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GENERATION OF ELECTRICITY USING FROM BISCUIT PROCESSINGINDUSTRIAL WASTE WATER BY MICROBIAL FUEL CELL

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Abstract - Disposal of wastes and their management is themost important environmental problem faced by the world today, waste water from the food industries creates variety of waste water pollutants and their treatment is difficult. Characteristics of waste water their level of pollutants vary from waste to waste. Rapid urbanization in developing countries like India propound major problems in generating the electricity, now a day's collection and disposal of waste are very difficult, this leads to public health problems and other environmental problems, for constructing a sustainable world we require to minimize the uses of fossilfuels and waste generation, for that we need to think alternative way of waste management technique. Microbial fuel cell is the best alternative technique to reduce waste generation and to produce electricity. MFC-1 of biscuit Industrial wastewater for the loading of 750mg/L COD shows maximum removal efficiency compare to other loading, corresponding removal efficiency are 64.9%COD,66.67%BOD,66.28%Chloride, 67.62% TS,64.32% TDS, 61.34%Nitrate 65.44% Sulphate and 59.55% Phosphate. The current, voltage and power generation in the reactor is 1.23mA, 0.91V& 0.06w/M^2 respectively.

MFC-2 of biscuit Industrial waste water for the loading of 750mg/L COD shows maximum removal efficiency compare to other loading, corresponding removal efficiency are 61.46%COD,68%BOD, 66.57%Chloride, 66.97% TS,63.60.36% TDS, 58.79%Nitrate 61.38% Sulphate and 53.93% Phosphate. The current, voltage and power generation in the reactor is 1.05mA, 0.85V& 0.05w/M^2 respectively.

Key Words: ***Microbial fuel cell, BOD, COD, waste water treatment.***

1.INTRODUCTION

The modern era is diverting towards the mechanization and metro politicization. This industrial revolution causes the environmental issues and energy crises. The main reason for these crises is the reliance on the fossil fuels and untreated effluent disposal [8]. Effluent water of biscuit Processing Industry contains the high organic content that microbes utilize along with dissolve oxygen of water causes it inappropriate for the atmosphere. Wastewater generated from these industries depicts wide variation in strength and characteristics. Variation due to the amount of water usage, type of vegetable and fruits used, type of product and different additives like salt, sugar, gelatin, colour, oil and preservatives added also leads to the pollution load in the wastewater but this wastewater is non toxic in nature because it comprises less hazardous compounds. Almost 50% of the water utilized in biscuit processing industry is for washing and rinsing purposes. Water being the primary ingredient is widely used as a cleaning agent in biscuit processing industry.

Every year the global energy demand increases. Approximately 86% of the world energy production comes from fossil fuels. Fossil fuels especially petroleum. Coals are being exhausted, leading to an energy crisis in the near future. Furthermore the combustion of the fossil fuels adds CO2 to the atmosphere and causes global warming. Consequently there is a need to develop a new type of energysource as alternative to fossil fuels.

To overcome this energy requirement mankind has been exploring the possibility of alternative sources of energy and has been trying tapping the energy resources of all origin; solar power, nuclear power, water power, wind power, geothermal power, tidal power, wave and ocean currents etc. One particular method of generating power is with the help of fuel cell, which can minimize the usage of fossil fuels. Unlike chemical fuel cell, such as methanol and hydrogen fuel cells, biofuel cells operate under mild reaction conditions, mainly ambient operational temperature and pressure.

Objectives

- To study the characteristics of biscuit Processing Industrial wastewater
- To fabricate single and double chambered non-mediated Microbial fuel cell.
- To study the treatment efficiency with respect Total solids, Dissolved solids, COD, BOD, Chloride, Nitrate, Sulphate and Phosphate.

- To study the rate of generation of current, voltage and power both in Single & double chambered microbial fuel cell.

METHOD USED TO TURN FRESH BISCUITS INTO BISCUIT PRODUCTS

Food processing is any method used to turn fresh biscuits into biscuit products. This can involve one or a combination of various processes including washing, chopping, pasteurizing, freezing, fermenting, packaging, cooking and many more. biscuit processing includes traditional (heat treatment, fermentation, pickling, smoking, drying, curing) and modern methods (pasteurization, ultra- heat treatment, high pressure processing, or modified atmosphere packaging).

Some of the common methods are described below:

- Canning
- Fermentation
- Freezing
- Modified atmosphere packaging
- Pasteurization
- Smoking

MANUFACTURING PROCESS

Biscuit industry in India in the organized sector produces around 60% of the total production, the balance 40% being contributed by the unorganized bakeries. The unorganized sector is estimated to have approximately 30,000 small & tiny bakeries across the country. Biscuit can he broadly categorized into the following segments: Glucose 44% Marie 13% Cream 10% Crackers 13% Milk 12% Others 8%. Though India is considered as the third largest producer of Biscuits after USA and China, the per capita consumption of biscuits in our country is only 2.1 Kg., compared to more than 10 kgin the USA, UK and West European countries and above 4.25 kg in south Asian countries, Le.Singapore, Hong Kong, Thailand, Indonesia etc.. Biscuits are manufactured from wheat flour, sugar, baking powder, condensed milk, Ghee, salt, millet, jelly, dry fruits. Various essences are added according to the taste selected. Biscuits are manufactured through baking process. There is totalaverage growth rate of biscuit industry is 7-9%.

CHARACTERISTICS OF BISCUIT PROCESSING INDUSTRIAL WASTEWATER

- Ph
- Color
- Total Solids
- Dissolved solids
- TOC
- COD
- BOD
- Chlorides
- Nitrates
- Sulphates
- pH
- Nitrogen

WASTE WATER TREATMENT METHODS

- Physical Treatment Methods
- Chemical Treatment Methods and
- Biological Treatment Methods

TREATMENT TECHNOLOGY

Although there are many treatments available nowadays, the industries need to choose the best method to treat their wastes efficiently. Many biscuit processing industries have been evaluating new technologies for improving wastewater treatment efficiencies, recovering valuable materials and recycling generated effluent after treatment.

- Biological Treatment Process
- Aerobic Treatment Process
- Anaerobic Treatment Process

MICROBIAL FUELCELL

Microbial fuel cells (MFC) are electrochemical devices that convert the chemical energy contained in organic matter into electricity by means of the catalytic (metabolic) activity of living microorganism.

Advantages

- Pollution due to burning of fossil fuels are eliminated by using MFC and water is the only by product.
- MFC gives high quality DC power and MFC maintenance is simple.
- Efficiency of MFC is higher than the diesel engine.
- It abolishes generation of greenhouse gases.
- Use different types of clean fossil fuels, renewable energy and variety of fuels

MATERIALS AND METHODOLOGY

MICROBIAL FUEL CELL (MFC)

Single (MFC-1) and Double chambered (MFC-2), Microbial fuel cells have been fabricated for the treatment of biscuit processing Industrialwastewater.

CONSTRUCTION OF MICROBIAL FUEL CELLS

- Selection of anode and cathode material
- Preparation of Agar Salt Bridge
- Assembling Of Electrode
- Assembling of Microbial Fuel Cell

OPERATING CONDITIONS

The whole study was conducted under ambient environmental conditions. The microorganisms present in Biscuit processing industrial wastewater acted as the substrate for MFCs. The Biscuit processing industrial wastewater samples were kept in refrigerator at 4^0C before use. The wastewaters are used as substrates for all the tests without any modifications such as pH adjustments or addition of nutrients etc. The study is conducted by feeding Biscuit industrial wastewater separately to MFC-1 and MFC-2 with different wastewater strengths.

MFC OPERATION

The anode chambers of MFC-1 and MFC-2 were ¾ filled with Biscuit processing industrial wastewater with different wastewater strengths as substrate for both the MFCs and ¼ filled with in columns asthe mixture of cow dung slurry, septic waste. In the cathode chamber of MFC- 2, 1 M Kcl solution was added as catholyte. The internal wiring of anode and cathode were connected to a multimeter to complete the circuit. The entire setup was left for 8 days for stabilization and the initial current & voltage reading was noted down. The wastewater parameters were analyzed for 1st and 5th day of the generation of electricity. The current & voltage readings are recorded daily using multimeter as shown in Fig 3.9. For other loading also the current & voltage generated were monitored. Similarly other parameters are recorded from the 1st and 10th day of the generation of electricity.

RESULTS

The characteristics of Biscuit Processing wastewater and analysis of the wastewater data relating to single chambered microbial fuel cell, double chambered microbial fuel cell are discussed in this chapter

CHARACTERISTICS	UNIT	BISCUIT INDUSTRY WASTEWATER
pH	-	5
Colours	-	Yellow
Total Solids	(mg/L)	6000
Total dissolvedsolids	(mg/L)	5000
Suspended Solids	(mg/L)	1000
BOD_5@20ºC	(mg/L)	960
COD	(mg/L)	1000
Chlorides	(mg/L)	473.85
Nitrate	(mg/L)	1.5
Sulphate	(mg/L)	326.2
Phosphate	(mg/L)	12.5
BOD/ COD ratio		0.96

CHARACTERISTICS OF BISCUIT INDUSTRY WASTE WATER

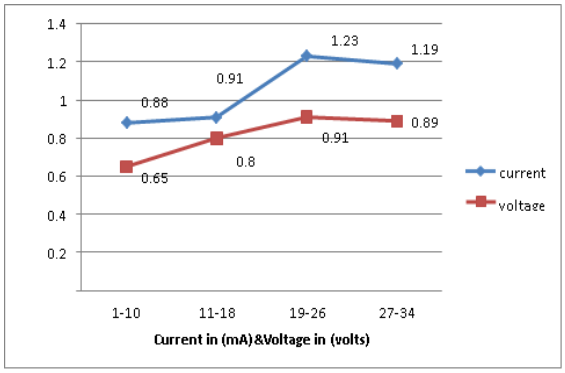
CURRENT AND VOLTAGE GENERATION IN MFC-1 AND MFC-2

The average value of current and voltage for each feed concentration in MFC-1 and MFC-2 are as given in the fig 4.17&4.18 the current and voltage showed a gradual increase with respect to increase in feed concentration. The highest average values of current and voltage obtained as 1.23mA and 1.05 mA in MFC-1 and MFC-2 with a feed concentration of 250 mg COD/L to 750 mg COD/L. Similarly the voltage values obtained were 0.91 V and 2.69 V The power produced for $1m^2$ area is 0.06 watt for MFC-1 and 0.05 watt for MFC-2.

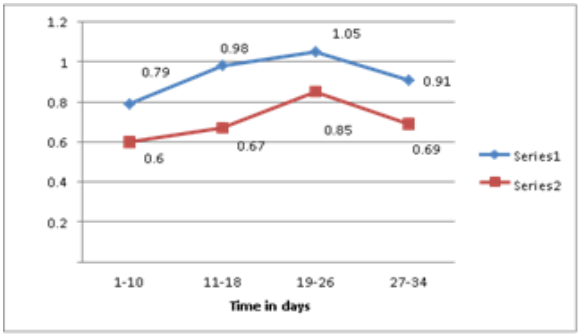
The current and voltage were much higher in single chamber MFC when compared with double chambered MFC. Logan et al., (2007) have reported the advantage of air cathode MFC (Compared with the cathode suspended in water) as oxygen transfer to the cathode occurs directly from air, and thus oxygen does not have to be dissolved in water. The abundant acceptor i.e., Oxygen availability in air is the reason for the higher current generation.

The most significant energy savings associated with the use of MFCs for wastewater treatment, besides electricity generation, results from savings in expenses for aeration and solids handling. The major operating costs for wastewater treatment are wastewater aeration, sludge treatment, and wastewater pumping. Aeration alone can account for half of the operation costs a typical treatment plant. Eliminating these costs can save an appreciable amount of energy.

The MFC process in inherently an anaerobic process,although, oxygen can diffuse into the system resulting in some aerobic organic matter removal also. The sludge yields for an anaerobic process are approximately one- fifth of that for an aerobic process. Thus, using MFCs could drastically reduce solids production at a wastewater treatment plant, substantially reducing operating costs for solids handling



CURRENT AND VOLTAGE GENERATION IN MFC-1



CURRENT AND VOLTAGE GENERATION IN MFC-2

CONCLUSION

- The waste water is strong & organic in nature which is biologically decomposable as observed from the BOD/COD ratio.
- MFC-1 of biscuit Industrial wastewater for the loading of 750mg/L CODshows maximum removal efficiency compare to other loading, corresponding removal efficiency are 64.9%COD,66.67%BOD,66.28%Chloride, 67.62% TS,64.32% TDS,61.34%Nitrate 65.44% Sulphate and 59.55% Phosphate. The current, voltage and power generation in the reactor is 1.23mA, 0.91V& 0.06w/M2 respectively.
- MFC-2 of biscuit Industrial wastewater for the loading of 750mg/L COD shows maximum removal efficiency compare to other loading, corresponding removal efficiency are 61.46%COD,68%BOD, 66.57%Chloride, 66.97% TS,63.60.36% TDS, 58.79%Nitrate 61.38% Sulphate and 53.93% Phosphate. The current, voltage and power generation in the reactor is 1.05mA, 0.85V& 0.05w/M2 respectively.
- Voltage and Current generation for both the MFC's are high in 750 mg/L COD loading for wastewater.
- Compared to MFC-2 in MFC-1 the removal efficiency and power generation are high with loading of 750mg/L COD.

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