APPENDIX A: SOUCE DATA FOR CHAPTER 2
KINETIC, BIOCHEMICAL AND REDOX RESPONSES ASSOCIATED WITH ANOXIC, MICROAEROBIC, AND AEROBIC BTX METABOLISM

Table A1. Source data for Figure 1 in chapter 2. (Date: 10/6/1998)

Time	ORP	Nitrate-N	Nitrite-N	Sulfate	Benzene	Toluene	*o*-Xylene	*m*-Xylene	*p*-Xylene	Benzoyl-CoA reductase	Catechol 1, 2-dioxygenase	Catechol 2, 3-dioxygenase
hr	mV	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mU/mg protein	mU/mg protein	mU/mg protein
0.0	-108	78.74	72.88	16.74	1.60	1.45	2.48	0.23	1.40	3.46	ND	0.69
0.5	-94	35.48	121.58	16.74	5.26	4.11	5.52	4.69	5.06	6.52	ND	0.21
1.0	-115	13.19	123.90	16.74	5.58	2.57	6.30	4.13	6.03	14.78	ND	ND
3.0	-111	9.26	100.71	16.74	5.24	0.86	5.98	3.03	5.72	11.23	0.72	0.20
6.0	-151	ND	58.97	16.74	5.68	0.26	6.56	1.96	6.28	11.49	ND	ND
9.0	-144	ND	44.56	16.74	5.26	ND	6.13	0.55	5.83	4.22	0.59	ND
12.0	-150	ND	22.41	16.74	5.18	ND	6.12	ND	5.82	3.39	0.57	ND
15.0	-144	ND	14.99	16.74	5.08	ND	5.96	ND	5.62	4.91	ND	ND
18.0	-146	ND	2.39	16.74	4.93	ND	5.85	ND	5.52	3.92	ND	ND
21.75	-162	ND	0.55	16.74	5.03	ND	5.98	ND	5.60	3.12	ND	ND

Table A2. Source data for Figure 2 in chapter 2. (Date: 10/19/98)

Time	ORP	Nitrate-N	Nitrite-N	Sulfate	Benzene	Toluene	*o*-Xylene	*m*-Xylene	*p*-Xylene	Benzoyl-CoA reductase	Catechol 1, 2-dioxygenase	Catechol 2, 3-dioxygenase
hr	mV	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mU/mg protein	mU/mg protein	mU/mg protein
0.0	-145	130.37	48.03	14.62	2.47	0.47	2.12	0.28	2.14	1.84	0.00	0.17
0.5	-155	47.87	107.21	14.62	5.37	4.28	4.81	4.69	4.86	3.97	0.00	0.46
1.0	-160	29.87	91.81	14.88	5.33	3.68	4.85	4.23	4.89	10.34	2.39	0.39
3.0	-177	ND	74.21	14.88	5.00	1.73	4.99	2.66	4.97	9.36	1.97	0.50
6.0	-177	ND	41.50	14.62	5.07	ND	5.01	1.54	4.97	4.12	0.00	0.31
9.0	-174	ND	3.94	14.62	5.20	ND	4.67	0.35	5.00	4.02	6.21	9.89
9.33	-90											
9.5	-54											
10.0	-33	ND	3.87	14.35	5.02	ND	4.64	ND	4.71	2.00	13.62	13.12
11.0	-22	0.40	3.83	14.62	4.90	ND	4.62	ND	4.42	1.44	13.92	11.92
13.0	60	1.05	3.68	14.62	3.75	ND	3.85	ND	3.85	1.21	20.02	27.21
15.0	65	3.00	3.43	14.62	2.76	ND	2.58	ND	2.35	0.86	16.19	25.67
18.0	68	4.20	3.28	14.62	0.56	ND	1.14	ND	0.66	1.18	12.18	17.89
21.75	70	4.20	3.28	14.62	0.00	ND	0.00	ND	0.00	0.75	11.60	4.68

Table A3. Source data for Figure 3 in chapter 2. (Date: 12/16/1998)

Time	ORP	Nitrate-N	Nitrite-N	Sulfate	Benzene	Toluene	*o*-Xylene	*m*-Xylene	*p*-Xylene	Benzoyl-CoA reductase	Catechol 1, 2-dioxygenase	Catechol 2, 3-dioxygenase
hr	mV	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mU/mg protein	mU/mg protein	mU/mg protein
0.0	-109	76.72	42.52	19.79	2.33	1.20	1.27	0.43	1.25	1.33	0.12	0.18
0.5	-146	43.48	87.55	19.79	5.03	4.61	4.94	5.32	5.04	3.92	ND	0.00
1.0	-125	19.99	85.60	19.79	5.20	3.77	5.21	4.93	5.25	22.16	ND	0.36
3.0	-147	0.42	69.35	19.54	5.18	2.56	5.14	3.70	5.27	9.78	ND	0.00
6.0	-159	0.33	34.13	19.79	5.04	ND	5.07	1.66	5.13	7.33	0.57	0.91
9.0	-169	0.30	14.82	18.77	5.07	ND	5.04	ND	5.10	4.25	ND	0.00
10.0	-54	0.29	14.41	18.77	4.80	ND	4.98	ND	4.97	1.39	12.58	15.56
11.0	-37	0.32	13.32	18.27	4.62	ND	4.43	ND	4.44	2.00	16.69	21.46
13.0	-27	0.34	10.72	18.77	3.24	ND	2.89	ND	2.52	0.96	18.06	28.45
15.0	-44	0.36	7.99	18.77	1.97	ND	1.40	ND	1.26	1.29	13.28	17.35
17.0	-37	0.35	7.80	18.77	0.49	ND	ND	ND	ND	0.95	11.49	13.78
21.75	-30	0.32	ND	19.03	ND	ND	ND	ND	ND	1.78	9.06	9.36

Table A4. Source data for Figure 4 in chapter 2. (1/29/1999)

Time hr	ORP mV	Nitrate-N mg/l	Nitrite-N mg/l	Sulfate mg/l	Benzene mg/l	Toluene mg/l	*o*-Xylene mg/l	*m*-Xylene mg/l	*p*-Xylene mg/l
0	-115	96.09	84.89	17.45	2.29	2.16	2.36	1.25	2.56
0.5	-145	27.33	109.55	18.51	4.76	3.98	4.89	5.33	4.91
1	-148	ND	94.11	16.39	4.65	3.38	5.03	4.66	4.83
3	-154	ND	52.59	17.45	4.68	1.84	5.09	3.64	4.92
6	-157	ND	31.05	16.98	4.71	ND	5.21	1.50	5.03
9	-172	ND	12.69	16.39	4.83	ND	5.29	ND	5.11
9.5	-92	ND	7.61	15.86	4.11	ND	4.99	ND	4.85
10	-47	ND	6.06	16.39	4.00	ND	4.48	ND	4.50
10.5	-30	ND	4.91	16.13	3.90	ND	4.37	ND	4.15
11	-40	ND	3.67	17.98	3.77	ND	4.17	ND	3.95
11.5	-45	ND	2.53	17.45	3.53	ND	3.94	ND	3.67
12	-60	ND	ND	16.54	3.31	ND	3.70	ND	3.42
12.5	-65	ND	ND	17.09	3.19	ND	3.51	ND	3.25
13	-69	ND	ND	17.09	3.09	ND	3.46	ND	3.10
13.5	-61	ND	ND	17.09	2.93	ND	3.25	ND	2.88
14	-65	ND	ND	17.09	2.84	ND	3.17	ND	2.83
14.5	-60	ND	ND	17.64	2.82	ND	3.15	ND	2.77
15	-62	ND	ND	17.09	2.63	ND	2.77	ND	2.63
15.5	-42	24.03	ND	17.04	2.35	ND	2.59	ND	1.86
16	-48	22.70	ND	17.04	2.02	ND	2.23	ND	1.74
16.5	-27	22.37	ND	17.04	1.67	ND	1.84	ND	1.45
17	-21	22.04	ND	16.37	1.32	ND	1.47	ND	1.16
17.5	-20	21.71	ND	16.37	0.96	ND	1.12	ND	0.81
18	-37	21.37	ND	16.37	0.62	ND	0.80	ND	0.54
18.5	-45	20.71	ND	16.37	0.27	ND	0.53	ND	0.23
19	-38	20.05	ND	16.37	0.06	ND	ND	ND	0.17
19.5	-35	19.75	ND	16.37	ND	ND	ND	ND	ND
20	-32	19.68	ND	16.37	ND	ND	ND	ND	ND
21	-45	19.22	ND	16.37	ND	ND	ND	ND	ND

DOC A1. Calculation of the energy balance presented in Figure 5.

Assumptions:
1. Biogenic substrates do not exist under microaerobic conditions. They are consumed under anoxic conditions.
2. Complete conversion of H_2O_2 into O_2.
3. Respiration rate was calculated based on a profile in the anoxic SBR. It is assumed that the respiration rate in anoxic reactor is the same as that in the anoxic/microaerobic SBR
4. In the calculation of the respiration rate, it is assumed that the substrates were completely consumed before 8th hour after the start of the reaction cycle in the anoxic reactor. The electron acceptor used is due to the respiration after the 8th hour.

Profile A:
Feed: biogenic substrates: 600mg/l COD;
Benzene, toluene , o-, m-, p-xylene: around 5 mg/l each;
nitrate-N: 167 mg/l (477.62 mg/l as COD)
2 L reactor

1. COD balance under anoxic conditions (0-9 hour)

a). oxygen demand due to the substrate consumption.

$$= S_0 \times (1 - Y_s) \times V + (1 - Y_x)[(S_{t0} - S_{tt}) \times f_t + (S_{mx0} - S_{mxt}) \times f_{mx}] \times V$$
$$= 600 \times (1 - 0.41) \times 2 + (1 - 0.34)[(5 - 0) \times 3.13 + (5 - 0) \times 3.17] \times 2$$
$$= 749.58 \text{ mg COD}$$

b). oxygen demand due to respiration

$$= R \times V \times T$$
$$= 7.11 \times 2 \times 9$$
$$= 127.98 \text{ mg COD}$$

c). oxygen demand satisfied with oxygen

$$= 0$$

d). oxygen demand satisfied with nitrite-N

$$= 0$$

e). oxygen demand satisfied with Nitrate-N

$$= (S_{n30} - S_{n3t}) \times f_{n3} \times V - (S_{n2t} - S_{n2o}) \times f_{n2} \times V$$
$$= (167 - 0) \times 2.86 \times 2 - (2.72 - 0) \times 1.71 \times 2$$
$$= 945.94 \text{ mg COD}$$

Total oxygen demand = oxygen demand due to substrate consumption +
Oxygen demand due to respiration

$$= 749.58 + 127.98$$
$$= 877.56 \text{ mg COD}$$

Total oxygen demand satisfied = oxygen demand satisfied with oxygen +
oxygen demand satisfied with nitrite-N +
oxygen demand satisfied with nitrate-N

$$= 0 + 0 + 945.94$$
$$= 945.94 \text{ mg COD}$$

2. COD balance under microaerobic condition with the presence of nitrite-N (9-11.5 hour)

a). oxygen demand due to the substrate consumption.

$$= (1 - Y_x) \times \left[(S_{b0} - S_{bt}) \times f_b + (S_{ox0} - S_{oxt}) \times f_{ox} + (S_{px0} - S_{pxt}) \times f_{px} \right] \times V$$
$$= (1 - 0.34) \times \left[(5.06 - 3.86) \times 3.07 + (5.19 - 4.0) \times 3.17 + (4.97 - 3.85) \times 3.17 \right] \times V$$
$$= 14.53 \text{ mg COD}$$

b). oxygen demand due to respiration

$$= R \times V \times T$$
$$= 7.11 \times 2 \times 2.5$$
$$= 35.56 \text{ mg COD}$$

c). oxygen demand satisfied with oxygen

$$= \frac{MW_{O2}}{2} \times \frac{F \times T \times 60 \times C_{h2O2}}{MW_{h2O2}}$$
$$= \frac{32}{2} \times \frac{0.03 \times 2.5 \times 60 \times 20}{34}$$
$$= 42.35 \text{ mg} O_2$$

d). oxygen demand satisfied with nitrite-N

$$= (S_{n20} - S_{n2t}) \times f_{n2} \times V$$
$$= (2.72 - 0) \times 1.71 \times 2$$
$$= 9.30 \text{ mg COD}$$

e). oxygen demand satisfied with Nitrate-N

$$= 0$$

Total oxygen demand = oxygen demand due to substrate consumption + Oxygen demand due to respiration

$$= 14.35 + 35.56$$
$$= 50.09 \text{ mg COD}$$

Total oxygen demand satisfied = oxygen demand satisfied with oxygen + oxygen demand satisfied with nitrite-N + oxygen demand satisfied with nitrate-N

$$= 42.35 + 9.3 + 0$$
$$= 51.65 \text{ mg COD}$$

3. COD balance under microaerobic condition without the presence of nitrite-N or nitrate (11.5-14 hour)

a). oxygen demand due to the substrate consumption.

$$= (1 - Y_x) \times \left[(S_{b0} - S_{bt}) \times f_b + (S_{ox0} - S_{oxt}) \times f_{ox} + (S_{px0} - S_{pxt}) \times f_{px} \right] \times V$$
$$= (1 - 0.34) \times \left[(3.86 - 3.37) \times 3.07 + (4.0 - 3.39) \times 3.17 + (3.85 - 3.16) \times 3.17 \right] \times V$$
$$= 7.43 \text{ mg COD}$$

b). oxygen demand due to respiration

$$= R \times V \times T$$
$$= 7.11 \times 2 \times 2.5$$
$$= 35.56 \text{ mg COD}$$

c). oxygen demand satisfied with oxygen

$$= \frac{MW_{O2}}{2} \times \frac{F \times T \times 60 \times C_{h2O2}}{MW_{h2O2}}$$
$$= \frac{32}{2} \times \frac{0.03 \times 2.5 \times 60 \times 20}{34}$$
$$= 42.35 \text{ mg} O_2$$

d). oxygen demand satisfied with nitrite-N

$$= 0$$

e). oxygen demand satisfied with Nitrate-N

$$= 0$$

Total oxygen demand = oxygen demand due to substrate consumption +
Oxygen demand due to respiration

$$= 7.43 + 35.56$$
$$= 42.99 \text{ mg COD}$$

Total oxygen demand satisfied = oxygen demand satisfied with oxygen +
oxygen demand satisfied with nitrite-N +
oxygen demand satisfied with nitrate-N

$$= 42.35 + 0 + 0$$
$$= 42.35 \text{ mg COD}$$

4. COD balance under microaerobic condition with the presence of nitrate-N (14-19 hour)

a). oxygen demand due to the substrate consumption.

$$= (1 - Y_x) \times \left[(S_{b0} - S_{bt}) \times f_b + (S_{ox0} - S_{oxt}) \times f_{ox} + (S_{px0} - S_{pxt}) \times f_{px} \right] \times V$$
$$= (1 - 0.34) \times \left[(3.37 - 0.57) \times 3.07 + (3.39 - 0.46) \times 3.17 + (3.16 - 0.54) \times 3.17 \right] \times V$$
$$= 34.57 \text{ mg COD}$$

b). oxygen demand due to respiration

$$= R \times V \times T$$
$$= 7.11 \times 2 \times 5$$
$$= 71.1 \,\text{mg COD}$$

c). oxygen demand satisfied with oxygen

$$= \frac{MW_{O2}}{2} \times \left(\frac{F \times T_1 \times 60 \times C_{H2O2_1}}{MW_{h2O2}} + \frac{F \times T_2 \times 60 \times C_{H2O2_2}}{MW_{h2O2}} \right)$$
$$= \frac{32}{2} \times \left(\frac{0.03 \times 3.5 \times 60 \times 20}{34} + \frac{0.03 \times 1.5 \times 60 \times 10}{34} \right)$$
$$= 72 \,\text{mg} \,O_2$$

d). oxygen demand satisfied with nitrite-N

$$= 0$$

e). oxygen demand satisfied with Nitrate-N

$$= (S_{n30} - S_{n3t}) \times f_{n2} \times V$$
$$= (25.94 - 22.43) \times 1.71 \times 2$$
$$= 20.08 \,\text{mg COD}$$

Total oxygen demand = oxygen demand due to substrate consumption +
Oxygen demand due to respiration

$$= 34.57 + 71.1$$
$$= 105.67 \,\text{mg COD}$$

Total oxygen demand satisfied = oxygen demand satisfied with oxygen +
oxygen demand satisfied with nitrite-N +
oxygen demand satisfied with nitrate-N

$$= 72 + 0 + 20.08$$
$$= 92.08 \,\text{mg COD}$$

DOC A1. Continued..

Profile B:

Feed: biogenic substrates: 600mg/l COD;
Benzene, toluene , o-, m-, p-xylene: around 5 mg/l each;
nitrate-N: 167 mg/l (477.62 mg/l as COD)
2 L reactor

1. COD balance under anoxic conditions (0-9 hour)

a). oxygen demand due to the substrate consumption.

$$= S_0 \times (1 - Y_s) \times V + (1 - Y_x)[(S_{t0} - S_{tt}) \times f_t + (S_{mx0} - S_{mxt}) \times f_{mx}] \times V$$
$$= 600 \times (1 - 0.41) \times 2 + (1 - 0.34)[(5 - 0) \times 3.13 + (5 - 0) \times 3.17] \times 2$$
$$= 749.58 \text{ mg COD}$$

b). oxygen demand due to respiration

$$= R \times V \times T$$
$$= 7.11 \times 2 \times 9$$
$$= 127.98 \text{ mg COD}$$

c). oxygen demand satisfied with oxygen

$$= 0$$

d). oxygen demand satisfied with nitrite-N

$$= 0$$

e). oxygen demand satisfied with Nitrate-N

$$= (S_{n30} - S_{n3t}) \times f_{n3} \times V - (S_{n2t} - S_{n2o}) \times f_{n2} \times V$$
$$= (167 - 0) \times 2.86 \times 2 - (12.69 - 0) \times 1.71 \times 2$$
$$= 911.84 \text{ mg COD}$$

Total oxygen demand = oxygen demand due to substrate consumption +
Oxygen demand due to respiration

$$= 749.58 + 127.98$$
$$= 877.56 \text{ mg COD}$$

Total oxygen demand satisfied = oxygen demand satisfied with oxygen +
oxygen demand satisfied with nitrite-N +
oxygen demand satisfied with nitrate-N

$$= 0 + 0 + 911.84$$
$$= 911.84 \text{ mg COD}$$

2. COD balance under microaerobic condition with the presence of nitrite-N (9-12 hour)

a). oxygen demand due to the substrate consumption.

$$= (1 - Y_x) \times [(S_{b0} - S_{bt}) \times f_b + (S_{ox0} - S_{oxt}) \times f_{ox} + (S_{px0} - S_{pxt}) \times f_{px}] \times V$$
$$= (1 - 0.34) \times [(4.83 - 3.31) \times 3.07 + (5.29 - 3.7) \times 3.17 + (5.11 - 3.42) \times 3.17] \times V$$
$$= 19.88 \text{ mg COD}$$

b). oxygen demand due to respiration

$$= R \times V \times T$$
$$= 7.11 \times 2 \times 3$$
$$= 42.66 \text{ mg COD}$$

c). oxygen demand satisfied with oxygen

$$= \frac{MW_{O2}}{2} \times \frac{F \times T \times 60 \times C_{h2O2}}{MW_{h2O2}}$$
$$= \frac{32}{2} \times \frac{0.03 \times 3 \times 60 \times 20}{34}$$
$$= 50.82 \text{ mg } O_2$$

d). oxygen demand satisfied with nitrite-N

$$= (S_{n20} - S_{n2t}) \times f_{n2} \times V$$
$$= (12.69 - 0) \times 1.71 \times 2$$
$$= 43.4 \text{ mg COD}$$

e). oxygen demand satisfied with Nitrate-N

$$= 0$$

Total oxygen demand = oxygen demand due to substrate consumption +
Oxygen demand due to respiration

$$= 19.88 + 42.66$$
$$= 62.54 \text{ mg COD}$$

Total oxygen demand satisfied = oxygen demand satisfied with oxygen +
oxygen demand satisfied with nitrite-N +
oxygen demand satisfied with nitrate-N

$$= 50.82 + 43.4 + 0$$
$$= 94.22 \text{ mg COD}$$

3. COD balance under microaerobic condition without the presence of nitrite-N or nitrate (12-15.5 hour)

a). oxygen demand due to the substrate consumption.

$$= (1 - Y_x) \times \lfloor (S_{b0} - S_{bt}) \times f_b + (S_{ox0} - S_{oxt}) \times f_{ox} + (S_{px0} - S_{pxt}) \times f_{px} \rfloor \times V$$
$$= (1 - 0.34) \times [(3.31 - 2.35) \times 3.07 + (3.7 - 2.59) \times 3.17 + (3.42 - 1.86) \times 3.17] \times V$$
$$= 15.06 \text{ mg COD}$$

b). oxygen demand due to respiration

$$= R \times V \times T$$
$$= 7.11 \times 2 \times 3.5$$
$$= 49.77 \text{ mg COD}$$

c). oxygen demand satisfied with oxygen

$$= \frac{MW_{O2}}{2} \times \frac{F \times T \times 60 \times C_{h2O2}}{MW_{h2O2}}$$
$$= \frac{32}{2} \times \frac{0.03 \times 3.5 \times 60 \times 20}{34}$$
$$= 59.29\,\text{mg}\,O_2$$

d). oxygen demand satisfied with nitrite-N

$$= 0$$

e). oxygen demand satisfied with Nitrate-N

$$= 0$$

Total oxygen demand = oxygen demand due to substrate consumption +
Oxygen demand due to respiration

$$= 15.06 + 49.77$$
$$= 64.83\,\text{mg COD}$$

Total oxygen demand satisfied = oxygen demand satisfied with oxygen +
oxygen demand satisfied with nitrite-N +
oxygen demand satisfied with nitrate-N

$$= 59.29 + 0 + 0$$
$$= 59.29\,\text{mg COD}$$

4. COD balance under microaerobic condition with the presence of nitrate-N (15.5-19 hour)

a). oxygen demand due to the substrate consumption.

$$= (1 - Y_x) \times \left[(S_{b0} - S_{bt}) \times f_b + (S_{ox0} - S_{oxt}) \times f_{ox} + (S_{px0} - S_{pxt}) \times f_{px} \right] \times V$$
$$= (1 - 0.34) \times \left[(2.35 - 0.06) \times 3.07 + (2.59 - 0) \times 3.17 + (1.86 - 0.17) \times 3.17 \right] \times V$$
$$= 27.19\,\text{mg COD}$$

b). oxygen demand due to respiration

$$= R \times V \times T$$
$$= 7.11 \times 2 \times 3.5$$
$$= 49.77\,\text{mg COD}$$

c). oxygen demand satisfied with oxygen

$$= \frac{MW_{O2}}{2} \times \left(\frac{F \times T_1 \times 60 \times C_{H2O2_1}}{MW_{h2O2}} + \frac{F \times T_2 \times 60 \times C_{H2O2_2}}{MW_{h2O2}} \right)$$

$$= \frac{32}{2} \times \left(\frac{0.03 \times 2.5 \times 60 \times 20}{34} + \frac{0.03 \times 1.0 \times 60 \times 10}{34} \right)$$

$$= 50.82 \,\text{mg}\, O_2$$

d). oxygen demand satisfied with nitrite-N

$$= 0$$

e). oxygen demand satisfied with Nitrate-N

$$= (S_{n30} - S_{n3t}) \times f_{n2} \times V$$

$$= (24.03 - 20.05) \times 1.71 \times 2$$

$$= 22.76 \,\text{mg COD}$$

Total oxygen demand = oxygen demand due to substrate consumption +
Oxygen demand due to respiration

$$= 27.19 + 49.77$$

$$= 76.96 \,\text{mg COD}$$

Total oxygen demand satisfied = oxygen demand satisfied with oxygen +
oxygen demand satisfied with nitrite-N +
oxygen demand satisfied with nitrate-N

$$= 50.82 + 0 + 22.76$$

$$= 73.58 \,\text{mg COD}$$

Symbols

S_0: initial concentration of biogenic substrates (mg/l as COD)
S_{b0}: initial benzene concentration (mg/l)
S_{t0}: initial toluene concentration (mg/l)
S_{ox0}: initial o-xylene concentration (mg/l)
S_{mx0}: initial m-xylene concentration (mg/l)
S_{px0}: initial p-xylene concentration (mg/l)
S_{bt}: final benzene concentration (mg/l)
S_{tt}: final toluene concentration (mg/l)
S_{oxt}: final o-xylene concentration (mg/l)
S_{mxt}: final m-xylene concentration (mg/l)
S_{pxt}: final p-xylene concentration (mg/l)
S_{n20}: initial NO_2^--N concentration (mg/l)
S_{n30}: initial NO_3^--N concentration (mg/l)
S_{n2t}: final NO_2^--N concentration (mg/l)
S_{n3t}: final NO_3^--N concentration (mg/l)

f_b: theoretical oxygen demand conversion factor for benzene (3.07mgCOD/mg benzene)
f_t: theoretical oxygen demand conversion factor for toluene (3.13 mgCOD/mg toluene)
f_{ox}: theoretical oxygen demand conversion factor for o-xylene (3.17 mgCOD/mg o-xylene)
f_{mx}: theoretical oxygen demand conversion factor for m-xylene (3.17 mgCOD/mg m-xylene)
f_{px}: theoretical oxygen demand conversion factor for p-xylene (3.17 mgCOD/mg p-xylene)
f_{n2}: theoretical oxygen demand conversion factor for NO_2^--N (1.71 mgCOD/mg NO_2^--N)
f_{n3}: theoretical oxygen demand conversion factor for NO_3^--N (2.86 mgCOD/ mg NO_3^--N)
V: reactor voluem (L)
C_{H2O2}: concentration of hydrogen peroxide (mg/ml)
F: flow rate of hydrogen peroxide (ml/min)
Ys: yield of biogenic substrates (0.41)
Yx: yield of xenobiogenic substrates (0.34)
R: respiration rate (7.11 mgCOD/L.hr)
T: reaction time (hr)
MW_{H2O2}: molecular weight of H_2O_2 (34 g/molar)
MW_{O2}: molecular weight of O_2 (32 g/molar)

Table A5. Source data for Figure 6 in chapter 2. (Date: Profile A: 12/28/1998, Profile B: 1/29/1999)

Profile A		Profile B	
Time (hr)	ORP (mV)	Time (hr)	ORP (mV)
0	-127	0	-115
0.5	-120	0.5	-145
1	-133	1	-148
3	-135	3	-154
6	-131	6	-157
9	-146	9	-172
9.5	-62	9.5	-92
10	-30	10	-47
10.5	-39	10.5	-30
11	-40	11	-40
11.5	-89	11.5	-45
11.75	-82	12	-60
12	-85	12.5	-65
12.25	-80	13	-69
12.5	-81	13.5	-61
12.75	-89	14	-65
13	-94	14.5	-60
13.25	-81	15	-62
13.5	-84	15.5	-42
14	-54	16	-48
14.5	-30	16.5	-27
15	-27	17	-21
15.5	-35	17.5	-20
16	-27	18	-37
16.5	-32	18.5	-45
17	-36	19	-38
17.5	-32	19.5	-35
18	-40	20	-32
18.5	-35	21	-45
19	-34		
19.5	-33		
20	-30		
20.5	-27		
21	-32		

Table A6. Source data for calculation of the endogenous respiration rate. (Date: 8/23/1998)

Time (hr)	Nitrite-N mg/l	Nitrate-N mg/l	Nitrite-N as mg/l COD	Nitrate-N as mg/l COD	Nitrite-N + Nitrate-N as mg/l COD
8	47.50	0.38	81.23	1.09	82.32
10	37.55	0.34	64.21	0.96	65.17
14	20.10	0.34	34.36	0.96	35.33
18	6.01	0.29	10.27	0.83	11.11
22	0.40	ND	0.69	0.00	0.69

Endogenous respiration rate is determined as: 7.11 mg COD/L.hr. Regression coefficient: 0.9954

Table A7. Source data for evaluating the toxicity of hydrogen peroxide on the sludge from wastewater treatment plant

Test 1				Test 2				Test 3			
w/air		w/H_2O_2+catalase		w/air		w/H_2O_2+catalase		w/air		w/H_2O_2+catalase	
Time (min)	DO (mg/l)	Time (min)	DO (mg/l)	Time (min)	DO (mg/l)	Time (min)	DO (mg/l)	Time (min)	DO (mg/l)	Time (min)	DO (mg/l)
0	8.56	0	8.78	0	8.96	0	9.36	0	8.27	0	8.40
1	8.4	1	8.53	1	8.83	1	9.14	0.5	8.17	0.5	8.34
1.5	8.31	2	8.32	2	8.66	2	8.95	1	8.1	1.5	8.21
2	8.23	3	8.11	3	8.48	3	8.76	1.5	8.05	2.5	8.07
2.5	8.12	4	7.9	4	8.32	4	8.54	2	7.99	4	7.87
3	8.03	5	7.67	5	8.13	5	8.35	2.5	7.93	6	7.58
3.5	7.94	6	7.44	7	7.73	6	8.14	3	7.88	8	7.27
4	7.81	7	7.21	8	7.54	7	7.92	3.5	7.82	10	6.97
5	7.55	8	7	9	7.34	8	7.7	4	7.76	12	6.72
6	7.36	9	6.79	10	7.15	9	7.5	4.5	7.72	14	6.44
7	7.18	10	6.58	11	6.95	10	7.32	5	7.66	16	6.17
8	6.94	11	6.38	12	6.77	11	7.08	5.5	7.58	18	5.89
9	6.69	12	6.17	13	6.57	12	6.88	6	7.53	20	5.62
10	6.51	13	5.98	14	6.38	13	6.67	6.5	7.48	23	5.24
11	6.31	14	5.77	15	6.18	14	6.46	7	7.42	25	4.98
12	6.11	15	5.57	17	5.81	15	6.27	7.5	7.37	27	4.73
13	5.91	16	5.37	18	5.61	16	6.08	8	7.31	29	4.48
14	5.7	17	5.18	19	5.42	17	5.88	8.5	7.25	31	4.23
15	5.5	18	4.99	20	5.23	18	5.68	9	7.2		
		19	4.8	21	5.04	19	5.48	9.5	7.14		
		20	4.62			20	5.28	10	7.09		
								12	6.87		
								14	6.64		
								16	6.44		
								18	6.24		
								20	6.02		
								24	5.63		
								26	5.43		
								28	5.23		
								30	5.03		
								32	4.83		
								34	4.64		

Table A7. Continued..

Test 4				Test 5				Test 6			
w/air		w/H_2O_2+catalase		w/air		w/H_2O_2+catalase		w/air		w/H_2O_2+catalase	
Time (min)	DO (mg/l)	Time (min)	DO (mg/l)	Time (min)	DO (mg/l)	Time (min)	DO (mg/l)	Time (min)	DO (mg/l)	Time (min)	DO (mg/l)
0	8.33	0	8.53	0	8.26	0	8.55	0	8.23	0	7.15
1	8.22	1	8.49	1	8.18	1	8.5	1	8.16	1	7.38
2	8.14	2	8.45	2	8.1	2	8.43	2	8.07	2	7.29
3	8.07	3	8.39	3	8.03	3	8.36	3	8.01	3	7.2
4	7.98	4	8.34	4	7.95	4	8.29	4	7.91	4	7.1
5	7.9	5	8.27	5	7.87	5	8.22	5	7.83	5	7.01
6	7.83	6	8.22	6	7.79	6	8.15	6	7.73	6	6.92
7	7.74	7	8.16	7	7.72	7	8.07	7	7.64	7	6.83
8	7.66	8	8.09	8	7.64	8	7.99	8	7.55	8	6.73
9	7.58	9	8.01	9	7.56	9	7.91	9	7.46	9	6.65
10	7.5	10	7.95	10	7.47	10	7.83	10	7.36	10	6.57
11	7.41	11	7.87	11	7.39	11	7.75	11	7.26	11	6.48
12	7.33	12	7.8	12	7.3	12	7.67	12	7.17	12	6.38
13	7.24	13	7.74	13	7.21	13		13	7.08	13	6.29
14	7.16	14	7.65	14	7.13	14	7.5	14	6.98	14	6.2
15	7.07	15	7.58	15	7.03	15	7.41	15	6.89	15	6.11
16	6.98	16	7.51	16	6.94	16	7.32	16	6.8	16	6.02
17	6.89	17	7.42	17	6.86	17	7.23	17	6.7	17	5.93
18	6.8	18	7.35	18	6.77	18	7.14	18	6.62	18	5.84
19	6.71	19	7.28	19	6.67	19	7.05	19	6.52	19	5.75
20	6.61	20	7.19	20	6.58	20	6.95	20	6.43	20	5.65
		21	7.11			21	6.86	21	6.35		
		22	7.02			22	6.76				
		23	6.94			23	6.66				
		24	6.85								
		25	6.77								

Table A7. Continued.. (Units: MLVSS: mg/l; SOUR: mg/l DO/mg/l MLVSS.min)

	w/air		w/H_2O_2+catalase	
	MLVSS	SOUR	MLVSS	SOUR
Test 1	392.5	0.000534	391.25	0.000537
Test 2	410	0.000463	398.75	0.000502
Test 3	307.5	0.000339	430	0.000316
Test 4	286	0.000295	284	0.000264
Test 5	298	0.000281	294	0.000284
Test 6	244	0.000377	245	0.000369

APPENDIX B SOURCE DATA FOR CHAPTER 3
BIODEGRADATION OF BTX IN ANOXIC AND MICROAEROBIC SEQUENCING BATCH REACTORS

Table B1. Source data for Figure 1 in chapter 3.

Date	Benzene mg/l	Toluene mg/l	*o*-Xylene mg/l	*m*-Xylene mg/l	*p*-Xylene mg/l
5/26/98	3.75	0.32	4.77	0.36	4.80
5/31/98	5.35	ND	4.59	ND	5.78
6/1/98	4.95	ND	5.49	ND	5.43
6/2/98	4.44	ND	4.43	ND	4.90
6/3/98	6.06	ND	5.48	ND	6.70
6/4/98	3.87	ND	4.31	ND	4.29
6/5/98	5.36	ND	5.05	ND	5.40
6/7/98	2.18	ND	4.55	ND	4.32
6/8/98	2.18	ND	3.71	ND	3.51
6/9/98	1.47	ND	3.72	ND	3.43
6/10/98	0.94	ND	3.80	ND	2.94
6/11/98	3.74	ND	3.51	ND	5.08
6/12/98	3.23	ND	3.94	ND	4.02
6/14/98	1.06	ND	3.10	ND	2.61
6/15/98	0.83	ND	3.17	ND	2.61
6/16/98	0.93	ND	2.96	ND	2.57
6/21/98	6.20	ND	3.81	ND	5.74
6/22/98	3.71	ND	3.76	ND	5.43
6/23/98	5.06	ND	3.82	ND	5.18
6/24/98	6.95	ND	5.14	ND	6.66
6/25/98	3.11	ND	3.65	ND	
7/5/98	1.50	ND	3.47	ND	2.70
7/7/98	2.90	ND	3.95	ND	3.00
7/15/98	4.85	ND	3.25	ND	4.84
7/16/98	5.78	ND	5.25	ND	5.97
7/19/98	5.15	ND	4.37	ND	5.78
7/21/98	4.66	ND	4.15	ND	5.79
7/29/98	5.03	ND	5.81	0.03	4.01
8/3/98	4.30	ND	7.25	ND	7.02
8/4/98	5.29	ND	4.97	ND	4.99
8/5/98	5.96	ND	5.39	ND	3.74
8/6/98	4.92	ND	4.32	ND	3.89
8/17/98	5.06	ND	3.52	ND	4.39
8/18/98	4.58	ND	3.56	ND	3.90
8/25/98	4.78	ND	4.93	ND	4.09
8/27/98	4.21	ND	4.85	ND	4.53
9/1/98	4.95	ND	5.70	6.53	6.45
9/3/98	4.35	ND	4.42	0.54	5.75
9/4/98	4.23	ND	3.74	ND	5.13
9/5/98	6.42	ND	4.78	ND	5.58
9/7/98	4.50	ND	3.57	ND	4.25
9/15/98	3.18	ND	3.79	ND	3.55
9/16/98	3.18	ND	3.25	ND	3.38
9/19/98	3.55	ND	3.80	ND	4.49
9/26/98	3.40	0.70	6.27	3.03	5.21
9/27/98	3.88	ND	5.04	0.77	4.30

Table B1. Continued..

Date	Benzene mg/l	Toluene mg/l	*o*-Xylene mg/l	*m*-Xylene mg/l	*p*-Xylene mg/l
9/28/98	3.62	ND	3.99	ND	3.60
9/29/98	4.47	ND	4.63	ND	5.23
9/30/98	3.33	ND	4.00	ND	3.77
10/1/98	3.27	ND	4.46	ND	3.82
10/2/98	3.29	ND	3.30	ND	3.68
10/3/98	3.19	ND	4.92	ND	4.00
10/4/98	3.02	0.23	4.03	ND	4.34
10/10/98	4.50	ND	4.65	ND	4.54
10/12/98	4.98	ND	4.23	ND	4.68
10/15/98	4.35	ND	4.98	ND	4.77
10/17/98	5.18	ND	5.23	ND	5.52
10/18/98	3.72	ND	4.16	ND	4.75
10/19/98	3.99	ND	4.10	ND	4.94
10/20/98	5.45	ND	4.75	ND	5.49
10/21/98	4.89	0.39	6.99	1.88	6.54
10/22/98	4.12	ND	5.98	ND	4.64
10/23/98	3.87	1.88	6.04	2.27	5.08
10/24/98	3.81	ND	4.06	ND	3.42
10/25/98	3.85	ND	5.25	ND	3.69
10/26/98	3.89	ND	3.90	ND	3.41
10/27/98	3.86	ND	4.44	ND	4.79
10/28/98	4.59	ND	4.13	0.49	3.63
10/29/98	4.77	ND	4.17	ND	3.02
11/1/98	4.32	ND	5.09	ND	5.30
11/2/98	4.21	ND	4.18	ND	4.79
11/4/98	2.94	ND	4.20	ND	3.65
11/5/98	2.22	ND	4.98	0.30	3.35
11/8/98	2.65	ND	4.85	0.42	4.06
11/9/98	4.79	ND	4.14	ND	3.34
11/10/98	4.60	ND	3.87	ND	3.11
11/12/98	4.39	ND	5.40	ND	3.19
11/13/98	4.61	ND	3.44	ND	4.12

Table B2. Source data for Figure 2 in chapter 3. (Date: 8/23/1998)

Time hr	ORP mV	Nitrite-N mg/l	Nitrate-N mg/l	Sulfate mg/l	Benzene mg/l	Toluene mg/l	*o*-Xylene mg/l	*m*-Xylene mg/l	*p*-Xylene mg/l
0	-166	51.99	96.90	14.04	2.15	ND	0.32	0.82	1.61
0.25	-175	101.75	47.64	13.86	4.74	2.22	2.86	1.55	1.97
0.47	-154	109.07	35.12	14.45	5.69	3.59	5.53	3.63	4.47
0.75	-135	114.02	23.40	14.39	6.12	4.22	6.03	5.41	5.66
1	-106	137.37	3.90	13.51	6.11	2.64	6.12	4.93	5.61
2	-152	146.57	ND	13.80	6.19	2.17	5.84	4.38	5.81
3	-160	106.47	0.71	13.92	6.08	1.52	5.82	3.21	5.57
4	-167	97.27	ND	14.10	6.08	0.72	5.81	2.31	5.53
6	-167	73.45	0.43	13.57	5.93	ND	5.50	1.11	5.21
8	-171	47.50	0.38	13.80	5.85	ND	5.18	0.18	5.08
10	-175	37.55	0.34	13.80	5.77	ND	5.11	ND	4.97
14	-182	20.10	0.34	13.92	5.32	ND	4.90	ND	5.02
18	-190	6.01	0.29	13.86	5.21	ND	4.87	ND	4.99
21.5	-194	0.40	ND	13.98	4.88	ND	5.16	ND	5.19

Table B3. Source data for the Figure 3 in chapter 3. (Date: 11/27/1998)

Time hr	ORP mV	Nitrite-N mg/l	Nitrate-N mg/l	Sulfate mg/l	Benzene mg/l	Toluene mg/l	*o*-Xylene mg/l	*m*-Xylene mg/l	*p*-Xylene mg/l
0	-148	72.19	40.82	16.03	2.56	1.21	2.58	0.60	2.41
0.5	-157	109.63	ND	16.03	5.51	4.83	5.45	6.21	5.57
1	-156	96.05	ND	15.80	5.42	4.62	5.75	5.49	5.87
2	-167	64.00	ND	15.58	5.42	3.61	5.71	4.75	5.82
3	-169	47.71	ND	15.35	5.42	2.46	5.66	3.64	5.82
5	-167	24.93	ND	15.13	5.41	0.47	5.73	2.17	5.96
7	-170	12.25	ND	15.13	5.47	ND	5.79	1.15	5.90
9	-169	7.86	ND	14.68	5.48	ND	5.74	ND	5.88
9.5	-53	5.45	ND	14.68	4.83	ND	5.94	ND	5.52
10	-50	4.59	ND	14.68	4.90	ND	5.07	ND	5.03
11	-33	3.61	ND	14.68	4.53	ND	4.11	ND	4.87
13	-30	2.00	ND	14.68	2.98	ND	2.01	ND	3.71
15	-30	1.50	ND	14.45	1.14	ND	0.40	ND	2.00
17	-35	0.20	ND		0.02	ND	ND	ND	0.92
21.75	-20	ND	ND	15.58	ND	ND	ND	ND	ND

APPENDIX C. SOURCE DATA FOR CHAPTER 4
THE DISTRIBUTION OF BTX DEGRADERS IN BTX-FED BIOLOGICAL REACTORS UNDER DIFFERENT REDOX CONDITIONS

Table C1. Source data for Figure 1 in chapter 4.

Time	Benzene (mg/l)		*o*-Xylene (mg/l)	
day	Blank	GM1	Blank	GM1
0	5.48	5.45	5.52	5.81
13	4.63	4.89	5.25	5.28
19	4.57	4.15	4.80	4.91

Table C1. Continued..

Time	Toluene (mg/l)		*m*-Xylene (mg/l)		*p*-Xylene (mg/l)	
hr	Blank	GM1	Blank	GM1	Blank	GM1
0	4.62	4.62	5.41	4.84	5.57	5.98
12	4.15	2.86	5.41	3.61	5.42	4.36
25	3.86	1.18	5.11	2.30	5.38	2.97
33	3.94	0.21	4.98	1.58	5.04	1.94
49	3.71	ND	4.72	ND	4.83	ND
72	3.64	ND				

Table C2. Source data for Figure 3 in chapter 4.

			S-*-Tarom-0162-a-A-21			
Temperature	40ng		30ng		average	stdev
C	Area	%	Area	%	%	%
30	545019.8	100	487087.5	100	100	0
33	544417.8	99.89	446102.6	91.59	95.74	5.87
36	471294	86.47	418705.6	85.96	86.22	0.36
39	436914.4	80.16	424421.2	87.13	83.65	4.93
42	511095.1	93.78	351877.4	72.24	83.01	15.23
45	399134.3	73.23	310297.5	63.70	68.47	6.74
48	261731.9	48.02	174856.8	35.90	41.96	8.57
51	128639.1	23.60	95781.13	19.66	21.63	2.79
54	81292.06	14.92	49102.16	10.08	12.50	3.42
57	121339.8	22.26	87430.06	13.46	17.86	6.22
60	ND	ND	ND	ND	ND	ND
68	ND	ND	ND	ND	ND	ND

Table C2. Continued..

	S-S-Atol-0481-a-A-18 (%)							
Temperature	50ng		100ng		200ng		average	stdev
°C	Area	%	Area	%	Area	%	%	%
26	99586.67	100	98112.44	100	107105.20	100	100	0
30	85265.63	85.62	103928.22	105.93	105152.70	98.18	96.57	10.25
33	78334.15	78.66	76866.19	78.34	76084.31	71.04	76.01	4.31
36	69107.52	69.39	70818.57	72.18	72513.38	67.70	69.76	2.26
39	52807.02	53.03	62950.75	64.16	63124.13	58.94	58.71	5.57
42	52026.21	52.24	50366.95	51.34	53458.05	49.91	51.16	1.17
45	45095.96	45.28	47718.22	48.64	44874.28	41.90	45.27	3.37
48	34162.41	34.30	42720.06	43.54	44620.56	41.66	39.84	4.88
51	25054.76	25.16	36076.71	36.77	36582.28	34.16	32.03	6.09
54	22648.44	22.74	21070.01	21.48	24503.86	22.88	22.37	0.77
57	ND	ND	ND	ND	ND	ND	ND	ND
64	ND	ND	ND	ND	ND	ND	ND	ND

Table C2. Continued..

	S-St-PpPaW-0816-a-A-21					
Temperature	5ng		10ng		average	stdev
°C	Area	%	Area	%	%	%
30	562441.1	100	814614.7	100.00	100	0.00
33	472566.6	84.02	739593.8	90.79	87.41	4.79
36	348160.8	61.90	541781.9	66.51	64.20	3.26
39	383993.5	68.27	517143.8	63.48	65.88	3.39
42	330413	58.75	545891.1	67.01	62.88	5.84
46	209157.79	37.19	382979.3	47.01	42.10	6.95
48	111325.8	19.79	218123.8	26.78	23.28	4.94
51	ND	ND	ND	ND	ND	ND
54	ND	ND	ND	ND	ND	ND
57	ND	ND	ND	ND	ND	ND
60	ND	ND	ND	ND	ND	ND
68	ND	ND	ND	ND	ND	ND

Table C2. Continued..

S-St-PpF1-0865-a-A-21												
Temperature	*P. putida* F1						*P. putida* PaW1					
°C	30ng		20ng				30ng		20ng			
	Area	%	Area	%	average	stdev	Area	%	Area	%	average	stdev
30	676218.9	100	443686.8	100	100	0.00	675402.4	100	455370.8	100	100	0
33	585619.9	86.60	238464	53.75	70.17	23.23	544638.3	80.64	327847.8	72.00	76.32	6.11
36	429837.8	63.56	224422.7	50.58	57.07	9.18	306261.6	45.35	171207.1	37.60	41.47	5.48
39	354296.1	52.39	211649.3	47.70	50.05	3.32	217114.2	32.15	85590.63	18.80	25.47	9.44
42	279797.1	41.38	151541	34.15	37.77	5.11	63437.91	9.39	33821.9	7.43	8.41	1.39
46	276857.1	40.94	144661.4	32.60	36.77	5.90	ND	ND	ND	ND	ND	ND
48	211888.8	31.33	94878.25	21.38	26.36	7.04	ND	ND	ND	ND	ND	ND
51	38855.32	5.75	75848.1	17.09	11.42	8.02	ND	ND	ND	ND	ND	ND
54	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
57	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
60	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
68	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table C2. Continued..

S-St-GM1-0997-a-A-21												
Temperature	*GM1*						*P. aeruginosa*					
C	10ng		20ng				10ng		20ng			
	Area	%	Area	%	average	stdev	Area	%	Area	%	average	stdev
30	446825.4	100	754238.7	100	100	0	479099	98.69	835094.1	94.86	96.77	2.71
33							485459.9	100	880384.6	100	100	0.00
36	423157.3	94.70	730036	96.79	95.75	1.48	364584.6	75.10	774409.1	87.96	81.53	9.09
39	380138.4	85.08	687805.6	91.19	88.13	4.33	434479.2	89.50	611119.6	69.42	79.46	14.20
42	328085.7	73.43	566649.6	75.13	74.28	1.20	173795.1	35.80	502541.6	57.08	46.44	15.05
46	238024.2	53.27	488614.8	64.78	59.03	8.14	ND	ND	ND	ND	ND	ND
48	203102.5	45.45	366937.1	48.65	47.05	2.26	ND	ND	ND	ND	ND	ND
51	128598.6	28.78	256721.5	34.04	31.41	3.72	ND	ND	ND	ND	ND	ND
54	113237.5	25.34	157465.4	20.88	23.11	3.16	ND	ND	ND	ND	ND	ND
57	61028.45	13.66	144639.4	19.18	16.42	3.90	ND	ND	ND	ND	ND	ND
60	9753.393	2.18	39356.18	5.22	3.70	2.15	ND	ND	ND	ND	ND	ND
68	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Table C3. Source data for the Figure 3 in chapter 4. (ML: DNA mass ladder)

1) data for the standard curves

S-D-Bact-0338-a-A-18		S-*-Tarom-0162-a-A-21		S-S-Atol-0484-a-A-18		S-St-PpPF1-0865-a-A-21		S-St-PpPaW-0816-a-A-21		S-St-GM1-0997-a-A-21	
mass per ML		mass per ML		mass per ML		mass per ML		mass per ML		mass per ML	
pg	area	pg	area	pg	area	pg	area	pg	area	pg	area
150	165710.82	150	156978.9	32.5	285693.6	75	456671	37.5	429445.4	75	221925.1
75	75596.94	75	109989.3	16.25	238772.6	37.5	349955.6	18.75	346229.1	37.5	111818.4
37.5	29016.65	37.5	67765.5	8.125	125950.5	18.75	164248.7	9.375	192641.9	18.75	53913.9
										9.4	33732.33

Table C3. Continued..

2) Standard curves

Probe	Equation	Regression coefficient
S-D-0338-a-A-18	Area=1213.1*mass per ML-16040	0.9999
S-*-Tarom-0162-a-A-21	Area=769.23*mass per ML+44271	0.9748
S-S-Atol-0484-a-A-18	Area=6029.8*mass per ML +102490	0.8348
S-St-PpF1-0865-a-A-21	Area=4862.5*mass per ML+110891	0.8857
S-St-PpPaW1-0816-a-A-21	Area=7850.9*mass per ML+151034	0.8759
S-St-GM1-0997-a-A-21	Area=2909.6*mass per ML+3038.1	0.9988

Table C3. Continued..

3) Sample hybridized with S-D-Bact-a-A-18

sample	mass per spec	mass per ML	
time (hr)	ng	area	pg
0	1.25	143401.1	131.43
0.5	1.25	147782.1	135.04
1	1.25	74280.31	74.45
3	1.25	58381.16	61.35
6	1.25	36453.91	43.27
9	2.5	163042.3	147.62
12	2.5	91928.5	89.00
15	2.5	137691.9	126.73
18	2.5	107235.1	101.62
21.75	2.5	133683.9	123.42

Table C3. Continued..

4) Sample hybridized with S-*-Tarom-0162-a-A-21

	Replicate 1				Replicate 2					
sample time (hr)	mass per spec ng	Area	mass per ML pg	activity %	mass per spec ng	area	mass per ML pg	activity %	activity average (%)	stdev %
0	300	135938.7	119.17	0.38	200	106929	81.46	0.39	0.38	0.0068
0.5	300	163617.8	155.15	0.48	200	130825	112.52	0.52	0.50	0.0297
1	300	161027.9	151.78	0.85	200	128948	110.08	0.92	0.89	0.0528
3	300	139798.9	124.19	0.84	200	109598	84.92	0.87	0.85	0.0154
6	300	90316.19	59.86	0.58	200	72545.3	36.76	0.53	0.55	0.0322
9	300	93491.13	63.99	0.36	200	75872.1	41.08	0.35	0.35	0.0094
12	300	77694.06	43.45	0.41	200	67965	30.80	0.43	0.42	0.0182
15	300	72962.75	37.30	0.25	200	59658.3	20.00	0.20	0.22	0.0339
18	300	ND	ND	ND	200	ND	ND	ND	ND	ND
21.75	300	ND	ND	ND	200	ND	ND	ND	ND	ND

Table C3. Continued..

5) Sample hybridized with S-S-Atol-0484-a-A-18

	Replicate 1				Replicate 2					
sample time (hr)	mass per spec ng	Area	mass per ML pg	activity %	mass per spec ng	area	mass per ML pg	activity %	activity average (%)	stdev %
0	150	222527.1	19.91	0.13	75	170892	11.34	0.14	0.14	0.0125
0.5	150	162139.9	9.89	0.06	75	131950	4.89	0.06	0.06	0.0005
1	150	146044.5	7.22	0.08	75	134568	5.32	0.12	0.10	0.0270
3	150	172853.2	11.67	0.16	75	146429	7.29	0.20	0.18	0.0279
6	150	152967.3	8.37	0.16	75	135237	5.43	0.21	0.19	0.0339
9	150	178186.7	12.55	0.14	75	131209	4.76	0.11	0.12	0.0242
12	150	111193.9	1.44	0.03	75	109986	1.24	0.05	0.04	0.0138
15	150	150323.4	7.93	0.10	75	108547	1.00	0.03	0.07	0.0551
18	150	104958.9	0.41	0.01	75	104276	0.30	0.01	0.01	0.0021
21.75	150	126431.9	3.97	0.05	75	118967	2.73	0.07	0.06	0.0143

Table C3. Continued..

6) Sample hybridized with S-St-PpF1-0865-a-A-21

	Replicate 1				Replicate 2					
sample time (hr)	mass per spec ng	Area	mass per ML pg	activity %	mass per spec ng	area	mass per ML pg	activity %	activity average (%)	stdev %
0	150	391719.7	57.75	0.37	75	293767	37.61	0.48	0.42	0.078
0.5	150	370705.8	53.43	0.33	75	216930	21.81	0.27	0.30	0.043
1	150	314904.6	41.96	0.47	75	175319	13.25	0.30	0.38	0.122
3	150	386172.1	56.61	0.77	75	149196	7.88	0.21	0.49	0.392
6	150	254379.8	29.51	0.57	75	121818	2.25	0.09	0.33	0.341
9	150	332794.2	45.64	0.52	75	140428	6.07	0.14	0.33	0.267
12	150	181481.5	14.52	0.27	75	131425	4.22	0.16	0.22	0.080
15	150	199729.4	18.27	0.24	75	128126	3.54	0.09	0.17	0.104
18	150	194044.3	17.10	0.28	75	131874	4.32	0.14	0.21	0.098
21.75	150	294236.1	37.71	0.51	75	204774	19.31	0.52	0.52	0.009

Table C3. Continued..

7) Sample hybridized with S-St-GM1-0997-a-A-21

	Replicate 1				Replicate 2					
sample time (hr)	mass per spec ng	Area	mass per ML pg	activity %	mass per spec ng	area	mass per ML pg	activity %	activity average (%)	stdev %
0	150	55870.39	18.16	0.12	75	40852.6	13.00	0.16	0.14	0.0351
0.5	150	38685.04	12.25	0.08	75	35489.2	11.15	0.14	0.11	0.0439
1	150	75044.44	24.75	0.28	75	27892.2	8.54	0.19	0.23	0.0607
3	150	44823.49	14.36	0.20	75	19667.2	5.72	0.16	0.18	0.0281
6	150	70406.2	23.15	0.45	75	20227.8	5.91	0.23	0.34	0.1544
9	150	43076.08	13.76	0.16	75	21786.9	6.44	0.15	0.15	0.0070
12	150	52061.51	16.85	0.32	75	19875.4	5.79	0.22	0.27	0.0699
15	150	ND	ND	ND	75	ND	ND	ND	ND	ND
18	150	ND	ND	ND	75	ND	ND	ND	ND	ND
21.75	150	ND	ND	ND	75	ND	ND	ND	ND	ND

DOC C1. An example showing the calculation of microbial activity associated with a specific probe.

Sample: Time 0 sample in Table C3.

Probe S-D-Bact-0338-a-A-18 serves as a universal bacterial probe.

Sample hybridized with S-*-Tarom-0162-a-A-21.

Standard curve of S-D-Bact-0338-a-A-18 as shown in Table C3, 2),

$$\text{Area} = 1213.1 \times \text{mass per ML} - 16040$$

$$\text{mass per ML} = \frac{(\text{Area} + 16040)}{1213.1}$$

In Table C3, 3), Time 0 sample has an area of 143401.1 when 1.25 ng (mass per spec) sample hybridized with S-D-Bact-0338-a-A-18.

Therefore,

$$\text{mass per ML} = \frac{(143401.1 + 16040)}{1213.1}$$

$$= 131.43 \text{ pg}$$

This shows that spectrophotometric mass estimates are larger than the mass determined by the DNA mass ladder.

Standard curve of S-*-Tarom-0162-a-A-21 as shown in Table C3, 2),

$$\text{Area} = 769.23 \times \text{mass per ML} + 44271$$

$$\text{mass per ML} = \frac{(\text{Area} - 44271)}{769.23}$$

In Table C5, 4), Time 0 sample has an area of 135938.7 when 300ng (mass per spec) sample hybridized with S-*-Tarom-0162-a-A-21.

Therefore,

$$\text{mass per ML} = \frac{(135938.7 - 44271)}{769.23}$$

$$= 119.17 \text{ pg}$$

specific microbial activity using probe S - * - Tarom - 0162 - a - A - 21 (%)

$$= \frac{\dfrac{\text{mass per ML determined by probe S - * - Tarom - 0162 - a - A - 21}}{\text{spectrophotometric mass of sample RNA loaded}}}{\dfrac{\text{mass per ML determined by probe S - D - Bact - 0338 - a - A - 18}}{\text{spectrophotometric mass of sample RNA loaded}}} \times 100$$

$$= \frac{\dfrac{119.17}{300}}{\dfrac{131.43}{1.25}} \times 100$$

$$= 0.38\%$$

Table C4. Source data for the Figure 6 in chapter 4. (ML: DNA mass ladder).

1) data for the standard curves

S-D-Bact-0338-a-A-18		S-*-Tarom-0162-a-A-21		S-S-Atol-0484-a-A-18		S-St-PpPF1-0865-a-A-21		S-St-PpPaW-0816-a-A-21		S-St-GM1-0997-a-A-21	
mass per ML		mass per ML		mass per ML		mass per ML		mass per ML		mass per ML	
pg	area	pg	area	pg	area	pg	area	pg	area	pg	area
150	268227.1	200	169569.6	130	502389.9	150	807456.2	75	268389.1	75	376106.8
75	121528.4	300	253464	65	372456.4	75	581951.8	150	495658.1	150	595475.7
37.5	68795.25	400	585941.6	32.5	211531.4	37.5	386233.1	200	666374.9	200	603655.1
										300	880155.4

Table C4. Continued..

2) standard curves

Probe	Equation	Regression coefficient
S-D-0338-a-A-18	Area=1798.9*mass per ML-4554.1	0.9943
S-*-Tarom-0162-a-A-21	Area=2081.9*mass per ML-288233	0.8938
S-S-Atol-0484-a-A-18	Area=2842.6*mass per ML +146565	0.938
S-St-PpF1-0865-a-A-21	Area=3638.9*mass per ML+273481	0.9779
S-St-PpPaW1-0816-a-A-21	Area=3171.8*mass per ML+27475	0.9989
S-St-GM1-0997-a-A-21	Area=2143.3*mass per ML+225370	0.9598

Table C4. Continued..

3) sample hybridized with S-D-Bact-0338-a-A-18

sample	mass per spec		mass per ML
time (hr)	ng	area	pg
0	1.25	259749.2	146.92
0.5	1.25	200601.8	114.05
1	1.25	188766.2	107.47
3	1.25	194377.9	110.59
6	1.25	185316.6	105.55
9	1.25	212356.3	120.58
10	1.25	236933.2	134.24
11	1.25	185566.9	105.69
13	1.25	202954.1	115.35
15	1.25	212699.7	120.77
18	1.25	226816.8	128.62
21	1.25	255491.8	144.56

Table C4. Continued..

4) sample hybridized with S-*-Tarom-0162-a-A-21

	Replicate 1				Replicate 2					
sample time (hr)	mass per spec ng	Area	mass per ML pg	activity %	mass per spec ng	area	mass per ML pg	activity %	activity average (%)	stdev %
0	600	508986.4	382.93	0.54	500	402931.9	331.99	0.56	0.55	0.02
0.5	600	495345.1	376.38	0.69	500	276262.6	271.14	0.59	0.64	0.07
1	600	540423.6	398.03	0.77	500	267850.5	267.10	0.62	0.70	0.11
3	600	460035	359.42	0.68	500	282146.6	273.97	0.62	0.65	0.04
6	600	564805.8	409.74	0.81	500	256522.9	261.66	0.62	0.71	0.13
9	600	668553.1	459.57	0.79	500	353145.3	308.07	0.64	0.72	0.11
10	600	407822.2	334.34	0.52	500	357919.9	310.37	0.58	0.55	0.04
11	600	405474.4	333.21	0.66	500	202635.4	235.78	0.56	0.61	0.07
13	600	422190.3	341.24	0.62	500	221934.8	245.05	0.53	0.57	0.06
15	600	405446.2	333.20	0.57	500	234035.2	250.86	0.52	0.55	0.04
18	600	479951.6	368.98	0.60	500	244327.3	255.80	0.50	0.55	0.07
21	600	302077.8	283.54	0.41	500	189924.8	229.67	0.40	0.40	0.01

Table C4. Continued..

5) sample hybridized with S-S-Atol-0484-a-A-18

	Replicate 1				Replicate 2					
sample time (hr)	mass per spec ng	Area	mass per ML pg	activity %	mass per spec ng	area	mass per ML pg	activity %	activity average (%)	stdev %
0	200	372434.4	79.46	0.34	300	460210.7	110.34	0.31	0.33	0.0177
0.5	200	321422.9	61.51	0.34	300	395009.3	87.40	0.32	0.33	0.0126
1	200	276011.1	45.54	0.26	300	351361	72.05	0.28	0.27	0.0102
3	200	230474	29.52	0.17	300	283972.7	48.34	0.18	0.17	0.0108
6	200	197797.3	18.02	0.11	300	264190.8	41.38	0.16	0.14	0.0400
9	200	225074.3	27.62	0.14	300	287799.8	49.69	0.17	0.16	0.0202
10	200	205961.6	20.90	0.10	300	313696.1	58.80	0.18	0.14	0.0603
11	200	241891.7	33.54	0.20	300	322908.3	62.04	0.24	0.22	0.0327
13	200	264141.5	41.36	0.22	300	345142.9	69.86	0.25	0.24	0.0200
15	200	279651	46.82	0.24	400	476649.9	116.12	0.30	0.27	0.0411
18	400	491890.5	121.48	0.30	300	387265.5	84.68	0.27	0.28	0.0147
21	200	293879.6	51.82	0.22	300	454263.7	108.25	0.31	0.27	0.0622

Table C4. Continued..

6) sample hybridized with S-St-PpF1-0865-a-A-21

	Replicate 1				Replicate 2					
sample time (hr)	mass per spec ng	Area	mass per ML pg	activity %	mass per spec ng	area	mass per ML pg	activity %	activity average (%)	stdev %
0	100	291070.3	4.83	0.04	150	446203.2	47.47	0.27	0.16	0.161
0.5	100	469438.3	53.85	0.59	150	493616.4	60.50	0.44	0.52	0.105
1	100	380516.8	29.41	0.34	150	439367.7	45.59	0.35	0.35	0.008
3	100	380516.8	29.41	0.33	150	439367.7	45.59	0.34	0.34	0.008
6	100	558515.8	78.33	0.93	150	624041	96.34	0.76	0.84	0.118
9	100	437439.6	45.06	0.47	150	558398	78.30	0.54	0.50	0.052
10	100	396983.6	33.94	0.32	150	468460.3	53.58	0.33	0.32	0.012
11	100	492983.1	60.32	0.71	150	600926.4	89.98	0.71	0.71	0.003
13	100	585838.2	85.84	0.93	150	711022.6	120.24	0.87	0.90	0.044
15	100	357445.5	23.07	0.24	150	584923.6	85.59	0.59	0.41	0.249
18	100	288343.9	4.08	0.04	150	360726.3	23.98	0.16	0.10	0.082
21	100	312090.8	10.61	0.09	150	424657.3	41.54	0.24	0.17	0.104

Table C4. Continued..

7) sample hybridized with S-St-PpPaW-0816-a-A-21

	Replicate 1				Replicate 2					
sample time (hr)	mass per spec ng	Area	mass per ML pg	activity %	mass per spec ng	area	mass per ML pg	activity %	activity average (%)	stdev %
0	400	587359.4	176.52	0.38	300	417094	122.84	0.35	0.36	0.0192
0.5	400	558849.5	167.53	0.46	300	350047.8	101.70	0.37	0.42	0.0619
1	400	407022.2	119.66	0.35	300	395611.9	116.07	0.45	0.40	0.0722
3	400	571494.1	171.52	0.48	300	232414.9	64.61	0.24	0.36	0.1706
6	400	605575.6	182.26	0.54	300	245314.1	68.68	0.27	0.41	0.1899
9	400	410634.1	120.80	0.31	300	192712.9	52.10	0.18	0.25	0.0941
10	200	208240.8	56.99	0.27	300	423359.4	124.81	0.39	0.33	0.0863
11	200	200737.4	54.63	0.32	300	358667.2	104.42	0.41	0.37	0.0627
13	200	268491.5	75.99	0.41	400	530294.2	158.53	0.43	0.42	0.0126
15	300	432785.9	127.79	0.44	400	639164.9	192.85	0.50	0.47	0.0411
18	400	383378.4	112.21	0.27	300	249335.7	69.95	0.23	0.25	0.0325
21	400	478224.2	142.11	0.31	300	280790	79.86	0.23	0.27	0.0545

Table C4. Continued..

8) sample hybridized with S-St-Gma-0997-a-A-21

	Replicate 1				Replicate 2					
sample time (hr)	mass per spec ng	Area	mass per ML pg	activity %	mass per spec ng	area	mass per ML pg	activity %	activity average (%)	stdev %
0	150	403385.4	83.06	0.47	200	565853.8	158.86	0.68	0.57	0.1447
0.5	150	398254.1	80.66	0.59	200	487211.1	122.17	0.67	0.63	0.0566
1	150	437033.6	98.76	0.77	200	411225.5	86.71	0.50	0.64	0.1849
3	150	379161	71.75	0.54	200	403703.8	83.21	0.47	0.51	0.0498
6	150	403098.6	82.92	0.65	200	374007.7	69.35	0.41	0.53	0.1726
9	150	462442.9	110.61	0.76	200	406538	84.53	0.44	0.60	0.2307
10	150	380253.1	72.26	0.45	200	470512.7	114.38	0.53	0.49	0.0593
11	150	320550.3	44.41	0.35	200	369688.4	67.33	0.40	0.37	0.0340
13	150	292633.5	31.38	0.23	200	454758.8	107.03	0.58	0.40	0.2497
15	150	308146.1	38.62	0.27	200	454758.8	107.03	0.55	0.41	0.2032
18	150	366755.3	65.97	0.43	200	459108.1	109.06	0.53	0.48	0.0725
21	300	505017.4	130.48	0.38	200	472122.8	115.13	0.50	0.44	0.0860

Table C5. Source data for the Figure 7 in chapter 4. (ML: DNA mass ladder)

1) data for the standard curves

S-D-Bact-0338-a-A-18		S-*-Tarom-0162-a-A-21		S-S-Atol-0484-a-A-18		S-St-PpPF1-0865-a-A-21		S-St-PpPaW-0816-a-A-21		S-St-GM1-0997-a-A-21	
mass per ML		mass per ML		mass per ML		mass per ML		mass per ML		mass per ML	
pg	area	pg	area	pg	area	pg	area	pg	area	pg	area
150	321865.8	75	208981.4	32.5	212327.3	18.75	64016.29	300	740692.7	37.5	63465.8
75	170445.2	150	453457.3	65	320583.1	37.5	186812.7	200	517266.9	75	137176.8
37.5	63515	200	501928.9	130	491787.8	75	397491.4	150	357168.1	150	263707.1
		300	650719.1			150	655893.3	75	139831.8	200	352972
		400	742963.9							300	656217.6

Table C5. Continued..

2) Standard curves

Probe	Equation	Regression coefficient
S-D-0338-a-A-18	Area=2256.8*mass per ML-12195	0.9917
S-*-Tarom-0162-a-A-21	Area=1552.6*mass per ML+162279	0.933
S-S-Atol-0484-a-A-18	Area=2833.1*mass per ML +126725	0.9963
S-St-PpF1-0865-a-A-21	Area=4422.4*mass per ML+15103	0.9788
S-St-PpPaW1-0816-a-A-21	Area=2681.2*mass per ML-47221	0.9934
S-St-GM1-0997-a-A-21	Area=2195.8*mass per ML-40155	0.9775

Table C5. Continued..

3) sample hybridized with S-D-Bact-0338-a-A-18

sample time (hr)	mass per spec ng	area	mass per ML pg
0	1.25	260987.4	121.05
0.5	1.25	181407.9	85.79
1	1.25	190843.5	89.97
3	0.625	175410.5	83.13
6	0.625	186654.9	88.11
9	1.25	221451.1	103.53
10	1.25	183053.9	86.52
11	1.25	149238	71.53
13	1.25	189370.6	89.31
15	1.25	156302.6	74.66
17	1.25	203488.9	95.57
21	1.25	108153.1	53.33

Table C5. Continued..

4) sample hybridized with S-*-Tarom-0162-a-A-21

	Replicate 1				Replicate 2					
sample time (hr)	mass per spec ng	Area	mass per ML pg	activity %	mass per spec ng	area	mas per ML pg	activity %	activity average (%)	stdev %
0	300	593615.4	277.82	0.96	400	632402.1	302.80	0.78	0.87	0.12
0.5	300	407989.9	158.26	0.77	400	405047.2	156.36	0.57	0.67	0.14
1	300	453613.8	187.64	0.87	500	585895.6	272.84	0.76	0.81	0.08
3	300	575557.8	266.18	0.67	400	759611.9	384.73	0.72	0.70	0.04
6	300	625787.4	298.54	0.71	400	843213.3	438.58	0.78	0.74	0.05
9	500	372764.6	135.57	0.33	600	611943.9	289.62	0.58	0.46	0.18
10	500	422360.4	167.51	0.48	600	574725.1	265.65	0.64	0.56	0.11
11	500	471947.3	199.45	0.70	600	535633.1	240.47	0.70	0.70	0.00
13	500	427047.4	170.53	0.48	600	528433.5	235.83	0.55	0.51	0.05
15	500	509034.4	223.34	0.75	600	513630.1	226.30	0.63	0.69	0.08
17	500	512200.1	225.38	0.59	600	627309.6	299.52	0.65	0.62	0.04
21	500	410312.5	159.75	0.75	600	419027.1	165.37	0.65	0.70	0.07

Table C5. Continued..

5) sample hybridized with S-S-Atol-0484-a-A-18

	Replicate 1				Replicate 2					
sample time (hr)	mass per spec ng	Area	mass per ML pg	activity %	mass per spec ng	area	mass per ML pg	activity %	activity average (%)	stdev %
0	400	407174.4	98.99	0.26	300	489391.6	128.01	0.44	0.35	0.1309
0.5	400	305982.8	63.27	0.23	300	267267.2	49.61	0.24	0.24	0.0074
1	400	281406.8	54.60	0.19	300	221954.6	33.61	0.16	0.17	0.0240
3	400	488608.5	127.73	0.24	300	446575.8	112.90	0.28	0.26	0.0303
6	400	496772.4	130.62	0.23	300	443582.3	111.84	0.26	0.25	0.0232
9	400	271589.3	51.13	0.15	300	214795.9	31.09	0.13	0.14	0.0207
10	400	294521.7	59.23	0.21	300	248036.9	42.82	0.21	0.21	0.0055
11	400	219508.9	32.75	0.14	300	180240.9	18.89	0.11	0.13	0.0234
13	400	291511.5	58.16	0.20	300	228087.8	35.78	0.17	0.19	0.0259
15	400	231738.1	37.07	0.16	300	183728.3	20.12	0.11	0.13	0.0303
17	400	227961.3	35.73	0.12	300	201513.8	26.40	0.12	0.12	0.0012
21	400	247592.1	42.66	0.25	300	201796.8	26.50	0.21	0.23	0.0304

Table C5. Continued..

6) sample hybridized with S-St-PpF1-0865-a-A-21

	Replicate 1				Replicate 2					
sample time (hr)	mass per spec ng	Area	mass per ML pg	activity %	mass per spec ng	area	mass per ML pg	activity %	activity average (%)	stdev %
0	200	654192.3	144.51	0.75	150	420424	91.65	0.63	0.69	0.081
0.5	200	326018.8	70.30	0.51	150	184191.5	38.23	0.37	0.44	0.100
1	200	220148.4	46.37	0.32	150	145919.8	29.58	0.27	0.30	0.034
3	200	621979.6	137.23	0.52	150	404644.4	88.08	0.44	0.48	0.053
6	200	663439.2	146.60	0.52	150	451839.6	98.76	0.47	0.49	0.037
9	200	221359.5	46.64	0.28	150	142912.6	28.90	0.23	0.26	0.035
10	200	222858.4	46.98	0.34	150	127075.1	25.32	0.24	0.29	0.068
11	200	212676.7	44.68	0.39	150	137946	27.78	0.32	0.36	0.047
13	200	262268.9	55.89	0.39	150	184628.94	38.33	0.36	0.37	0.024
15	200	509781.9	111.86	0.94	150	251982.8	53.56	0.60	0.77	0.239
17	200	672853	148.73	0.97	150	544537.9	119.72	1.04	1.01	0.050
21	200	179940.6	37.27	0.44	150	126728.1	25.24	0.39	0.42	0.030

Table C5. Continued..

7) sample hybridized with S-St-PpPaW-0816-a-A-21

	Replicate 1				Replicate 2					
sample time (hr)	mas per spec ng	Area	mass per ML pg	activity %	mass per spec ng	area	mass per ML pg	activity %	activity average (%)	stdev %
0	400	525628.4	213.65	0.55	300	700893.6	279.02	0.96	0.76	0.2891
0.5	400	195832.6	90.65	0.33	300	136898.4	68.67	0.33	0.33	0.0023
1	400	159733.1	77.19	0.27	300	111444.1	59.18	0.27	0.27	0.0042
3	400	523527.8	212.87	0.40	300	362039.2	152.64	0.38	0.39	0.0124
6	400	505240.7	206.05	0.37	300	392618.7	164.05	0.39	0.38	0.0159
9	400	119608.8	62.22	0.19	300	95132.56	53.09	0.21	0.20	0.0183
10	400	163928.4	78.75	0.28	300	135184.1	68.03	0.33	0.31	0.0305
11	400	123611.3	63.71	0.28	300	101836	55.59	0.32	0.30	0.0322
13	400	134550.5	67.79	0.24	300	86904.19	50.02	0.23	0.24	0.0027
15	400	200138.3	92.26	0.39	300	181277.3	85.22	0.48	0.43	0.0633
17	400	205787.7	94.36	0.31	300	179462.1	84.55	0.37	0.34	0.0425
21	400	156455.6	75.96	0.45					0.22	

Table C5. Continued..

8) sample hybridized with S-St-GM1-0997-a-A-21

	Replicate 1				Replicate 2					
sample time (hr)	mass per spec ng	Area	mass per ML pg	activity %	mass per spec ng	area	mass per ML pg	activity %	activity average (%)	stdev %
0	200	415853.5	207.67	1.07	300	537857.8	263.24	0.91	0.99	0.1175
0.5	400	360316.9	182.38	0.66	300	244973.2	129.85	0.63	0.65	0.0238
1	400	265086.5	139.01	0.48	300	192689.6	106.04	0.49	0.49	0.0058
3	200	344499.6	175.18	0.66	300	543408.9	265.76	0.67	0.66	0.0053
6	200	412739.6	206.25	0.73	300	656559.3	317.29	0.75	0.74	0.0132
9	400	271605.1	141.98	0.43	300	167311.9	94.48	0.38	0.40	0.0342
10	400	300087.4	154.95	0.56	300	209123.6	113.53	0.55	0.55	0.0092
11	400	300004.4	154.91	0.68	300	223151.6	119.91	0.70	0.69	0.0154
13	400	205942.4	112.08	0.39	300	129453.1	77.24	0.36	0.38	0.0225
15	400	559843.5	273.25	1.14	300	371430.6	187.44	1.05	1.09	0.0690
17	200	448892.1	222.72	1.46	300	448892.1	222.72	0.97	1.21	0.3433
21	400	260827.9	137.07	0.80	300	201198.8	109.92	0.86	0.83	0.0393

APPENDIX D: PROFILE AND HISTORICAL DATA FOR ANOXIC SBR

Table D1. Abiotic tests for ANX SBR

Time (hr)	Benzene (mg/l)	Toluene (mg/l)	*o*-Xylene (mg/l)	*m*-Xylene (mg/l)	*p*-Xylene (mg/l)
0	1.95	0.48	0	0	0
0.08	3.50	1.64	0.99	0.66	1.44
0.17	4.10	2.52	1.81	1.24	2.66
0.33	4.81	4.05	4.16	3.06	6.40
0.42	6.43	5.72	6.78	5.02	10.53
0.5	4.83	4.54	6.00	4.54	9.62
0.75	4.97	4.96	6.80	5.48	11.60
1	4.91	4.95	6.81	5.58	11.79
1.5	4.84	4.98	6.87	5.69	12.03
2	4.75	4.90	6.79	5.60	11.86
3	4.78	4.96	6.92	5.68	12.04
4	4.57	4.70	6.58	5.36	11.33
5	4.38	4.51	6.40	5.07	10.90
6	4.60	4.76	6.58	5.32	11.40
7	4.61	4.68	6.61	5.32	11.25
8	4.54	4.67	6.64	5.20	11.12
10	4.21	4.34	6.23	4.95	10.40
12	4.41	4.49	6.51	5.10	10.77
14	4.32	4.44	6.33	5.00	10.55
16	4.13	4.22	5.98	4.66	9.86
18	4.21	4.31	6.13	4.77	9.97
20	4.30	4.34	6.21	4.78	10.00
22	4.18	4.22	6.06	4.64	9.74
24	4.18	4.15	5.96	4.65	9.70

Table D2. Historical data for ANX SBR (Unit: mg/L)

Date	Benzene	Toluene	*o*-Xylene	*m*-Xylene	*p*-Xylene	COD	nitrite-N	nitrate-N	MLSS	MLVSS
2/2/98	4.57	2.27	7.37	5.46	5.73	112			2726	2433
2/3/98	3.22	1.34	5.39	5.22	4.22	138			2886	2485
2/4/98	3.21	0.98	6.20	5.05	4.66				2747	2460
2/5/98	3.25	1.01	6.37	6.22	4.28				2587	2267
2/6/98	2.88	0.86	6.82	4.85	4.45	95.04			2533	2233
2/10/98	1.73	0.23	5.84	5.18	4.26				2760	2387
2/11/98	2.22	0.32	6.37	5.89	4.64	112.4	45.44	7.97	2875	2495
2/12/98	3.83	0.41	7.06	5.67	4.90	192	76.09	16.38	2773	2333
2/13/98	2.11	0.37	5.67	5.49	4.18	241	78.44	4.32	2940	2453
2/14/98	4.67	0.47	6.03	4.89	4.44	120	81.54	57.05	2790	2333
2/15/98	4.24	0.56	7.46	4.46	4.16	142	82.75	73.97		
2/16/98	2.30	0.40	5.99	5.31	4.41	136	85.16	80.31		
2/17/98	1.84	0.44	6.24	5.44	4.24	136	90.00	85.95		
2/18/98						88	91.20	85.25		
2/19/98	2.49	0.43	5.03	4.59	4.85	124	88.18	84.54		
2/20/98	2.36	0.37	5.42	4.58	5.22	102	86.37	132.47		
2/21/98	4.53	0.39	4.67	4.06	4.33	145	85.07	125.16	2932	2680
2/22/98	3.41	0.36	5.25	4.65	4.35	120	84.58	11.76	2836	2532
2/23/98	2.26	0.30	4.94	6.31	4.59	124	82.38	16.59	2963	2468
2/24/98	2.50	0.25	5.03	3.28	4.41	136	83.48	23.50	2895	2626
2/25/98	2.18	0.08	5.16	1.16	4.20	172	78.72	54.58		
2/26/98	1.27	0.08	3.94	1.86	3.46	89.64	78.72	60.79		
2/27/98	1.99	0.08	4.31	3.56	3.98	97.61	77.50	85.65		
2/28/98	2.29	0.25	4.63	3.20	4.21	125.5	75.09	84.59	2765	2465
3/1/98	3.09	0.26	4.76	3.21	3.96	117.5	0.00	1.28	2708	2368
3/2/98	2.61	0.08	4.26	2.94	3.74	98.6	17.66	0.00	2727	2272
3/3/98	2.02	0.08	3.88	2.06	3.32	173	40.87	1.28		
3/4/98	1.80	0.08	4.20	1.91	2.97	144	43.32	0.00		
3/5/98	2.78	0.08	4.26	0.20	2.79	92.3	45.76	0.00	2813	2513
3/6/98	2.55	0.08	4.58	2.67	3.67	74.6	47.27	9.70		
3/7/98	2.74	0.08	3.76	3.06	3.77	141	56.16	14.12	2773	2472
3/8/98	2.73	0.08	4.37	2.83	3.81	107.5	62.69	21.25		
3/15/98	2.11	ND	4.09	0.40	2.98	113.3	ND	ND		
3/18/98	1.88	ND	6.14	3.58	3.87	106.7	ND	0.20		
3/19/98	2.92	0.20	6.93	5.32	5.35	107.5	ND	ND		
3/20/98	2.64	0.13	6.15	6.60	4.95	113.3	ND	ND		
3/21/98	3.92	0.60	5.78	4.87	4.46	66.43	ND	ND		
3/22/98	4.20	1.62	5.62	4.80	4.88	132.0	ND	ND	2810	2214
3/23/98	3.49	2.52	5.87	4.66	4.62	133.9	ND	ND		
3/24/98	4.47	2.48	6.13	5.15	4.91	101.9	ND	ND		
3/25/98	3.09	1.94	3.99	3.73	3.88	68.06		5.85		
3/26/98	6.03	0.83	5.49	5.82	5.23	86.11		14.80		
3/27/98						78.88		28.77		
3/28/98	3.89	0.26	5.65	5.08	5.20	110.9	9.25	2.47	2557.5	2162.5
3/29/98	3.34	0.14	4.24	6.12	5.27	70.21	3.25			
3/30/98	2.95	0.10	3.81	5.09	4.89	71.78	1.68			

Table D2. Continued..

Date	Benzene	Toluene	*o*-Xylene	*m*-Xylene	*p*-Xylene	COD	nitrite-N	nitrate-N	MLSS	MLVSS
3/31/98	4.07	0.10	3.76	4.82	4.95	82.43	2.46	1.37	2538	2148
4/1/98	3.63	ND	3.62	4.78	5.06	75.33	ND	1.69	2547	2147
4/2/98	2.60	ND	4.59	5.22	5.28	63.11	2.89	17.11		
4/3/98	2.19	0.05	5.34	4.74	4.91	56.4	5.98	14.49		
4/4/98						58.37	4.69	17.03		
4/5/98	6.97	2.60	5.59	6.10	6.43	85.98	10.11	26.26		
4/6/98	4.79	0.08	5.45	5.22	5.03	61.92	ND	ND		
4/7/98	2.95	ND	7.00	7.87	4.84	104.5	ND	ND		
4/8/98						93.53	6.32	15.63		
4/9/98	1.79	ND	5.37	5.22	4.25	87.35	ND	ND		
4/10/98	1.95	ND	4.32	ND	4.25	76.22	ND	ND		
4/11/98	1.92	ND	4.47	ND	3.96		ND	ND		
4/12/98	2.41	ND	3.38	0.24	3.89	61.8	ND	ND		
4/13/98							ND	ND		
4/14/98	2.62	ND	3.53	ND	4.24	53.56	ND	ND		
4/15/98	2.14	ND	3.61	ND	3.73	63.86	ND	ND	2823	2490
4/16/98	2.00	ND	3.47	0.25	3.66	63.34	ND	0.37		
4/17/98	2.33	ND	3.89	0.32	4.63		ND	0.34		
4/18/98	2.12	ND	3.21	ND	3.36		ND	0.34		
4/19/98	2.26	ND	2.94	ND	3.91	71.3	ND	0.37		
4/20/98	2.37	ND	3.44	ND	3.10	69.31	ND	0.37		
4/21/98	2.43	ND	3.60	ND	3.64	70.9	ND	0.34		
4/22/98	2.13	ND	3.34	ND	3.70		ND	0.37		
4/23/98							ND	0.44		
4/24/98	3.67	ND	3.17	ND	3.65					
4/25/98										
4/26/98										
4/27/98	2.14	ND	4.00	ND	3.32				2793	2493
4/28/98										
4/29/98	2.69	ND	6.34	0.29	4.88	76.98	ND	0.43825		
4/30/98	2.33	ND	5.21	ND	4.53		ND	0.43825		
5/1/98	2.52	ND	4.10	ND	4.16	72.22	ND	0.43825		
5/2/98							ND	0.43825		
5/3/98	0.66	ND	4.23	0.22	4.47	82.14	ND	0.43825		
5/4/98	0.16	ND	3.36	ND	3.52		ND	0.43825		
5/5/98	0.27	ND	3.84	ND	3.70	86.11	ND	ND	2540	2307.5
5/6/98	0.23	ND	4.13	ND	3.44					
5/7/98	0.20	ND	3.65	ND	3.21		ND	ND		
5/8/98	0.24	ND	3.30	ND	3.31					
5/10/98	1.15	0.38	4.19	0.38	4.42	96.82	ND	ND	2512	2137.5
5/11/98	0.08	3.34	1.28	3.34	1.38					
5/12/98	3.43	3.27	5.63	3.27	5.11					
5/13/98	3.60	2.63	4.12	2.63	4.77					
5/14/98	2.39	0.62	4.51	0.62	3.90					
5/18/98	1.64	ND	2.93	ND	3.81	80.16	ND	ND	2902	2556
5/19/98	1.52	ND	3.03	ND	3.56		ND	ND		
5/20/98	2.65	ND	5.23	ND	4.88	60	ND	ND		

Table D2. Continued..

Date	Benzene	Toluene	o-Xylene	m-Xylene	p-Xylene	COD	nitrite-N	nitrate-N	MLSS	MLVSS
5/21/98	3.40	ND	3.87	ND	4.85	60.8	ND	ND		
5/22/98	2.87	ND	4.04	ND	4.98		ND	ND		
5/25/98	2.31	ND	3.82	ND	4.04				2802.5	2517.5
5/26/98	3.75	0.32	4.77	0.36	4.80	62.4	15.75	ND		
5/31/98	5.35	ND	4.59	ND	5.78	56.8	ND	ND	2995	2540
6/1/98	4.95	ND	5.49	ND	5.43		ND	0.23		
6/2/98	4.44	ND	4.43	ND	4.90	59.2	ND	ND		
6/3/98	6.06	ND	5.48	ND	6.70		ND	ND		
6/4/98	3.87	ND	4.31	ND	4.29	56.4	ND	ND		
6/5/98	5.36	ND	5.05	ND	5.40		ND	ND		
6/7/98	2.18	ND	4.55	ND	4.32	63.6	ND	ND	2947.5	2557.5
6/8/98	2.18	ND	3.71	ND	3.51		ND	ND		
6/9/98	1.47	ND	3.72	ND	3.43		ND	ND		
6/10/98	0.94	ND	3.80	ND	2.94	54.4	ND	ND		
6/11/98	3.74	ND	3.51	ND	5.08		ND	ND		
6/12/98	3.23	ND	3.94	ND	4.02	56.8	ND	0.23		
6/14/98	1.06	ND	3.10	ND	2.61					
6/15/98	0.83	ND	3.17	ND	2.61	49.61				
6/16/98	0.93	ND	2.96	ND	2.57	53.65	3.08	0.31		
6/21/98	6.20	ND	3.81	ND	5.74					
6/22/98	3.71	ND	3.76	ND	5.43	54.86				
6/23/98	5.06	ND	3.82	ND	5.18		1.46	ND		
6/24/98	6.95	ND	5.14	ND	6.66	55.26	6.98	ND		
6/25/98	3.11	ND	3.65	ND	4.20		4.54	ND		
7/5/98	1.50	ND	3.47	ND	2.70	52.84	2.07	0.36		
7/7/98	2.90	ND	3.95	ND	3.00	57.82	5.97	ND	2945	2602.5
7/15/98	4.85	ND	3.25	ND	4.84	57.02	16.90	ND		
7/16/98	5.78	ND	5.25	ND	5.97					
7/19/98	5.15	ND	4.37	ND	5.78	81.98				
7/21/98	4.66	ND	4.15	ND	5.79	79.6	14.43	ND		
7/29/98	5.03	ND	5.81	ND	4.01	84.35	38.81	ND		
8/3/98	4.30	ND	7.25	ND	7.02	96.23	11.16	ND		
8/4/98	5.29	ND	4.97	ND	4.99		13.58	ND		
8/5/98	5.96	ND	5.39	ND	3.74		18.98	ND	2402.5	2087.5
8/6/98	4.92	ND	4.32	ND	3.89		14.88	ND		
8/17/98	5.06	ND	3.52	ND	4.39					
8/18/98	4.58	ND	3.56	ND	3.90	82.06				
9/1/98	4.95	ND	5.70	ND	6.45					
9/3/98	4.35	ND	4.42	ND	5.75	75.1				
9/4/98	4.23	ND	3.74	ND	5.13					
9/5/98	6.42	ND	4.78	ND	5.58					
9/7/98	4.50	ND	3.57	ND	4.25					
9/15/98	3.18	ND	3.79	ND	3.55	74.32	12.89	ND	2497.5	2182.5
9/16/98	3.18	ND	3.25	ND	3.38					

Table D2. Continued..

Date	Benzene	Toluene	*o*-Xylene	*m*-Xylene	*p*-Xylene	COD	nitrite-N	nitrate-N	MLSS	MLVSS
9/19/98	3.55	ND	3.80	ND	4.49		31.53	ND		
9/26/98	3.40	0.70	6.27	3.03	5.21	97.54				
9/27/98	3.88	ND	5.04	0.77	4.30	95.92				
9/28/98	3.62	ND	3.99	ND	3.60					
9/29/98	4.47	ND	4.63	ND	5.23					
9/30/98	3.33	ND	4.00	ND	3.77	84.91	10.1	ND		
10/1/98	3.27	ND	4.46	ND	3.82		0.76	ND		
10/2/98	3.29	ND	3.30	ND	3.68		16	ND		
10/3/98	3.19	ND	4.92	ND	4.00	60.54	7.27	0.48		
10/4/98	3.02	0.23	4.03	ND	4.34	57.40	17.98	1.23		
10/17/98	5.18	ND	5.23	5.12	5.52		ND	ND		
10/18/98	3.72	ND	4.16	4.30	4.75		ND	ND		
10/19/98	3.99	ND	4.10	3.54	4.94		ND	ND		
10/20/98	5.45	ND	4.75	1.68	5.49		ND	ND		
10/21/98	4.89	0.39	6.99	4.88	6.54		ND	ND		
10/22/98	4.12	ND	5.98	3.47	4.64	102.21	ND	ND		
10/23/98	3.87	1.88	6.04	2.27	5.08		ND	ND		
10/24/98	3.81	ND	4.06	ND	3.42		ND	ND		
10/25/98	3.85	ND	5.25	ND	3.69		12.24	ND		
10/26/98	3.89	ND	3.90	ND	3.41		5.79	ND		
10/27/98	3.86	ND	4.44	ND	4.79	84.13	10.92	ND		
10/28/98	4.59	ND	4.13	0.49	3.63	82.56	3	ND		
10/29/98	4.77	ND	4.17	ND	3.02		30.72	ND		
11/1/98	4.32	ND	5.09	ND	5.30		17.02	1.17		
11/2/98	4.21	ND	4.18	ND	4.79	82.56	ND	ND		
11/4/98	2.94	ND	4.20	ND	3.65	86.49	ND	ND		
11/5/98	2.22	ND	4.98	0.30	3.35		ND	ND		
11/8/98	2.65	ND	4.85	0.42	4.06	90.02	ND	ND		
11/9/98	4.79	ND	4.14	ND	3.34		ND	ND		
11/10/98	4.60	ND	3.87	ND	3.11		6.1	0.25		
11/12/98	4.39	ND	5.40	ND	3.19	99.07	17.5	ND		
11/13/98	4.61	ND	3.44	ND	4.12		ND	ND		

Table D3. Data for profile 1 during an anxoic SBR experiment including redox potential, electron acceptor concentration, BTX concentration, and specific enzyme actvitiy (Date: 10/30/1998)

Time	ORP	Benzene	Toluene	*o*-Xylene	*m*-Xylene	*p*-Xylene	Nitrite-N	Nitrate-N	Sulfate	Benzoyl-CoA reductase	Catechol 2,3 -dioxygenase	Catechol 1,2-dioxygenase
hr	mV	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mU/mg protein	mU/mg protein	mU/mg protein
0	-119	2.37	1.19	3.11	0.60	1.46	116.21	67.19	12.56	3.69	ND	ND
0.5	-143	4.38	4.70	6.22	4.84	4.41	106.73	37.52	12.35	7.04	0.170	ND
1	-101	5.02	5.57	7.02	5.78	5.76	107.46	23.23	12.56	9.20	0.296	ND
3	-148	4.55	4.39	6.81	4.66	5.26	109.76	ND	12.35	10.50	0.623	1.916
6	-133	4.41	2.89	6.77	2.90	5.28	85.01	ND	12.35	9.38	0.485	1.328
9	-160	4.45	0.51	6.64	0.81	5.35	67.17	ND	12.35	10.37	0.171	0.306
12	-182	4.36	ND	6.05	ND	5.18	52.21	ND	12.35	5.21	ND	ND
15	-199	4.21	ND	5.60	ND	4.88	36.67	ND	12.35	3.27	0.189	0.192
18	-208	4.25	ND	5.64	ND	4.92	25.52	ND	12.35	3.68	ND	ND
22	-227	4.00	ND	5.33	ND	4.76	19.30	ND	12.35	2.21	ND	ND

Table D4. Data for profile 2 during an anoxic SBR experiment including redox potential, electron acceptor concentration, and BTX concentration. (Date: 8/23/1998)

Time	ORP	Benzene	Toluene	o-Xylene	m-Xylene	p-Xylene	Nitrite-N	Nitrate-N	Sulfate
hr	mV	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
0	-166	2.15	0.00	0.32	0.82	1.61	51.99	96.90	14.04
0.3	-175	4.74	2.22	2.86	1.55	1.97	101.75	47.64	13.86
0.5	-154	5.69	3.59	5.53	3.63	4.47	109.07	35.12	14.45
0.8	-135	6.12	4.22	6.03	5.41	5.66	114.02	23.40	14.39
1.5	-106	6.11	2.64	6.12	4.93	5.61	137.37	3.90	13.51
2	-152	6.19	2.17	5.84	4.38	5.81	146.57	ND	13.80
3	-160	6.08	1.52	5.82	3.21	5.57	106.47	0.71	13.92
4	-167	6.08	0.72	5.81	2.31	5.53	97.27	ND	14.10
6	-167	5.93	ND	5.50	1.11	5.21	73.45	0.43	13.57
8	-171	5.85	ND	5.18	0.18	5.08	47.50	0.38	13.80
10	-175	5.77	ND	5.11	ND	4.97	37.55	0.34	13.8
14	-182	5.32	ND	4.90	ND	5.02	20.10	0.34	13.9
18	-190	5.21	ND	4.87	ND	4.99	6.01	0.29	13.9
22	-194	4.88	ND	5.16	ND	5.19	0.40	ND	14

APPENDIX E: PROFILE AND HISTORICAL DATA FOR ANX/MA/AER SBR

Table E1. Abiotic test for ANX/MA/AER SBR

Time (hr)	Benzene (mg/l)	Toluene (mg/l)	o-Xylene (mg/l)	m-Xylene (mg/l)	p-Xylene (mg/l)
0	1.22	1.07	0.46	0.61	0.63
0.25	3.83	2.96	5.02	3.12	2.90
0.5	4.46	3.71	6.25	4.65	4.20
0.75	4.26	4.16	6.57	4.91	4.49
1	4.54	4.62	7.25	5.44	5.10
1.5	4.53	4.69	7.51	5.73	5.35
2	4.58	4.72	7.82	5.85	5.43
3	4.52	4.64	7.43	5.67	5.27
4	4.48	4.62	7.41	5.60	5.22
5	4.32	4.42	7.15	5.39	5.02
6	4.33	4.45	7.19	5.43	5.05
10	3.84	3.92	6.52	4.77	4.41
12	3.72	3.79	6.30	4.57	4.23
14	3.79	3.83	6.41	4.62	4.27
16	3.72	3.76	6.31	4.52	4.19
18	3.63	3.65	6.14	4.34	4.02
20	3.57	3.61	6.05	4.29	3.94
22	3.54	3.54	5.97	4.24	3.91

Table E2. Historical data for ANX/MA/AER SBR. (Unit: mg/L)

Date	Benzene	Toluene	o-Xylene	m-Xylene	p-Xylene	COD	nitrite-N	nitrate-N	MLSS	MLVSS
3/18/98	1.85		4.70	4.26	3.42				2744	2296
3/19/98	2.05	1.15	5.30	5.09	3.66					
3/20/98	2.77	1.62	9.65	4.64	4.68				2724	2416
3/21/98	1.54	1.02	7.25	4.32	3.85					
3/22/98	0.67	0.18	4.28	2.02	2.81					
3/23/98	1.55	1.12	4.35	2.37	2.94					
3/24/98	1.16	0.68	4.58	2.29	2.63					
3/25/98	1.41	0.96	4.63	2.04	2.58					
3/26/98	3.41	2.35	3.97	4.00	3.67					
3/28/98	2.59	1.74	4.95	4.25	4.07				2960	2562.5
3/29/98	3.20	1.78	5.64	4.48	4.98					
3/30/98	2.01	1.27	4.78	4.23	3.45					
3/31/98	2.16	1.86	4.19	4.06	3.99				2588	2228
4/1/98	1.92	0.47	5.35	6.16	4.63					
4/2/98	2.79	1.05	8.18	5.80	4.84				2418	2110
4/3/98	2.29	1.37	5.23	5.79	4.42					
4/5/98	3.79	1.84	5.17	5.49	5.33					
4/6/98	2.28	0.16	5.19	4.66	4.67					
4/7/98	1.29	ND	5.01	3.93	3.23					
4/9/98	0.43	ND	2.90	1.08	1.63				2443	2183
4/10/98	0.13		3.83	0.75	1.43					
4/11/98	ND	ND	1.98	0.26	0.51					
4/12/98	0.04	ND	2.74	0.48	0.79		55.81	9.31		
4/13/98							43.79	90.50		
4/14/98	ND	ND	1.40	ND	0.31	126.07	32.45	72.12	2400	2135
4/15/98	ND	ND	0.86	ND	0.24	128.55	27.61	50.23		
4/16/98	0.09	ND	0.91	0.44	0.55	134.23	13.08	2.23		
4/17/98	0.09	ND	1.20	0.34	0.51					
4/18/98	ND	ND	0.64	ND	ND					
4/19/98	ND	ND	0.94	ND	ND	103.16	ND	0.44		
4/20/98	ND	ND	1.61	ND	ND	101.58	10.64	3.19		
4/21/98	0.05	ND	1.00	ND	0.24	98.78	ND	0.63		
4/22/98	0.92	ND	2.78	2.02	2.30		ND	0.51		

Table E2. Continued..

Date	Benzene	Toluene	o-Xylene	m-Xylene	p-Xylene	COD	nitrite-N	nitrate-N	MLSS	MLVSS
4/23/98	0.88	ND	2.94	1.13	1.64		ND	0.54		
4/24/98	0.35	ND	2.05	0.27	0.64		ND	0.50		
4/27/98	2.03	ND	5.04	1.45	2.39				2960	2693
4/29/98	0.36	ND	1.89	0.28	0.55	129.36	ND	ND		
4/30/98	0.82	ND	1.19	0.23	0.47		ND	0.47		
5/1/98	0.83	ND	1.34	0.40	0.62	139.28	ND	0.50		
5/3/98	0.26	ND	0.59	ND	0.36	132.53	ND	ND		
5/4/98	0.99	ND	1.93	1.21	2.01		ND	0.44	2715	2480
5/5/98	1.75	ND	2.26	2.47	3.42		ND	ND		
5/6/98										
5/7/98	0.32	ND	2.09	1.44	2.06	131.74	ND	ND		
5/8/98	0.22	ND	0.81	0.81	1.11					
5/10/98	0.82	ND	1.18	1.29	1.53	135.71	ND	ND	2542.5	2262.5
5/11/98	0.13	ND	0.65	1.67	0.88					
5/12/98	2.80	0.35	3.10	2.74	3.22				2342	2063
5/13/98	2.37	ND	0.91	2.16	2.41					
5/14/98	1.01	0.38	2.03	1.35	1.96				2363	2032
5/18/98	ND	ND	ND	ND	ND	124.6	ND	0.40		
5/19/98	0.17	ND	ND	ND	0.63		ND	0.81		
5/20/98	0.17	ND	ND	ND	0.41	103.2	ND	0.63		
5/21/98	ND	ND	ND	ND	ND	103.2	ND	0.63		
5/22/98	ND	ND	ND	ND	ND		ND	0.67	2970	2610
5/26/98	0.47	ND	0.47	ND	0.36	96	ND	1.16		
5/27/98	ND	ND	ND	ND	ND		ND	0.66		
5/29/98	0.55	ND	0.55	0.55	0.77					
5/31/98	1.47	ND	1.47	0.58	1.02	95.2	ND	1.07	2890	2522.5
6/1/98	0.63	ND	0.63	ND	ND		ND	0.43		
6/2/98	0.25	ND	0.25	ND	ND	90	ND	0.76		
6/3/98	0.63	ND	0.63	ND	0.27		ND	1.21		
6/4/98	ND	ND	ND	ND	0	90.8	ND	0.44		
6/5/98	0.47	ND	0.47	ND	0		ND	1.12		
6/7/98	ND	ND	ND	ND	0	96	ND	1.75	3087.5	2737.5
6/8/98	ND	ND	ND	ND	0		ND	0.53		

Table E2. Continued..

Date	Benzene	Toluene	o-Xylene	m-Xylene	p-Xylene	COD	nitrite-N	nitrate-N	MLSS	MLVSS
9/15/98	5.94	6.02	6.18	5.73	6.05				2860	2390
9/16/98	5.98	6.54	5.98	6.07	6.09					
9/17/98	4.21	4.35	4.47	5.05	5.07					
9/26/98	4.44	3.86	5.66	5.16	4.68					
9/27/98	4.47	3.98	4.98	4.55	4.86					
9/28/98	3.69	2.47	4.79	4.11	4.17					
9/29/98	5.48	3.38	6.45	4.95	5.46					
9/30/98							37.2	ND		
10/1/98							5.3	ND		
10/2/98							ND	ND		
10/3/98							ND	ND		
10/4/98	1.54	0.48	7.01	5.92	4.23		ND	ND		
10/6/98	2.95	1.43	7.08	4.91	4.72					
10/7/98	3.47	1.39	7.35	5.43	5.49		ND	ND		
10/10/98	ND	ND	ND	ND	ND		ND	ND		
10/11/98	ND	ND	ND	ND	ND		ND	ND		
10/12/98	ND	ND	ND	ND	ND		ND	ND		
10/13/98	ND	ND	ND	ND	ND					
10/14/98	ND	ND	ND	ND	ND		ND	ND		
10/15/98	ND	ND	ND	ND	ND		ND	ND		
10/16/98							ND	ND		
10/17/98							3.28	4.2		
10/18/98	ND	ND	ND	ND	ND		ND	ND		
10/21/98	1.52	ND	5.07	2.01	3.00		ND	ND		
10/22/98	0.68	ND	2.72	1.12	1.87		ND	ND		
10/23/98	0.33	ND	3.53	ND	0.99		22.1	2.5		
10/24/98	ND	ND	1.35	ND	ND		24.8	3.59		
10/25/98	ND	ND	0.94	ND	ND		14.59	2.38		
10/26/98	ND	ND	0.47	ND	ND		ND	ND		
10/27/98	ND	ND	ND	ND	ND	120.29	ND	ND		
10/28/98	ND	ND	ND	ND	ND	97.10	ND	ND		
10/29/98	0.58	ND	1.48	ND	0.58		ND	ND		
10/31/98							ND	ND		

Table E2. Continued..

Date	Benzene	Toluene	o-Xylene	m-Xylene	p-Xylene	COD	nitrite-N	nitrate-N	MLSS	MLVSS
11/1/98	ND	ND	ND	ND	ND		ND	ND		
11/2/98	ND	ND	ND	ND	ND	104.96	ND	ND		
11/4/98	ND	ND	ND	ND	ND	101.43	ND	ND		
11/5/98	ND	ND	ND	ND	ND		ND	ND		
11/8/98	ND	ND	ND	ND	ND	95.92	ND	ND		
11/9/98	ND	ND	ND	ND	ND		ND	ND		
11/10/98	ND	ND	ND	ND	ND		3.59	ND		
11/12/98						87.67	ND	ND		

Table E3. Data for profile 1 during an ANX/MA/AER SBR experiment including redox potential, electron acceptor concentration, BTX concentration, and specific enzyme activity. (11/6/1998)

Time	ORP	Benzene	Toluene	o-Xylene	m-Xylene	p-Xylene	Nitrite-N	Nitrate-N	Sulfate	Benzoyl-CoA reductase	Catechol 2,3 -dioxygenase	Catechol 1,2-dioxygenase
hr	mV	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mU/mg protein	mU/mg protein	mU/mg protein
0	-148	3.84	1.54	2.75	2.77	2.82	79.9	52.90	18.63	1.77	0.37	ND
0.5	-167	4.82	4.05	4.74	4.58	4.28	107.3	ND	17.40	4.85	0.36	0.87
1	-179	4.82	3.69	4.68	4.09	4.68	87.1	ND	18.13	14.57	0.61	2.06
3	-185	4.89	2.10	4.92	3.13	4.80	40.2	ND	17.64	11.22	0.74	1.54
6	-189	4.93	ND	4.82	1.61	4.89	10.1	ND	17.15	8.94	0.65	0.80
9	-207	4.92	ND	5.13	0.63	4.92	ND	ND	17.15	4.10	9.76	5.92
9.3	-56											
9.5	-44											
10	-40	5.03	ND	4.81	ND	4.88	ND	ND	17.15	3.13	14.28	14.72
11	-40	5.04	ND	4.55	ND	4.55	ND	ND	17.15	1.92	18.00	17.82
13	60	3.88	ND	3.65	ND	3.65	ND	ND	17.15	1.92	36.79	28.32
15	65	3.06	ND	1.43	ND	1.74	ND	ND	18.63	1.20	30.21	21.95
18	68	1.28	ND	0.0	ND	ND	ND	ND	17.15	1.25	21.37	12.29
22	85	0.00	ND	0.0	ND	ND	ND	ND	17.15	1.29	15.79	12.18

Table E4. Data for profile 2 during an ANX/MA/AER SBR experiment including redox potential, electron acceptor concentration, BTX concentration (8/27/1998)

Time	ORP	Benzene	Toluene	o-Xylene	m-Xylene	p-Xylene	Nitrite-N	Nitrate-N	Sulfate
hr	mV	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
0	-85	2.32	1.55	0.21	ND	0.12	28.27	92.16	25.31
0.25	-99	6.17	2.04	2.08	1.78	1.84	48.32	67.19	24.72
0.47	-108	6.20	4.15	5.04	4.65	4.47	64.84	65.21	24.72
1	-115	5.88	3.06	5.09	4.79	4.57	81.94	20.40	24.72
2	-84	5.77	1.94	5.86	3.90	5.29	81.94	7.39	24.72
4	-143	5.86	0.44	6.08	2.87	5.45	62.71	ND	24.72
6	-156	5.79	0.22	5.90	1.92	5.32	36.53	ND	24.13
8	-173	5.81	ND	5.22	1.22	4.81	13.33	ND	24.72
9	-179	5.95	ND	5.17	0.17	4.82	5.27	ND	24.28
9.5	-49								
10	-40	5.70	ND	4.99	ND	4.71	0.51	ND	23.66
10.5	-48								
11.4	-32	5.81	ND	4.80	ND	4.48	ND	ND	24.13
12	32	5.31	ND	4.61	ND	4.22	ND	ND	24.13
13	52	4.25	ND	4.23	ND	3.63	ND	ND	24.13
15	81	2.55	ND	3.81	ND	2.27	ND	ND	24.13
18	99	0.21	ND	2.33	ND	ND	ND	ND	24.13
21.8	148	ND	ND	ND	ND	ND	ND	ND	24.13

APPENDIX F: PROFILE AND HISTORICAL DATA FOR ANX/MA SBR

Table F1. Historical data for ANX/MA SBR

Date	Benzene	Toluene	o-Xylene	m-Xylene	p-Xylene	COD	Nitrite-N	Nitrate-N	MLSS	MLVSS
11/12/98	0.41	ND	1.44	0.44	1.00		ND	ND	2860	2517
11/13/98	0.41	ND	1.27	0.51	1.02		ND	ND		
11/14/98							ND	ND		
11/15/98							ND	ND		
11/16/98	0.60	ND	2.05	ND	1.31		ND	ND		
11/17/98	0.48	ND	2.41	ND	1.21		ND	ND		
11/19/98							ND	ND		
11/20/98	ND	ND	ND	ND	ND		ND	ND		
11/21/98	ND	ND	ND	ND	ND					
11/22/98	ND	ND	ND	ND	ND		ND	ND		
11/23/98	ND	ND	ND	ND	ND		ND	ND	2795	2502.5
11/24/98	ND	ND	ND	ND	ND		ND	ND		
11/25/98	ND	ND	ND	ND	ND	78.19	7.9	0.47		
11/26/98	ND	ND	ND	ND	ND		ND	ND		
12/1/98	ND	ND	ND	ND	ND	89.81				
12/2/98	ND	ND	ND	ND	ND				2835	2440
12/3/98	ND	ND	ND	ND	ND	96	ND	ND		
12/4/98	ND	ND	ND	ND	ND		ND	ND		
12/7/98	1.32	ND	2.66	0.61	1.52	104.13	ND	ND		
12/8/98	0.30	ND	1.29	ND	0.61		ND	ND		
12/9/98	0.16	ND	1.04	ND	0.41	79.35	4.19	ND		
12/10/98	ND	ND	ND	ND	ND					
12/11/98	ND	ND	ND	ND	ND					
12/12/98	ND	ND	ND	ND	ND					
12/13/98	ND	ND	ND	ND	ND	65.42	37.89	ND	2602.5	2277.5
12/14/98	ND	ND	ND	ND	ND		36.18	ND		
12/15/98	ND	ND	ND	ND	ND					
12/23/98	ND	ND	ND	ND	ND	65.81				
12/24/98	ND	ND	ND	ND	ND					
12/25/98	ND	ND	ND	ND	ND	60.77				
12/26/98	ND	ND	ND	ND	ND					
12/27/98	ND	ND	ND	ND	ND					
1/1/99	ND	ND	ND	ND	ND	68.13	ND	ND		
1/6/99	ND	ND	ND	ND	ND	69.29	ND	ND		

Table F1. Continued..

Date	Benzene	Toluene	o-Xylene	m-Xylene	p-Xylene	COD	Nitrite-N	Nitrate-N	MLSS	MLVSS
1/11/99	ND	ND	ND	ND	ND	70.45	ND	ND		
1/13/99	ND	ND	ND	ND	ND		ND	ND		
1/15/99	ND	ND	ND	ND	ND					
1/17/99	ND	ND	ND	ND	ND	102.58	ND	ND		
1/18/99	ND	ND	ND	ND	ND		ND	ND		
1/19/99						104.13	ND	ND		
1/20/99	ND	ND	ND	ND	ND		7.68	ND		
1/25/99	ND	ND	ND	ND	ND	71.61	8.76	ND		
1/26/99	ND	ND	ND	ND	ND		7.61	ND		
1/28/99							4.03	ND	2505	2107
2/5/99	ND	ND	ND	ND	ND					
2/6/99	ND	ND	ND	ND	ND					
2/10/99	ND	ND	ND	ND	ND					

Table F3. Data for profile 1 during an ANX/MA SBR experiment including redox potential, electron acceptor concentration, BTX concentration, and specific enzyme activity. (12/6/1998)

Time	ORP	Benzene	Toluene	o-Xylene	m-Xylene	p-Xylene	Nitrite-N	Nitrate-N	Sulfate	Benzoyl-CoA reductase	Catechol 2,3 -dioxygenase	Catechol 1,2-dioxygenase
hr	mV	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mU/mg protein	mU/mg protein	mU/mg protein
0	-152	2.67	1.48	2.76	0.83	2.52	106.01	23.02	14.71	2.26	ND	ND
0.5	-172	5.05	4.65	5.00	5.00	5.33	117.93	ND	14.71	3.48	0.45	1.49
1	-173	4.97	4.59	5.22	4.90	5.24	117.49	ND	14.71	10.29	0.30	1.12
3	-160	5.10	3.72	5.36	3.84	5.44	46.00	ND	15.21	9.51	0.38	0.21
6	-154	5.21	2.04	5.46	1.83	5.57	24.23	ND	14.71	10.68	0.77	0.15
9	-165	5.41	0.00	5.79	0.00	5.88	10.63	ND	13.69	6.59	0.11	0.00
10	-79	4.92	0.00	5.37	0.00	5.41	4.49	ND	14.20	2.36	15.67	14.34
11	-54	3.92	0.00	4.07	0.00	4.09	2.81	ND	13.43	1.44	27.49	19.32
13	-45						2.70	ND	13.94	1.12	33.31	25.77
15	-40	2.27	ND	2.51	ND	2.51	2.70	ND	13.18	0.43	29.52	21.58
17	-38	0.43	ND	0.00	ND	ND	ND	ND	14.20	1.01	14.42	10.22
22	-35	0.00	ND	0.00	ND	ND	ND	ND	14.96	0.66	10.59	3.23

Table F4. Data for profile 2 during an ANX/MA SBR to investigate whether benzoyl-CoA reductase is induced with the presence of toluene under microaerobic conditions. (2/14/1999)

Time	ORP	Benzene	Toluene	o-Xylene	m-Xylene	p-Xylene	Nitrite-N	Nitrate-N	Sulfate	Benzoyl-CoA reductase	Catechol 2,3 -dioxygenase	Catechol 1,2-dioxygenase
hr	mV	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mU/mg protein	mU/mg protein	mU/mg protein
0	-106	2.83	2.13	3.33	3.41	3.34	60.36	84.34	19.03	1.74	0.36	0.12
0.5	-130	5.35	5.31	5.61	5.70	5.88	62.09	51.59	19.03	2.98	ND	ND
1	-146	5.08	4.14	5.15	4.95	5.45	71.15	30.03	19.03	8.11	0.16	0.11
3	-160	5.36	1.59	5.65	3.53	5.41	52.61	10.49	19.03	9.29	0.25	0.23
6	-176	5.11	ND	5.28	1.75	5.46	24.58	ND	17.64	6.20	ND	ND
9	-182	5.26	ND	5.50	ND	5.77	14.32	ND	17.64	4.12	0.16	ND
10	-50	4.90	4.75	5.01	ND	4.44	13.45	ND	17.64	3.15	14.42	12.42
11	-42	4.13	3.91	4.48	ND	3.79	9.83	ND	18.10	2.30	25.19	15.67
13	-38	2.63	2.01	3.10	ND	2.69	4.57	ND	18.57	1.33	24.37	13.99
15	-45	2.00	5.50	1.89	ND	2.01	ND	ND	19.03	1.62	22.61	14.47
17	-79	1.25	4.82	1.27	ND	1.87	ND	ND	18.57	0.38	17.74	13.20
19	-88	0.50	3.35	0.89	ND	1.07	ND	ND	19.96	0.88	12.86	10.24
22	-70	ND	1.73	ND	ND	ND	ND	ND	19.03	1.24	12.40	13.81

Table F5. Data for profile 3 during an ANX/MA SBR experiment including redox potential, electron acceptor concentration, and BTX concentration. (Date: 11/27/1998)

Time hr	ORP mV	Benzene mg/l	Toluene mg/l	o-Xylene mg/l	m-Xylene mg/l	p-Xylene mg/l	Nitrite-N mg/l	Nitrate-N mg/l	Sulfate mg/l
0	-148	2.56	1.21	2.58	0.60	2.41	72.19	40.81991	16.03
0.5	-157	5.51	4.83	5.45	6.21	5.57	109.63	ND	16.03
1	-156	5.42	4.62	5.75	5.49	5.87	96.05	ND	15.80
2	-167	5.42	3.61	5.71	4.75	5.82	64.00	ND	15.58
3	-169	5.42	2.46	5.66	3.64	5.82	47.71	ND	15.35
5	-167	5.41	0.47	5.73	2.17	5.96	24.93	ND	15.13
7	-170	5.47	ND	5.79	1.15	5.90	12.25	ND	15.13
9	-169	5.48	ND	5.74	ND	5.88	4.86	ND	14.68
9.5	-53	4.83	ND	5.94	ND	5.52	3.45	ND	14.68
10	-50	4.90	ND	5.07	ND	5.03	2.59	ND	14.68
11	-33	4.53	ND	4.11	ND	4.87	1.61	ND	14.68
13	-30	2.98	ND	2.01	ND	3.71	1.50	ND	14.68
15	-30	1.14	ND	0.40	ND	2.00	1.50	ND	14.45
17	-35	0.02	ND	ND	ND	0.92	1.18	ND	
21.75	-20	ND	ND	ND	ND	ND	ND	ND	15.58

Table F6. Data for profile 4 during an ANX/MA SBR experiment including redox potential, electron acceptor concentration, and BTX concentration. (Date: 12/28/1998)

Time hr	ORP mV	Benzene mg/l	Toluene mg/l	o-Xylene mg/l	m-Xylene mg/l	p-Xylene mg/l	Nitrite-N mg/l	Nitrate-N mg/l	Sulfate mg/l
0	-127	3.05	2.96	3.09	1.79	2.06	64.28	54.21	16.52
0.5	-120	5.14	4.32	5.33	5.04	4.77	119.38	3.73	16.77
1	-133	5.18	3.63	5.39	5.02	5.03	104.90	ND	17.01
3	-135	5.29	2.13	5.56	3.09	5.24	53.56	ND	16.28
6	-131	5.23	ND	5.43	1.88	5.11	20.57	ND	15.80
9	-146	5.06	ND	5.19	ND	4.97	2.72	ND	15.07
9.5	-62	4.91	ND	5.27	ND	4.99	2.24	ND	
10	-30	4.68	ND	5.01	ND	4.71	1.39	ND	15.31
10.5	-39	4.42	ND	4.58	ND	4.37	0.92	ND	15.31
11	-40	4.05	ND	4.31	ND	3.94	0.63	ND	15.07
11.5	-89	3.86	ND	4.00	ND	3.85	ND	ND	15.07
11.75	-82	3.87	ND	4.04	ND	3.76			15.07
12	-85	3.84	ND	3.97	ND	3.75	ND	ND	15.07
12.25	-80	3.68	ND	3.77	ND	3.62	ND	ND	15.07
12.5	-81	3.65	ND	3.73	ND	3.60	ND	ND	15.07
12.75	-89	3.53	ND	3.66	ND	3.48	ND	ND	15.07
13	-94	3.46	ND	3.60	ND	3.43	ND	ND	17.01
13.25	-81	3.43	ND	3.54	ND	3.38	ND	ND	16.04
13.5	-84	3.45	ND	3.48	ND	3.31	ND	ND	15.80
14	-54	3.37	ND	3.39	ND	3.16	ND	25.94	15.80
14.5	-30	3.13	ND	3.19	ND	3.07	ND	25.39	15.61
15	-27	2.94	ND	2.94	ND	2.78	ND	25.20	15.80
15.5	-35	2.77	ND	2.67	ND	2.48	ND	25.02	16.04
16	-27	2.50	ND	2.12	ND	2.19	ND	24.65	16.04
16.5	-32	2.14	ND	1.70	ND	1.72	ND	24.46	16.04
17	-36	1.38	ND	1.46	ND	1.58	ND	24.28	16.04
17.5	-32	1.32	ND	1.25	ND	1.36	ND	24.09	16.04
18	-40	1.08	ND	0.99	ND	1.04	ND	23.91	16.04
18.5	-35	0.74	ND	0.64	ND	0.78	ND	23.17	16.04
19	-34	0.57	ND	0.46	ND	0.54	ND	22.43	15.80
19.5	-33	0.45	ND	0.27	ND	0.31	ND		16.04
20	-30	0.17	ND	ND	ND	ND	ND	20.99	16.04
20.5	-27	ND	ND	ND	ND	ND	ND	20.40	16.04
21	-32	ND	ND	ND	ND	ND	1.19	17.25	16.52

APPENDIX G. GEL IMAGE FOR STANDARD BLOTS

Figure G1. Gel image for standard blots for probes S-D-Bact-0338-a-A-18 and S-S-Atol-0484-a-A-18

Lane 1-6: ***Escherichia coli.*** **33.9, 20.1, 15.6, 11.7, 7.8, 4.1 ng per mass ladder**

Lane 7-11: Mass ladder. 40, 30, 20, 10, 5 ng.

Lane 12-16: ***Azoarcus tolulyticus*** **Tol-4. 26.7, 10.2, 16.1, 12.7, 8.6 ng per mass ladder**

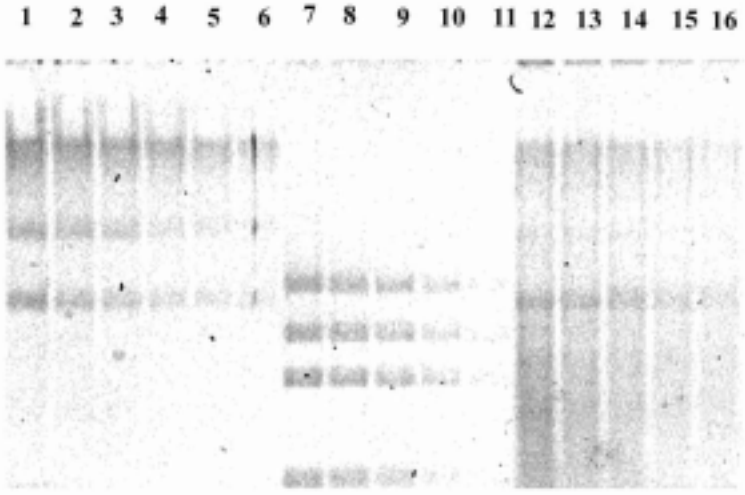

Figure G2. Gel image for standard blots for probes S-St-PpPaW-0816-a-A-21, S-St-GM1-0997-a-A-21, and S-*-Tarom-0162-a-A-21.

Lane 1-5: *Pseudomonas putida* PaW1. 44.1, 31.7, 27.3, 16.6, 9.8 ng per mass ladder

Lane 6-10: Mass ladder. 40, 30, 20, 10, 5 ng

Lane 11-15: GM1. 23.3, 14.6, 11.8, 8.8, 4.8 ng per mass ladder

Lane 16-20: *Thauera aromatica* T1. 22.5, 11.4, 9.9, 5.1, 0.7 ng per mass ladder

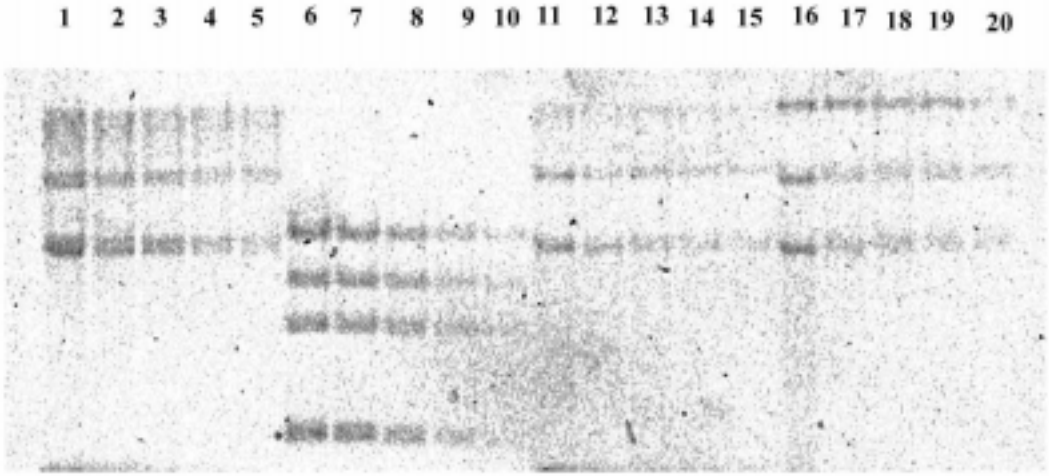

Figure G3. Gel image for negative control for probe S-St-GM1-0997-1-A-21

Lane 1-5: Mass ladder: 40, 30, 20, 10, 5 ng

Lane 6-8: *Pseudomonas aeruginosa*. 19, 17, 15 ng per mass ladder

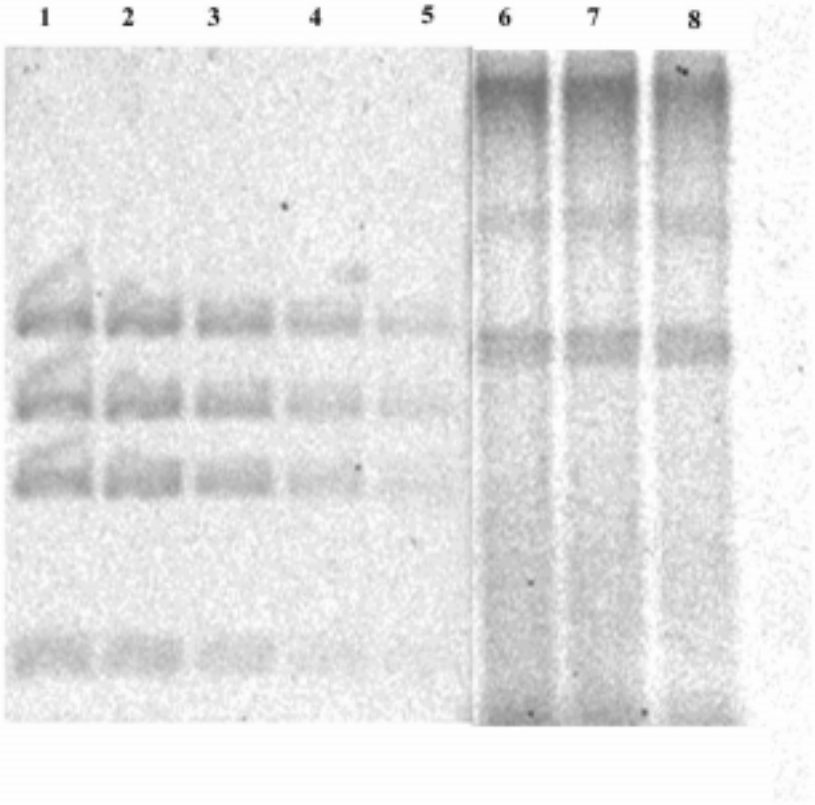

Figure G4. Gel image for standard blots for probe S-St-PpF1-0865-a-A-21

Lane 1-6: *Pseudomonas putida* F1. 75.5, 47.9, 34.8, 23.2, 14.1, 13.5 ng per mass ladder

Lane 7-11: Mass ladder. 40, 30, 20, 10, 5 ng

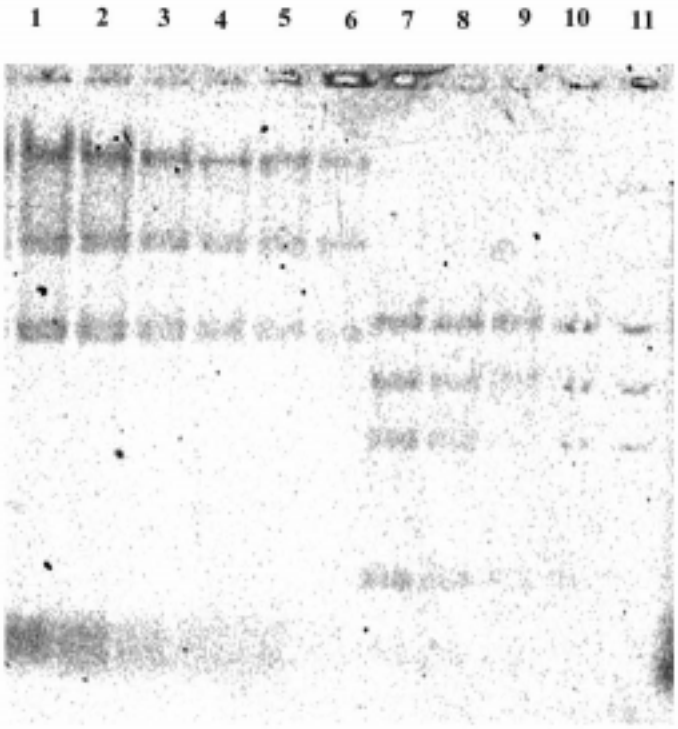

Figure G5. Gel image for negative control for probe S-S-Atol -0484-a-A-18

Lane 1-5: Mass ladder. 40, 30, 20, 10, 5 ng.

Lane 6-13. *Azoarcus indigens* VB32. 33, 33, 33, 31, 28.6, 23.2, 16.1, 12.5 ng per mass ladder