

ICR TREATMENT STUDY ANALYSIS

Base Analysis and Data Review Comments

Treatment Study ID	1060
Study Protocol	GAC RSSCT treatment study
Plant ICR Number	542
PWS Name	City of Tulsa
City, State, Zip	Tulsa, OK 74117

These are general comments that do not need to be responded to directly.

Major comments:

1. SDS-TOX breakthrough during all 4 quarters was highly variable, and did not usually show typical breakthrough curves, such as those seen for SDS-THM4 and SDS-HAA6. See specific comments below.

General Comments:

1. Quarter 1: High immediate breakthrough of SDS-TOX for the 10 minute EBCT contactor (70 µg/L as Cl⁻). No "typical" breakthrough curve observed, as values fluctuate between 40 and 100 µg/L as Cl⁻. The results contrast SDS-THM4 and SDS-HAA6 breakthrough curves, which look normal. For the 20 minute EBCT run, SDS-TOX control is poor, which does not match the results observed for SDS-THM4 or SDS-HAA6.
2. Quarter 2: Relatively high immediate breakthrough of SDS-TOX not seen in SDS-THM4 or SDS-HAA6.
3. Quarter 3: Unusual SDS-TOX breakthrough trends not observed in SDS-THM4 or SDS-HAA6, especially for the 20 minute EBCT run.
4. Quarter 4: Very unusual SDS-TOX breakthrough trends, again not similar to those observed for other parameters.

Outlier Data:

No outliers were removed.

Cell: A1

Comment: 1060-SAS.xls 2/6/00 18:28

All curve fits reviewed and approved. See below for log of refit datasets.

Cell: C5

Comment: 1060-10-01 - Run 1 (CHBr3) 2/6/00 18:18
Original value (CoefA0) = -0.8001 New value = -0.303
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: D5

Comment: 1060-10-01 - Run 1 (CHBr3) 2/6/00 18:18
Original value (CoefAf) = 5.388 New value = 5.2384
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: E5

Comment: 1060-10-01 - Run 1 (CHBr3) 2/6/00 18:18
Original value (CoefB) = 4.9863 New value = 20.134
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: F5

Comment: 1060-10-01 - Run 1 (CHBr3) 2/6/00 18:18
Original value (CoefD) = 0.1597 New value = 0.2913
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: J5

Comment: 1060-10-01 - Run 1 (CHBr3) 2/6/00 18:18
Original value (S) = -0.0396 New value = -0.0473
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: C27

Comment: 1060-10-02 - Run 3 (CHBr3) 2/6/00 18:20
Original value (CoefA0) = -0.1938 New value = -0.8379
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: D27

Comment: 1060-10-02 - Run 3 (CHBr3) 2/6/00 18:20
Original value (CoefAf) = 1.9796 New value = 4.043
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: E27

Comment: 1060-10-02 - Run 3 (CHBr3) 2/6/00 18:20
Original value (CoefB) = 0.6254 New value = 20.1518
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: F27

Comment: 1060-10-02 - Run 3 (CHBr3) 2/6/00 18:20
Original value (CoefD) = 0.1484 New value = 0.6198
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: J27

Comment: 1060-10-02 - Run 3 (CHBr3) 2/6/00 18:20
Original value (S) = 0 New value = -0.0388
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: C30

Comment: 1060-10-02 - Run 3 (DBAA) 2/6/00 18:21
Original value (CoefA0) = -0.0434 New value = 1.0398
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: D30

Comment: 1060-10-02 - Run 3 (DBAA) 2/6/00 18:21
Original value (CoefAf) = 3.4959 New value = 2.0904
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: E30

Comment: 1060-10-02 - Run 3 (DBAA) 2/6/00 18:21
Original value (CoefB) = 3.674 New value = 17.6937
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: F30

Comment: 1060-10-02 - Run 3 (DBAA) 2/6/00 18:21
Original value (CoefD) = 0.1219 New value = 0.3003
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: J30

Comment: 1060-10-02 - Run 3 (DBAA) 2/6/00 18:21
Original value (S) = 0 New value = -0.0353
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: C52

Comment: 1060-10-03 - Run 5 (DBAA) 2/6/00 18:24
Original value (CoefA0) = -1.4146 New value = -1.3404
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: D52

Comment: 1060-10-03 - Run 5 (DBAA) 2/6/00 18:24
Original value (CoefAf) = 4.244 New value = 4.5129
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: E52

Comment: 1060-10-03 - Run 5 (DBAA) 2/6/00 18:24
Original value (CoefB) = 2.1162 New value = 2.6258
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: F52

Comment: 1060-10-03 - Run 5 (DBAA) 2/6/00 18:24
Original value (CoefD) = 0.0577 New value = 0.0567
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: J52

Comment: 1060-10-03 - Run 5 (DBAA) 2/6/00 18:24
Original value (S) = 0 New value = -0.0144
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: C74

Comment: 1060-10-04 - Run 7 (DBAA) 2/6/00 18:25
Original value (CoefA0) = 0.0724 New value = -0.2457
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: D74

Comment: 1060-10-04 - Run 7 (DBAA) 2/6/00 18:25
Original value (CoefAf) = 1.9882 New value = 2.3913
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: E74

Comment: 1060-10-04 - Run 7 (DBAA) 2/6/00 18:25
Original value (CoefB) = 13.3897 New value = 85.4636
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: F74

Comment: 1060-10-04 - Run 7 (DBAA) 2/6/00 18:25
Original value (CoefD) = 0.1778 New value = 0.3471
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: J74

Comment: 1060-10-04 - Run 7 (DBAA) 2/6/00 18:25
Original value (S) = -0.01 New value = -0.0142
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: C93

Comment: 1060-20-01 - Run 2 (CHBr3) 2/6/00 18:19
Original value (CoefA0) = 0.0028 New value = -0.2426
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: D93

Comment: 1060-20-01 - Run 2 (CHBr3) 2/6/00 18:19
Original value (CoefAf) = 3.5869 New value = 4.8296
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: E93

Comment: 1060-20-01 - Run 2 (CHBr3) 2/6/00 18:19
Original value (CoefB) = 20 New value = 20.0739
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: F93

Comment: 1060-20-01 - Run 2 (CHBr3) 2/6/00 18:19
Original value (CoefD) = 0.1413 New value = 0.1751
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: J93

Comment: 1060-20-01 - Run 2 (CHBr3) 2/6/00 18:19

Original value (S) = -0.0113 New value = -0.0223
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: C115

Comment: 1060-20-02 - Run 4 (CHBr3) 2/6/00 18:22
Original value (CoefA0) = -0.1153 New value = -0.3904
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: D115

Comment: 1060-20-02 - Run 4 (CHBr3) 2/6/00 18:22
Original value (CoefAf) = 2.7565 New value = 3.9451
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: E115

Comment: 1060-20-02 - Run 4 (CHBr3) 2/6/00 18:22
Original value (CoefB) = 6.1358 New value = 15.6414
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: F115

Comment: 1060-20-02 - Run 4 (CHBr3) 2/6/00 18:22
Original value (CoefD) = 0.1059 New value = 0.2126
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: J115

Comment: 1060-20-02 - Run 4 (CHBr3) 2/6/00 18:22
Original value (S) = -0.0149 New value = -0.0283
Poor peak curve fit. Data was refit by iterative curve fit procedure.

ICR Information

ID / ICR#: OK1020418 / 542
 ICR Contact: Ken Burman
 Phone No.: 918-591-4576
 Period: 5/9/98 - 5/18/98 (8 B-S days)

Design Information

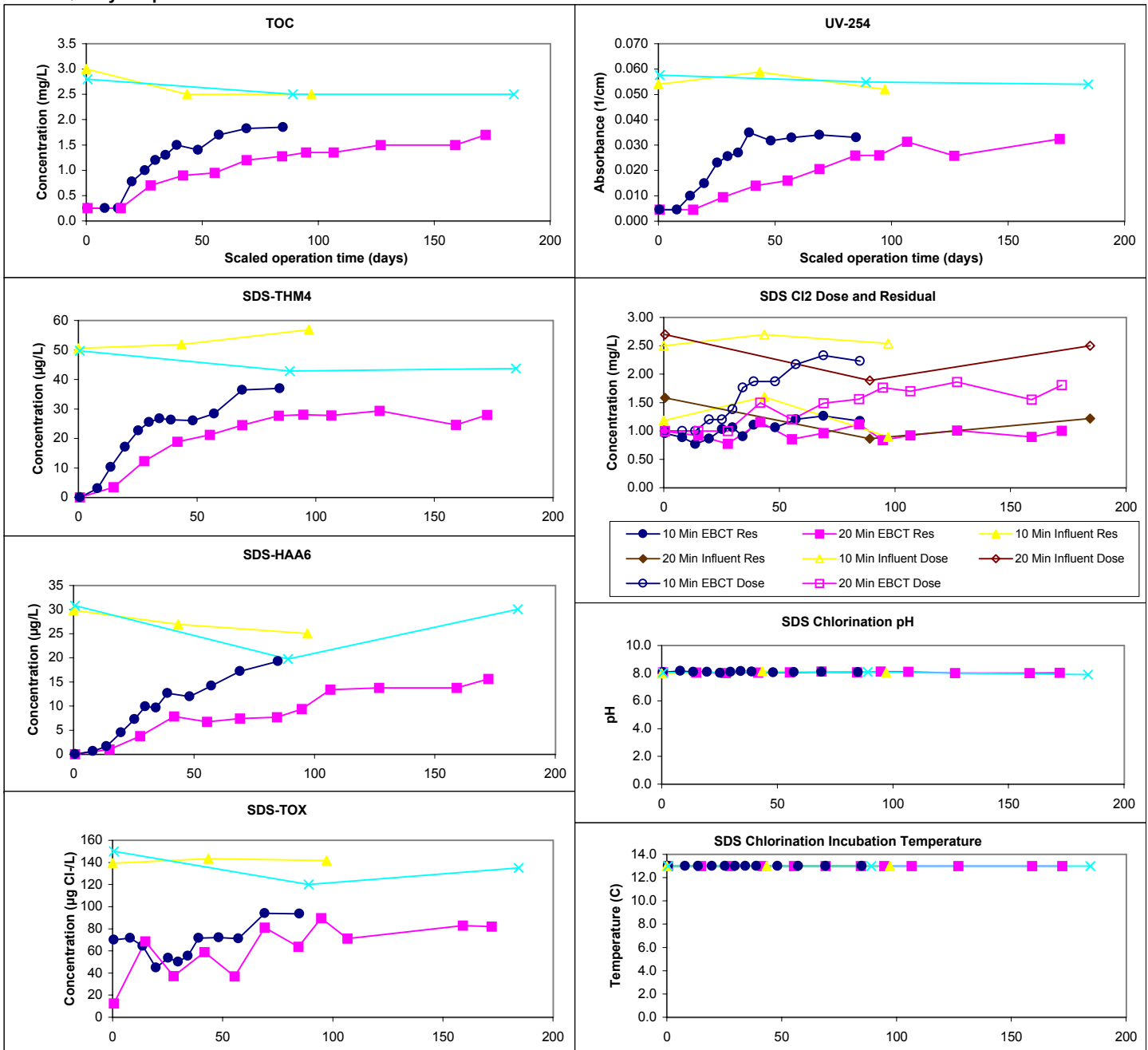
Design TOC: 2.5 mg/L
 Col Diameter: 8.0 mm
 Min Reynolds#: 0.41
 Full-Scale Temp: 13.2 C

Full-Scale GAC Size: 8x30 Lignite
 Bench-Scale GAC Size: 100x200
 Scaling Factor: 14.30
 Meas Dry Bed Density: 0.40 g/cm3

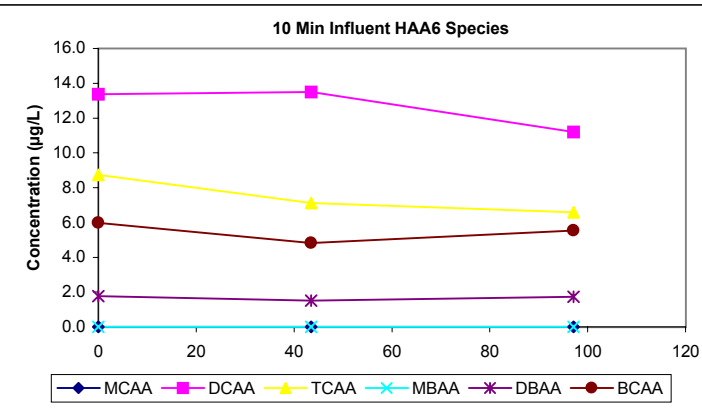
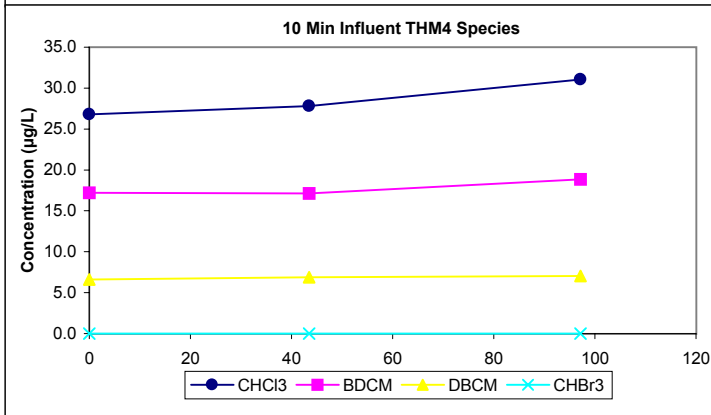
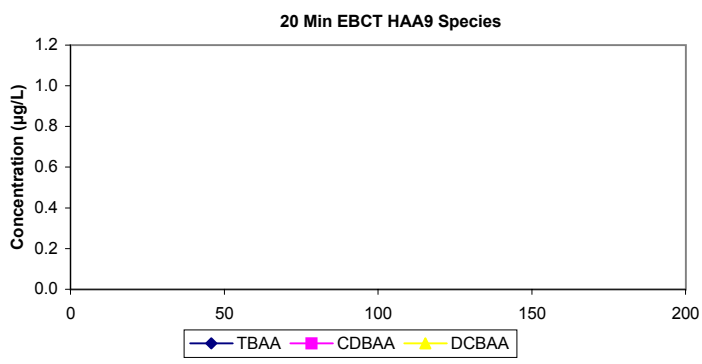
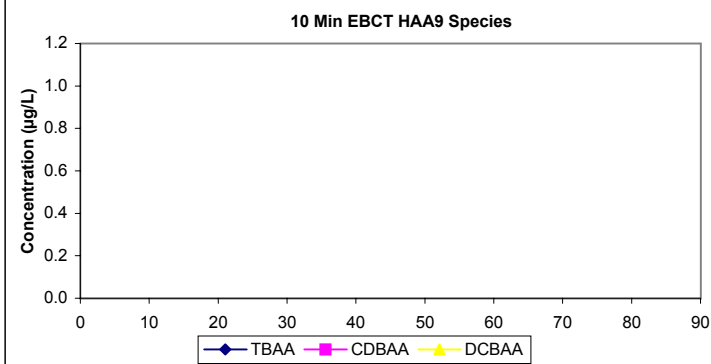
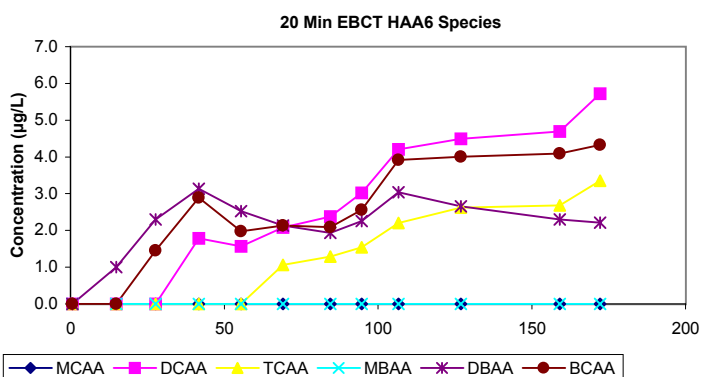
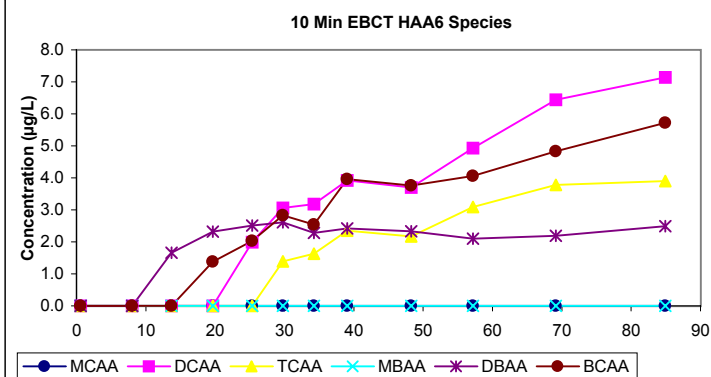
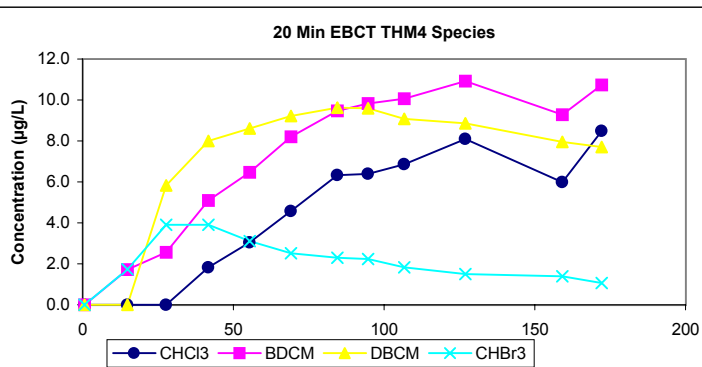
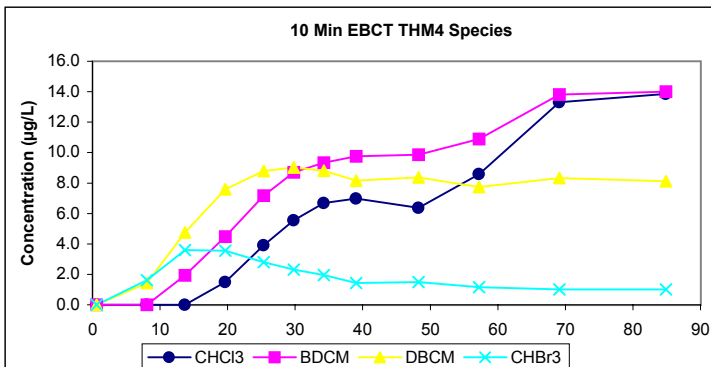
Water Quality Summary

Influent	10 Min Influent				20 Min Influent				Cumulative SDS Conditions			
	Mean	SD/RD	Count	Min/Max	Mean	SD/RD	Count	Min/Max	Res (0)	Mean	SD	Count
TOC	2.7	0.3	3	2.5 - 3.0	2.6	0.2	3	2.5 - 2.8	1.04	0.20		30
pH	7.7	0.1	2	7.7 - 7.8	7.9	0.0	3	7.9 - 7.9	Temp	13.0	0.0	30
UV254	0.055	0.003	3	0.052 - 0.059	0.056	0.002	3	0.054 - 0.058	pH	8.1	0.1	30
SUVA	2.08	0.28	3	1.80 - 2.35	2.14	0.07	3	2.06 - 2.20	Time	7.0	0.0	30
Bromide	56	6	2	53 - 59	63	11	2	57 - 68	Comments:			
SDS-TOX	141	2	3	139 - 143	135	15	3	120 - 150				
SDS-THM4	53	3	3	51 - 57	45	4	3	43 - 50	Chart Legend:			
SDS-HAA6	27	2	3	25 - 30	27	6	3	20 - 31				
Effluent	10 Min EBCT (7 B-S days)				20 Min EBCT (12 B-S days)				Chart Legend:			
Effluent pH	7.9	0.2	12	7.4 - 8.0	8.0	0.1	12	7.7 - 8.1				
Effluent Temp	23.0	0.0	12	23.0 - 23.0	23.2	0.6	12	23.0 - 25.0				

Water Quality Graphs



Water Quality Graphs (Continued)



ICR Information

ID / ICR#: OK1020418 / 542
 ICR Contact: Ken Burman
 Phone No.: 918-591-4576
 Period: 7/6/98 - 7/14/98 (8 B-S days)

Design Information

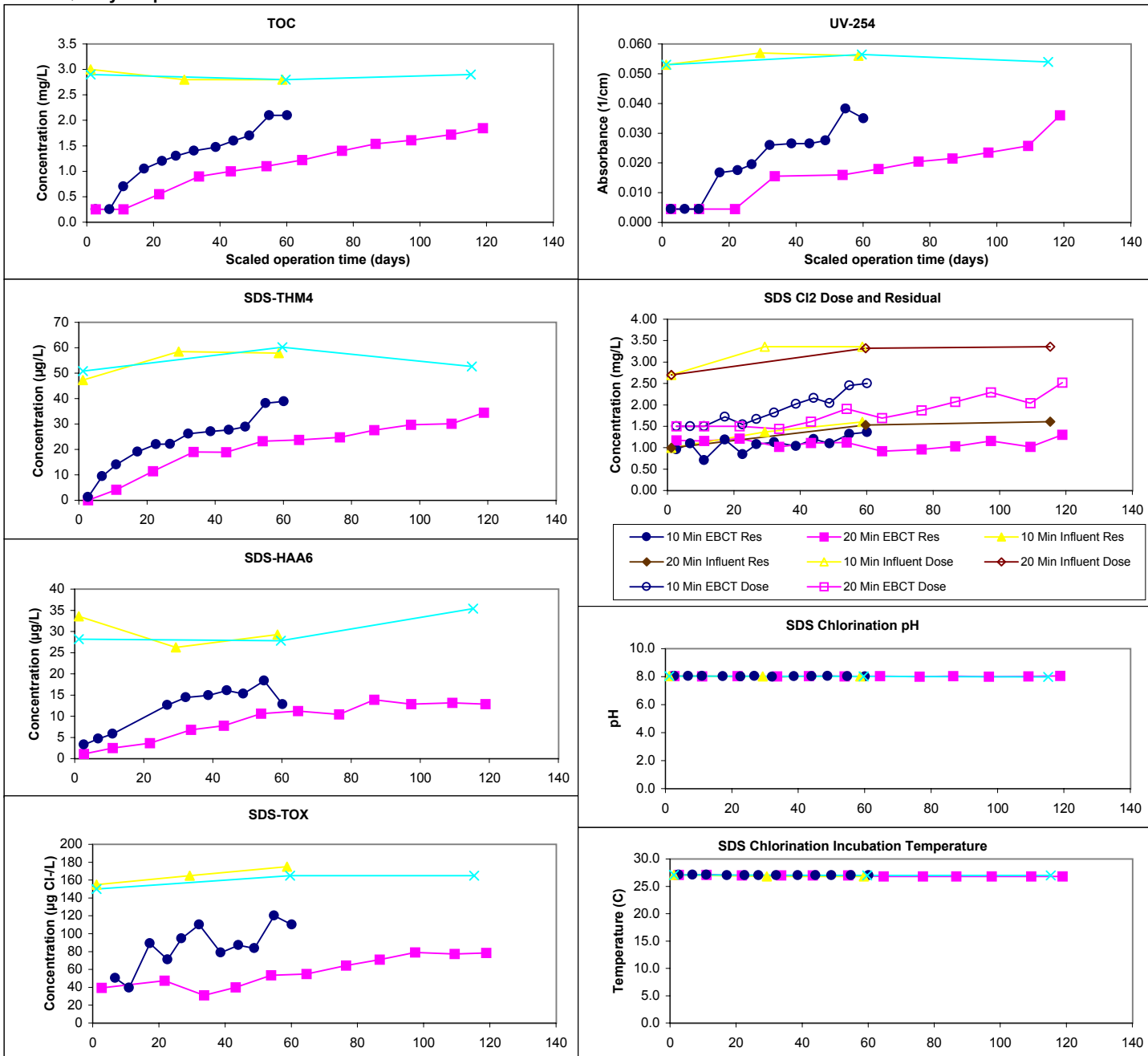
Design TOC: 2.9 mg/L
 Col Diameter: 8.0 mm
 Min Reynolds#: 0.59
 Full-Scale Temp: 28.1 C

Full-Scale GAC Size: 8x30 LIGNITE
 Bench-Scale GAC Size: 100x200
 Scaling Factor: 14.30
 Meas Dry Bed Density: 0.40 g/cm3

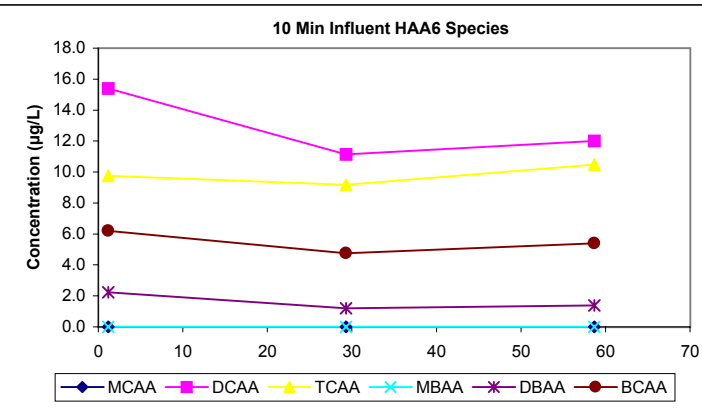
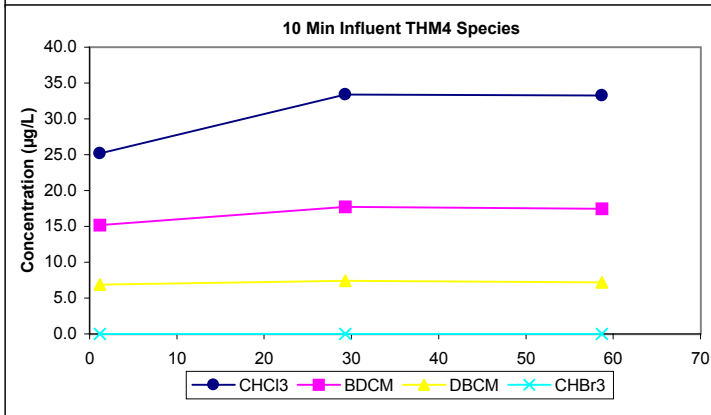
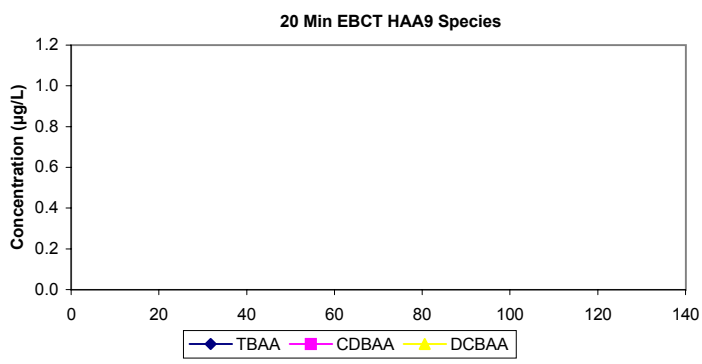
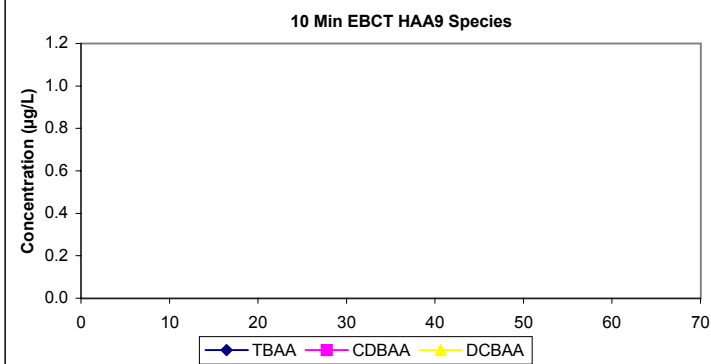
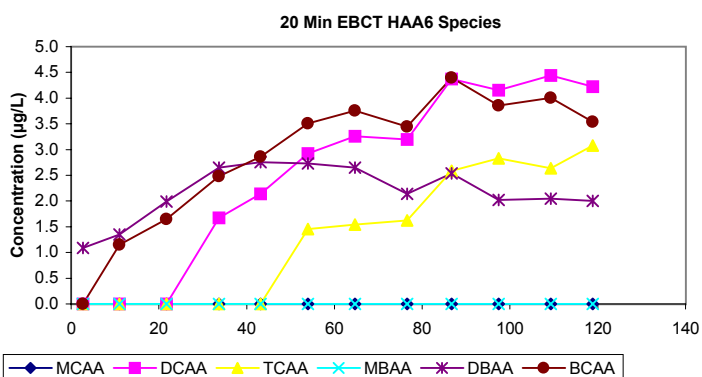
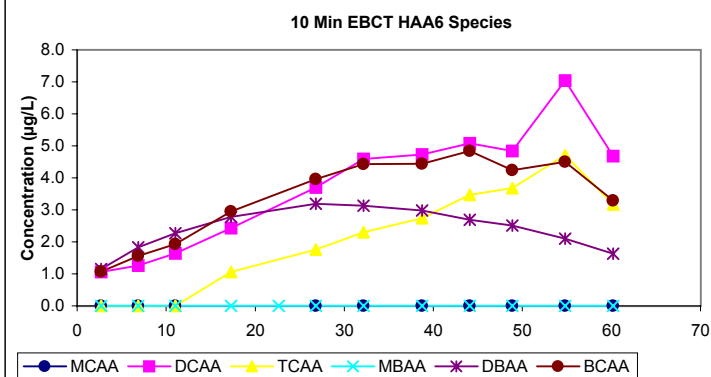
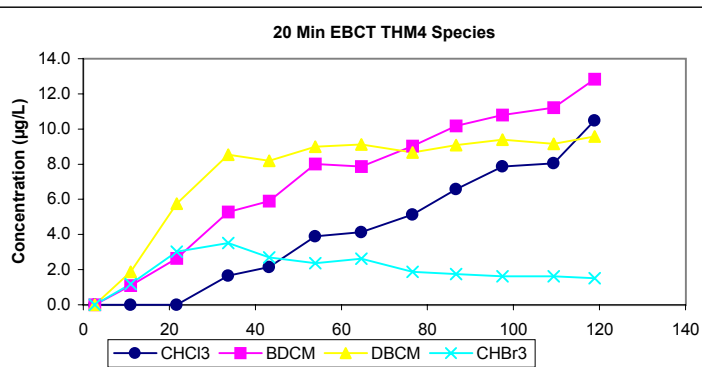
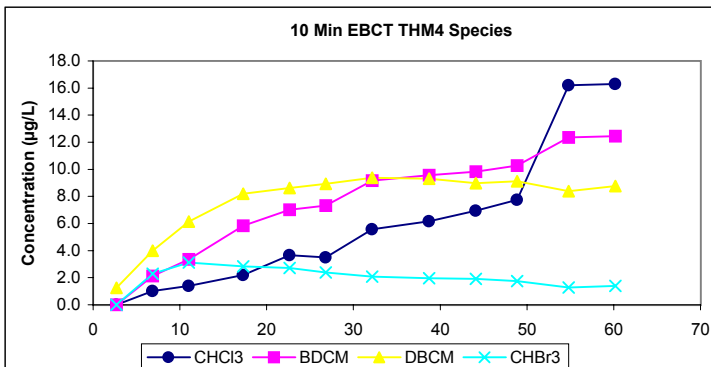
Water Quality Summary

Influent	10 Min Influent				20 Min Influent				Cumulative SDS Conditions			
	Mean	SD/RD	Count	Min/Max	Mean	SD/RD	Count	Min/Max	Res (0)	Mean	SD	Count
TOC	2.9	0.1	3	2.8 - 3.0	2.9	0.1	3	2.8 - 2.9	1.14	0.21		30
pH	7.9	0.0	3	7.9 - 8.0	8.0	0.1	3	7.9 - 8.1	Temp	27.0	0.1	30
UV254	0.055	0.002	3	0.053 - 0.057	0.055	0.002	3	0.053 - 0.057	pH	8.0	0.0	30
SUVA	1.93	0.15	3	1.77 - 2.04	1.90	0.10	3	1.83 - 2.02	Time	7.0	0.0	30
Bromide	64	2	2	63 - 65	62	2	2	61 - 63	Comments:			
SDS-TOX	165	10	3	155 - 175	160	9	3	150 - 165				
SDS-THM4	55	6	3	47 - 59	55	5	3	51 - 60	Chart Legend:			
SDS-HAA6	30	4	3	26 - 34	30	4	3	28 - 35				
Effluent	10 Min EBCT				20 Min EBCT							
	Mean	SD/RD	Count	Min/Max	Mean	SD/RD	Count	Min/Max				
Effluent pH	8.0	0.0	12	8.0 - 8.1	8.0	0.1	12	7.9 - 8.1				
Effluent Temp	21.6	2.1	12	18.0 - 24.0	21.8	2.1	12	17.5 - 24.0				

Water Quality Graphs



Water Quality Graphs (Continued)



ICR Information

ID / ICR#: OK1020418 / 542
 ICR Contact: Ken Burman
 Phone No.: (918) 591-4576
 Period: 11/10/98 - 11/16/98 (6 B-S days)

Design Information

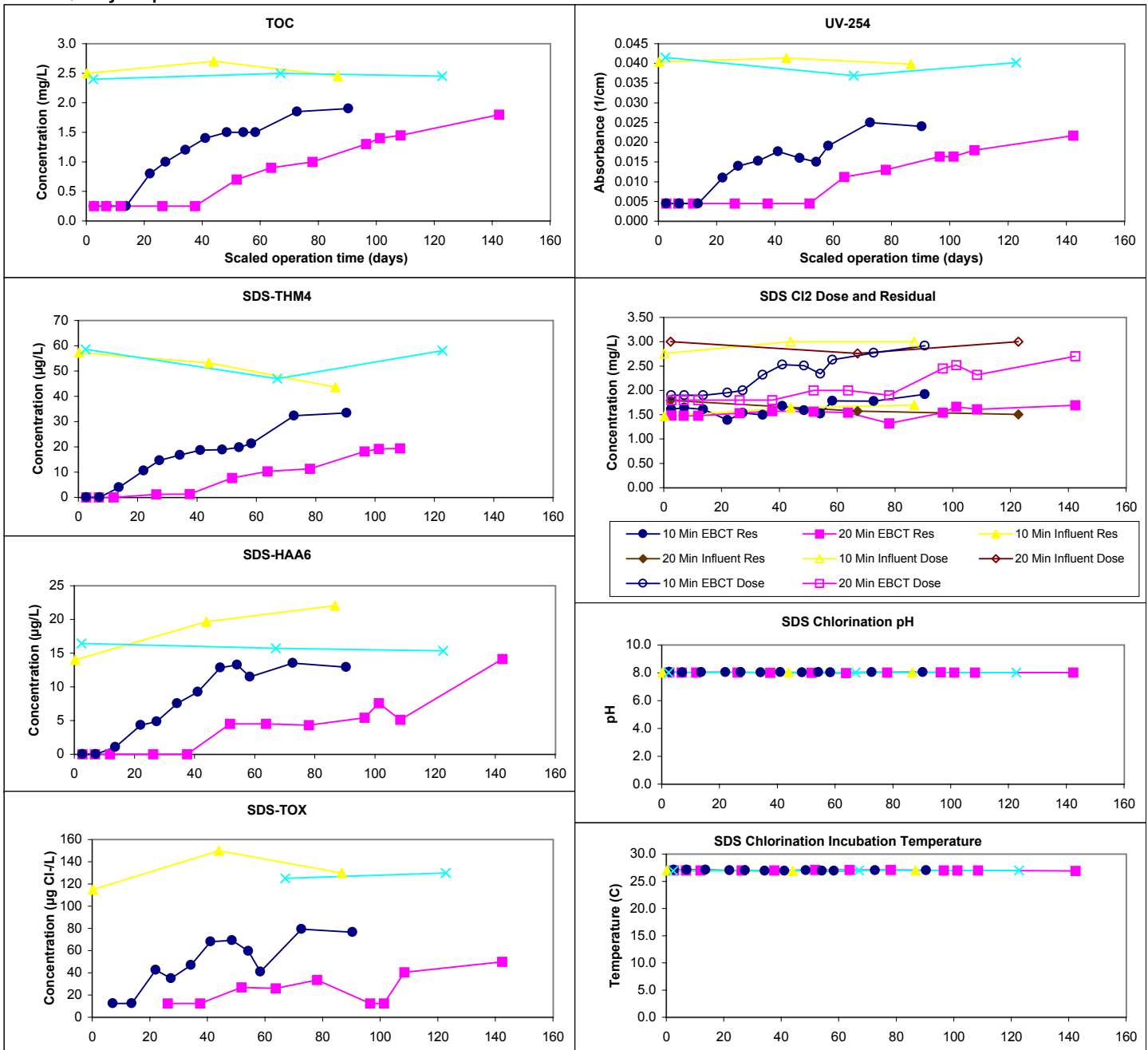
Design TOC: 2.4 mg/L
 Col Diameter: 8.0 mm
 Min Reynolds#: 0.49
 Full-Scale Temp: 20.4 C

Full-Scale GAC Size: 8x30 Lignite
 Bench-Scale GAC Size: 100x200
 Scaling Factor: 14.30
 Meas Dry Bed Density: 0.40 g/cm3

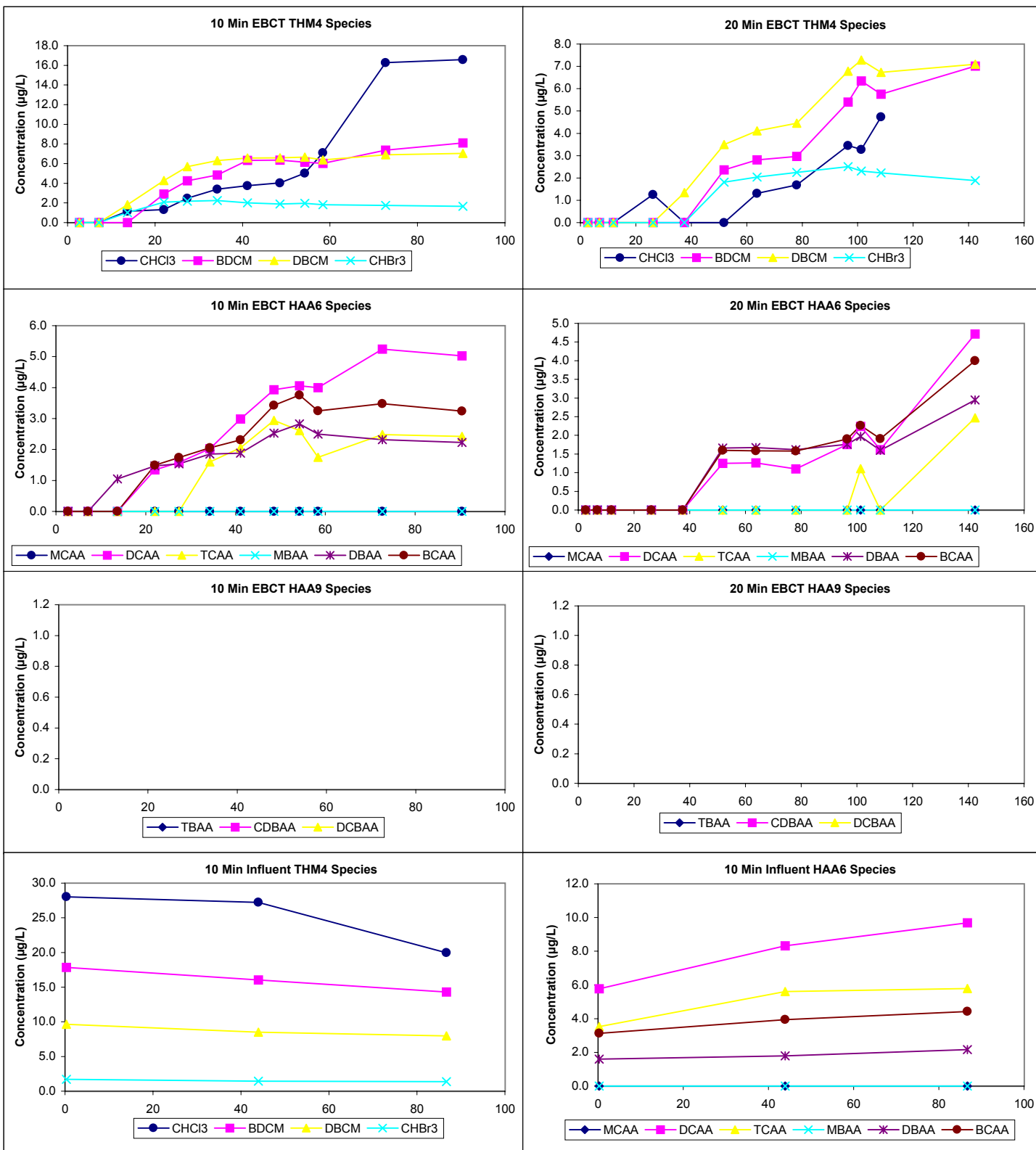
Water Quality Summary

Influent	10 Min Influent				20 Min Influent				Cumulative SDS Conditions			
	Mean	SD/RD	Count	Min/Max	Mean	SD/RD	Count	Min/Max	Res (0)	Mean	SD	Count
TOC	2.6	0.1	3	2.5 - 2.7	2.5	0.0	3	2.4 - 2.5	1.59	0.13		30
pH	7.8	0.1	3	7.8 - 7.9	7.7	0.1	3	7.7 - 7.8	Temp	27.0	0.1	30
UV254	0.041	0.001	3	0.040 - 0.041	0.040	0.002	3	0.037 - 0.042	pH	8.0	0.0	30
SUVA	1.59	0.05	3	1.53 - 1.62	1.62	0.13	3	1.48 - 1.73	Time	7.0	0.0	30
Bromide	55	3	2	53 - 56	55	1	2	54 - 55	Comments:			
SDS-TOX	132	18	3	115 - 150	128	5	2	125 - 130				
SDS-THM4	51	7	3	44 - 57	55	7	3	47 - 59	Chart Legend:			
SDS-HAA6	19	4	3	14 - 22	16	1	3	15 - 16				
Effluent	10 Min EBCT				20 Min EBCT							
	Mean	SD/RD	Count	Min/Max	Mean	SD/RD	Count	Min/Max				
Effluent pH	8.0	0.1	12	7.9 - 8.2	8.0	0.1	12	7.9 - 8.1				
Effluent Temp	21.9	0.9	12	20.0 - 23.0	21.5	1.1	12	20.0 - 23.0				

Water Quality Graphs



Water Quality Graphs (Continued)



ICR Information

ID / ICR#: OK1020418 / 542
 ICR Contact: Ken Burman
 Phone No.: (918) 591-4576
 Period: 2/18/99 - 2/24/99 (6 B-S days)

Design Information

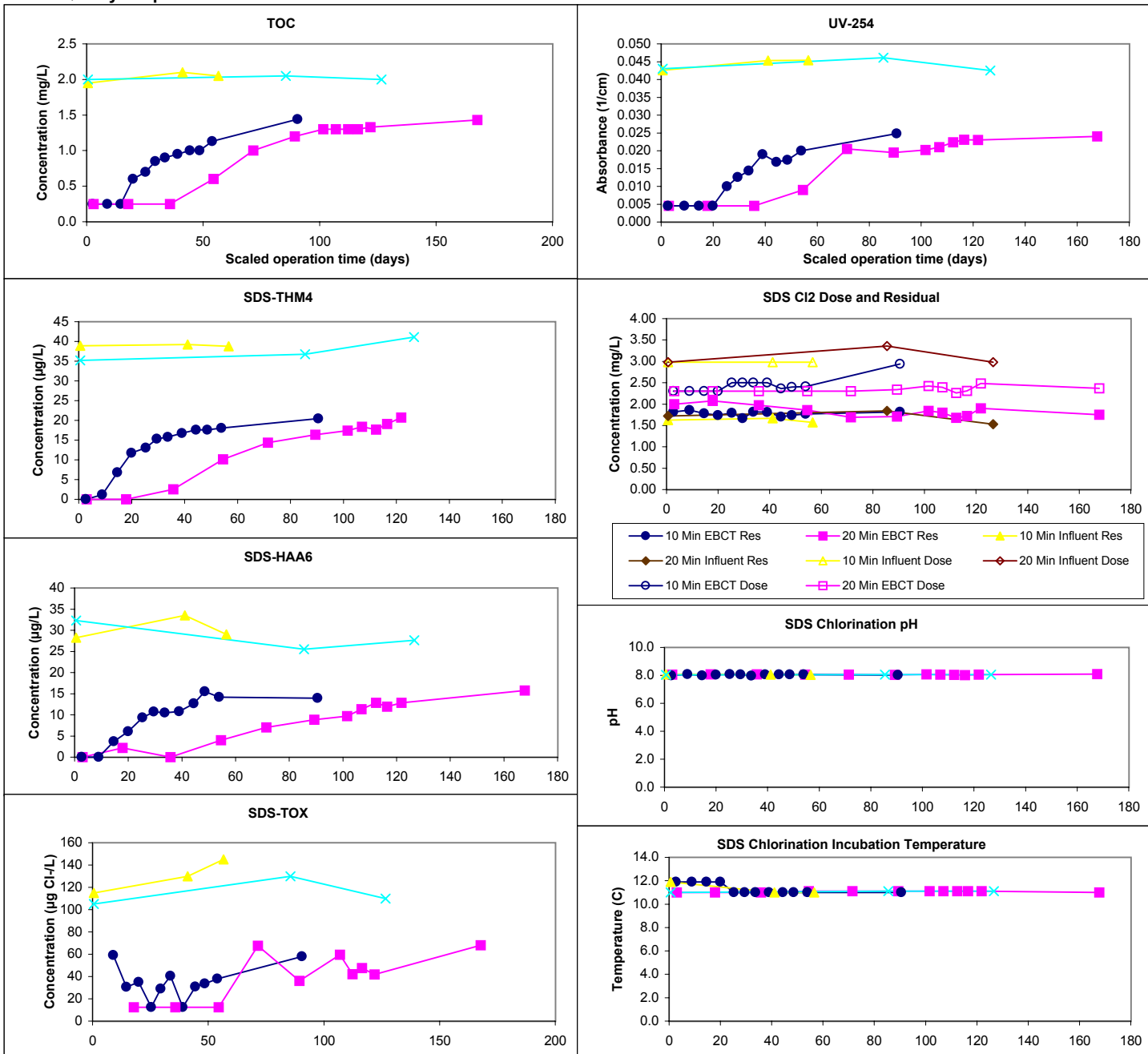
Design TOC: 1.9 mg/L
 Col Diameter: 8.0 mm
 Min Reynolds#: 0.34
 Full-Scale Temp: 20.0 C

Full-Scale GAC Size: 8x30 Lignite
 Bench-Scale GAC Size: 100x200
 Scaling Factor: 14.30
 Meas Dry Bed Density: 0.40 g/cm3

Water Quality Summary

Influent	10 Min Influent				20 Min Influent				Res (0)	Mean	SD	Count	Min/Max
	Mean	SD/RD	Count	Min/Max	Mean	SD/RD	Count	Min/Max					
TOC	2.0	0.1	3	2.0 - 2.1	2.0	0.0	3	2.0 - 2.1		1.78	0.12	30	1.53 - 2.07
pH	8.1	0.1	3	8.0 - 8.1	8.1	0.0	3	8.1 - 8.1	Temp	11.2	0.3	30	11.0 - 11.9
UV254	0.044	0.002	3	0.043 - 0.045	0.044	0.002	3	0.043 - 0.046	pH	8.0	0.0	30	8.0 - 8.1
SUVA	2.19	0.03	3	2.16 - 2.21	2.17	0.07	3	2.13 - 2.25	Time	7.0	0.0	30	7.0 - 7.0
Bromide	38	0	2	38 - 38	39	1	2	38 - 39	Comments:				
SDS-TOX	130	15	3	115 - 145	115	13	3	105 - 130					
SDS-THM4	39	0	3	39 - 39	38	3	3	35 - 41					
SDS-HAA6	30	3	3	28 - 34	28	3	3	25 - 32					
Effluent	10 Min EBCT (6 B-S days)				20 Min EBCT (12 B-S days)				Chart Legend:	<div><div><div></div><div>10 Min EBCT</div></div><div><div></div><div>20 Min EBCT</div></div><div><div></div><div>10 Min Influent</div></div><div><div></div><div>20 Min Influent</div></div></div>			
Effluent pH	7.8	0.3	12	7.2 - 8.2	8.1	0.1	12	7.8 - 8.3					
Effluent Temp	21.0	0.9	12	20.0 - 23.0	22.0	1.1	12	20.0 - 24.0					

Water Quality Graphs



Water Quality Graphs (Continued)

