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Self-Sustained Desalination in Combination with Wastewater Treatment – Hybrid Microbial Desalination

Our previous study, Phase I, demonstrated that the microbial desalination cell (MDC) was a promising new technology for self-sustained desalination and wastewater treatment process. However, the electron acceptor used in the cathode was ferriccyanide, a toxic and relatively expensive chemical. Therefore, Phase II of our study investigated the use of a new electron acceptor, dissolved oxygen from the air, by innovating the design of the MDC to include an air cathode. The wastewater was also re-circulated between the anode and the cathode to minimize the change in pH of the anode and cathode.

Our experiments were conducted with a three-cell air cathode MDC as the batch operation system. Anion and cation exchange membranes were used to separate the chambers to enable desalination in the middle chamber. The desalination efficiency was assessed using 10 g/L sodium chloride solution and real reverse osmosis (RO) concentrate.

The following was concluded:
1. Continuous circulation of wastewater balancing the pH variation in the anode and cathode cells without addition of pH buffer solutions
2. Oxygen, dissolved naturally from air into the catholyte through an air cathode, is as effective an electron acceptor as ferriccyanide.
3. Desalinating RO concentrate is more beneficial to MDC performance than a pure salt solution because RO concentrate contains organics that can provide additional nutrients for the microbes.

Therefore, the modified MDC is a viable process that desalinates salt brine and treats domestic wastewater without the addition of chemicals. The study improves the MDC to be more applicable to the real world.