STUDIES ON WASTE WATER TREATMENT AND GENERATION OF BIO ELECRTICITY FROM AUTOMOBILE WASTE WATER USING PSEUDOMONAS AERUGINOSA

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ABSTRACT: Because of industrial effluents, the environment is deteriorating day by day. Toxic substances are present in the effluents, which pollute groundwater and lead to the emergence of new diseases. The expense of treating industrial effluents is rising. The goal of this research is to reduce the toxicity of industrial wastewater by employing Microbial Fuel Cells to reduce, recycle, and reuse. Pseudomonas aeruginosa was used in batch operations to improve oxygen levels and minimise toxicity in Appughar waste water. MFC design, NaCl concentration, Agar concentration, fructose dose, pH, DO, COD, BOD, Treatment efficiency, Growth Yield, Electrode Potential power generation are some of the parameters investigated. The data show high oxygen levels and a significant drop in pH from 7.8 to 7.0. COD, BOD, and DO levels have decreased from 1050 to 450 parts per million, 560 to 220 parts per million, and 2.5 to 4.2 parts per million, respectively.
Keywords: pH, DO, COD, BOD, Treatment efficiency, Growth Yield, Electrode Potential are some of the terms used in this study.

1.0 INTRODUCTION:

Green synthesis **[1]** is also being used to explore for alternative potential energy sources. The spread of energy sources has wreaked havoc on energy engineering**.** Among the several types of pollution, Water pollution is a serious problem since it causes the human body to malfunction. Many ways are employed to eliminate water pollution, but only the most cost-effective methods should be utilised often to prevent water pollution and try to repurpose the waste. Microbial fuel cells (MFCs) have been the focus of recent research because they have the potential to be environmentally friendly. Microbial fuel cells are required for the treatment of effluent water and the simultaneous transfer of electrons for power generation. MFC is a method that uses a variety of concentrations. MFCs are primarily driven by redox potential differences between anodic and cathodic environments, and therefore do not necessitate sophisticated reactant or reaction condition adjustment. The use of MFCs in the field is limited by two factors: a conductive aquatic environment and the existence of organic matter as a fuel source **[2]**. Electrolytes are essential for transporting positive charge from the anode to the cathode in MFC processes, and they are found in a well-conductive aquatic environment. Cathodes floating on the water's surface will accept electrons via external circuits and positive charge through the water, with oxygen in the air serving as the electron acceptor. In this experiment, the influence of microbial activity on the change of Oxygen levels in wastewater treatment was thoroughly investigated. Copper electrodes, volume capacity of 1.25 lit (bottles capacity-1.5 lit), 3 mM NaCl salt bridge concentration, and **Pseudomonas aeruginosa** organism were used in this experiment . The experiment's goal is to lower COD and BOD levels in locally available waste water while increasing DO levels and decreasing TSS and TDS levels as well as chlorides and sulphates.

2.0 EXPERIMENTAL PROCEDURE

Airtight plastic bottles with 1.5-liter capacities were used to make the dual chambered MFC (anode and cathode chamber). Each bottle had a 1 cm radius side hole that was connected

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with a PVC pipe at a height of 9 cm from the bottom of the bottle (roughly in the centre). By heating 100 g of agar with 100 g of sodium chloride (NaCl) salt in a 1000 ml water bath, the molten agar was allowed to cool before being put into the PVC pipe and sealed at one end with a plastic cap and cello-tape.The agar was allowed to solidify uninterrupted. The PVC tubing with the salt-agar combination was epoxy-fixed between the two bottles and acted as a salt-bridge, aiding the proton transfer process during MFC operation. Copper electrodes (7 cm*4cm) were employed.

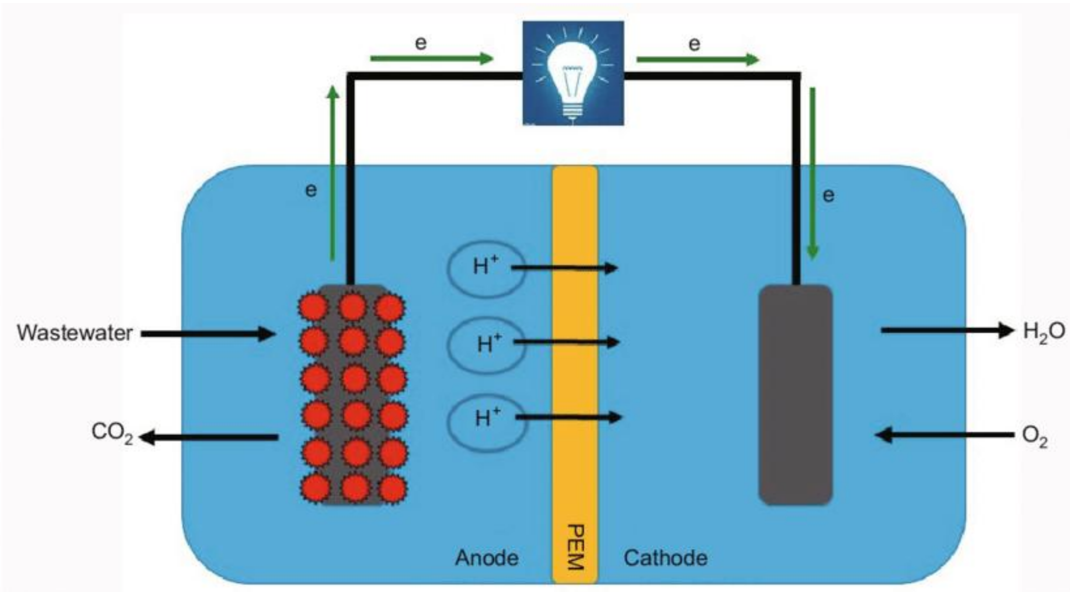

Fig.2.1 Schematic diagram of Microbial Fuel Cells

The distance between the two chambers was maintained at distance of 5 ,10, 15, 20, 25 cm in the MFC setup. The electrodes were connected to the circuit with copper wires. A digital multimeter was used to measure the readings of an external resistance (R) of 100 ,200 , 330, 470, 510 and 1000. The collected sample was examined using industry-standard procedures to track the biodegradation process inside the MFC. Many parameters are used to determine waste water characteristics**[3-4]** .To evaluate the efficiency of the MFC, pH, TSS, TDS, BOD, COD, DO, Chlorides and Sulphates, and other parameters were examined in this study. Every 5 days, a waste water sample is collected and analysed to determine its various parameters. During the operation, voltage and current are also measured with a multimeter.

3.1Characterization of Synthetic waste water sample:

3.1.2 Estimation of BOD:

Preparation of dilution water:

Water is aerated by passing compressed air through a diffusion tube until it is completely saturated. Take about 5 ml of the sample and dilute it to 300 ml with dilution water. The diluted sample is taken in two bottles filled up to the neck. The dissolved oxygen in one bottle is determined immediately and in the other bottle after five days of incubation.

3.1.3 Determination of dissolved oxygen (DO):

1. 250 ml of sample is taken in a stoppered bottle avoiding contact with air.Add 0.2 ml $MnSO_4$ solution to it by means of a pipette, dipping the end well below the surface of water,add 2 ml of alkaline iodide-azide solution to it. Shake thoroughly. Allow brown precipitates of MnO $(OH)_2$ to settle down. When some portion of the liquid below the stopper is clear, add 2ml of concentrated H_2SO_4 with the help of a pipette. Mix till the precipitate is completely dissolved. Brown color of iodine is produced.
2. Transfer 100 ml of the above solution in a 250 ml flask with a pipette. Titrate the liberated I_2 with standardized sodium thio-sulphate solution until the sample solution becomes pale yellow.
3. Add 2 ml of starch solution, the solution will turn blue. Continue titration till the blue color disappears. Repeat to get another reading.
4. Volume of the water sample taken for titration =100ml

3.1.4 Estimation of COD:

Take reflux flask an add to it 0.4gms of H_2SO_4 and 20 ml of sample.(If required dilute to suitable degree) Mix well. Add 10 ml of 0.25N, $K_2Cr_2O_7$. Drop some pumice stone and slowly add 30 ml of Conc.H_2SO_4- $AgSO_4$ reagent. Mix the contents thoroughly and connect the flask to condenser. Reflux for 2 hours. Cool and wash down the condensers. Dilute the mixture to 150 ml by adding distilled water. Add 3 drops of Ferroin indicator and titrate with N/10 Ferrous ammonium sulphate solution, till the color changes from green to wine red. Note the end point. Perform the same procedure with 'Blank' using distilled water instead of the sample.

Fig3.2:MFC SET UP

4.0 RESULTS AND DISCUSSION:

4.1. Effect of pH

A pH metre was used to determine the pH of the waste sample (automotive waste water). The pH range of the sample taken over a period of time. The results demonstrate that the pH of the Automotive waste water has decreased over time (see Fig4.1.).

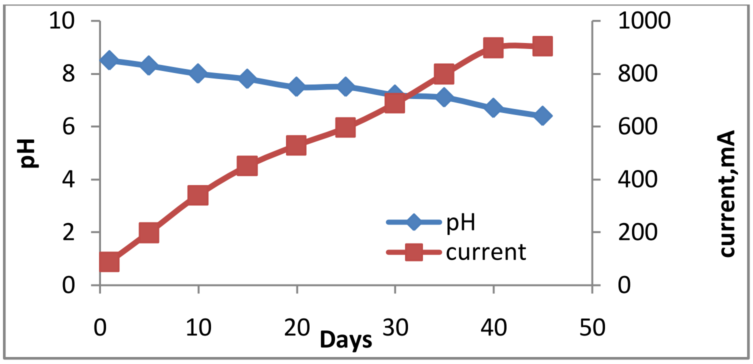

Fig. 4.1 Variation of pH with Time and current

In previous studies on the influence of pH, MFCs were operated at different anodic and cathodic pH, and the difference in MFCs performance may also stem from the difference in anodic and cathodic pH. In this study, the pH of anodic and cathodic electrolytes in each MFC were set equal. Anodic microbes play an important role in MFC operation, and they are sensitive to pH conditions. Although much effort has been spent on exploring the influences of pH on MFCs, few studies have reported the effects of pH on anodic microbes in MFCs. In addition, the relationship between pH changes and voltage output is not clear. This work attempts to study the effects of pH on electricity generation in MFCs, including the influence of initial pH in batch operation on MFC performance and anodic microbes (in terms of both species and bio film appearance), and the correlation of time-course pH changes with electricity generation. Initial pH influenced the performance of MFCs and the types and abundance of anodic microbes. Under acidic conditions, voltage outputs (232–284 mV vs. 311–339 mV) and power generation (95–116mW m−2 vs. 182–237mW m−2) were lower, while COD removal was faster. The acidic idea of automotive waste water is due to the expansion of Dextrose, which serves as food for bacteria. The pH was reduced from 8.5 to 6.4, which is within the acceptable range of BIS recommendations. The cathodic responses utilise proton, which causes the pH to rise fundamentally **[5-10].**

4.2. Effect of Dissolved Oxygen:

The Aquatic life and other organisms depend on decomposed oxygen (oxygen found in water) to survive. The amount of oxygen broken down in streams is affected by water temperature, the number of dregs in the stream, the amount of oxygen removed from the framework by breathing and rotting life forms, and the amount of oxygen returned to the framework by photosynthetic plants, the stream, and air circulation. The amount of broken up oxygen in a litre is measured in milligrammes per litre (mg/l) or parts per million (ppm) (ppm).

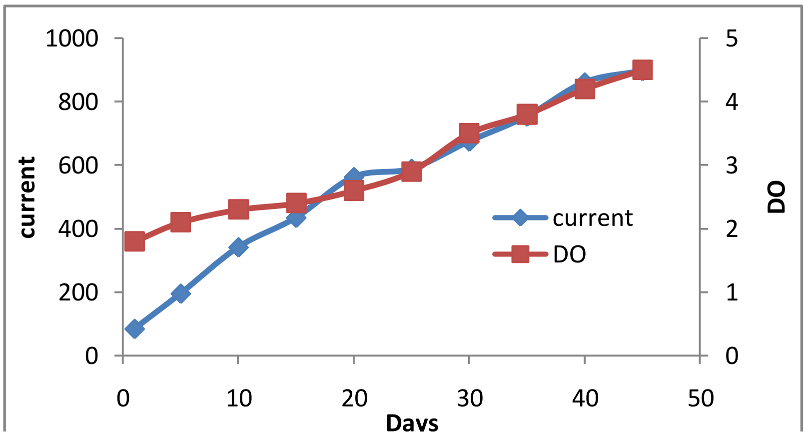

Fig. 4.2 Variation of Dissolved oxygen with time and current

Depicts the variation of dissolved oxygen over time. The dissolved oxygen concentration increased from 1.72mg/L to 4.2 mg/L, according to the findings. The decrease in the degrees of BOD and COD in the Automobile squander water test and air circulation is the reason for the increase in dissolved oxygen in Automotive waste water. Many writers **[11-12]** conducted comparable tests.

4.3. Effect of Chemical oxygen demand (COD)

COD is a proportion of the total quantity of oxygen required to oxidize all-natural material into carbon dioxide and water, and it does not distinguish between organically accessible and idle natural matter. The waste is calculated in terms of the amount of oxygen required for the oxidation of natural matter in order to deliver CO_2 and water. Tests were preserved using H_2SO_4 for COD assurance and handled for COD assurance once the entire examining process was completed. Throughout the activity, MFC was regularly checked for waste (as COD) evacuation in order to determine the power module's potential to function as a waste water treatment unit. The COD of an automotive burn via water at various time intervals is shown in **Fig.4.3**

The COD of the Automotive waste water has decreased from an initial value of 360 mg/L to 129mg/L as a result of the Automotive waste water developing and corrupting the natural matter in the waste test. The possibility for COD expulsion in automotive waste water was demonstrated, exhibiting the ability of microorganisms found in squander waters to use carbon sources as electron contributors. Has also removed the COD ingredient from home grown waste water, from which test results reveal that flow age and COD evacuation are relatively similar **[13-14].**

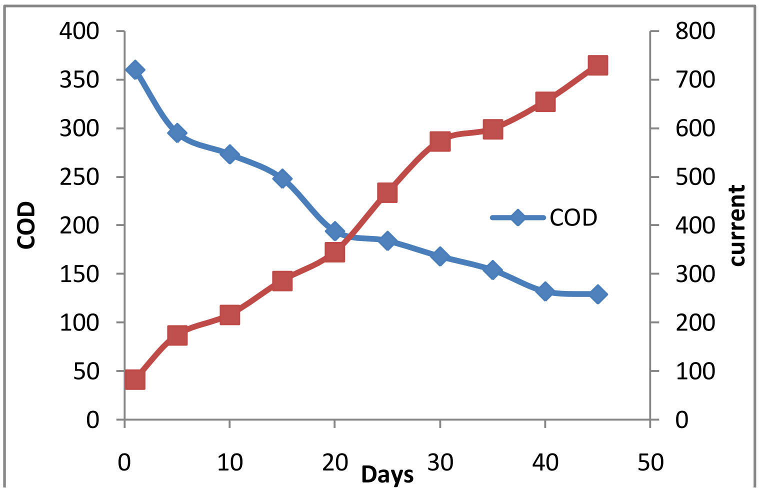

Fig. 4.3 Variation of COD with time and current

In the aeration process, COD reduced as bacteria can break down organic compounds in water**[15]**. These bacteria are called heterotrophic bacteria break down organic compounds due to the use of oxygen.

4.4. Effect of Biochemical oxygen demand (BOD):

BOD is a measure of how much oxygen a species will consume while breaking down natural stuff in extreme settings. Figure 4.13 depicts the effect of a Microbial Fuel Cell on the BOD of automotive waste water. BOD has decreased from an initial value of 218 mg/L to a final value of 127 mg/L, according to the findings.

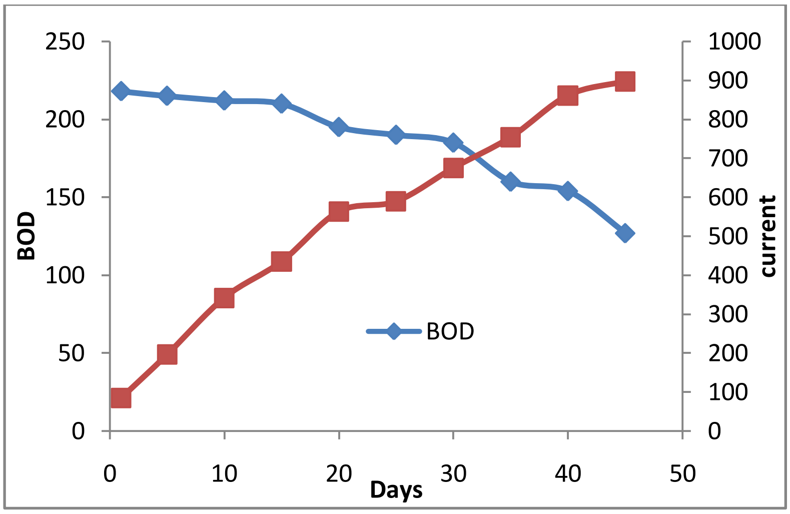

Fig. 4.4 Variation of BOD and current with Time

4.5 Effect of Treatment Efficiency:

Figure: Depicts the effect of MFC on Treatment Efficiency. Treatment Efficiency increased from 25.77 mg/L to 73.3 mg/L as a result of the study **[16-17].**

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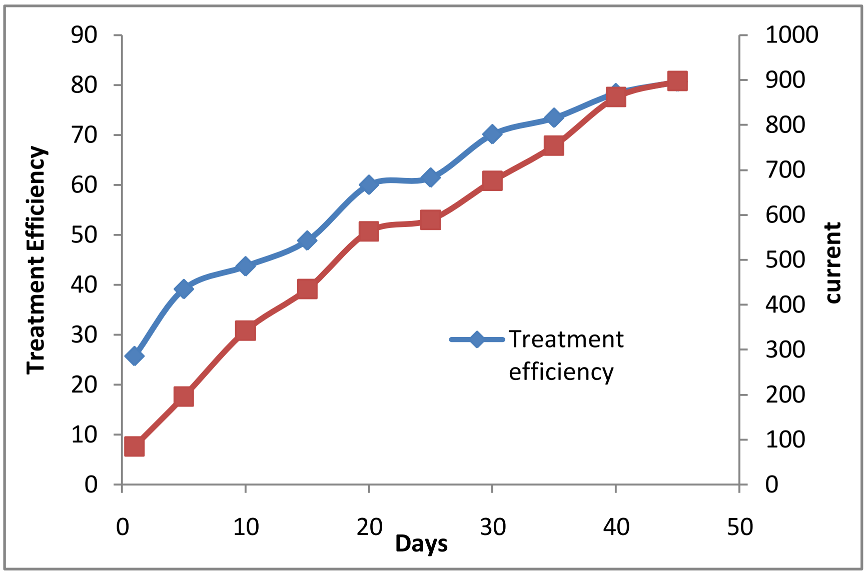

Fig4.6: Variation of Treatment Efficiency with Time and current

4.6 Growth Yeild :

The installation of a new set of electrodes was a practical method of enriching bacteria growing in an MFC, but overall power generation in this system was not enhanced, most likely due to the cathode and PEM's power generating constraints **[18]**. Other writers **[19-20]** have conducted similar experiments.

Growth Yield

$Y = \frac{X}{\Delta\, COD}$

X = Biomass produced over time

$\Delta\, COD = COD_1 - COD_7$

Y = 0.14 g biomass/g substrate

4.7 Electrode Potential :

With Current density increased from 0.38 A/m^2 to 1.46 A/m^2, the cathode potential of the DCMFC decline faster than the cathode potential of the SCMFC , which was in contrast to the faster increase in anode potential in the DCMFC .Similar work is done by other authors .

Electrode potential

$E_{cell} = E_{cathode} - E_{anode}$

$E_{cathode}$ = Electrode potential of distilled water = 1.23 V

E_{anode} = Electrode Potential of Copper =0.34V

E_{cell} = 0.89V

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5.0 CONCLUSIONS:

The goal of this research was to look at some of the biological methods used in waste water treatment. The Microbial Fuel Cell was chosen for this investigation to improve waste water quality while also generating power. When compared to the initial features of Automoblie waste water, the amount of pH ,COD, BOD has decreased.The DO and Treatment Efficiency is increased, Growth Yield is 0.14 g biomass/g of substrate,Electrode Potential is 0.89V .The MFC was efficient, cost-effective, simple to maintain, and did not necessitate the use of paid labour. They surely offer energy recovery potential during wastewater treatment. The availability of bio-degradable chemicals contained in the waste water sample was discovered to be the primary principle guiding the elimination of toxicity and the creation of energy.

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