Microbial Fuel Cell for Wastewater Treatment

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Abstract

Microbial fuel cells are a technology that utilize microorganisms to treat wastewater while simultaneously generating electrical energy. This process uses microorganisms to convert organic matter in wastewater into electrical energy. This project focuses on studying the feasibility and approaches for applying this technology in wastewater treatment systems, utilizing the oxidation reactions of the bacterium *Priestia aryabhattai* and to compare the electron acceptor systems at the anode side of the fuel cell between oxygenation and the use of potassium permanganate solution, along with the measurement of related parameters such as concentration of nitrite and ammonium including DO and BOD in wastewater before and after treatment. Additionally, the voltage and current flowing through resistors of various sizes were measured, and the power output was calculated daily throughout the 6-day treatment period. The results indicated that using potassium permanganate as the electron acceptor produced the most power output, electricity production efficiency and results in a decreased concentration of nitrite and BOD after treatment.

Introduction

Microbial fuel cell is biochemical system using microorganism to convert chemical energy from organic substrates into electrical energy. *Priestia aryabhattai* is a gram positive, rod bacterium. It has ability to survive in extreme environments and has been studied for various applications such as wastewater treatment and microbial fuel cell.

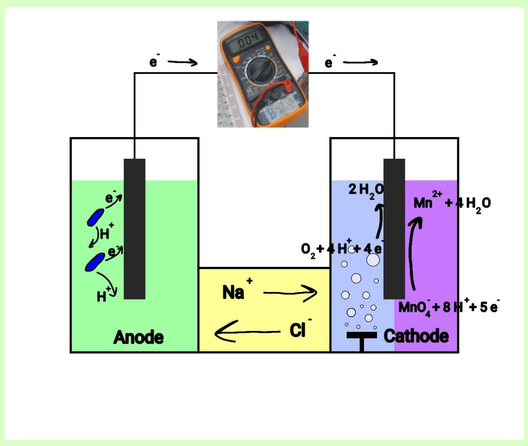


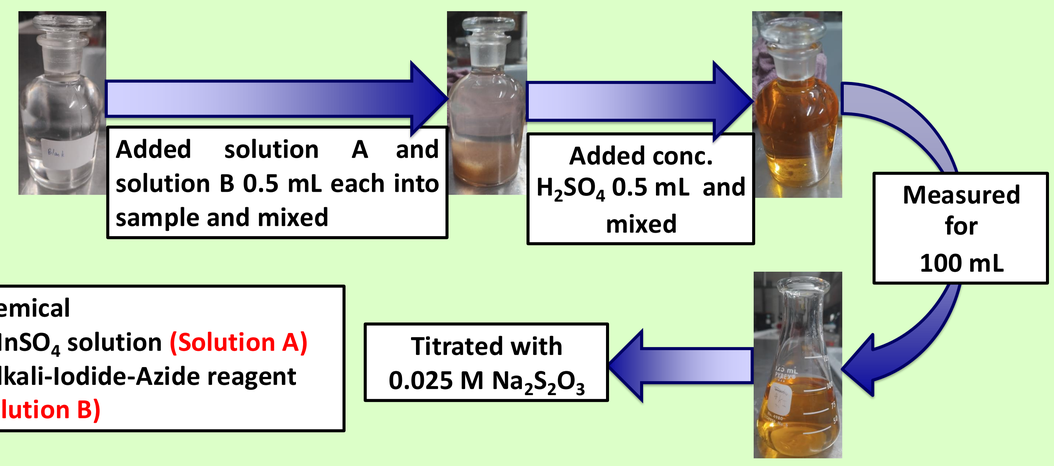
Fig 1. Microbial fuel cell system

Objectives

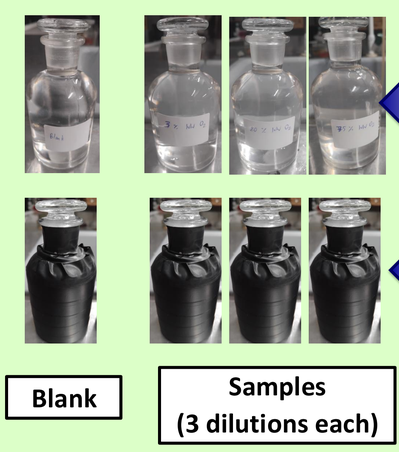
-To study on wastewater treatment using *Priestia aryabhattai*
-To study power and electricity production efficiency of microbial fuel cell

Materials and Methods

1.DO (Dissolved oxygen)



2.BOD



3.Electricity

Voltage and current were measured and calculated power. Polarization curve and power curve were evaluated.

4.Nitrite and ammonium

Determined using test kits.

Results

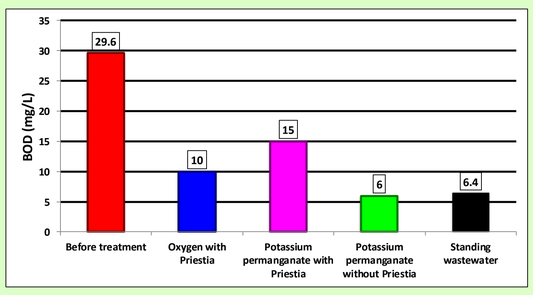
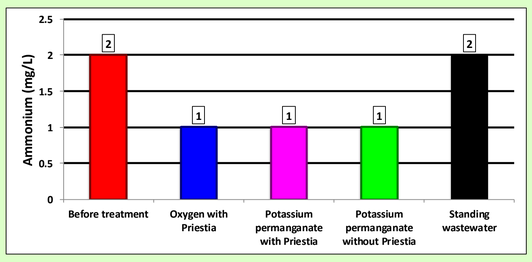


Fig 2. BOD value in wastewater (control):T1, system with anode=oxygen (T2), system with KMnO4 = anode and presence of *P. aryabhattai* (T3), system with KMnO4 = anode and without *P. aryabhattai* (T4) and standing wastewater for 6 days (T5)

P. aryabhattai can decrease BOD value in all treatments both using oxygen and $KmnO_4$ as anode. The decomposition of organic matter not occur efficiently for other



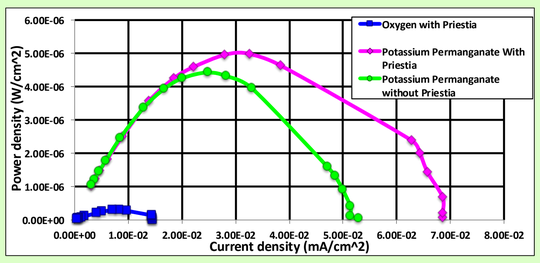


Fig 5. Power density production by *P. aryabhattai* in microbial fuel cell using oxygen as anode, using $KMnO_4$ as anode and using $KMnO_4$ as anode without *P. aryabhattai* (control)

Potassium permanganate with *P. aryabhattai* is the most power output

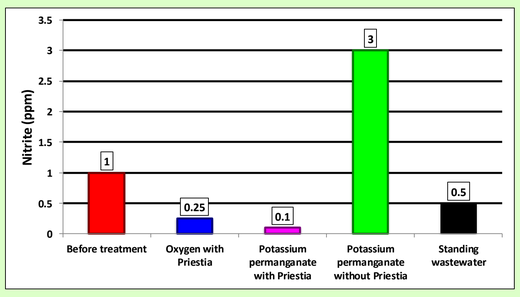


Fig 3. The concentration of nitrite in wastewater (control):T1, system with anode=oxygen (T2), system with KMnO4 = anode and presence of *P. aryabhattai* (T3), system with KMnO4 = anode and without *P. aryabhattai* (T4) and standing wastewater for 6 days (T5)

P. aryabhattai can decrease concentration of nitrite in all treatments both using oxygen and KMnO4 as anode. The concentration of nitrite increase in system with with $KMnO_4$ = anode and without *P. aryabhattai* from ammonium oxidation. In standing wastewater concentration of nitrite decrease by nitrite reduction of other microorganism in wastewater

Fig 4. The concentration of ammonium in wastewater (control):T1, system with anode=oxygen (T2), system with KMnO4 = anode and presence of *P. aryabhattai* (T3), system with KMnO4 = anode and without *P. aryabhattai* (T4) and standing wastewater for 6 days (T5)

The concentration of ammonium decrease in all microbial fuel cell systems from ammonium oxidation

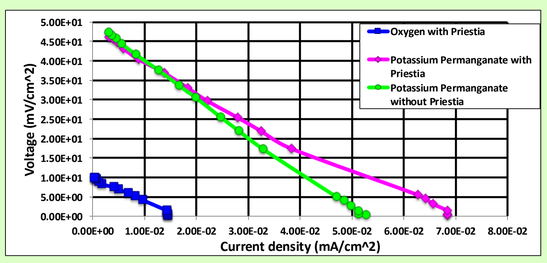


Fig 6. Electricity production efficiency by *P. aryabhattai* in microbial fuel cell using oxygen as anode, using $KMnO_4$ as anode and using $KMnO_4$ as anode without *P. aryabhattai* (control)

Potassium permanganate with *P. aryabhattai* is the most electricity efficiency

Conclusions

- ***Priestia aryabhattai* can be used for wastewater treatment as it decrease the amount of nitrite and BOD.**
- **The most electricity production efficiency and power density of microbial fuel cell is found in microbial fuel cell using potassium permanganate as the electron receptor**

References

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