

OFFICIAL ABSTRACT and CERTIFICATION

Remediation of Wastewater Using a Microbial Fuel Cell with Optimized Electricity Generation and an Algae Bioreactor

Sanjna Kedia and Emily Ma

Manhasset High School, Manhasset, NY, U.S.A.

According to the EPA, approximately \$25 billion is annually spent on domestic wastewater treatment, largely due to the aeration technology as it consumes 45-75% of wastewater treatment plant costs. A microbial fuel cell (MFC) is an apparatus that uses bacteria as the catalysts to oxidize organic and inorganic matter and generate current, used as an alternative for wastewater treatment. The purpose of this study was to create a novel MFC that would be more efficient than current aeration technologies and a control treatment, and whether it could remediate the water as well as produce electricity efficiently, with subsequent treatment of using an algae bioreactor. The control treatment consisted of still artificial wastewater, the aeration reactor consisted of artificial wastewater circulated by an aquarium diffuser, and the MFC consisted of two chambers (cathode and anode) joined together by a proton exchange, or Nafion membrane. All three reactors were tested for the increase in dissolved oxygen by 90%, which showed complete remediation of the water. The control treatment took 11 days to remediate, the aeration reactor took 3 days, and the MFC took 22 hours to remediate. The MFC was capable of producing voltage as it produced 0.62 V at its max. The algae bioreactor used the growth of Anabaena biomass in the remediated wastewater as a method to reduce nitrates. As shown in this study, MFC treatment holds promise for a more electrically and cost efficient method for treating wastewater.

Category

Pick one only — mark an "X" in box at right

- ☐ Animal Sciences
- ☐ Behavioral & Social Sciences
- ☐ Biochemistry
- ☐ Biomedical & Health Sciences
- ☐ Biomedical Engineering
- ☐ Cellular & Molecular Biology
- ☐ Chemistry
- ☐ Computational Biology & Bioinformatics
- ☐ Earth & Environmental Sciences
- ☐ Embedded Systems
- ☒ Energy: Sustainable Materials and Design
- ☐ Engineering Mechanics
- ☐ Environmental Engineering
- ☐ Materials Science
- ☐ Mathematics
- ☐ Microbiology
- ☐ Physics & Astronomy
- ☐ Plant Sciences
- ☐ Robotics & Intelligent Machines
- ☐ Systems Software
- ☐ Translational Medical Sciences

1. As a part of this research project, the student directly handled, manipulated, or interacted with (check ALL that apply):

- ☐ human participants ☐ potentially hazardous biological agents
☐ vertebrate animals ☐ microorganisms ☐ rDNA ☐ tissue

2. I/we worked or used equipment in a regulated research institution or industrial setting: ☐ Yes ☒ No

3. This project is a continuation of previous research. ☐ Yes ☒ No

4. My display board includes non-published photographs/visual depictions of humans (other than myself): ☐ Yes ☒ No

5. This abstract describes only procedures performed by me/us, reflects my/our own independent research, and represents one year's work only: ☒ Yes ☐ No

6. I/we hereby certify that the abstract and responses to the above statements are correct and properly reflect my/our own work. ☒ Yes ☐ No

This stamp or embossed seal attests that this project is in compliance with all federal and state laws and regulations and that all appropriate reviews and approvals have been obtained including the final clearance by the Scientific Review Committee.

