Supporting information

Evaluating a multi-panel air cathode through electrochemical and biotic tests

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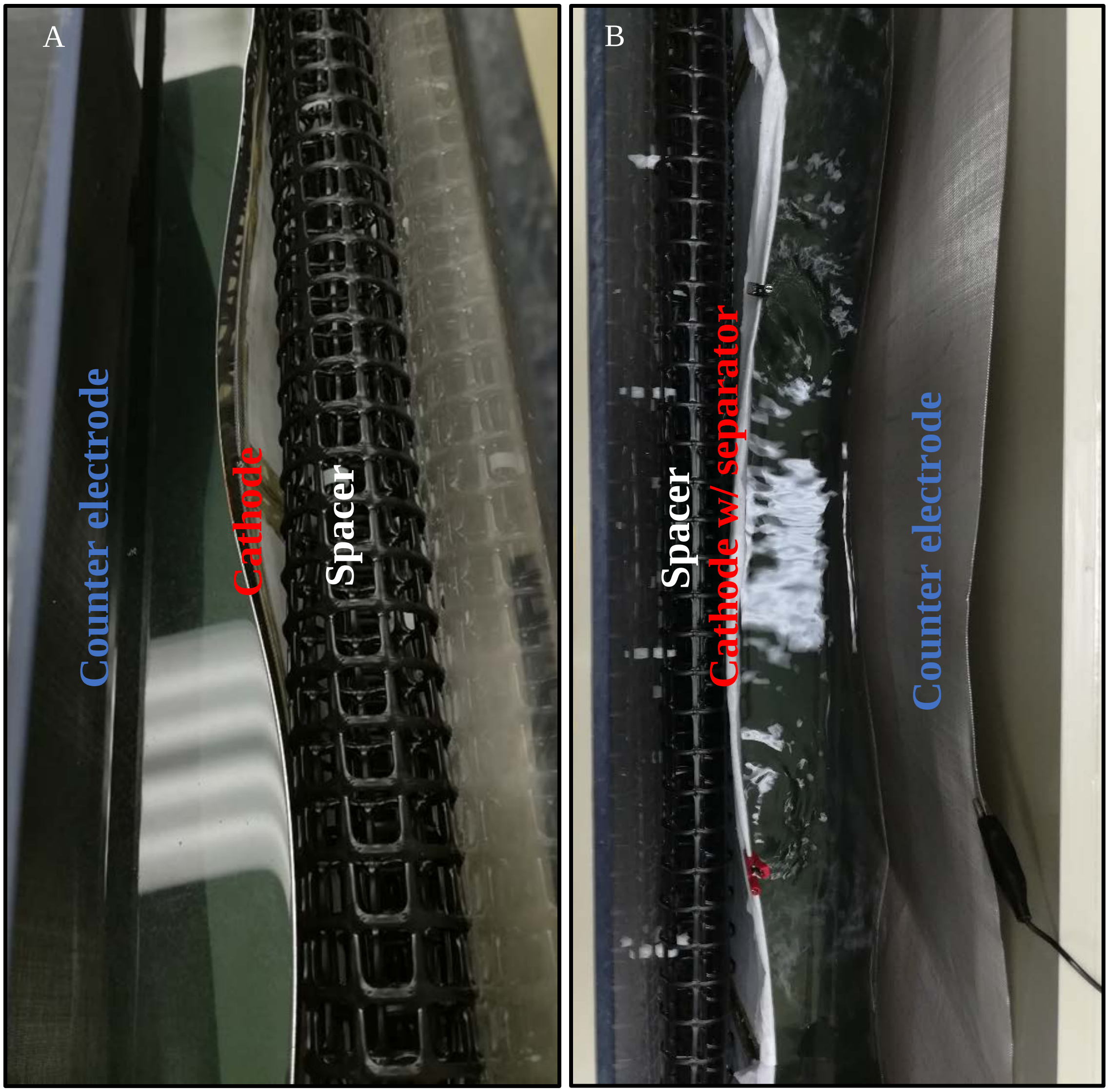

Figure S1. Photos of the plastic spacers in the large chamber (A) in the absence and (B) in the presence of a separator.

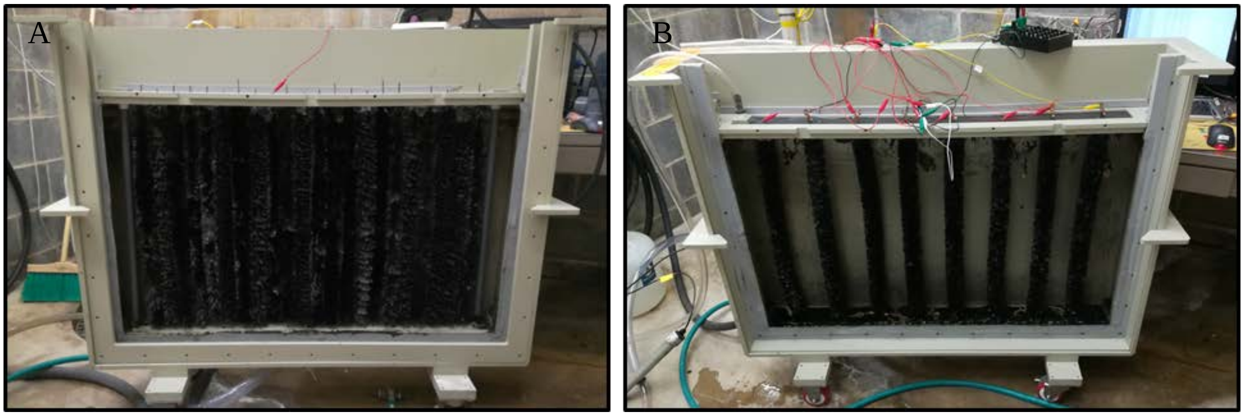

Figure S2. Photos of the anode module of the large chamber with (A) 22 anodes and (B) 8 anodes.

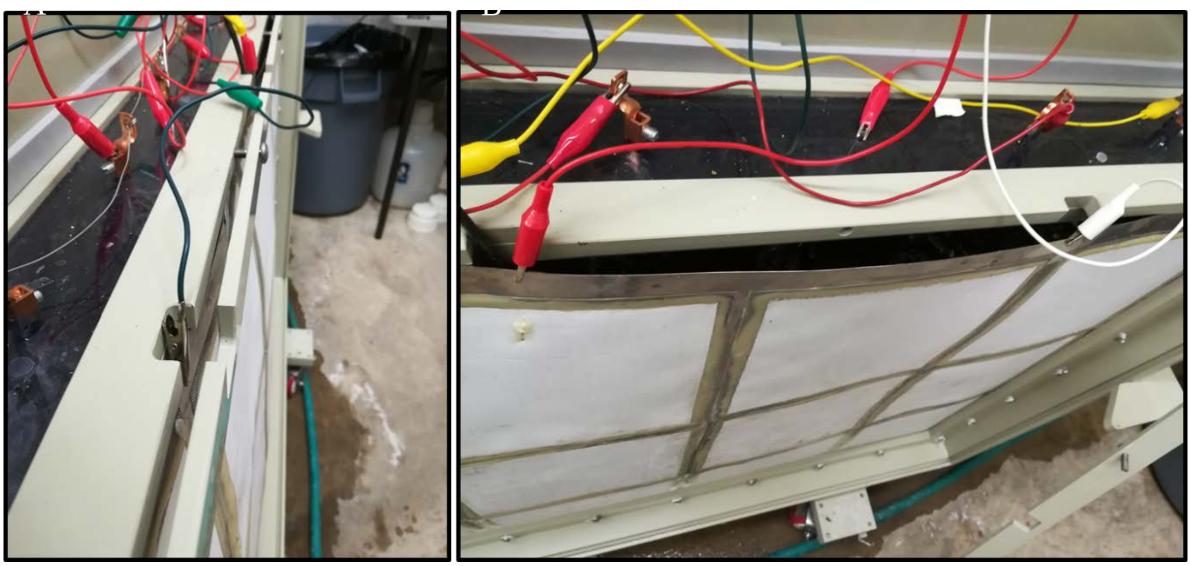

Figure S3. (A) Side view and (B) front view of the clips at the top of the anode module.

Correcting electrode potentials for ohmic drops with increased current

The distance between the working electrode (WE) and the reference electrode (RE) contributes to deviations in the WE voltage registered by a potentiostat due to the ohmic resistance (i.e., IR or ohmic drop). The WE potential corrected for the ohmic resistance can be estimated using the measured potential as

$$E_{WE-RE} = E_{WE} - \left(\frac{10^3\, R_\Omega\, d_{WE-RE}}{l}\right) i$$

where d_{WE-RE} is the distance (cm) between the WE and the RE, i is the current (A) and $\frac{R_\Omega}{l}$ is the solution ohmic resistance per unit length, that can be calculated as

$$\frac{R_\Omega}{l} = \frac{10^3}{\sigma A}$$

where A is the cross-sectional area of the electrode (0.0007 m^2 and 0.0033 m^2), and 10^3 is to convert mS into S (where 1 S = Ω^{-1}). The impact of the ohmic drop can be seen based on the corrected WE potentials compared to the measured potentials in Figure S4. This IR drop will reduce the maximum power density that can be produced in an MFC from the electrode potentials.

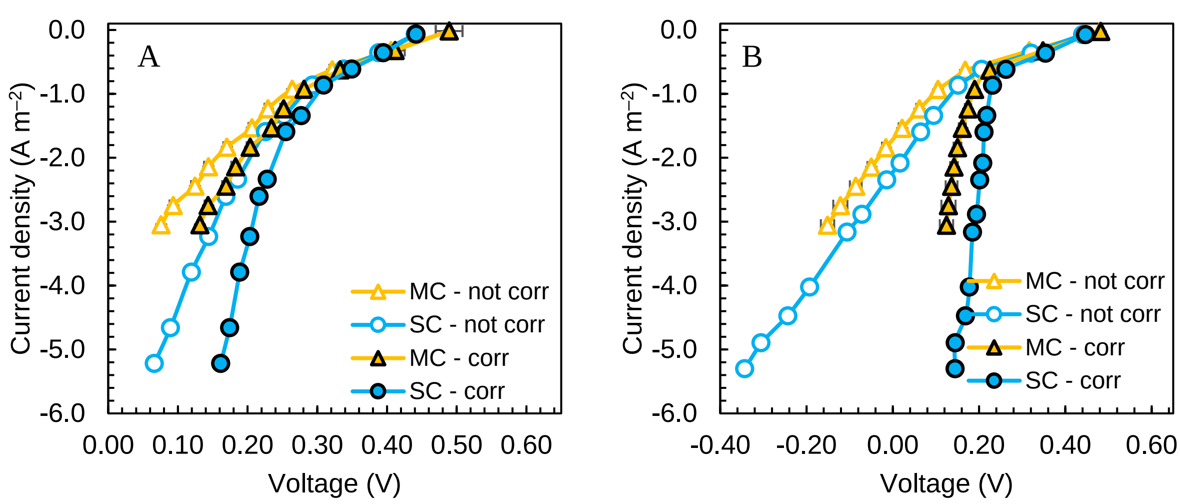

Figure S4. Corrected (corr) and not corrected (not corr) cathode potential as a function of current density measured in the electrochemical cell for the cathodes in the small (SC) and medium chamber (MC) in (A) 50 mM PBS (6.25 mS cm^{-1}) and (B) tap water with NaCl (1.45 ± 0.05 mS cm^{-1}) with an electrode spacing (d_{WE-RE}) of 1.2 cm.

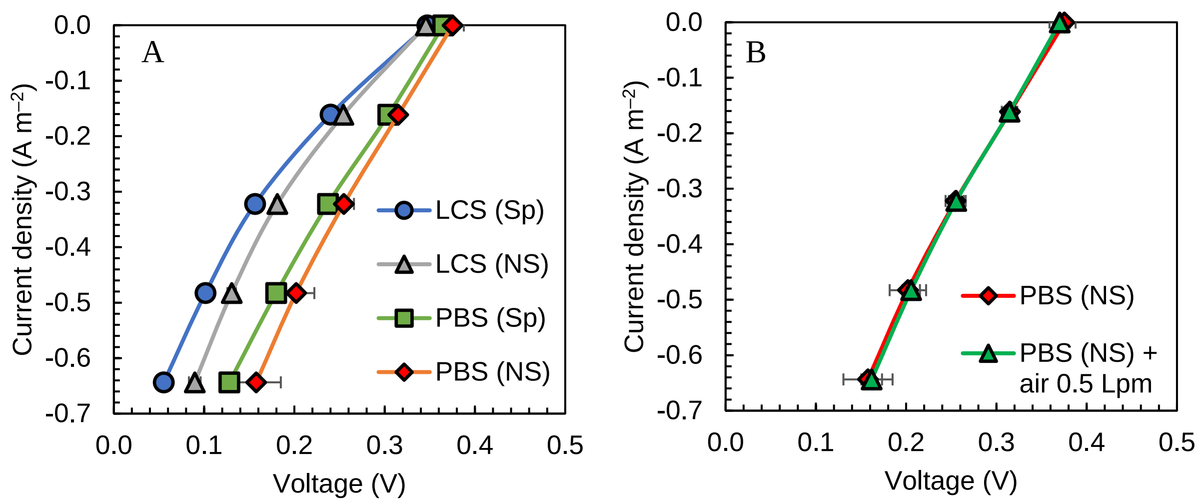

Figure S5. (A) Chronopotentiograms of cathodes in the large (85 L) chamber in 50 mM PBS and in tap water amended with NaCl (LCS) in the presence (Sp) and the absence (NS) of the separator. (B) Chronopotentiograms of cathodes in the large (85 L) chamber in 50 mM PBS in the absence (NS) of the separator, with and without blowing additional air through the air chamber at a flowrate of 0.5 liters per minute (air 0.5 Lpm).

Correcting electrode potentials for increased electrode spacing

Polarization tests using the small chamber MFCs were conducted with an electrode spacing of 1.4 cm, while in the 85 L MFC the distance between anode and cathode was 3.5 cm. Thus, to estimate the performance of the larger reactor for a set of electrode potentials, the power lost to the ohmic drop must be included in the calculation. The anode potentials not corrected for the IR drop obtained using wastewater were fit using a straight trendline, allowing prediction of the anode potentials at any current density (Figure S6). The anode potential was then corrected for the increased ohmic resistance due to the higher anode–cathode spacing

$$E_{WE-RE} = E_{WE} - \left(\frac{10^3\, R_\Omega\, d_{WE-RE}}{l}\right) i$$

Increasing the distance between anode and cathode from 1.4 cm 3.5 cm resulted in an increase in the ohmic resistance from 142 Ω to 352 Ω with a solution conductivity of 1.4 mS cm^{-1}.

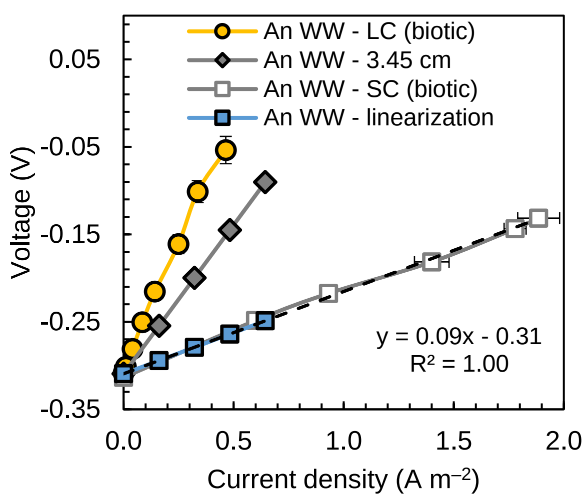

Figure S6. Measured, linearized and estimated anode potentials in 28 mL MFCs (SC) and measured anode potentials in 85 L MFCs (LC) in wastewater (WW).