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Constructing a Microbial Desalination Fuel Cell to Generate Electricity from Anaerobic Wastewater Sludge and Reduce Conductivity of Salt Water

As a human race we face many global challenges. There is an increasing demand for new and green energy sources and more than 780 million people around the world lack access to clean drinking water. While scientists are exploring wind, geothermal, and solar options, we have overlooked the power of wastewater.

The purpose of this project was to create a device that can produce clean drinking water and generate electricity simultaneously. Microbial Desalination Fuel Cells (MDFC) leverage the digestion process of anaerobic bacteria to produce electricity and desalinate sea water. As the anaerobic bacteria from the waste water sludge completes its digestion process carbohydrates and fats are broken down to release methane and carbon dioxide. At the same time, during oxidation, free electrons are released in the anode. As the electrons move out of the anode and into the cathode through the external circuit, there is a positive charge created in the anode. This helps the chloride ions (Cl-) in the desalination chamber to travel towards the anode. Similarly, the cathode receives the electrons and that results in a negative charge. This helps the sodium ion (Na+) enter the cathode, thereby decreasing the conductivity of the salt solution in the desalination chamber.

With just 300 mL of anaerobic sludge obtained from the Littleton/Englewood Waste Water Treatment Plant, I was able to generate up to 5.1 millivolts of electricity over a ten day period. During this time, the conductivity level in the desalination chamber dropped from 58.1 mS to 52.3 mS.