A Smart Monitoring System for Textile Wastewater Treatment

T. Sarathi[1], K.G. Padmasine[2]

[1]*Department of Electronics And Instrumentation, Bharathiar University, Coimbatore-641046, Tamil Nadu, India.*
[2]*Department of Electronics And Instrumentation, Bharathiar University, Coimbatore-641046, Tamil Nadu, India.*

---***---

Abstract - This project develops the purification of textile wastewater using microbial fuel cells (MFC), generating electricity as a byproduct. A NodeMCU module and current sensor setup are used to monitor current production. Through the use of microbial activity, the MFC system breaks down chemicals to produce electrical energy and harmless byproducts. The NodeMCU module makes wireless communication and real-time data capture possible, allowing for remote current output monitoring. IoT technology integration helps with environmental impact assessment and process management. This study presents an environmentally friendly technique for treating textile wastewater using MFC technology with the Internet of Things to produce electricity and purify the water effectively.

Key Words: textile wastewater treatment, microbial fuel cell, smart monitoring system.

1.INTRODUCTION

The textile sector is a major contributor to global manufacturing, providing a wide range of products essential to everyday living. But in addition to its economic benefits, the sector produces large amounts of wastewater that are contaminated with various toxins, which pose serious environmental problems. The complex composition of textile effluents is sometimes too complex for conventional wastewater treatment procedures to handle, which has a negative effect on ecosystems and water resources. Various techniques are evolving to provide efficient and environmentally friendly wastewater treatment systems in response to these issues. Using microbial fuel cells (MFCs) to simultaneously purify wastewater and produce electricity is one such strategy that is gaining attention. MFCs use microorganisms' metabolic activity to break down organic contaminants in wastewater, producing electrical energy as a byproduct in the process. Using MFC technology to purify textile wastewater is the main goal of this project, which also aims to reduce pollution in the environment and employ renewable energy sources. Making use of microorganisms' biological ability to break down organic molecules, MFCs present an option to efficiently clean complicated industrial waste. Additionally, we use current sensors and NodeMCU modules to integrate Internet of Things (IoT) technologies to improve the MFC system's efficiency and monitoring capabilities. This integration makes it easier to monitor and collect data on the electrical current generated throughout the wastewater treatment process in real time. In addition to facilitating process optimization, these remote monitoring capabilities offer insightful data regarding the efficacy and performance of the system. Our goal with this project is to help the textile sector create sustainable wastewater treatment solutions.

2. Objective of Paper

Real-time monitoring: Develop a real-time monitoring system to track and analyze the environmental factors in MFCs producing voltage, current, current density, and power density. The system will include sensors to measure these parameters and will be able to transmit data wirelessly to a central database or to the user's device.

Low Energy Consumption: MFCs produce power through the microbial breakdown of organic matter. This technique can be energy-neutral or even fuel-positive in some situations since it can be very effective at removing contaminants from textile wastewater without requiring extra energy input.

Customizable design: Develop a modular design that allows for customization of the chamber based on the volume of the wastewater treatment process. Design the chamber in a way that allows for easy maintenance and the replacement of components as needed.

Easy to operate: Create a user-friendly interface that allows for easy control and monitoring of the wastewater conditions. Provide detailed instructions and support for the setup and operation of the MFC chambers.

Data management: Create a centralized database to store and analyze data collected from the sensors. Develop data visualization tools to help users easily understand and interpret the data collected by the system.

Reduce environmental impact: Design the whole setup to minimize its environmental impact by using sustainable materials and energy-efficient components. Implement MFC technologies and wastewater management to reduce the toxic amount of wastewater.

International Journal of Scientific Research in Engineering and Management (IJSREM)
Volume: 08 Issue: 04 | April - 2024 SJIF Rating: 8.448 ISSN: 2582-3930

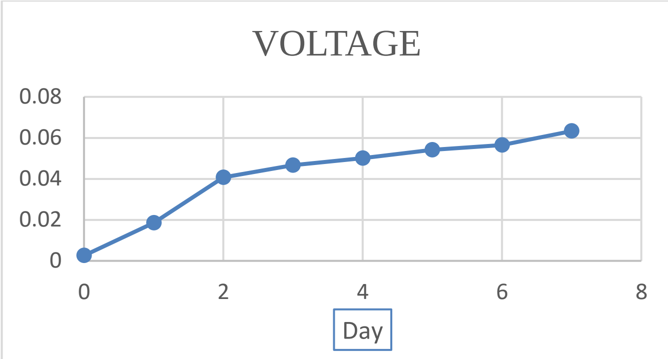
Table -1

DAY	VOLTAGE	RES (ohm)	CURRENT	CURRENT DENSITY	POWER DENSITY
0	0.00256	1000	0.0000256	1.03434E-07	6.5536E-09
1	0.01849	1000	0.00001849	7.47071E-07	3.4188E-07
2	0.0407	1000	0.0000407	1.64444E-06	1.65649E-06
3	0.0466	1000	0.0000466	1.88283E-06	2.17156E-06
4	0.0501	1000	0.0000501	2.02424E-06	2.51001E-06
5	0.0542	1000	0.0000542	2.1899E-06	2.93764E-06
6	0.0565	1000	0.0000565	2.28283E-06	3.19225E-06
7	0.0633	1000	0.0000633	2.55758E-06	4.00689E-06

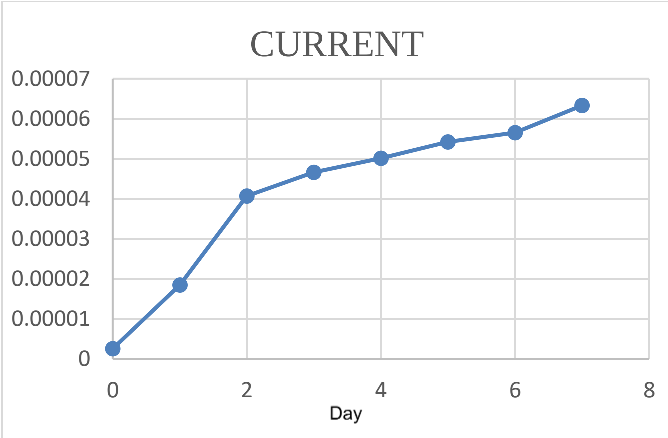
Fig -1: MFC Chamber

The production of voltage, current, current densities, and power densities is the outcome of the MFC treatment of textile wastewater. These amounts increase throughout the duration of the day. The Chart – (1), (2), (3), (4) below illustrate the results.

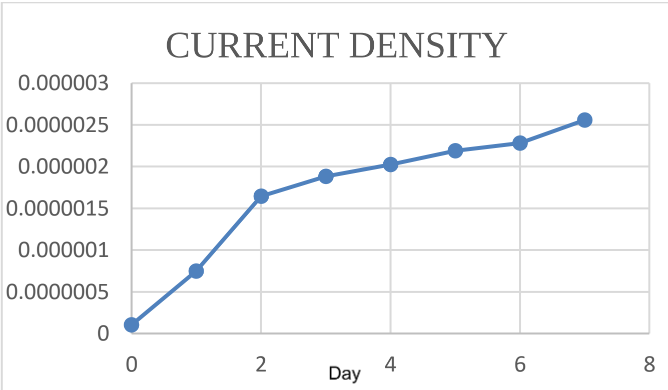
Charts-1



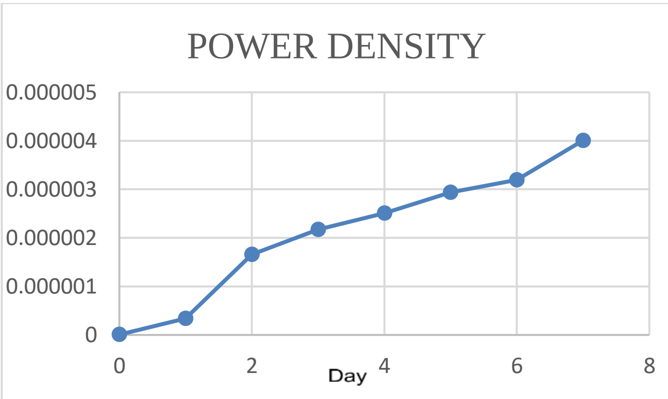
Charts-2



Charts-3



Charts-4



3. CONCLUSIONS

In conclusion, our study successfully demonstrated that purifying textile wastewater with Microbial Fuel Cells (MFC) is possible. We successfully monitored key parameters like voltage, current, current density, and power density in real-time monitoring using Internet of Things (IoT) technology. This creative method not only made wastewater treatment more effective, but it also provided valuable information that improved MFC performance. Our research shows how MFCs and IoT may be used to provide sustainable wastewater treatment solutions for the textile industry, providing the way to resource conservation and environmentally friendly methods.

REFERENCES

1. Liu, Guangli, et al. "Microbial fuel cells for textile dyeing wastewater treatment: Recent advances and perspectives." Bioresource Technology Reports 13 (2021): 100677. [DOI: 10.1016/j.biteb.2020.100677]

2. Rezaei, Fatemeh, et al. "Electrochemical monitoring and optimization of microbial fuel cell performance for the treatment of textile wastewater." Environmental Science and Pollution Research 27.15 (2020): 17966-17977. [DOI: 10.1007/s11356-020-08209-0]

3. Venkata Mohan, S., et al. "Microbial fuel cell: Critical factors regulating bio-catalyzed electrochemical process and recent advancements." Renewable and Sustainable Energy Reviews 40 (2014): 779-797. [DOI: 10.1016/j.rser.2014.07.185]