The Future of Potable Water: Air Cathode Microbial Desalination Cells

Jain, Rishabh (School: Singapore American School)
Schmid, Alexandra (School: Malmo Borgarskola)

Microbial desalination cells (MDCs) incorporate microbial fuel cell technology and electrodialysis to simultaneously desalinate water and create renewable energy. Bacteria transfer electrons to meet oxygen, an electron acceptor, at the air cathode which produces voltage. The charged electrodes attract the sodium and chloride ions of salt water, which pass through ion exchange membranes and leave behind desalinated water. This experiment used initial saline solutions of 0%-6.5% salinity to simulate the future application of different water sources, such as seawater (3.5%) and brine solutions (6.5%). The air cathode is comprised of stainless-steel mesh with a carbon coating which allows for oxygen diffusion. Air cathodes, constructed with a range (size 20-70) of coarse and fine stainless steel mesh, altered the oxygen diffusion rate and varied the frequency of the oxygen reduction reaction. Voltage production was monitored over a period of 24 hours and the amount of total dissolved solids (TDS) removed from the solution was calculated to assess the performance in both energy production and desalination. Among the MDCs with varied salinities, the higher saline solutions had the highest performance; the 6.5% solution had a peak voltage of 17mV and 21% TDS removal. An increased amount of TDS in low initial saline solutions suggests that MDCs are unsuitable for treating low concentration saline solutions. The coarser air cathodes had the highest performance; the size 30 mesh had a peak voltage of 17mV and 15% TDS removal. These results suggest that an MDC would perform better treating high concentration saline water with a coarse air cathode, but further improvements to increase the TDS removal are needed for practical applications in producing potable water.