Supporting information

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

Ruggero Rossi[a], David Jones[a], Jaewook Myung[b], Emily Zikmund[a], Wulin Yang[a], Yolanda Alvarez Gallego[c], Deepak Pant[c], Patrick J. Evans[d], Martin A. Page[e], Donald Cropek[e], Bruce E. Logan[a]*

[a] Department of Civil and Environmental Engineering, The Pennsylvania State University, University Park, PA 16802, USA
[b] Department of Civil and Environmental Engineering, Southern Methodist University, Dallas, TX 75205, USA
[c] Separation & Conversion Technology, Flemish Institute for Technological Research (VITO), Boeretang 200, Mol 2400, Belgium
[d]CDM Smith, Bellevue, WA 98007, USA
[e]U.S. Army Corps of Engineers, Engineer Research and Development Center, Construction Engineering Research Laboratory, Champaign, IL 61822, USA

*Corresponding author. Tel.: +1 814 863 7908; fax: +1 814 863 7304.
E–mail address: blogan@psu.edu (B.E. Logan).

No of Pages: 8
Number of Figures: 7
Number of Tables: 1

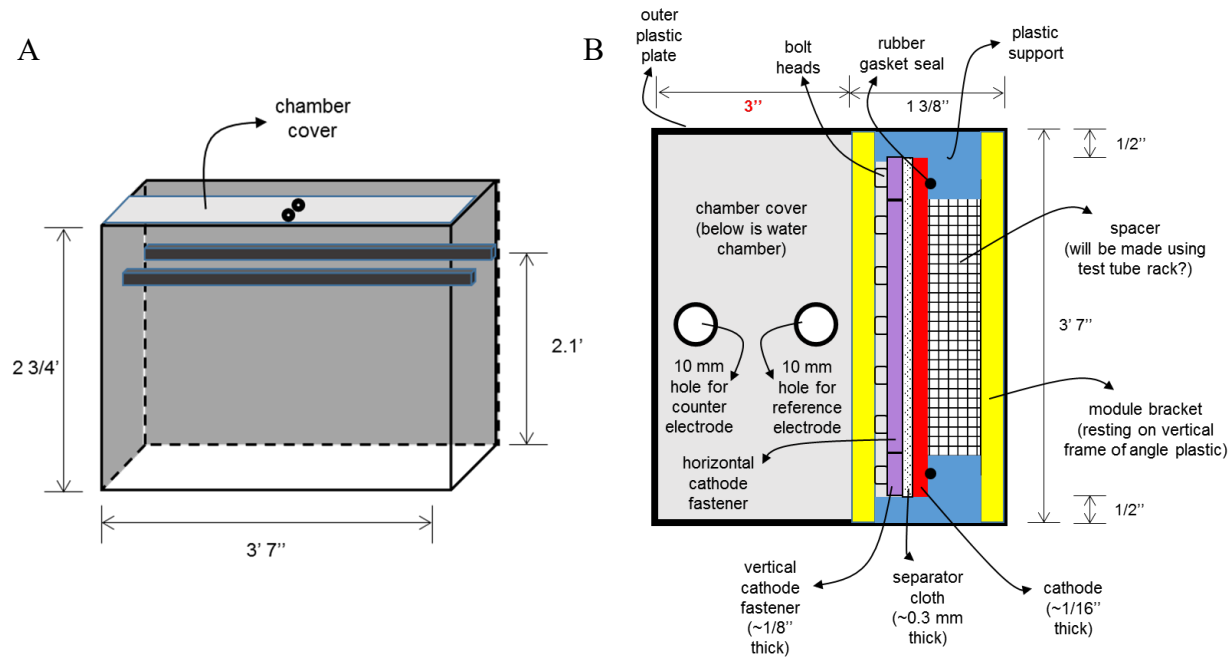

Figure S1. Design of the large-scale chamber. (A) Side view and (B) top view of the chamber.

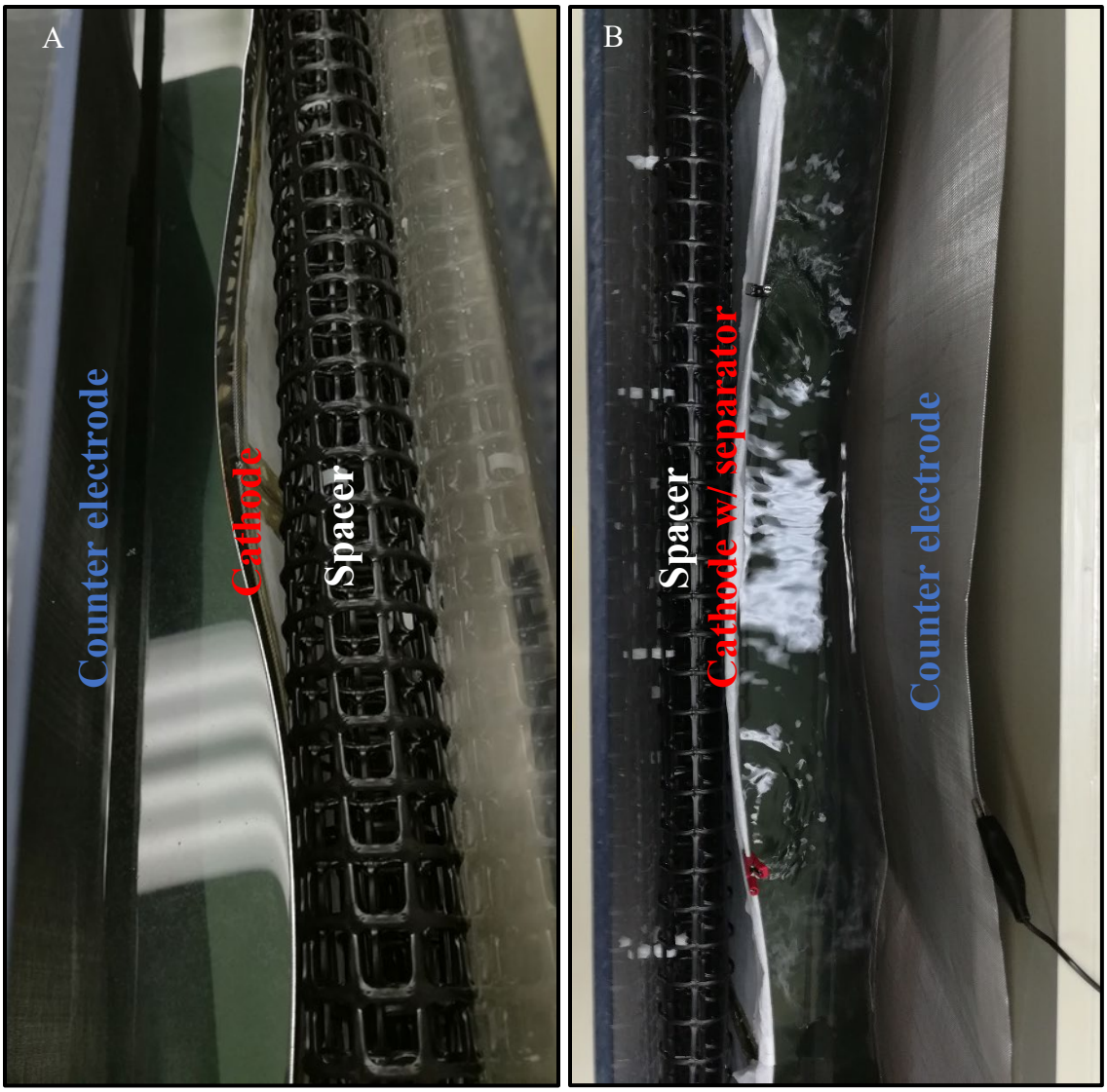

Figure S2. Photos of the plastic spacers in the large chamber (A) in the absence and (B) in the presence of a separator.

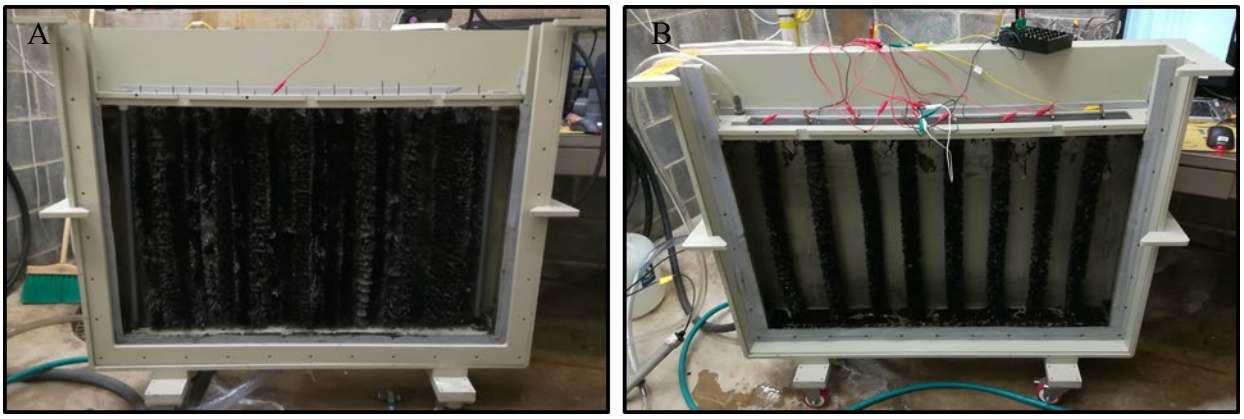

Figure S3. Photos of the anode module of the large chamber with (A) 22 anodes and (B) 8 anodes.

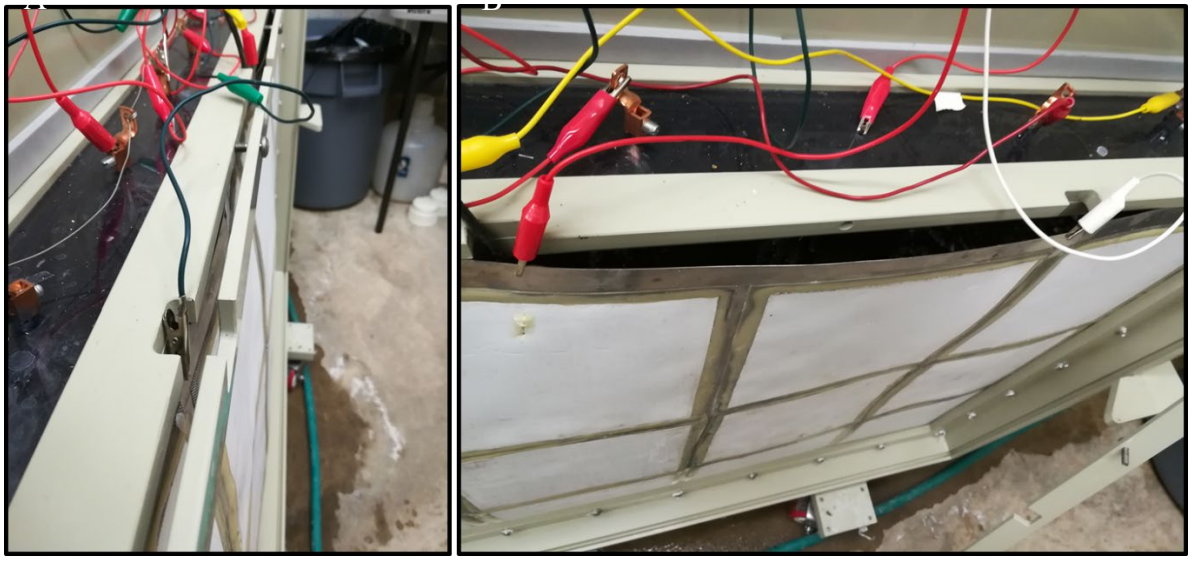

Figure S4. (A) Side view and (B) front view of the clips at the top of the anode module.

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 0.62 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.

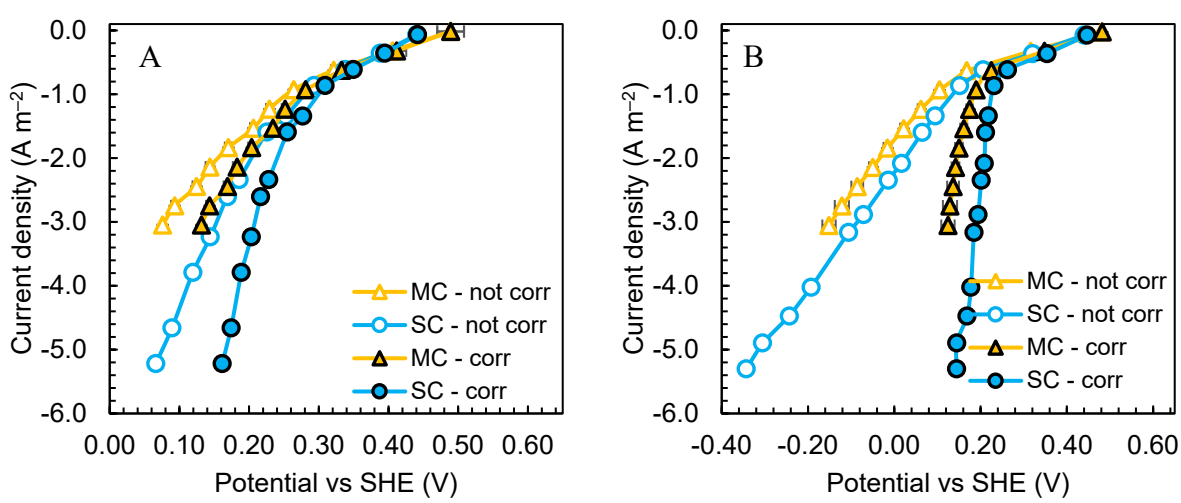

Figure S5. Corrected (corr) and not corrected (not corr) cathode potential as a function of current density measured in the electrochemical cell for the cathodes in the small (SC) and medium

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.

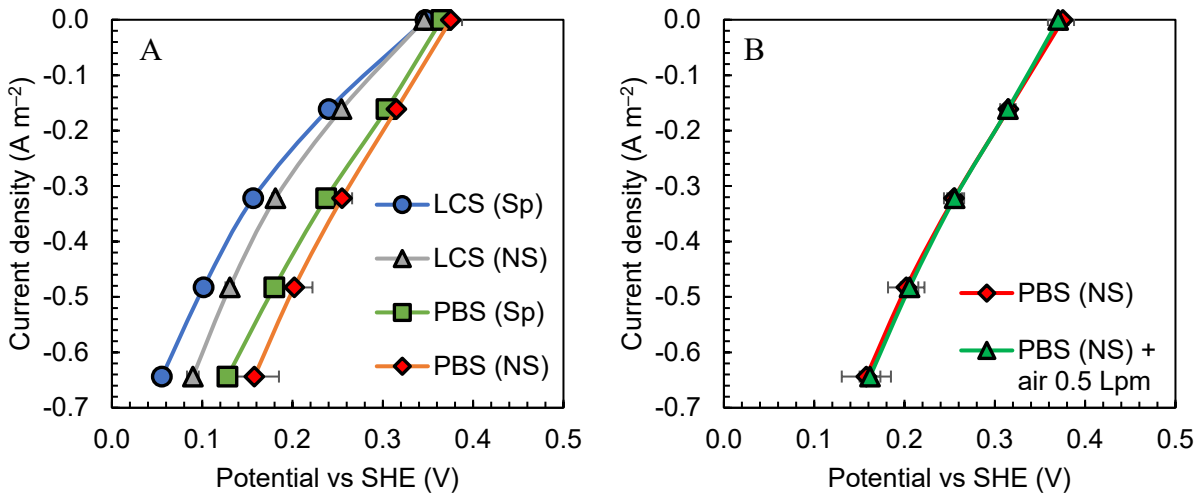

Figure S6. (A) Chronopotentiograms of cathodes in the large (85 L) chamber in 50 mM PBS and in tap water amended with NaCl (LCS) in the presence (Sp) and the absence (NS) of the separator. (B) Chronopotentiograms of cathodes in the large (85 L) chamber in 50 mM PBS in the absence (NS) of the separator, 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 (distance anode-RE = 0.2 cm), while in the 85 L MFC the distance between anode and cathode was 3.5 cm (distance anode-RE = 3.3 cm). Thus, to allow a fair comparison of the performance of the anode is the large and in the small cells, the anode potentials of the 85 L and of the 28 mL MFCs were both corrected for the ohmic drop, allowing comparison between the two studies (Figure S7).

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

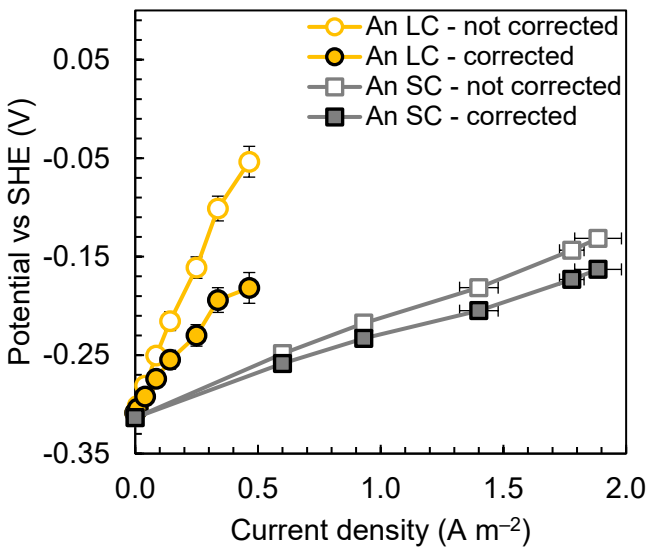

Figure S7. Measured and corrected anode potentials in 28 mL MFCs (SC) and in 85 L MFCs (LC) in wastewater.

Table S1. Operational parameters of the 85 L MFC in different configurations from the polarization tests. The anode and cathode potentials were not corrected for the ohmic losses.

Cell configuration	*P_{max}* *(W m^{-2})*	*Cathode potential at P_{max} vs SHE* *(V)*	*Anode potential at P_{max} vs SHE* *(V)*	*OCV* *(V)*	*Current density at P_{max}* *(A m^{-2})*
22 anode brushes	0.083 ± 0.006	0.17 ± 0.03	-0.16 ± 0.01	0.67 ± 0.03	0.250 ± 0.006
8 anode brushes	0.061 ± 0.003	0.17 ± 0.01	-0.121 ± 0.006	0.63 ± 0.03	0.206 ± 0.006