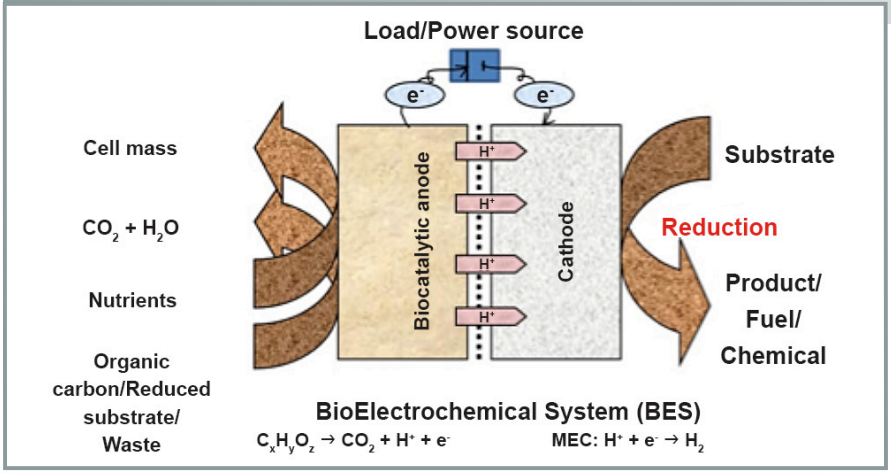
Bioelectrochemical Waste Treatment Yields Hydrogen/Electricity

UT-B ID 200802041, 200802057, 200802114



Technology Summary

Water scarcity is becoming a major issue for the United States and other countries as water use for agricultural and biofuel crops and industrial processes such as fracking increases. The issue is compounded by the fact that water used for food, fuel, and energy production results in large amounts of wastewater laden with organic compounds, salts, and other contaminants. The contaminants could be introduced to surface waters, and therefore technologies are needed to treat the growing volumes of wastewater. Researchers at ORNL have developed a waste treatment system based on the microbial fuel cell that produces energy while it reduces the unwanted chemicals in process water streams so that more of the water can be recycled rather than being disposed of as waste.

The bioelectrochemical device developed at ORNL is intended primarily as an online component in the treatment systems for process water from the petroleum and biofuels industries, but it can be adapted to other wastewater streams as well. It can be configured either as a fuel cell, which produces electricity, or as an electrolytic cell, which produces hydrogen gas. Both products can be used to power other devices. The bioelectrochemical device can also be configured so that its electrodes scavenge salts and other inorganic compounds found in wastewater streams.

Microbial fuel cells generate electricity by harvesting the electrons produced by specialized bacteria that grow in a film on the negative electrode. The bacteria are nourished by waterborne organic compounds and produce carbon dioxide, free electrons, and hydrogen ions. The ORNL research focused on solving the problems inherent in cost-effectively applying microbial cells to treatment systems for wastewater streams (e.g., optimizing the electrochemically active biofilms for energy production while digesting the complex, inhibitory, and toxic contaminants found in wastewaters). Currently the technology is being refined to produce energy more efficiently by minimizing losses to competing biochemical processes.

Advantages

- Safe, clean, cost-effective
- Creates energy while it removes contaminants
- Can be configured to remove organic or inorganic contaminants
- Compatible with existing technologies

Potential Applications

- Treatment of wastewater from oil drilling, hydraulic fracturing (fracking), and biofuels production
- Treatment of other wastewater streams
- Production of electricity
- Production of hydrogen fuel

Patents

Abhijeet P. Borole and Constantino Tsouris. *Microbial Fuel Cell Treatment of Fuel Process Wastewater,* US Patent 8,597,513 B2, issued December 3, 2013.

Abhijeet P. Borole. *Microbial Fuel Cell Treatment of Ethanol Fermentation Process Water,* US Patent 8,192,854 B2, issued June 5, 2012.

Abhijeet P. Borole. *Microbial Fuel Cell with Improved Anode,* US Patent 7,695,834 B1, issued April 13, 2010.

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