Waste Water Treatment and Energy Reaping from Distillery Waste using Bio Electrochemical System (BES)

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ABSTRACT

The energy need will be increased day by day in next 20years and especially cleanly-generated electricity. This resulted in serious search of alternate energy in order to tackle the above said tribulations. In this scenario, renewable energy technologies are emerging as a major alternative to provide long term sustainable and environmental friendly energy source. At the same time pollution also become very serious problem. We are disposing many wastes without any treatment. So, if we convert waste into the energy then it will solve the two problems and also we need to develop the ecofriendly methods for the disposal of this high strength wastewater. A microbial fuel cell (MFC) is an emerging technology. It has been known for many years that it is possible to generate electricity directly by using bacteria to break down organic substrates. The recent energy crisis has reinvigorated interests in MFCs among academic researchers as a way to generate electric power or hydrogen from biomass without a net carbon emission into the ecosystem. The traditional method, anaerobic digestion is not an efficient one amid its drawbacks like energy cost, foot print, investment costs etc. To know the maximumefficiency of MFC in distillery waste water synthetic (artificial) waste water is used. In this project, the electrodeoptimization is mainly considered to attain the maximum efficiency regarding the electrode and to find the maximum efficient electrode. As the distance between the electrode plays main role in the efficiency so, the in reactor design two provisions are made.

KeywordsElectricity, Pollution, Eco-friendly, Reactor, Electrode, Efficiency

I. INTRODUCTION

The Indian distillery units use sugarcane molasses as a preferred raw material because of its easy and large scale availability for alcohol production. There are about 642 sugar mills and 425 distilleries in India (as per January 2013 survey). Currently, about 45.72 million m3of spent wash is generated annually from distilleries alone in India The production and characteristics of spent wash are highly variable and dependent on feed stocks and various aspects of the ethanol production process. The spent wash is acidic (pH 3.94 - 4.30) dark brown liquid with high BOD (45000 –100000 mg/Lit) and COD (90000 – 210000 mg/lit), and emits obnoxious odor. Althoughit does not contain toxic substances, its discharge without any treatment brings about immediate discoloration and depletion of dissolved oxygen in the receiving water streams, posing serious threat to the aquatic flora and fauna.

In India bulk of the alcohol is being produced from sugar cane molasses. Molasses is a thick viscous byproduct of the sugar industry which is acidic in This alcohol is used for various purposes including potable and industrial. For manufacture of alcoholic beverages, the alcohol is, if required, matured and blended with malt alcohol (for manufacture of whisky) and diluted to requisite strength to obtain the desired type of liquor/ Indian Made Foreign Liquor (IMFL). This is bottled in bottles of various sizes for the convenience of consumers. Over the last fifteen years, MOJJ has supplied several fermentation and distillation plants, which are essentially designed to suit international norms of spirit quality and fermentation efficiency. The fermentation plant designs include cascade fermentation with cell recycle, cascade fermentation with yeast recycle and cascade fermentation with granulating yeast and gravity settling.

II. LITERATURE

Zhenhe ,norbertwagner , shelled minteer&largust.(2006) Study was aimed that we have used such a flow pattern in an up flow microbial fuel cell (UMFC).In addition to a practical configuration, UMFCs achieved promising power outputs. Recently, an UMFC with a wet anode volume of 210 mL generated a maximum volumetric power of 90 W/m3during continuous treatment of acetate. However, scale up of this UMFC with an exterior cathode would considerably increase the volume to surface area ratio and thus increase the electrode distance.

Vinay Sharma, P.P. KunduBiocatalysts in microbial fuel cells (2010)The MFC produces electricity with the help of microorganisms. In the present review, the biocatalysts or microorganisms used in the MFCs are discussed. The most used microorganisms in the MFCs belong to Shewanella, Proteobactor and Pseudomonas families. In waste water based MFCs, mixed cultures are mostly used. This review covers the biocatalysts used in both anode and cathode. In the recent times, one of the most valuable development in the MFCs is the use of biocathodes, which eliminated various drawbacks of these cells and enhanced the power generation capabilities as well as the production of some useful gases like hydrogen.

The present state of art of this technology still requires development in certain power output areas such as improvement of efficiency and cost reduction.

III. METHODOLOGY

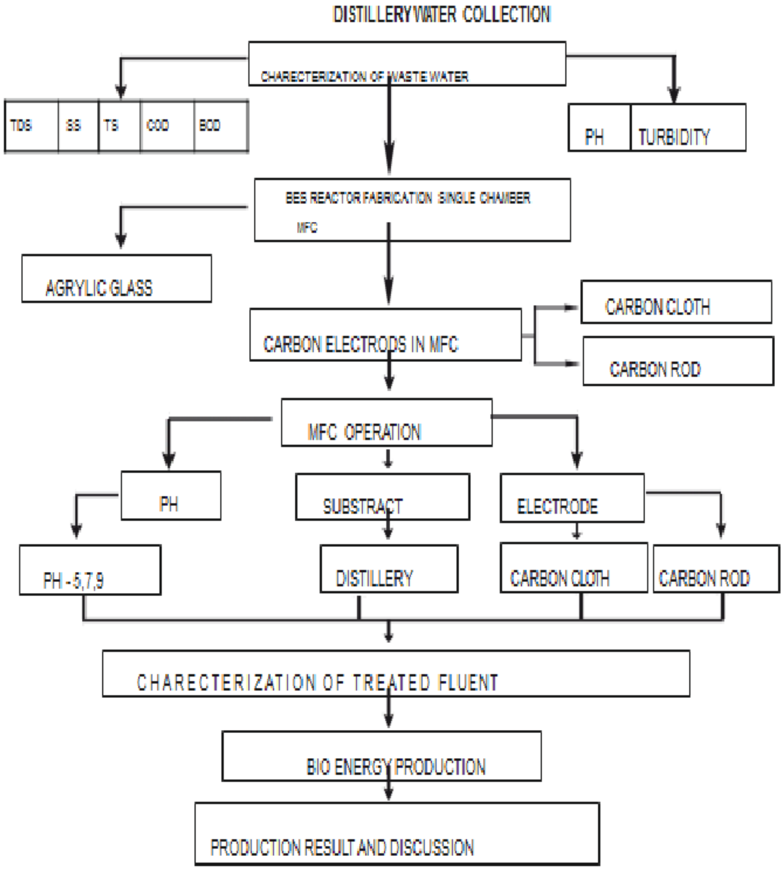

FIGURE 1
METHODOLOGY

IV. MATERIALS AND METHODS

Determination of pH and temperature:

p can be viewed as an abbreviation for power of hydrogen or more completely, power of the concentration of hydrogen ion. It says that the pH is equal to the negative log of the hydrogen ion concentration, or pH+ = -log [H].p = -log [H3O].p values are calculated in powers of 10. The hydrogen ion concentration of a solution with pH 1.0is 10 times larger than the hydrogen concentration in a solution with pH 2.0. The larger thehydrogen ion concentration, the smaller the pH.

Determination of BOD:

Biochemical oxygen demand or BOD is a chemical procedure for determining the amount ofdissolved oxygen needed by aerobic biological organisms in a body of water to break downorganic material present in a given water sample at certain temperature over a specific timeperiod.

Uses of BOD incubator:

Heating

Indirect heating system is provided in our units, comprising of air heaters made of high gradeKanthal A-1 wires of suitable voltage. The warm air is evenly distributed throughout the chamberthrough efficient motor fans ensuring a very good temperature sensitivity.

Cooling

An energy efficient cooling unit is installed in our bod incubators to enable bio chemical demandstudies at lower room temperatures. We use ISI marked high end CFC free compressors ofKirloskar/Tecumseh make, conforming to latest international standards and guidelines.

Principle

BOD is measure of biodegradable organic material present in wastewater and can be defined asthe amount of oxygen required by the microorganisms in stabilizing the biologically degradableorganic matter under aerobic conditions. The principle of the method involves, measuring thedifference of the dissolved oxygen concentration of the sample and after incubation it for 5 days at200 ºC.

Determination of COD

The COD is considered mainly the representation of pollution level of domestic and industrialwastewater or contamination level of surface, ground and potable water.This is determined interms of total oxygen required to oxidize the organic matter to $CO2$ and water. The COD valuesinclude the oxygen demand created by biodegradable as well as non-biodegradable substancesbecause it involves oxidation of organic matter with strong oxidizing chemicals. As a result, CODvalues are greater than BOD and may be much greater when significant amounts of biologicallyresistant organic matter is present.

V. DETERMINATION OF TS, TDS, TSS, TVS

Principle

A well-mixed filtered through a standard glass fiber filter, and the filtrate is evaporated to drynessin weighed dish and dried to constant weight at 179-181℃.The increase in dish weight representsthe total dissolved solids.A well-mixed sample is filtered through a weighed standard glass fiber filter and the residueretained on the filter is dried to a constant weight at 103-105°C.The increase in weight of the filterrepresents the total suspended solids. If the suspended solids clogs the filter and prolongs thefiltration, the difference between the total solids and total dissolved solids may provide an estimateof the total suspended solids.

Determination of alkalinity

The alkalinity of the water is a measure of its capacity to neutralize acids. The alkalinity of naturalwaters is due primarily to the salts of week acids.

$$\text{Alkalinity (mol/L)} = [HCO3^-] + 2\,[CO3^{2-}] + [OH^-] - [H^+]$$

Determination of acidity

Acids contribute to corrosiveness and influence chemical reaction rates, chemical speciation andbiological processes. Acidity of water is its quantitative capacity to react with a strong base to adesignated pH. The measured value may vary significantly with the end point pH used in thedetermination.

Determination of total hardness

To determine the concentrations of Ca2+(aq) and Mg2+(aq) ions in a commercial sample water.

Determination of electrical conductivity

Conductivity of a substance is defined as 'the ability or power to conduct or transmit heat,electricity or sound. When an electrical potential difference is placed across a conductor, itsmovable charges flow, giving rise to an electric current. This property is called conductivity. Sincethe charge on ions in solution facilitates the conductance of electrical current, the conductivity of asolution is proportional to its ion concentration.

Reactor Analysis

In the operation of mediator-less MFC several factors are considered as limiting steps forelectricity generation, such as, fuel oxidation at the anode, presence of electrochemically.Activeredox enzymes for efficient electrons transfer to the anode, external resistance of the circuit,proton transfer through the membrane to the cathode, and oxygen reduction at the cathode.Amembrane-less microbial fuel cell (ML–MFC) which converted organic contaminants.Fromartificial wastewater to electricity.

FIGURE 2
MEMBRANE

VI. RESULTS AND DISCUSSION

Characteristics of Synthetic Waste Water

TABLE 1
CHARACTERISTICS OF SYNTHETIC WASTEWATER

S.NO	PARAMETERS	VALUE
1.	pH	4.2*
2.	Total Solids(mg/l)	1350
3.	Total Suspended Solids(mg/l)	190
4.	Total Dissolved Solids(mg/l)	1350
5.	Total Volatile Solids(mg/l)	600
6.	COD(mg/l)	6000
7.	BOD(mg/l)	3300
8.	Acidity $CaCO_3$ (mg/l)	1100
9.	Temperature (°C)	34
10.	Total hardness (mg/l)	1428
11.	Electrical conductivity (μmho/cm)	3450
12.	Alkalinity (mg/l)	600

Electricity Production Based On GeobacterSulfurreducens

Electricity produced in the microbial fuel cell was analysed by multimeter using the geobactersulfurreducen. During this batch sugarcane waste water is used.

TABLE 2

CHARACTERISTICS OF SYNTHETIC WASTEWATER

S. No.	Contact time (Hours)	Current in µA	P max (mW/m^2)
1	0	0	0
2	10	0	0
3	20	0	0
4	30	0	0
5	35	0	0
6	40	0	0
60	255	23.24	13367.446
61	256	23.25	13594.112
62	268	23.30	14760.547
63	269	23.40	14880.240
64	270	23.60	14880.240
65	271	23.80	14880.240

VII. CONCLUSION

The membrane-less microbial fuel cell, inoculated with mixed anaerobic sludge Time inHoursdemonstrated its effectiveness as a wastewater treatment process along with electricityproduction, without incorporating any costly component, such as mediator and membrane.The COD, BOD removal were achieved at varying levels. Granulation of biomass wasobserved in the anode compartment of the ML–MFC. Maximum power density wasobserved spacing between the electrodes and optimizing microorganisms. Further studieswould be necessary to optimize the electricity production from this ML–MFC. With furtherimprovements and optimization, it could be possible to increase power generation. AlsoMFC as a continuous reactor can also be used. Going further toward the condition to bemaintained in the reactor, aerated condition produces more electricity and it isinstantaneous.

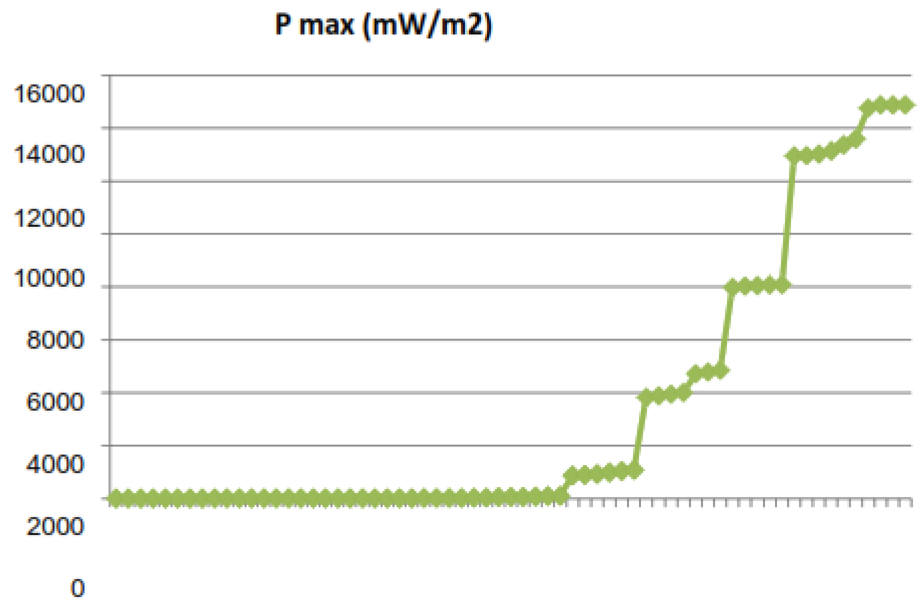

FIGURE 3
ELECTRICITY PRODUCTION IN GEOBACTER

In case of unaerated chamber, the current production is delayed by sometime, due to inability of the reactor to complete the reaction in both chambers. 6-8 weeksof sludge is recommended for reaction. Thus, the combination of wastewater treatmentalong with electricity production might help in compensating the cost of wastewatertreatment.

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