STUDY OF EFFECT OF AGITATION BY MFC

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ABSTRACT

A Microbial Fuel Cell (MFC) used to find BOD and COD present in sample. In cathode chamber the rpm was constant, and effect of agitation at stagnant 5 days and agitation condition next 5 days, found out showing a wide increase in removal efficiency from 55.64% BOD to 88.36%BOD, 59.73% COD to 91.24%COD and voltage 195mV to 264mV.

Keywords: Microbial Fuel Cells, BOD, COD.

1. INTRODUCTION

1. Problem Definition-

Industrial and domestic wastewater that is disposed in nearby water bodies results in water pollution which is a major problem in the global context. India is former manufacturer of Sugar and its by-products. Effluents from sugar industries induce environmental pollution, and are contributing to water pollution in ways due to its strong concentration. One way to reduce water pollution is by using Microbial Fuel cell for its wastewater treatment. The need of MFC is to identify the most effective and suitable way to optimize operating parameters which affects the removal efficiency of pollutants is important because it can produce the best result and at the same time give the best effectiveness and efficiency in wastewater treatment with a new form of energy which can serve the world to gratify its need.

2. General-

Today in India the condition is so precarious that there is need to find the alternative to fossil fuels. Current methods to produce energy are not sustainable, and concerns about climate change and global warming require developing new methods of energy production using renewable and carbon-neutral sources.[1] MFC can be defined as a device that converts chemical energy stored in the organic matter to electricity using microorganisms as the biocatalyst. The organic matter is oxidized with the help of microorganisms, producing energy, electrons and protons. The energy is stored by microorganisms and used for the growth. The electrons are brought to the anode from the inside of microorganisms by the mediator, and flow to the cathode through copper wire. They react with the oxygen and the electrons on the cathode, producing water. In this way, the organic matter is converted to electricity [2]

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II. MATERIALS & METHODS

Sr. No	Component	Description of the Component
1	Cathode Chamber	The cathode chamber consist of plastic container of volume 1lt.which is non-reactive, non-conducting and holds the Electrode in an aqueous solution. The final reaction reduction of oxygen occurs in this chamber. This chamber was filled with Distilled water having pH 7. This chamber is completely sealed off from the outside environment by means of a wax and cello tape.
2	Cathode Electrode	The Cathode electrode is composed of graphite which is 2cm diameter, and 15 cm long. The Cathode Electrode is composed of graphite since the material of construction was already decided before testing began in the experimental prototypes.
3	Salt Bridge	Since Proton Exchange Membranes are very expensive and fragile, an agar salt bridge was used. The salt bridge is prepared by taking 50ml of distilled water in a beaker, heat it till boiling, then add 20gm KCl to it, stir well till KCl is dissolved, now add 15gm agar and stir continuously so that all the filaments gets break and even viscous solution is formed. Fill this solution in a 1" diameter and 10 cm long PVC pipe by keeping on side closed. Keep this filled pipe in refrigerator so that it can be used.
4	Anode Chamber	The anode chamber consist of plastic container of volume 1lt. which is non-reactive, non-conducting and contains the electrode immersed in inoculated media. This chamber is completely sealed off from the outside environment by means of a wax and cello tape.
5	Anode Electrode	The anode electrode is also of graphite which is 2cm diameter, and 15 cm long. This anode helps to develop the bio-film which helps to accelerate the process by multiplication of microorganisms.
6	Multimeter	During the process the output in the form of voltage was measured using the Digital multimeter.
7	Circuit Assembly	Two chambers were internally connected by salt bridge and externally the circuit was connected with copper wires which were joined to the two electrodes at its ends and to the multimeter by another ends.

III. RESULTS AND DISCUSSION

1. Initial Characteristics of Waste water

Sr No.	Parameter	Value	Unit
1	Colour	Brown	----
2	pH	10.45	---
3	BOD	2515	mg/lit
4	COD	6820	mg/lit

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2. Effect of Agitation Speed on COD removal and voltage generation by microbial fuel cell for Sugar wastewater sample.

To study the COD removal efficiency of sugar industrial wastewater sample The setup was placed on a magnetic stirrer bed and resolution and firstly checked with varying agitation speed of 5-50 rpm, and ultimately the optimum voltage output was found at 40rpm so keeping this constant for finding the effect on BOD, COD removal of 40 per min was set at stagnant and agitated conditions, the MFC was operated continuously for 10 days. During this tenure the effect of stagnant condition was observed for 5 days and agitation or stirring effect was observed for remaining 5 days. The results observed had more removal efficiency of 88.36% BOD, 91.24% COD, in agitated conditions compared to stagnant condition values of 55.64% BOD, 59.73% COD removal. This may be because the time taken for carbon exhaustion was relatively less in the agitated Conditions and more diffusion and mixing of substrate and microorganisms which ultimately helped in COD removal efficiency.

Also during the process the voltage generated was recorded and the best results were showed which generated 284mV Voltage on 9th day of operation. As these voltage is generated due to the diffusion of electrons caused by microorganisms, Agitation or stirring of the solution eliminates this diffusion-limited condition.

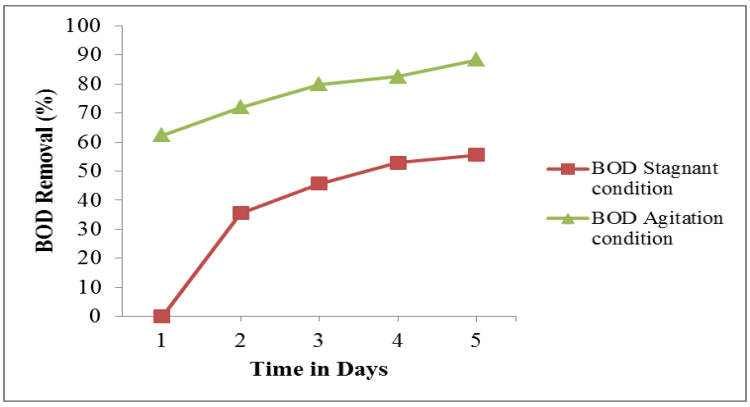

Fig. 2. Effect of agitation on BOD Removal

From Fig.2, the COD Removal increases drastically from 55.64% in stagnant condition to 88.36% in agitation condition, this may be due to more diffusion and mixing of substrate and microorganisms which ultimately helped in BOD removal efficiency enhancement of the MFCs.

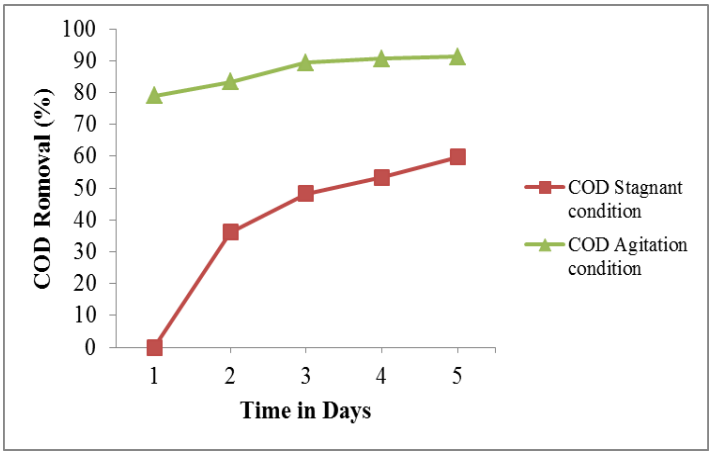

Fig. 3. Effect of agitation on COD Removal

From Fig.3. the COD Removal increases drastically from 59.73%in stagnant condition to 91.24% in agitation condition, this may be due to more diffusion and mixing of substrate and microorganisms which ultimately helped in COD removal efficiency enhancement of the MFCs.

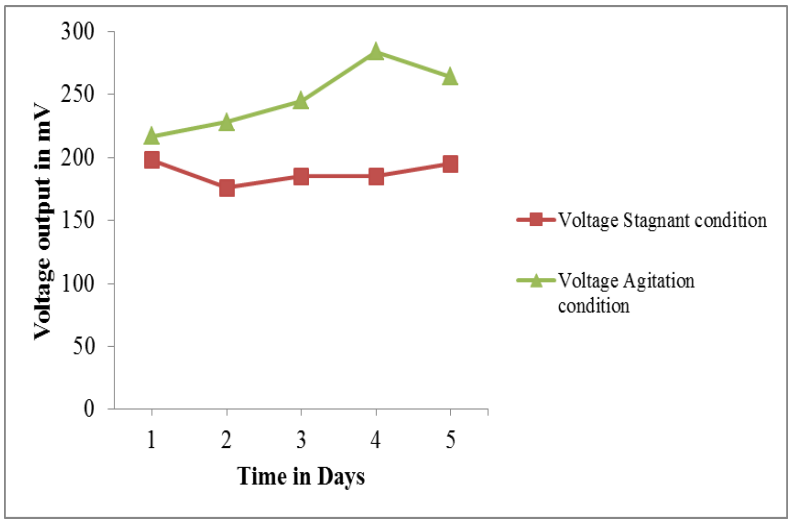

Fig. 4 Effect of agitation speed on voltage output

From the Fig 4. it can be concluded in the agitated conditions at 40 rpm maximum current of 284mV was obtained this implies that more diffusion and mixing of substrate and microorganisms takes place and that the time taken for carbon exhaustion was relatively less and hence we get more output in the form of Voltage.

IV. CONCLUSION

From the study of effect of Agitation Speed it is concluded that removal efficiency increases with increase in agitation speed. But at higher agitation speed, the loosely attached molecules on the surfaces might re-enter into the electrolyte, hence lowering the percentage BOD and COD reduction. Thus at average agitation speed of 40rpm, BOD, COD removal efficiency is observed to be best. Even though the agitation condition gives more removal efficiency compared to stagnant condition still it cannot be preferred because the agitation requires external power supply which will consume energy, and the aim will not be satisfied.

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