Supplementary data:

MICROBIAL FUEL CELLS FOR SULFIDE REMOVAL

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Summary:

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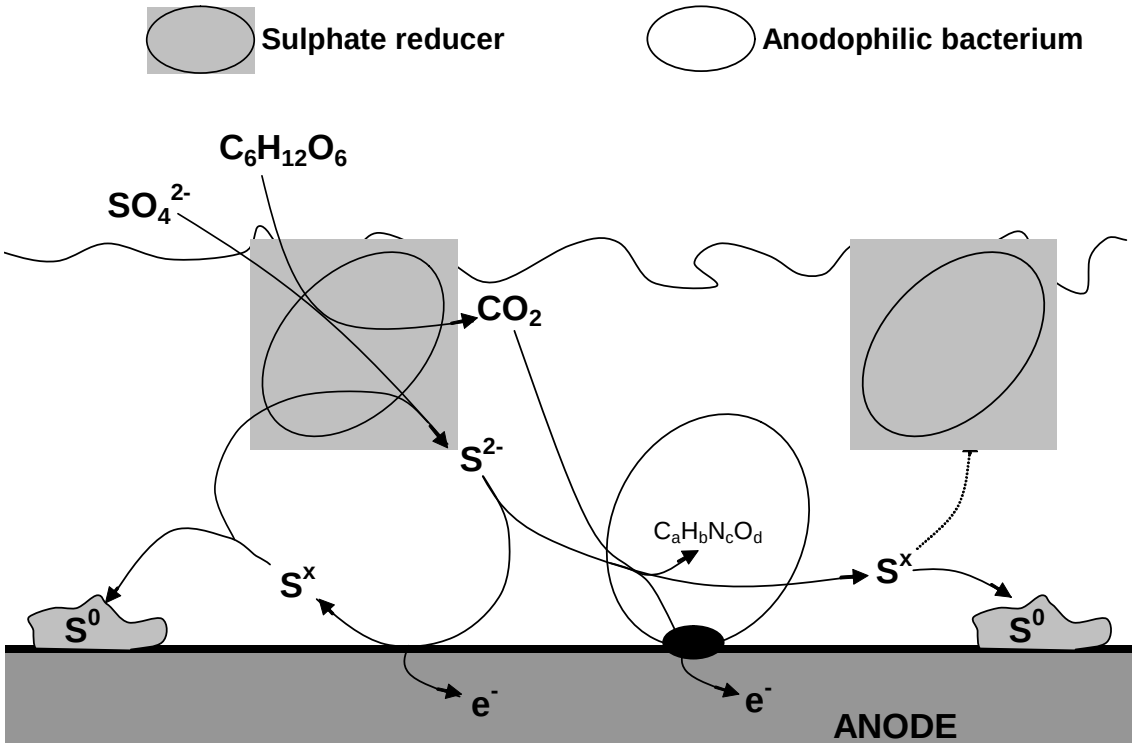

Figure S1. Hypothesized model of the sulfur cycle in microbial fuel cells. Sulfate is reduced at the top of the anodic biofilm. The produced sulfide migrates into the biofilm matrix where it can evolve, biologically or chemically, to more oxidized sulfur species through the oxidative effect of the anode. Dependent on the electrode potential, or the biological oxidation, elemental sulfur can be precipitated and hence removed from the feed stream. S^x: oxidized sulfur species as e.g. polysulfides and S_2O_3.

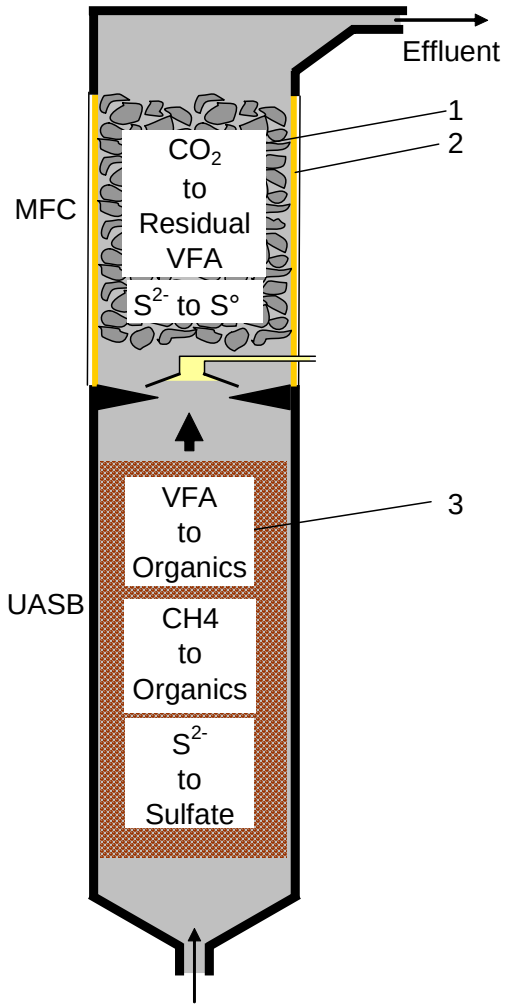

Figure 6. Principle of MFC-UASB combinatory technology. In the lower reactor part, anaerobic aggregates microbiologically convert organics present in the influent to fatty acids (VFA) and methane and reduce the sulfate to sulfide. In the upper MFC part, the sulfides and the residual VFA are oxidized with the formation of CO_2 and S°. The result is (i) a liquid effluent free of organics and sulfides, (ii) electricity from the MFC and (iii) a biogas consisting mainly of methane and CO_2. 1: Anode material; 2: Membrane and open air cathode; 3: anaerobic zone with microbial UASB aggregates.

Table S1. Overview of the obtained data presented in this study. Additional experiments are included i.e. two experiments on simultaneous acetate and sulfide removal out of a synthetic effluent (M9 basis with 0.29 g/l acetate, 0.29 g/l S^{2-} as Na_2S) and two experiments on simultaneous lactate and sulfate removal (M9 basis with 0.097 g/l SO_4^{2-} -S and 0.29 g/l lactate)

Experiment	Sulfide removal	Sulfate removal	Acetate removal	COD removal	Power (max)	CE sulfide	CE Carbon compounds	Sulfur production
	(mg S l^{-1} influent)	(mg S l^{-1} influent)	(mg l^{-1} influent)	(mg l^{-1} influent)	(mW l^{-1} NAC)	%	%	%
Square type MFC								
Batch sulfide,								
Control, 100 mg l^{-1}	13 ± 10.0	-	-	-	-	-	-	/
MFC, 100 mg l^{-1}	97 ± 4	-	-	-	37[¥]	50 ± 4	-	/
Cont. sulfide, 100 mg l^{-1}	98 ± 2	-	-	-	1.1 ± 0.6 (3.5)	30 ± 8	-	9 ±4
Cont. sulfide, 330 mg l^{-1}	324 ± 8	-	-	-	3.3 ± 6.2 (27.8)	15 ± 4	-	
Controlled, sulfide, 100 mg l^{-1}	100[×]	-	-	-	27.5 ± 1.1 (80.4)[∞]	32 ± 3	-	/
Tubular type MFC								
Acetate and sulfide								
Control	17 ± 15	-	558 ± 446	-	-	-	-	79
MFC, UASB eff	79 ± 60	-	1391 ± 139	-	26 ± 24 (101)	35[†]		59
MFC, bis[+]	288 ± 2	-	288 ± 3	-	20.3 ± 0.5 (21.1)	12[†]		/
Glucose and sulfate								
Control	440 ± 37*	472 ± 33	-	413 ± 339	-	-	-	/
MFC	496 ± 29*	498 ± 29	-	374 ± 327	16 - 36	not distinguishable		/
Lactate and sulfate								
MFC, 97 mg SO_4^{2-}. S	61 ± 4*	71 ± 1	-	-364 ± 674	5.4 ± 0.5 (14.9)	not distinguishable		/

- \- not applicable
- n.d. below detection limit
- / not determined
- * based on the assumption that all sulfate was reduced to sulfide
- [+] additional experiment, 0.29 g/l acetate, 0.29 g/l S^{2-}, modified M9
- [¥] maximum value due to batch type profile
- [×] effluent concentrations below detection limit
- [†] pooled efficiency for acetate and sulfide
- [∞] value between -300 and -200 mV vs. SHE
- CE Coulombic efficiency