Treatment of Salt Contaminated Wastewater Using Multi Chamber Microbial Fuel Cell

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Abstract: This is the first study with one anode and four cathode chambers for treatment of various concentration of salt solution. In this study, we investigated the potential of using five chamber Microbial Fuel Cell (MFC) to remove salt. Here the anode chamber is surrounded by four cathode chambers and laponite is used as the bridge for all four connections. While used vegetable oil was used in the anode chamber, concentration of salt solutions were 5, 10, 20 and 35 g/L in the all four cathode chambers. Bio surfactant was produced in the anode chamber and the salt solution was treated in the cathode chambers.

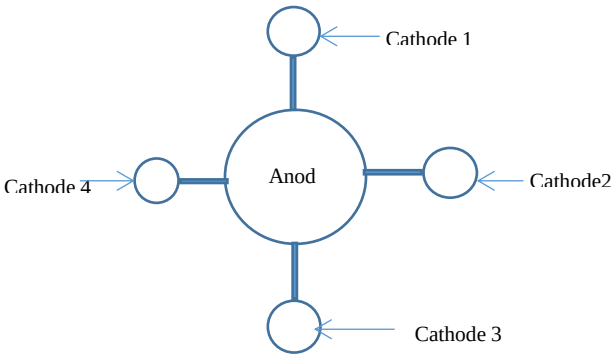
1. Introduction:

In the environment near to 97.5 % is salt solution and it is necessary to treat that solution in efficient way to meet the water demand in the environment. MFC is one of the newly developed topic to treat the salt water in the name of Microbial Desalination Cell (MDC) .This is one of the energy efficient process and environmental friendly operation which can be used to treat waste water. In recent years, MFC is being used to remove salt by using three chambers (Cao et al., 2009).

2. Objective:

Investigate the potential of multi chamber Microbial fuel cell to remove sodium chloride from various concentrations.

3. Materials and Methods:



Five chamber MFC method was used for this experiment. The anode chamber is surrounded by four cathode chambers. Anode and cathode chambers were connected by Laponite Bridge. Anode chamber was filled with 500 mL wastewater with used vegetable oil and all four Cathode chambers were filled with 150mL of 5, 10, 20, 35 g/L NaCl solution. Carbon fiber brushes were used as anode and cathode electrodes. This MFC was connected with 1 kilo ohm external resistance and voltage was monitored half an hour interval. Resistivity, NaCl content and pH of all solutions were monitored with the time.

4. Results and Analyses:

In this reactor, Bacteria in the anode chamber oxidized the organic substrate and released electrons. These electrons were delivered to the cathode solution through the external circuit resulting in the solution reaction:

$$Na^{+} + \text{electron} \rightarrow Na$$

Reduction of surface tension indicates that bio surfactant is produced in the anode chamber. pH in the anode chamber reduced with time due to protons in the anode chamber.

5. Conclusion:

It is possible to calculate the NaCl reduction with time. Highest reduction is achieved in the 5 g/L NaCl solution chamber which is 22% within three hour of operation. Bio surfactant is produced in the anode chamber and it can be used for various other purposes.

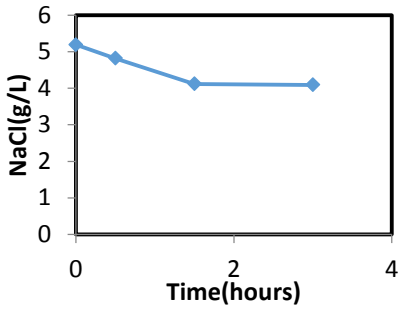


Figure 1: 5 g/L NaCl solution

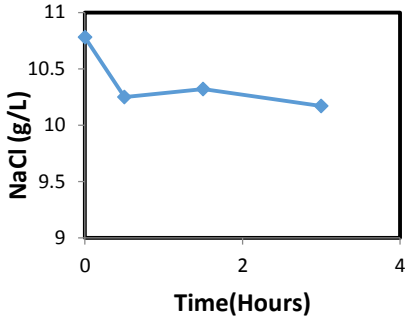


Figure 2:10 g/L NaCl solution

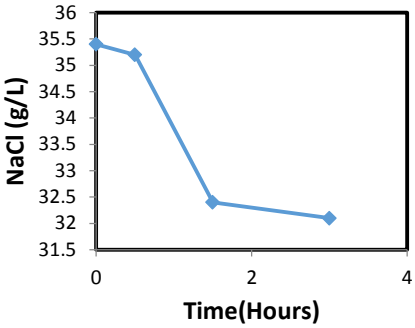


Figure 3. 35 g/L NaCl solution

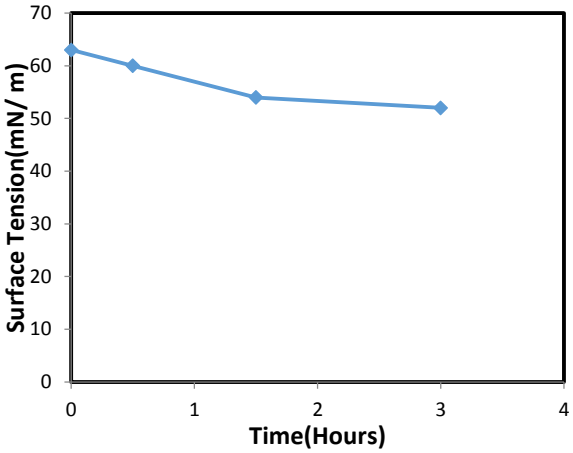


Figure 4. Anode Surface tension with time

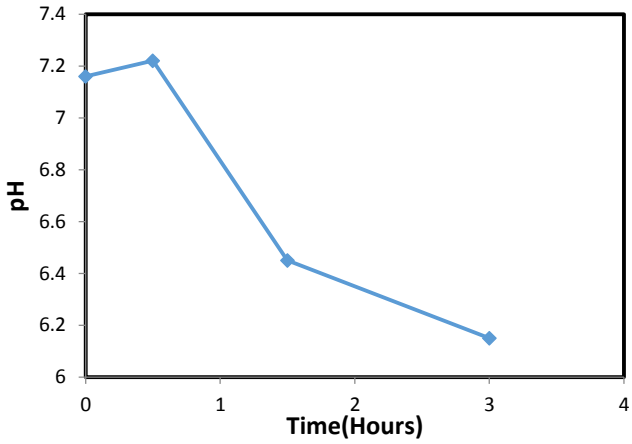


Figure 5. Anode pH with Time

6. Acknowledgements: This study was supported by the Center for Innovative Grouting Materials and Technology (CIGMAT), University of Houston, Houston, Texas with funding from the Texas Hazardous Waste Research Center (THWRC)

7. References:

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