microbial fuel cell (MFC) is a device that uses microorganisms as the biocatalysts for the oxidation of the organic matter to generate electricity. The electrodes used in the construction of microbial fuel cells should have a good electrical conductivity. More surface area, less resistance & should be non corrosive, biocompatible, chemically & mechanically stable to obtain a reproducible result. The anode materials such as graphite rod, graphite fiber, brush, carbon cloth, carbon paper, carbon felt & RVC have been used in the microbial fuel cells The higher current was obtained when the platinum- coated graphite was used in the place of fresh graphite cathode The distance between the electrode is also plays an important role in the performance of the microbial fuel cell so distance should be a close as possible to overcome the electrical leakage & to have a more internal resistance one of the critical challenges in microbial fuel cell is the selecting proper electrodes (cathode & anode) which affect the power output. The basic components of MFC include anode, cathode, ion exchange membrane & electrode catalyst.

METHODOLOGY

Samples of waste water were randomly collected from various sources. Sample collected from paper industry, dairy, sugarcane industry, domestic waste etc. Synthetic waste sample prepared in our laboratory.

Sampling sites: Samples were collected from following different locations with an aim to generate electricity as well as treatment of sewage.

Domestic waste : This domestic waste collected from. Annabrahma mess in T.C. college hostel, Baramati, domestic waste mainly contains vegetable parts, food ingredients etc.

Dairy waste : This dairy waste collected from Nimbalkar dairy Baramati. In this dairy there are large production of milk & milk products. Waste sample contains whey droplets of milk etc. & also mainly waste collected from cleaning equipments

Sugarcane Industry : This sugarcane waste sample collected from "shree someshwar sahakari sakhar karkhana someshwar, Baramati." Sugarcane waste mainly contain molasses, extract of sugarcane etc.

Paper Industry : This paper waste sample collected from

Synthetic waste sample : This sample was prepared in Microbiology laboratory of T.C. college Baramati. Systhetic waste mainly contains chemical ingradients

Construction of MFC

Dual chambered MFC was using air-tight food grade plastic containers of 1.3 liter volume each. A side opening of 1.23 cm radius was made at a height of 6 cm from the bottom of the container on each contained & was connected with PVC pipe. PVC pipe is of length 12 cm & diameter is 2.5 cm is required. Agarose of concentrations ranging from 7% to 12% along with 4% potassium chloride (KCl) salt was prepared by heating is in a water bath & the molten agarose was allowed to cool down & poured into the PVC pipe & pipe sealed at one end using cello-tape. The PVC pipe containing the salt-agarose mixture was

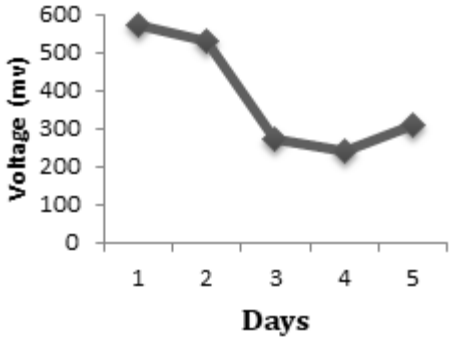
fixed between the two containers using epoxy material such as M-ceal & Acradilite & behaved like the salt bridge assisting in the proton transfer mechanism during the MFC operation. Carbon rods are of usually 9 cm in height & 0.5 cm in diameter were used as electrodes. The distance between the two electrodes was maintained. Copper wires were used to connect the electrodes to the circuit. An external resistance (R) of 1.2 kΩ was connected & readings were measured using a digital multimeter

RESULTS AND DISCUSSION

The anode chamber of the MFC was inoculated with the wastewater collected from the industries of the wastewater treatment plant. Before inoculation the physico-chemical analysis of the samples was performed & the such as BOD, COD, TSS, TDS & pH, E.C. & nitrogen. The setup was placed in room of temperature of 27°c to 35° c.

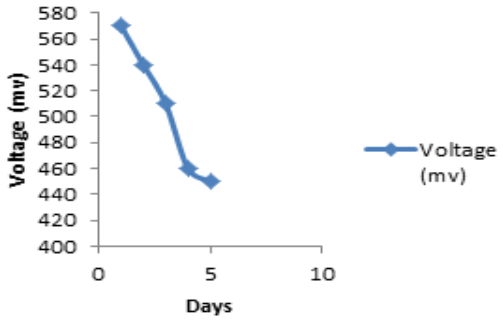
1] **Domestic Waste:** During the treatment of waste water electricity generation and other parameters were measured. For generation of electrical energy, zinc and copper used as electrode. The volume of waste water used is 1.3 liter

	Parameters	Influent	Effluent
1	pH	8	7.5
2	Conductivity	$1.5x10^{-3}$	$0.8x10^{-3}$
3	TSS(mg/lit)	250	130
4	TDS (mg/lit)	400	200
5	Nitrogen	30%	20%
6	DO (mg/lit)	6.4	4.8
7	BOD(mg/lit)	400	290
8	COD (mg/lit)	1500	1100



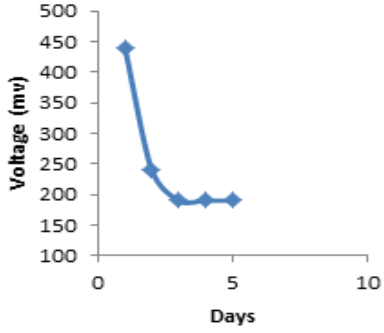
For domestic waste, zinc was used as anode and cathode. The parameters and electricity generated were measured.

	Parameters	Influent	Effluent
1	pH	8	7.4
2	Conductivity	$1.3x10^{-3}$	$0.7x10^{-3}$
3	TSS(mg/lit)	720	570
4	TDS (mg/lit)	360	220
5	Nitrogen	65%	40%
6	DO (mg/lit)	6.4	4.7
7	BOD(mg/lit)	800	630
8	COD (mg/lit)	1100	840



2] **Dairy Waste:** For dairy waste, zinc was used as anode and copper as cathode. The parameters and electricity generated were measured.

	Parameters	Influent	Effluent
1	pH	7.8	7.2
2	Conductivity	$1.3x10^{-3}$	$0.7x10^{-3}$
3	TSS(mg/lit)	220	180
4	TDS (mg/lit)	300	220
5	Nitrogen	40%	22%
6	DO (mg/lit)	8	6
7	BOD(mg/lit)	700	545
8	COD (mg/lit)	1220	930



It was observed that the parameters such as BOD, COD, TSS, TDS & pH, E.C. & nitrogen are decreased and the electricity generated is also decreased rapidly.

Conflicts of interest: The authors stated that no conflicts of interest.

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