Low Cost Continuous Flow Microbial Desalination Cells for Environmentally Sustainable Integrated Water Treatment

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Microbial Desalination Cells (MDCs), modified microbial fuel cells with a chamber for water desalination made of ion exchange membranes, are a promising new technology in environmentally sustainable water treatment. Electrogenic bacteria in the anode produce current that is transferred to the cathode where reduction occurs, then the electrons flow back across the system, ionizing saline water in a central chamber. The salt ions are attracted to the anode and cathode through the ion exchange membranes, leaving desalinated water in the center. Waste water used as fuel for the system also allows for simultaneous, but separate, waste water treatment. These systems produce no toxic byproducts, require almost no outside energy, and can sustain use for long periods of time. However, current construction methods are costly and investigation into performance in real-world applications is needed. A tubular MDC system that allows for continuous water treatment of both salt-water and waste water was constructed using low-cost materials. The treatment goal was a 50-60% reduction in salinity with both aerobic and anaerobic waste water treatment. Additionally, applied external voltage was analyzed as a method to increase desalination efficiency. Changes in pH, conductivity, Total Dissolved Solids, and peak voltage were used to determine system effectiveness. The system met design and treatment objectives, with up to 59.3% desalination without applied voltage and up to 85.4% desalination with applied voltage, and cost approximately $450 to construct. These results support the use of MDCs outside of laboratory settings, and potentially as a way to pre-treat water used in other water treatment processes to reduce energy expenditures, and to bioremediate waste water.

Awards Won:
Third Award of $1,000