Optimizing External Load in Microbial Desalination Cell System for Electricity Production via Seawater Desalination

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Abstract

The maximum produced cell potential was 431.95 mV during inoculation stage with external resistance 50 Ω when activated, digester sludge and whey solution were mixed with the raw wastewater. The maximum removal of chemical oxygen demand (COD) and TS were 57.14% and 14.29%, respectively, from the raw sewage. The maximum increase in substrate conductivity after the treatment of raw sewage was 167 μS/cm using the external resistance 150 Ω, while, the maximum decrease in pH was 1.05 for the external resistance 100 Ω. The maximum desalination efficiency and the reduction in conductivity for the seawater were 46.52% and 18.10 mS/cm, respectively, at the external resistance 10 Ω. The maximum pH reduction was 1.15 for the seawater for the external resistance 50 Ω. The maximum cell potential was recorded at the external resistance of 150 Ω was 586.28 mV. The achieved maximum electric current, power and columbic efficiency (CE) at an external resistance of 25 Ω were 17.59 mA, 7731.68 mW and 58.30%, respectively. The maximum open circuit (OCV) was found to be 918.00 mV for the operating resistance of 20 Ω, which showed the best applied resistance for the MDC system. With this best operating resistance, the system produced the maximum power density of 302.25 mW/m² with substrate loading of 336 mg/l as raw sewage. The performance of the MDC reactor in term of acid and base production was not significant. The pH of phosphate buffering solution increased instead of decreasing. The performances of
the investigated MDC system showed a great potential for recovering electrical power with a significant removal of organics from wastewater and salt from seawater.