ICR TREATMENT STUDY ANALYSIS

Base Analysis and Data Review Comments

Treatment Study ID 1010

Study Protocol GAC RSSCT treatment study

Plant ICR Number 538

PWS Name Akron Public Utilities Bureau

City, State, Zip Akron, OH 44309-3665

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

Major comments:

1. This study evaluated three seasons: Summer, Autumn and Winter. The fourth session of testing was used to evaluate a lignite based GAC to provide a comparison with the bituminous based GAC used during the three other sessions. The lignite/bituminous GAC comparison was conducted during the 2nd (Autumn) session.

2. A constant SDS incubation temperature of 13°C was used during all quarters. However, the full-scale temperature varies between 4.9 and 24.7°C.

   Response: Based on the City of Akron's experience, a temperature of 13°C was thought to better match distribution system temperatures as compared to using the plant full-scale water temperature. This temperature would probably better match water temperature in the distribution system than the water temperature in the plant and entering the distribution system. Since constant chlorination conditions were used, variability in SDS-DBP data generated by this study can be attributed to seasonal changes in source water quality. The treatment study results do not show how the extremes in full-scale temperature may have impacted DBP formation before and after GAC treatment.

General Comments:

1. In Table 60 of the report, the percentiles for SDS-MCAA and SDS-MBAA appear to be incorrect.

   Response: Due to a systematic error, QA/QC data reported in Table 60 of the Treatment Study Summary Report were incorrect. The values have been corrected, and the updated

version of Table 60 has been added to the hard copy and to the electronic version (PDF) of the report.

2. The MRL for UV-254 is reported at 0.009 1/cm, but values as low as 0.001 1/cm are reported in the Data Collection Spreadsheets. The MRL for TOC is reported as 0.5 mg/L, but values as low as 0.25 are reported in Data Collection Spreadsheets. The MRL for TOX is reported as 25 ug/L, but values as low as 13 ug/L are reported in Data Collection Spreadsheets. It is acceptable to use these measured values below the MRL, but comments should be included that indicate these values are BMRL. Alternatively, the MRL could be revised if it was determined according to acceptable procedures.

   Response: Values below the MRL in the Data Collection Spreadsheets are estimates. A comment indicating this has been added to the Data Collection Spreadsheets.

3. Note that the influent water quality is the same for sessions 2 and 3 since the side-by-side comparison of lignite and bituminous GAC was conducted during the Autumn quarter of testing. Two influent A samples and five influent B samples were collected during this quarter.

4. The results of the GAC comparison study indicate slightly better performance of bituminous GAC compared to lignite GAC. Also, for bituminous GAC, superior performance was observed for the 20 minute contactor compared to the 10 minute contactor; however, no significant difference was observed for the 10 and 20 minute contactors for the lignite base GAC.

Outlier Data:

No outlier data.

Cell: A1
Comment: 1010_SAS.xls 1/31/00 13:05

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

1010_SAS.xls 2/3/00 09:52

Curve fit review updated and approved. See below for log of refit datasets.

Cell: C8
Comment: 1010-10-01 - Run 1 (DBAA) 1/31/00 12:53
Original value (CoefA0) = 1 New value = 1
Fewer than 6 points above MRL, average above 1/2 MRL. Step function applied.

1010-10-01 - Run 1 (DBAA) 2/3/00 09:31
Original value (CoefA0) = 1 New value = 1.22
Fewer than 6 points above MRL, average above 1/2 MRL. Peak curve/step function combination applied.

Cell: D8
Comment: 1010-10-01 - Run 1 (DBAA) 1/31/00 12:53
Original value (CoefAf) = 0 New value = 0
Fewer than 6 points above MRL, average above 1/2 MRL. Step function applied.

1010-10-01 - Run 1 (DBAA) 2/3/00 09:31
Original value (CoefAf) = 0 New value = 0
Fewer than 6 points above MRL, average above 1/2 MRL. Peak curve/step function combination applied.

Cell: E8
Comment: 1010-10-01 - Run 1 (DBAA) 1/31/00 12:53
Original value (CoefB) = 0 New value = 0
Fewer than 6 points above MRL, average above 1/2 MRL. Step function applied.

1010-10-01 - Run 1 (DBAA) 2/3/00 09:31
Original value (CoefB) = 0 New value = 0
Fewer than 6 points above MRL, average above 1/2 MRL. Peak curve/step function combination applied.

Cell: F8
Comment: 1010-10-01 - Run 1 (DBAA) 1/31/00 12:53
Original value (CoefD) = 0 New value = 0
Fewer than 6 points above MRL, average above 1/2 MRL. Step function applied.

1010-10-01 - Run 1 (DBAA) 2/3/00 09:31
Original value (CoefD) = 0 New value = 0
Fewer than 6 points above MRL, average above 1/2 MRL. Peak curve/step function combination applied.

Cell: J8
Comment: 1010-10-01 - Run 1 (DBAA) 1/31/00 12:53

Original value (S) = 0 New value = 0
Fewer than 6 points above MRL, average above 1/2 MRL. Step function applied.

1010-10-01 - Run 1 (DBAA) 2/3/00 09:31
Original value (S) = 0 New value = -0.155
Fewer than 6 points above MRL, average above 1/2 MRL. Peak curve/step function combination applied.

Cell: K8
Comment: 1010-10-01 - Run 1 (DBAA) 1/31/00 12:53
Original value (t0) = 0 New value = 43.349
Fewer than 6 points above MRL, average above 1/2 MRL. Step function applied.

1010-10-01 - Run 1 (DBAA) 2/3/00 09:31
Original value (t0) = 43.349 New value = 43.349
Fewer than 6 points above MRL, average above 1/2 MRL. Peak curve/step function combination applied.

Cell: C114
Comment: 1010-20-02 - Run 4 (CDBAA) 1/31/00 13:00
Original value (CoefA0) = 2 New value = 2
Fewer than 6 points above MRL, average above 1/2 MRL. Step function applied.

1010-20-02 - Run 4 (CDBAA) 2/3/00 09:42
Original value (CoefA0) = 2 New value = 2.5819
Fewer than 6 points above MRL, average above 1/2 MRL. Step function applied.

Cell: D114
Comment: 1010-20-02 - Run 4 (CDBAA) 1/31/00 13:00
Original value (CoefAf) = 0 New value = 0
Fewer than 6 points above MRL, average above 1/2 MRL. Step function applied.

1010-20-02 - Run 4 (CDBAA) 2/3/00 09:42
Original value (CoefAf) = 0 New value = 0
Fewer than 6 points above MRL, average above 1/2 MRL. Step function applied.

Cell: E114
Comment: 1010-20-02 - Run 4 (CDBAA) 1/31/00 13:00
Original value (CoefB) = 0 New value = 0
Fewer than 6 points above MRL, average above 1/2 MRL. Step function applied.

1010-20-02 - Run 4 (CDBAA) 2/3/00 09:42
Original value (CoefB) = 0 New value = 0
Fewer than 6 points above MRL, average above 1/2 MRL. Step function applied.

Cell: F114
Comment: 1010-20-02 - Run 4 (CDBAA) 1/31/00 13:00
Original value (CoefD) = 0 New value = 0
Fewer than 6 points above MRL, average above 1/2 MRL. Step function applied.

1010-20-02 - Run 4 (CDBAA) 2/3/00 09:42
Original value (CoefD) = 0 New value = 0
Fewer than 6 points above MRL, average above 1/2 MRL. Step function applied.

Cell: J114
Comment: 1010-20-02 - Run 4 (CDBAA) 1/31/00 13:00
Original value (S) = 0 New value = 0
Fewer than 6 points above MRL, average above 1/2 MRL. Step function applied.

1010-20-02 - Run 4 (CDBAA) 2/3/00 09:42
Original value (S) = 0 New value = 0
Fewer than 6 points above MRL, average above 1/2 MRL. Step function applied.

Cell: K114
Comment: 1010-20-02 - Run 4 (CDBAA) 1/31/00 13:00
Original value (t0) = 0 New value = 163.6
Fewer than 6 points above MRL, average above 1/2 MRL. Step function applied.

1010-20-02 - Run 4 (CDBAA) 2/3/00 09:42
Original value (t0) = 163.6 New value = 163.5933
Fewer than 6 points above MRL, average above 1/2 MRL. Step function applied.

Cell: C125
Comment: 1010-20-02 - Run 4 (MBAA) 2/3/00 09:43
Original value (CoefA0) = 0 New value = 1
Fewer than 6 points above MRL, average above 1/2 MRL. Peak curve/step function combination applied.

Cell: D125
Comment: 1010-20-02 - Run 4 (MBAA) 2/3/00 09:43
Original value (CoefAf) = 0 New value = 0
Fewer than 6 points above MRL, average above 1/2 MRL. Peak curve/step function combination applied.

Cell: E125
Comment: 1010-20-02 - Run 4 (MBAA) 2/3/00 09:43
Original value (CoefB) = 0 New value = 0
Fewer than 6 points above MRL, average above 1/2 MRL. Peak curve/step function combination applied.

Cell: F125
Comment: 1010-20-02 - Run 4 (MBAA) 2/3/00 09:43
Original value (CoefD) = 0 New value = 0
Fewer than 6 points above MRL, average above 1/2 MRL. Peak curve/step function combination applied.

Cell: J125
Comment: 1010-20-02 - Run 4 (MBAA) 2/3/00 09:43
Original value (S) = 0 New value = -0.148
Fewer than 6 points above MRL, average above 1/2 MRL. Peak curve/step function combination applied.

Cell: K125
Comment: 1010-20-02 - Run 4 (MBAA) 2/3/00 09:43
Original value (t0) = 0 New value = 119.0484
Fewer than 6 points above MRL, average above 1/2 MRL. Peak curve/step function combination applied.

Akron Public Utilities Bureau | **Bench-Scale RSSCT Treatment Study Summary** | **Quarter:** 1

ICR Information

ID / ICR#: OH 77000 11 / 538
ICR Contact: Bill Marchand, Civil Engineer
Phone No.: (330) 375-2690
Period: 6/22/97 - 7/14/97 (21 B-S days)

Design Information

Design TOC:	2.7 mg/L	**Full-Scale GAC Size:**	12x40 Bituminous
Col Diameter:	10.0 mm	**Bench-Scale GAC Size:**	140x230
Min Reynolds#:	0.49	**Scaling Factor:**	12.57
Full-Scale Temp:	19.0 C	**Meas Dry Bed Density:**	0.52 g/cm3

Water Quality Summary

	Influent				Influent			
Influent	Mean	SD/RD	Count	Min/Max	Mean	SD/RD	Count	Min/Max
TOC	2.7	0.1	3	2.6 - 2.9				
pH	6.3	0.0	3	6.3 - 6.4				
UV254	0.057	0.002	3	0.055 - 0.059				
SUVA	2.08	0.05	3	2.05 - 2.14				
Bromide	30	2	2	29 - 31				
SDS-TOX	274	5	3	268 - 277				
SDS-THM4	58	1	3	58 - 60				
SDS-HAA6	60	4	3	56 - 65				
Effluent	**10 Min EBCT**			(11 B-S days)	**20 Min EBCT**			(22 B-S days)
Effluent pH	7.2	0.2	13	6.6 - 7.4	6.9	0.1	12	6.7 - 7.1
Effluent Temp	23.0	0.3	13	22.5 - 23.2	22.1	0.7	12	21.2 - 24.0

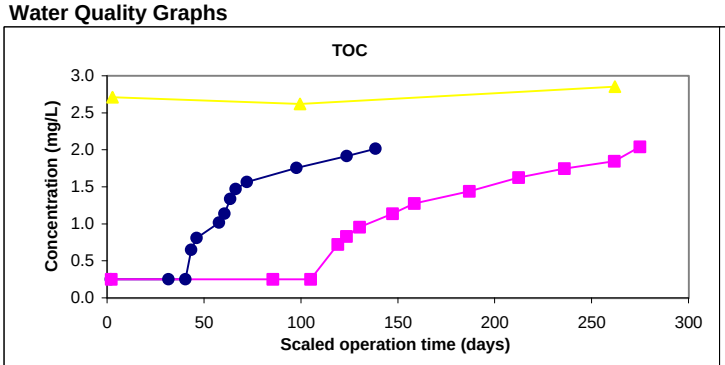
Cumulative SDS Conditions

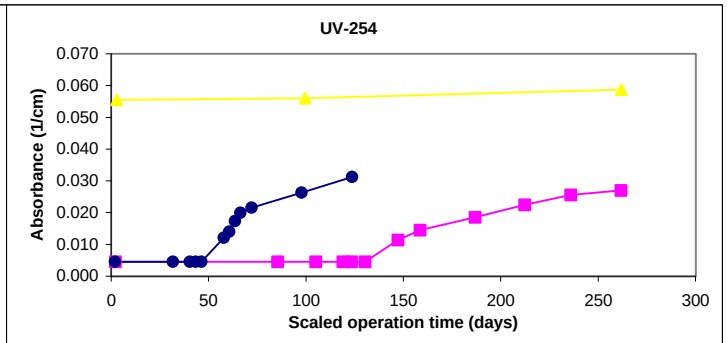
	Mean	SD	Count	Min/Max
Res (0)	1.36	0.12	27	1.17 - 1.65
Temp	13.0	0.1	27	12.9 - 13.1
pH	7.3	0.0	27	7.2 - 7.3
Time	48.1	0.1	27	47.8 - 48.3

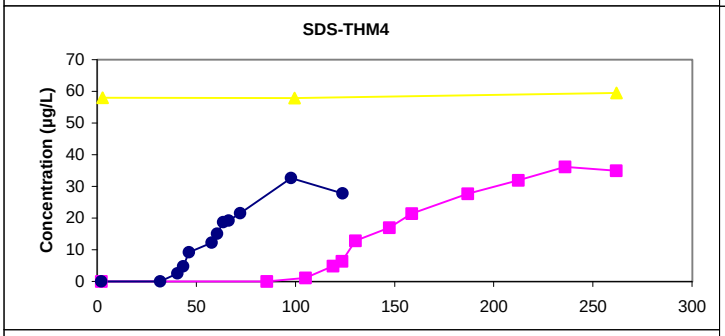
Comments:

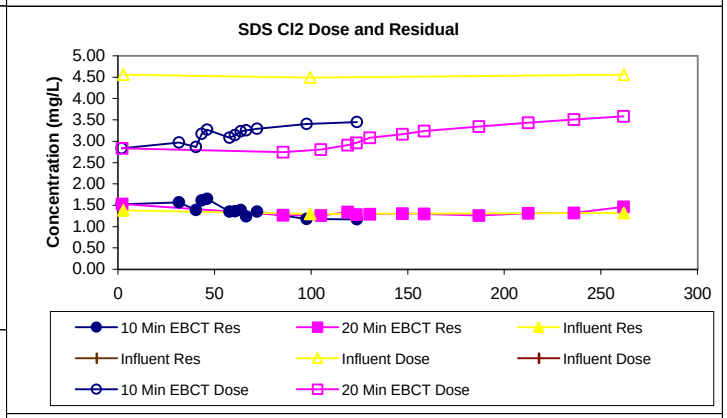
Chart Legend: 10 Min EBCT; 20 Min EBCT; Influent; Influent

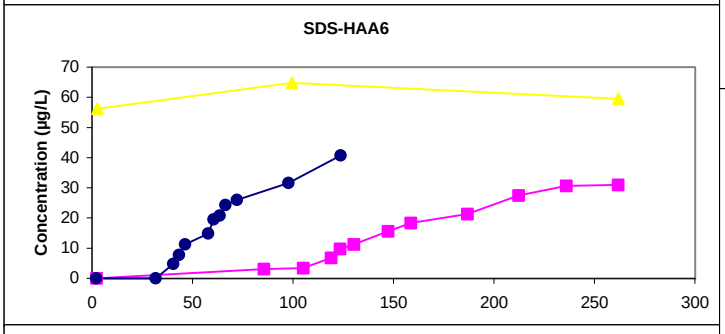
Water Quality Graphs

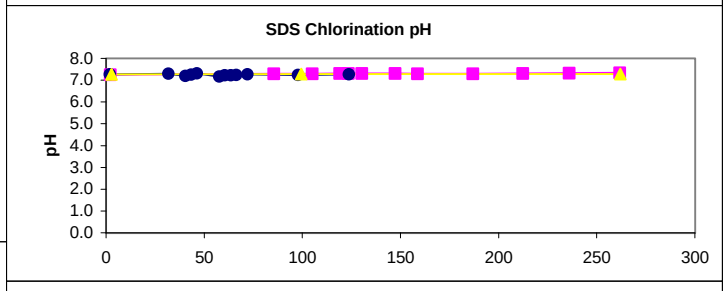


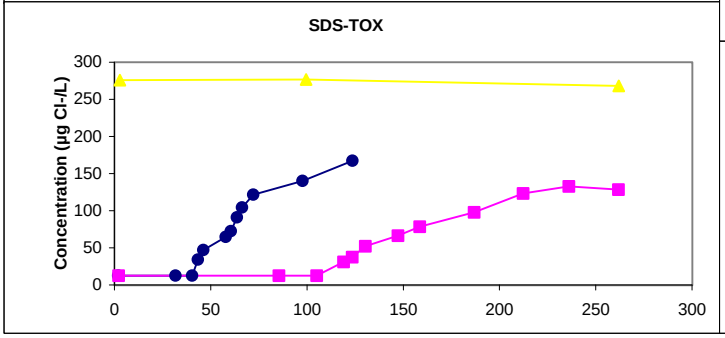


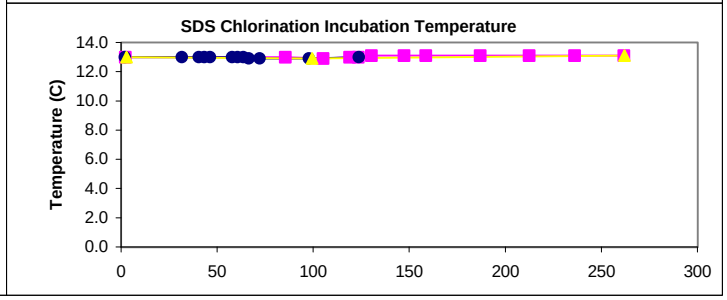




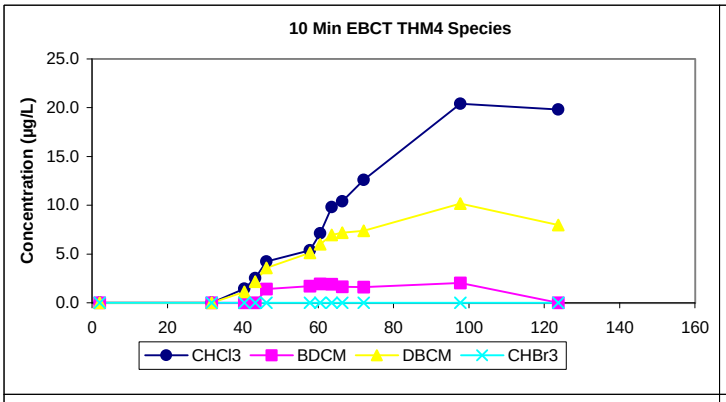


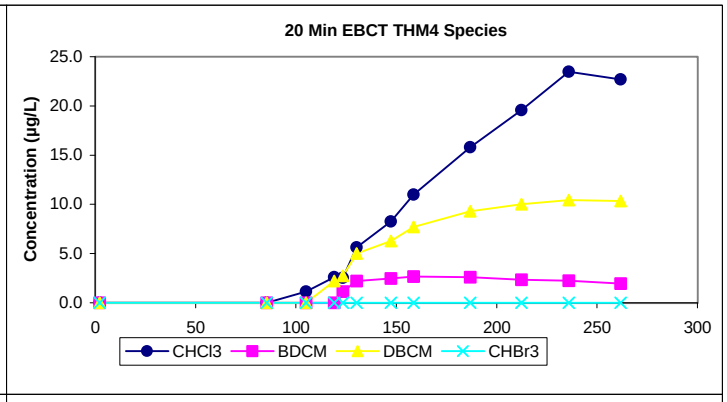


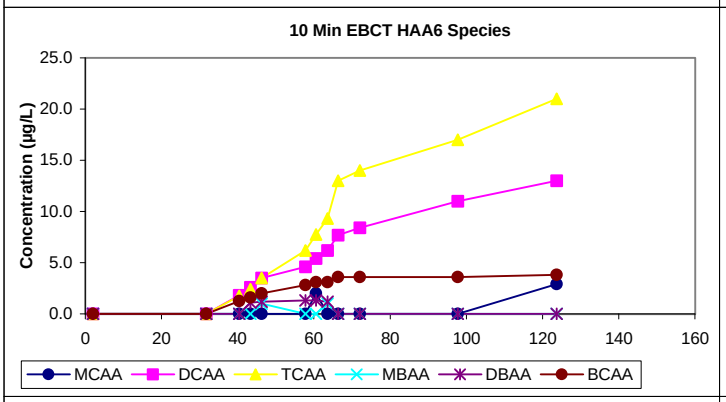


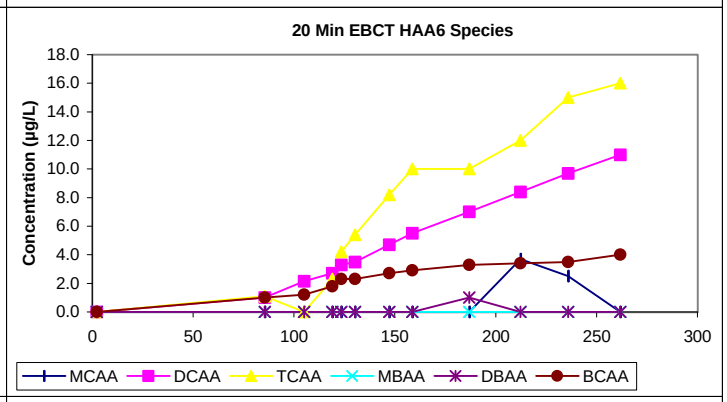


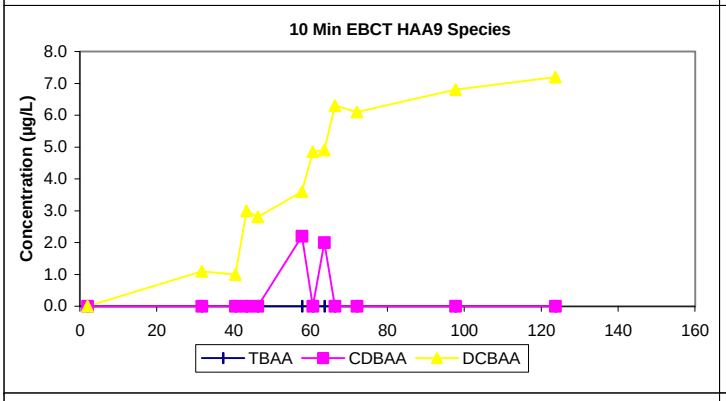
Water Quality Graphs (Continued)

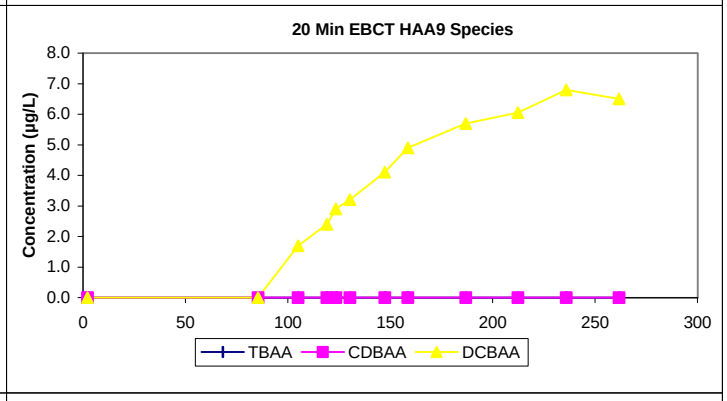


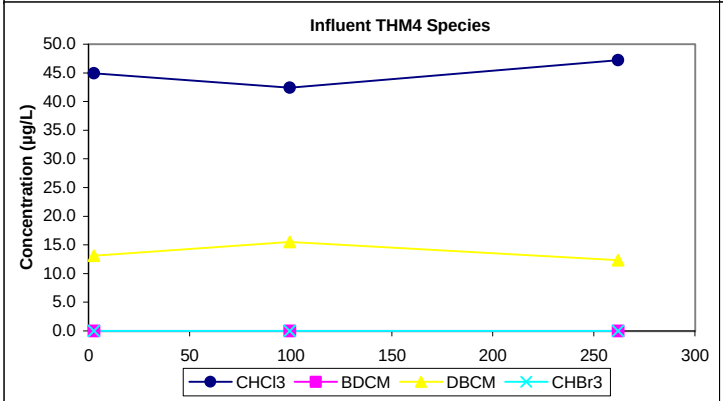


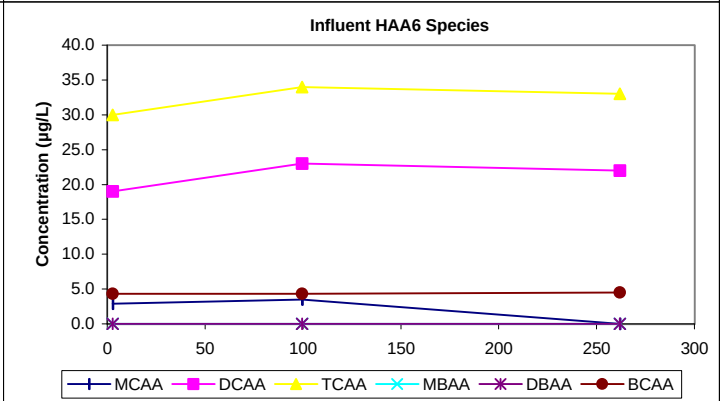












Akron Public Utilities Bureau | **Bench-Scale RSSCT Treatment Study Summary** | **Quarter:** 2

ICR Information

ID / ICR#: OH 77000 11 / 538
ICR Contact: Bill Marchand, Civil Engineer
Phone No.: (330) 375-2690
Period: 10/3/97 - 10/24/97 (20 B-S days)

Design Information

Design TOC:	2.7 mg/L	**Full-Scale GAC Size:**	12x40 Bituminous
Col Diameter:	8.0 mm	**Bench-Scale GAC Size:**	140x230
Min Reynolds#:	0.40	**Scaling Factor:**	12.57
Full-Scale Temp:	18.0 C	**Meas Dry Bed Density:**	0.54 g/cm3

Water Quality Summary

	10 Min Influent				20 Min Influent			
Influent	Mean	SD/RD	Count	Min/Max	Mean	SD/RD	Count	Min/Max
TOC	2.7	0.1	5	2.6 - 2.7	2.7	0.1	5	2.6 - 2.7
pH	6.8	0.0	5	6.8 - 6.8	6.8	0.0	5	6.8 - 6.8
UV254	0.053	0.001	5	0.052 - 0.054	0.053	0.001	5	0.052 - 0.054
SUVA	1.99	0.04	5	1.94 - 2.05	1.99	0.04	5	1.94 - 2.05
Bromide	36	0	2	36 - 36	36	0	2	36 - 36
SDS-TOX	235	19	5	219 - 268	235	19	5	219 - 268
SDS-THM4	54	2	5	52 - 57	54	2	5	52 - 57
SDS-HAA6	50	4	5	44 - 54	50	4	5	44 - 54
Effluent	**10 Min EBCT**			(11 B-S days)	**20 Min EBCT**			(21 B-S days)
Effluent pH	7.6	0.1	13	7.4 - 7.8	7.4	0.1	12	7.3 - 7.7
Effluent Temp	22.3	0.9	13	20.7 - 23.6	21.6	1.0	12	19.4 - 22.7

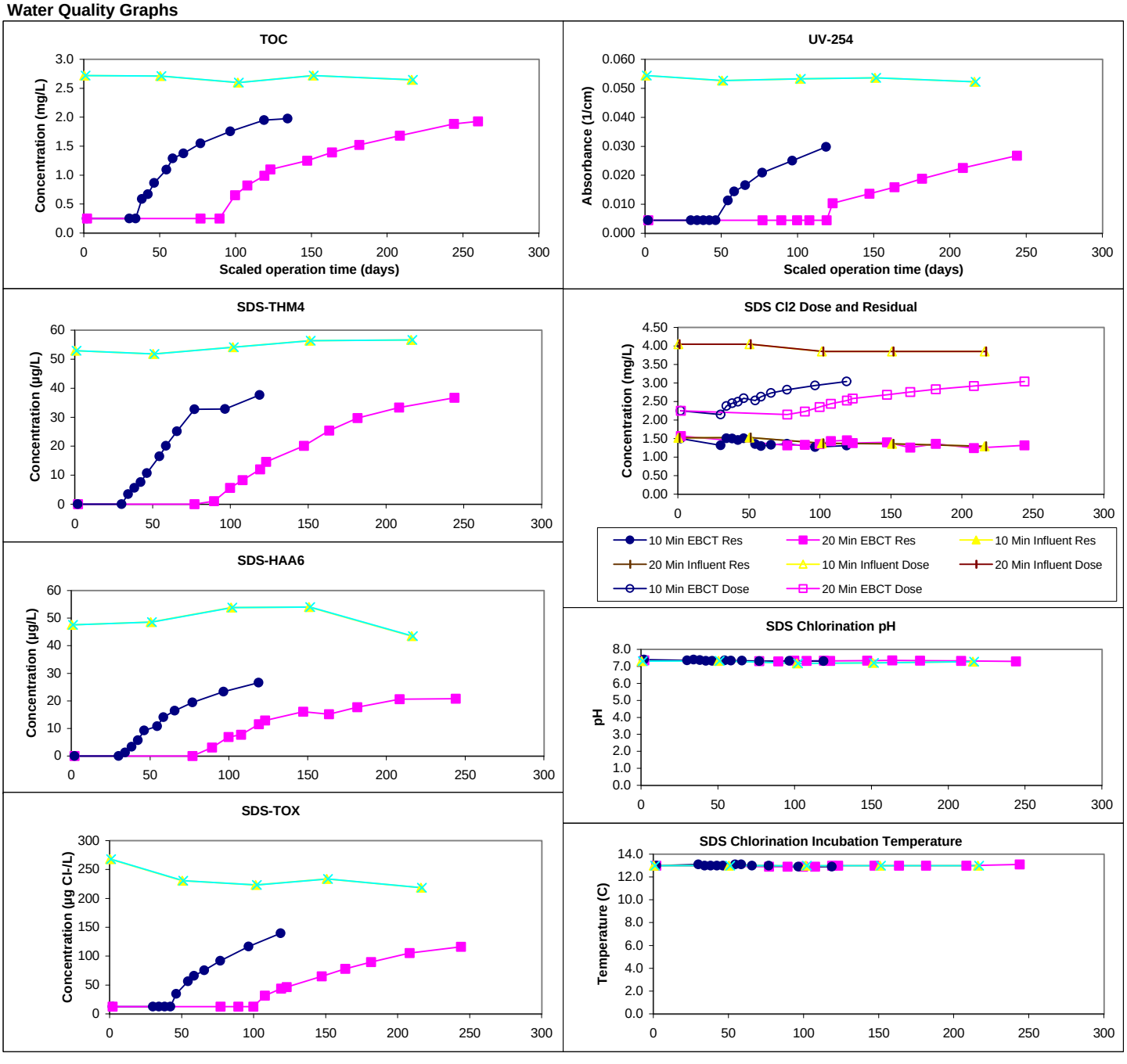
Cumulative SDS Conditions

	Mean	SD	Count	Min/Max
Res (0)	1.39	0.09	34	1.24 - 1.57
Temp	13.0	0.1	34	12.9 - 13.1
pH	7.3	0.1	34	7.2 - 7.4
Time	48.1	0.4	34	47.0 - 48.8

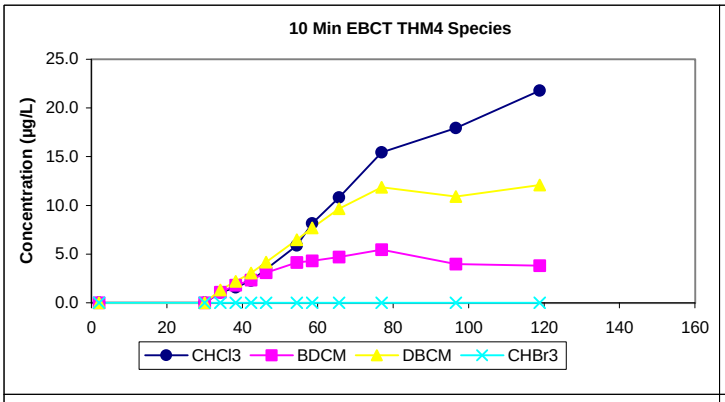
Comments:

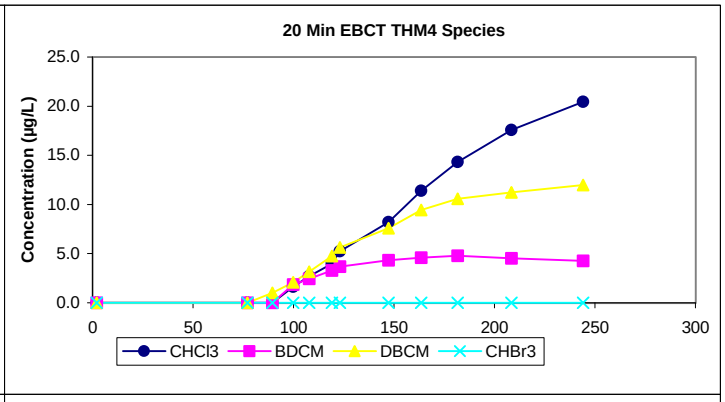
Chart Legend: 10 Min EBCT; 20 Min EBCT; 10 Min Influent; 20 Min Influent

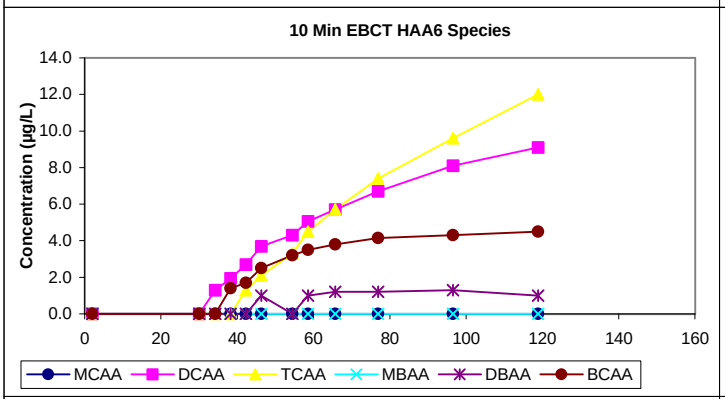
Water Quality Graphs

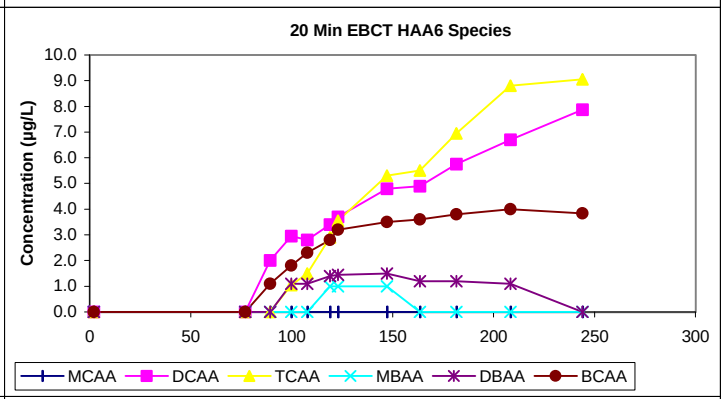


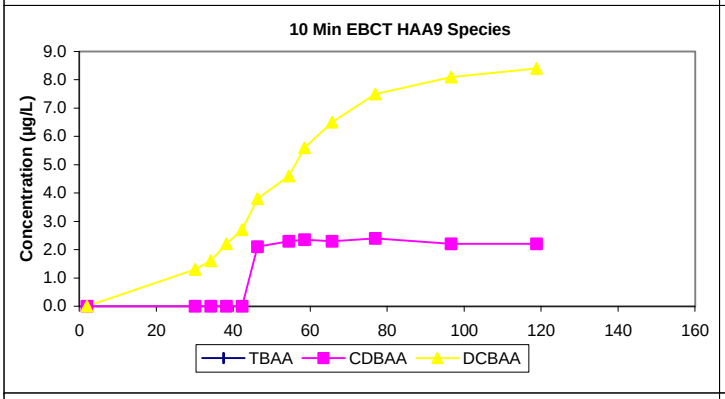
Water Quality Graphs (Continued)

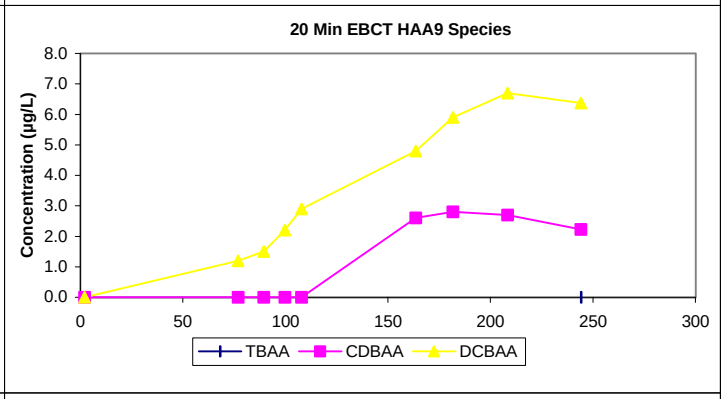


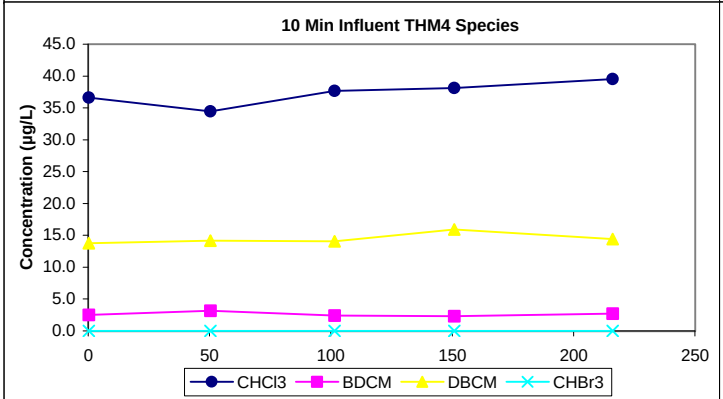


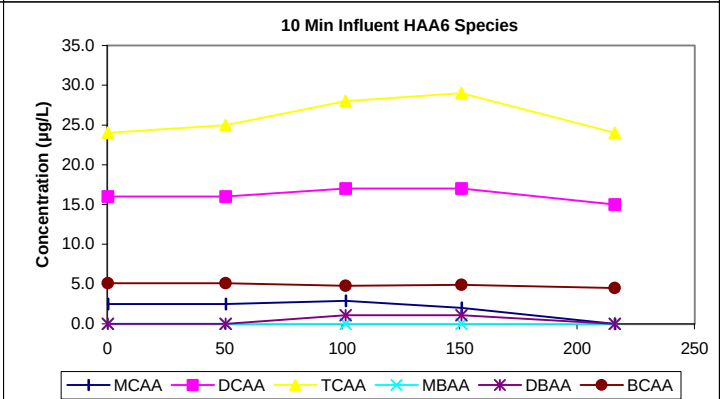












Akron Public Utilities Bureau | **Bench-Scale RSSCT Treatment Study Summary** | **Quarter:** 3

ICR Information

ID / ICR#: OH 77000 11 / 538
ICR Contact: Bill Marchand, Civil Engineer
Phone No.: (330) 375-2690
Period: 10/7/97 - 10/20/97 (13 B-S days)

Design Information

Design TOC:	2.7 mg/L	**Full-Scale GAC Size:**	12x40 Lignite
Col Diameter:	8.0 mm	**Bench-Scale GAC Size:**	140x230
Min Reynolds#:	0.40	**Scaling Factor:**	12.57
Full-Scale Temp:	18.0 C	**Meas Dry Bed Density:**	0.41 g/cm3

Water Quality Summary

	10 Min Influent				20 Min Influent			
Influent	Mean	SD/RD	Count	Min/Max	Mean	SD/RD	Count	Min/Max
TOC	2.7	0.1	5	2.6 - 2.7	2.7	0.1	5	2.6 - 2.7
pH	6.8	0.0	5	6.8 - 6.8	6.8	0.0	5	6.8 - 6.8
UV254	0.053	0.001	5	0.052 - 0.054	0.053	0.001	5	0.052 - 0.054
SUVA	1.99	0.04	5	1.94 - 2.05	1.99	0.04	5	1.94 - 2.05
Bromide	36	0	2	36 - 36	36	0	2	36 - 36
SDS-TOX	235	19	5	219 - 268	235	19	5	219 - 268
SDS-THM4	54	2	5	52 - 57	54	2	5	52 - 57
SDS-HAA6	50	4	5	44 - 54	50	4	5	44 - 54
Effluent	**10 Min EBCT**			(9 B-S days)	**20 Min EBCT**			(17 B-S days)
Effluent pH	7.6	0.1	12	7.5 - 7.7	7.5	0.1	11	7.3 - 7.7
Effluent Temp	22.5	0.5	12	21.8 - 23.4	22.1	0.6	11	21.0 - 22.9

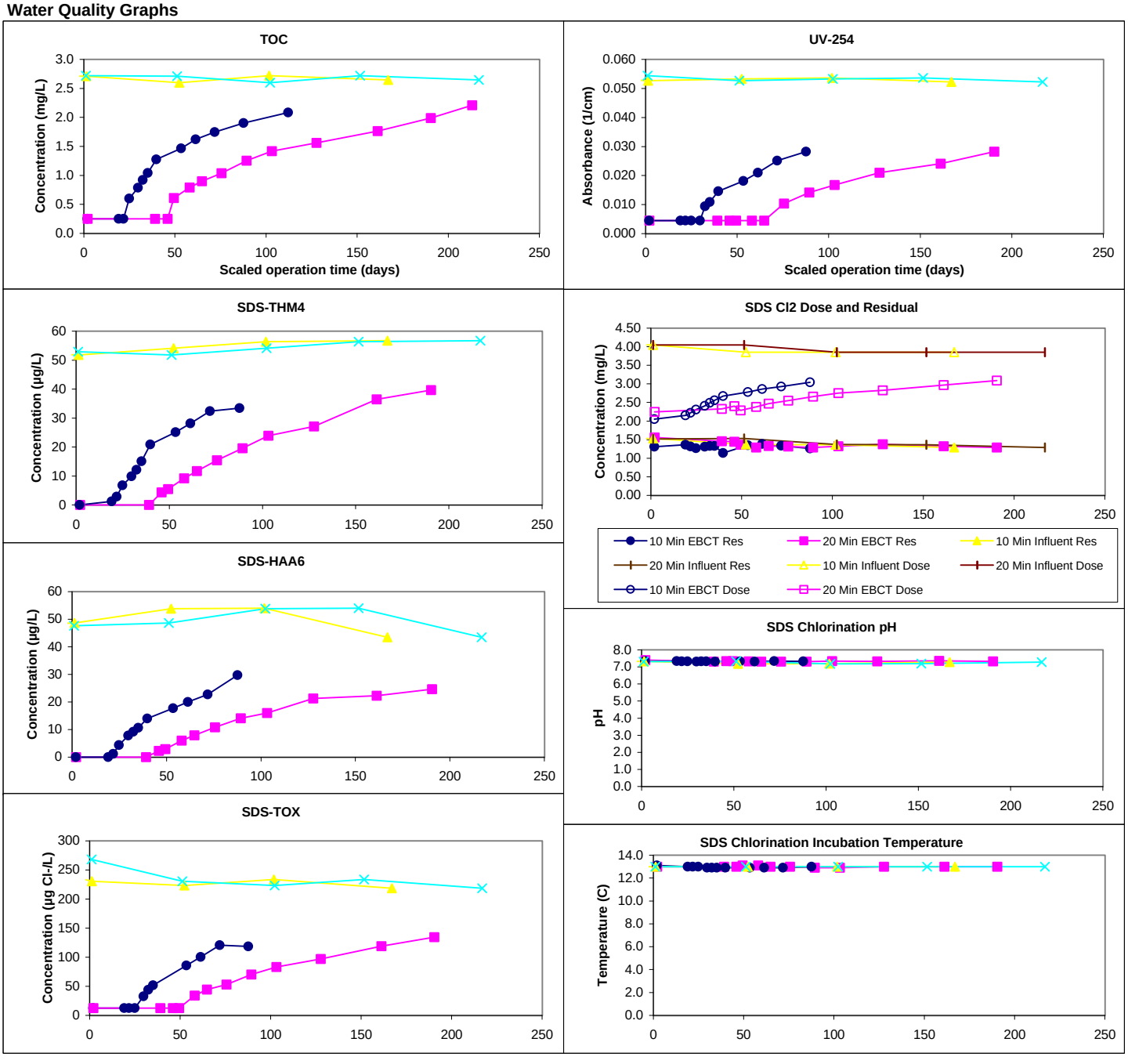
Cumulative SDS Conditions

	Mean	SD	Count	Min/Max
Res (0)	1.36	0.09	34	1.14 - 1.56
Temp	13.0	0.1	34	12.9 - 13.1
pH	7.3	0.0	34	7.2 - 7.4
Time	48.0	0.4	34	47.0 - 48.7

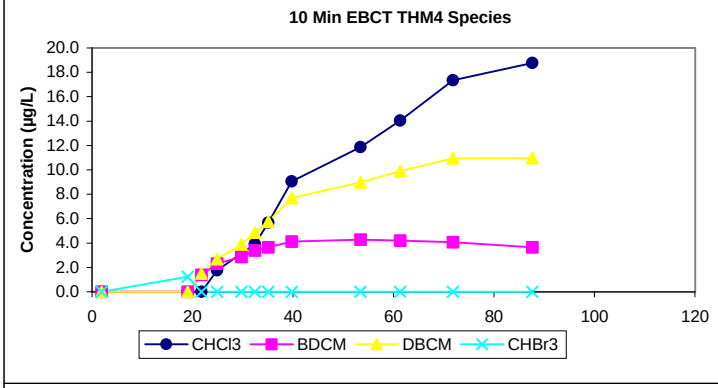
Comments:

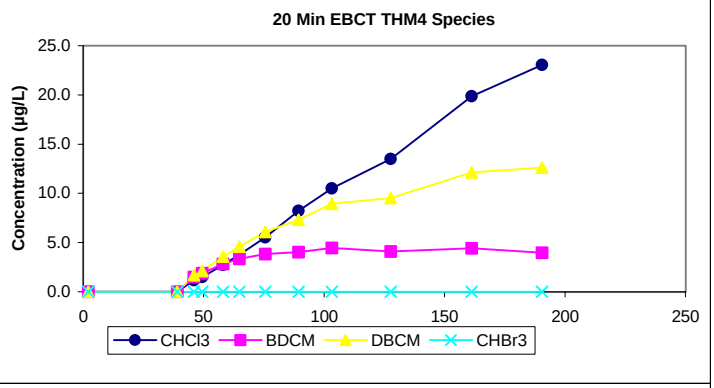
Chart Legend: 10 Min EBCT; 20 Min EBCT; 10 Min Influent; 20 Min Influent

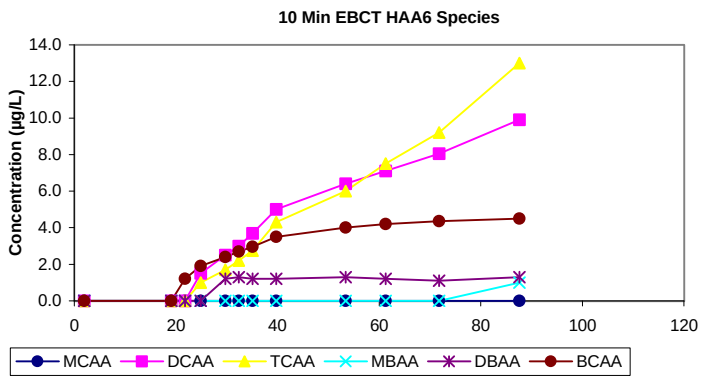
Water Quality Graphs

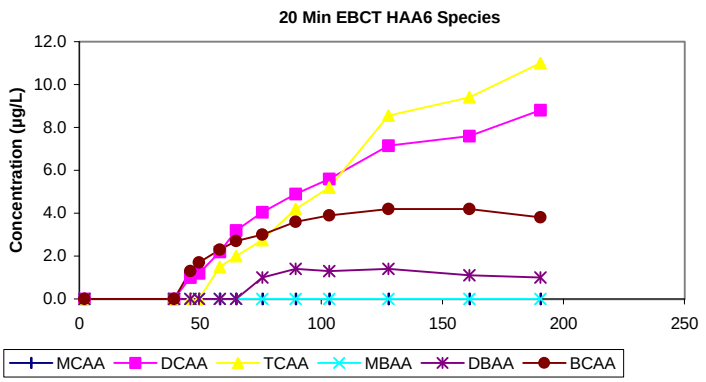


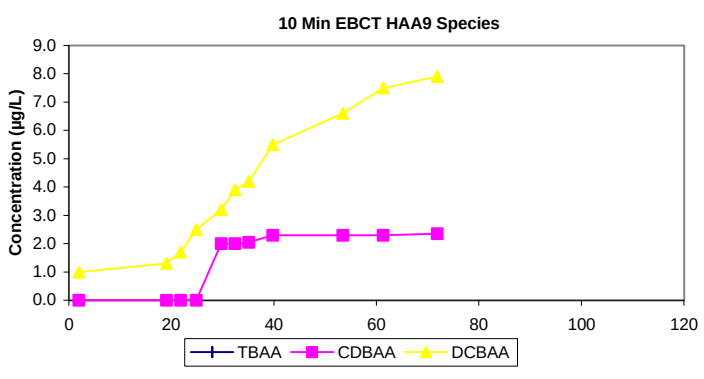
Water Quality Graphs (Continued)

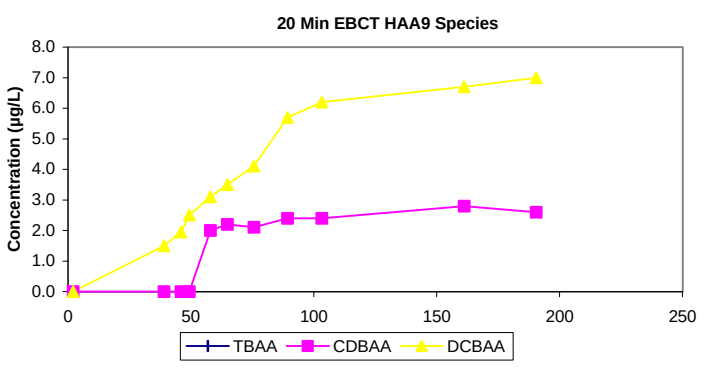


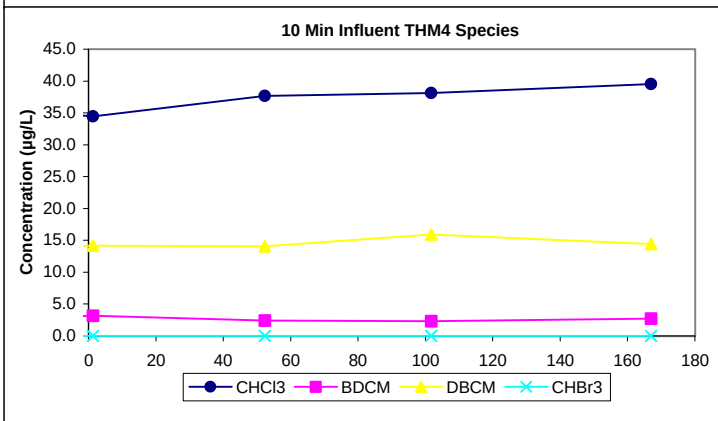


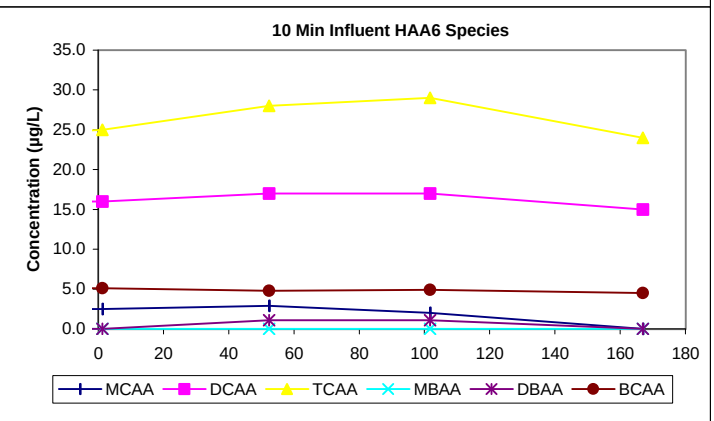












Akron Public Utilities Bureau | **Bench-Scale RSSCT Treatment Study Summary** | **Quarter:** 4

ICR Information

ID / ICR#: OH 77000 11 / 538
ICR Contact: Bill Marchand, Civil Engineer
Phone No.: (330) 375-2690
Period: 1/12/98 - 1/29/98 (17 B-S days)

Design Information

Design TOC:	2.6 mg/L	**Full-Scale GAC Size:**	12x40 Bituminous
Col Diameter:	8.0 mm	**Bench-Scale GAC Size:**	140x230
Min Reynolds#:	0.30	**Scaling Factor:**	12.57
Full-Scale Temp:	2.0 C	**Meas Dry Bed Density:**	0.52 g/cm3

Water Quality Summary

	Influent				Influent			
Influent	Mean	SD/RD	Count	Min/Max	Mean	SD/RD	Count	Min/Max
TOC	2.6	0.1	4	2.6 - 2.8				
pH	7.1	0.0	4	7.1 - 7.1				
UV254	0.054	0.001	3	0.053 - 0.055				
SUVA	2.05	0.08	3	1.96 - 2.13				
Bromide	10	0	2	10 - 10				
SDS-TOX	239	2	3	236 - 241				
SDS-THM4	50	1	3	49 - 51				
SDS-HAA6	52	2	3	50 - 54				
Effluent	**10 Min EBCT**			(8 B-S days)	**20 Min EBCT**			(17 B-S days)
Effluent pH	7.7	0.1	13	7.6 - 7.9	7.9	0.2	12	7.8 - 8.6
Effluent Temp	21.3	0.5	13	20.3 - 22.0	22.0	0.3	12	21.3 - 22.6

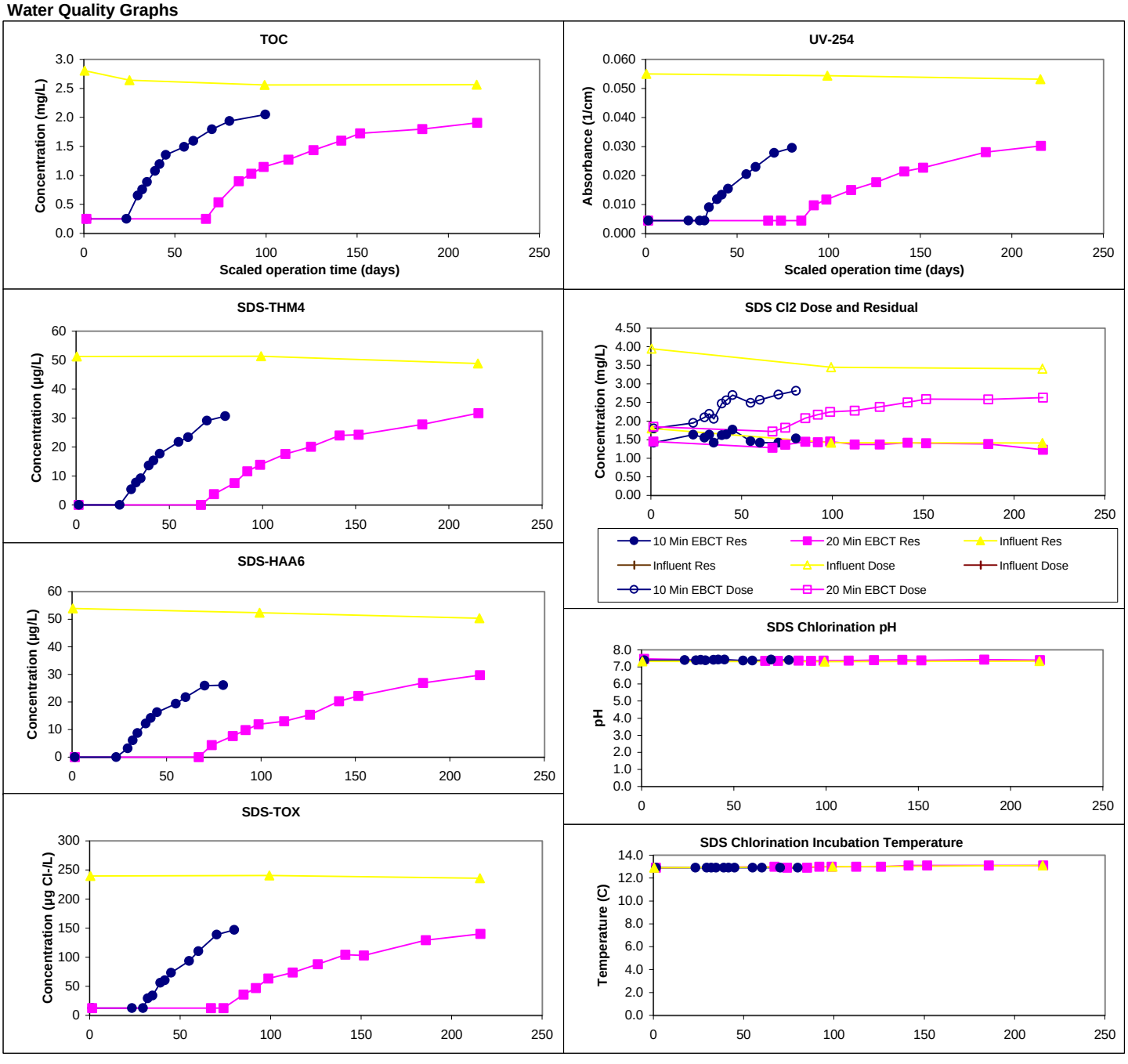
Cumulative SDS Conditions

	Mean	SD	Count	Min/Max
Res (0)	1.47	0.13	27	1.23 - 1.80
Temp	13.0	0.1	27	12.9 - 13.1
pH	7.4	0.0	27	7.3 - 7.5
Time	48.0	0.2	27	47.6 - 48.3

Comments:

Chart Legend: 10 Min EBCT; 20 Min EBCT; Influent; Influent

Water Quality Graphs



Water Quality Graphs (Continued)