Abstract

By taking advantage of the electricity generated by bacteria, Microbial electrochemical systems (MESs) are able to serve a variety of purposes, such as providing renewable energy, desalinating water and synthesizing molecules and compounds. Unfortunately, the exoelectrogenic microorganisms that power the reactors take a very long time to adjust to their new environment and thrive, which is delaying the rate of advancements in this technology. Eliminating or significantly reducing acclimation time will considerably propel the rate of new discoveries. By freezing exoelectrogenic microorganisms at -80°C, they can be stored for future use. Results showed that they can be reactivated within 24 hours. Microbial fuel cells (MFCs) containing the frozen microbes reached voltage outputs of 0.4042, 0.3865, 0.4931, and 0.4274 V after 24 hours. During standard acclimation, reactors achieved an average output of 0.0136 V after the same time span.

Materials and Methods

MFCs:
- Brush anode, air cathode
- Anaerobic sludge
- 2 g/L CH3COONa
- 50 mM PBS

Storage Methods
- Dessication
  - CaSO4
  - Pebble sizes 10-20 mesh
- Lyophilization
  - 0.060 mbar
  - -51°C
- Freezing
  - -80°C

Background and Hypothesis

- It is hypothesized that electrochemically active exoelectrogenic microbes from a fuel cell can be suspended in a dessicated, lyophilized, or frozen state and reactivated on demand.
- Microorganisms have the highest survival rates when lyophilized.

Results

After 24 hours, average voltage outputs for dessicated, lyophilized, and frozen anodes were 0.0056, 0.0165, and 0.4278 V respectively. The controls achieved an average of 0.0136 V during the same time span.

Average anode potential before freezing was implemented was -0.4960 V. After freezing, anode potential dropped to -0.4944 V.

Discussion

1. The results obtained in the study indicate for the first time that freezing exoelectrogenic microbes at -80°C is a viable option for storage.
2. Future studies should investigate the survivability of the bacteria after lyophilization with different set parameters.
3. Different humidification methods should also be applied to lyophilized microbes to see if results improve.
4. Various freezing temperatures should be implemented to discover what temperatures the bacteria can tolerate.

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