ICR TREATMENT STUDY ANALYSIS

Base Analysis and Data Review Comments

Treatment Study ID 1003

Study Protocol GAC RSSCT treatment study

Plant ICR Number 539

PWS Name Mahoning Valley Sanitary District

City, State, Zip Youngstown, OH 44515

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

Major comments:

None

General Comments:

1. In Table 61 of the report, the mean and the percentiles for the RPD of the field duplicate results for SDS-MCAA are all reported as 200, indicating that all five RPDs for this parameter were identical.

   Response: Due to a systematic error, QA/QC data reported in Table 61 of the Treatment Study Summary Report were incorrect. The values have been corrected, and the updated version of Table 61 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. Site specific cost parameters are not reported in the Data Collection Spreadsheets; however, there are values for these parameters in the Summary Report.

   Response: The values used in the Summary Report were model default values. Site specific values have been added to the Data Collection Spreadsheets.

4. During Quarter 1, DCAA in the 10 minute EBCT effluent shows a peak followed by a decrease followed by a second increasing leg. The 20 minute contactor does not show this trend. There is some evidence of this trend in quarters 2 and 4, but it is not as pronounced as it is during the 1st quarter, 10 minute EBCT run.

   Response: It is possible that the breakthrough of preformed DCAA caused these systematic early peaks. Instantaneous HAAs were analyzed in the RSSCT influent due to the presence of chlorinated washwater return at the plant. Levels of DCAA measured were 4 µg/L, 3 µg/L, 1 µg/L, and BMRL during Quarters 1, 2, 3, and 4, respectively. A possible explanation of the peak-decrease-increase behavior is rapid breakthrough of preformed DCAA to influent levels, along with breakthrough of DCAA precursors, followed by some biodegredation of preformed DCAA in the RSSCT, which leads to a plateau or slight decrease in effluent measured SDS-DCAA as DCAA precursors continue to break through, and finally an increase in effluent measured SDS-DCAA due to continued DCAA precursor breakthrough. During this study, instantaneous DBP breakthrough was not monitored.

5. Unlike THM and TOX, HAA formation does not increase significantly with increasing SDS incubation temperature. In the Summary Report, the consultant indicates that this may be due to the high SDS chlorination pH which favors THM formation over HAA formation.

Outlier Data:

Q4 2 HAA9 outlier data points removed.

Cell: A1
Comment: 1003_SAS.xls 2/6/00 13:00

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

Cell: C4
Comment: 1003-10-01 - Run 1 (CDBAA) 2/6/00 11:29
Original value (CoefA0) = 0 New value = 2
Fewer than 6 points above MRL, average above 1/2 MRL. Step function applied.

Cell: D4
Comment: 1003-10-01 - Run 1 (CDBAA) 2/6/00 11:29
Original value (CoefAf) = 0 New value = 0
Fewer than 6 points above MRL, average above 1/2 MRL. Step function applied.

Cell: E4
Comment: 1003-10-01 - Run 1 (CDBAA) 2/6/00 11:29
Original value (CoefB) = 0 New value = 0
Fewer than 6 points above MRL, average above 1/2 MRL. Step function applied.

Cell: F4
Comment: 1003-10-01 - Run 1 (CDBAA) 2/6/00 11:29
Original value (CoefD) = 0 New value = 0
Fewer than 6 points above MRL, average above 1/2 MRL. Step function applied.

Cell: J4
Comment: 1003-10-01 - Run 1 (CDBAA) 2/6/00 11:29
Original value (S) = 0 New value = 0
Fewer than 6 points above MRL, average above 1/2 MRL. Step function applied.

Cell: K4
Comment: 1003-10-01 - Run 1 (CDBAA) 2/6/00 11:29
Original value (t0) = 0 New value = 35.1706
Fewer than 6 points above MRL, average above 1/2 MRL. Step function applied.

Cell: C27
Comment: 1003-10-02 - Run 3 (CHBr3) 2/6/00 12:43
Original value (CoefA0) = 1 New value = -0.2873
Fewer than 6 points above MRL. Data was fit to peak curve by iterative curve fit procedure.

Cell: D27
Comment: 1003-10-02 - Run 3 (CHBr3) 2/6/00 12:43
Original value (CoefAf) = 0 New value = 3.0668
Fewer than 6 points above MRL. Data was fit to peak curve by iterative curve fit procedure.

Cell: E27
Comment: 1003-10-02 - Run 3 (CHBr3) 2/6/00 12:43
Original value (CoefB) = 0 New value = 20.0389
Fewer than 6 points above MRL. Data was fit to peak curve by iterative curve fit procedure.

Cell: F27
Comment: 1003-10-02 - Run 3 (CHBr3) 2/6/00 12:43
Original value (CoefD) = 0 New value = 0.2643
Fewer than 6 points above MRL. Data was fit to peak curve by iterative curve fit procedure.

Cell: J27
Comment: 1003-10-02 - Run 3 (CHBr3) 2/6/00 12:43
Original value (S) = 0 New value = -0.1369
Fewer than 6 points above MRL. Data was fit to peak curve by iterative curve fit procedure.

Cell: C38
Comment: 1003-10-02 - Run 3 (MCAA) 2/6/00 12:34
Original value (CoefA0) = 0 New value = 2
Fewer than 6 points above MRL. Step function applied.

Cell: D38
Comment: 1003-10-02 - Run 3 (MCAA) 2/6/00 12:34
Original value (CoefAf) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: E38
Comment: 1003-10-02 - Run 3 (MCAA) 2/6/00 12:34
Original value (CoefB) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: F38
Comment: 1003-10-02 - Run 3 (MCAA) 2/6/00 12:34
Original value (CoefD) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: J38
Comment: 1003-10-02 - Run 3 (MCAA) 2/6/00 12:34
Original value (S) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: K38
Comment: 1003-10-02 - Run 3 (MCAA) 2/6/00 12:34
Original value (t0) = 0 New value = 36.1736
Fewer than 6 points above MRL. Step function applied.

Cell: C49
Comment: 1003-10-03 - Run 5 (CHBr3) 2/6/00 12:45
Original value (CoefA0) = 1 New value = -0.298
Fewer than 6 points above MRL. Data was fit to peak curve by iterative curve fit procedure.

Cell: D49
Comment: 1003-10-03 - Run 5 (CHBr3) 2/6/00 12:45
Original value (CoefAf) = 0 New value = 3.6584
Fewer than 6 points above MRL. Data was fit to peak curve by iterative curve fit procedure.

Cell: E49

Comment: 1003-10-03 - Run 5 (CHBr3) 2/6/00 12:45
Original value (CoefB) = 0 New value = 20.0436
Fewer than 6 points above MRL. Data was fit to peak curve by iterative curve fit procedure.

Cell: F49
Comment: 1003-10-03 - Run 5 (CHBr3) 2/6/00 12:45
Original value (CoefD) = 0 New value = 0.2748
Fewer than 6 points above MRL. Data was fit to peak curve by iterative curve fit procedure.

Cell: J49
Comment: 1003-10-03 - Run 5 (CHBr3) 2/6/00 12:45
Original value (S) = 0 New value = -0.2036
Fewer than 6 points above MRL. Data was fit to peak curve by iterative curve fit procedure.

Cell: C60
Comment: 1003-10-03 - Run 5 (MCAA) 2/6/00 12:48
Original value (CoefA0) = 0 New value = 2.1
Fewer than 6 points above MRL. Peak curve/step function combination applied.

Cell: D60
Comment: 1003-10-03 - Run 5 (MCAA) 2/6/00 12:48
Original value (CoefAf) = 0 New value = 0
Fewer than 6 points above MRL. Peak curve/step function combination applied.

Cell: E60
Comment: 1003-10-03 - Run 5 (MCAA) 2/6/00 12:48
Original value (CoefB) = 0 New value = 0
Fewer than 6 points above MRL. Peak curve/step function combination applied.

Cell: F60
Comment: 1003-10-03 - Run 5 (MCAA) 2/6/00 12:48
Original value (CoefD) = 0 New value = 0
Fewer than 6 points above MRL. Peak curve/step function combination applied.

Cell: J60
Comment: 1003-10-03 - Run 5 (MCAA) 2/6/00 12:48
Original value (S) = 0 New value = -0.245
Fewer than 6 points above MRL. Peak curve/step function combination applied.

Cell: C74
Comment: 1003-10-04 - Run 7 (DBAA) 2/6/00 12:51
Original value (CoefA0) = -0.5801 New value = -0.1821
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: D74
Comment: 1003-10-04 - Run 7 (DBAA) 2/6/00 12:51
Original value (CoefAf) = 3.45 New value = 2.6816
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: E74
Comment: 1003-10-04 - Run 7 (DBAA) 2/6/00 12:51

Original value (CoefB) = 3.0888 New value = 20.0265
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: F74
Comment: 1003-10-04 - Run 7 (DBAA) 2/6/00 12:51
Original value (CoefD) = 0.1204 New value = 0.273
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: J74
Comment: 1003-10-04 - Run 7 (DBAA) 2/6/00 12:51
Original value (S) = 0 New value = -0.0122
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: C99
Comment: 1003-20-01 - Run 2 (DCBAA) 2/6/00 12:09
Original value (CoefA0) = 0 New value = 1
Fewer than 6 points above MRL, average above 1/2 MRL. Step function applied.

Cell: D99
Comment: 1003-20-01 - Run 2 (DCBAA) 2/6/00 12:09
Original value (CoefAf) = 0 New value = 0
Fewer than 6 points above MRL, average above 1/2 MRL. Step function applied.

Cell: E99
Comment: 1003-20-01 - Run 2 (DCBAA) 2/6/00 12:09
Original value (CoefB) = 0 New value = 0
Fewer than 6 points above MRL, average above 1/2 MRL. Step function applied.

Cell: F99
Comment: 1003-20-01 - Run 2 (DCBAA) 2/6/00 12:09
Original value (CoefD) = 0 New value = 0
Fewer than 6 points above MRL, average above 1/2 MRL. Step function applied.

Cell: J99
Comment: 1003-20-01 - Run 2 (DCBAA) 2/6/00 12:09
Original value (S) = 0 New value = 0
Fewer than 6 points above MRL, average above 1/2 MRL. Step function applied.

Cell: K99
Comment: 1003-20-01 - Run 2 (DCBAA) 2/6/00 12:09
Original value (t0) = 0 New value = 44.0337
Fewer than 6 points above MRL, average above 1/2 MRL. Step function applied.

Cell: C126
Comment: 1003-20-02 - Run 4 (MCAA) 2/6/00 12:35
Original value (CoefA0) = 0 New value = 2.25
Fewer than 6 points above MRL. Step function applied.

Cell: D126
Comment: 1003-20-02 - Run 4 (MCAA) 2/6/00 12:35
Original value (CoefAf) = 0 New value = 0

Fewer than 6 points above MRL. Step function applied.

Cell: E126
Comment: 1003-20-02 - Run 4 (MCAA) 2/6/00 12:35
Original value (CoefB) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: F126
Comment: 1003-20-02 - Run 4 (MCAA) 2/6/00 12:35
Original value (CoefD) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: J126
Comment: 1003-20-02 - Run 4 (MCAA) 2/6/00 12:35
Original value (S) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: K126
Comment: 1003-20-02 - Run 4 (MCAA) 2/6/00 12:35
Original value (t0) = 0 New value = 67.5288
Fewer than 6 points above MRL. Step function applied.

Cell: C158
Comment: 1003-20-04 - Run 8 (CDBAA) 2/6/00 12:39
Original value (CoefA0) = 2 New value = 2.41
Fewer than 6 points above MRL. Step function applied.

Cell: D158
Comment: 1003-20-04 - Run 8 (CDBAA) 2/6/00 12:39
Original value (CoefAf) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: E158
Comment: 1003-20-04 - Run 8 (CDBAA) 2/6/00 12:39
Original value (CoefB) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: F158
Comment: 1003-20-04 - Run 8 (CDBAA) 2/6/00 12:39
Original value (CoefD) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: J158
Comment: 1003-20-04 - Run 8 (CDBAA) 2/6/00 12:39
Original value (S) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: K158
Comment: 1003-20-04 - Run 8 (CDBAA) 2/6/00 12:39
Original value (t0) = 37.6 New value = 37.5568
Fewer than 6 points above MRL. Step function applied.

Mahoning Valley Sanitary District **Bench-Scale RSSCT Treatment Study Summary** **Quarter:** 1

ICR Information

ID / ICR#: OH7801811 / 539
ICR Contact: John Zackasee, Superintendent-Purification
Phone No.: (330) 652-3614
Period: 1/19/97 - 2/4/97 (15 B-S days)

Design Information

Design TOC:	3.9	mg/L
Col Diameter:	10.0	mm
Min Reynolds#:	0.33	
Full-Scale Temp:	5.0	C

Full-Scale GAC Size: 12x40 Bituminous
Bench-Scale GAC Size: 100x200
Scaling Factor: 9.44
Meas Dry Bed Density: 0.50 g/cm3

Water Quality Summary

Influent	Influent Mean	SD/RD	Count	Min/Max	Influent Mean	SD/RD	Count	Min/Max
TOC	3.9	0.0	3	3.9 - 3.9				
pH	8.9	0.1	3	8.8 - 9.0				
UV254	0.079	0.001	3	0.077 - 0.080				
SUVA	2.03	0.05	3	1.97 - 2.07				
Bromide	36	4	2	34 - 38				
SDS-TOX	212	25	3	183 - 228				
SDS-THM4	66	1	2	66 - 67				
SDS-HAA6	38	1	3	37 - 39				
Effluent	**10 Min EBCT**			(9 B-S days)	**20 Min EBCT**			(16 B-S days)
Effluent pH	8.2	0.4	12	7.4 - 8.8	8.4	0.4	12	8.0 - 9.5
Effluent Temp	22.3	1.3	12	20.8 - 24.4	21.7	1.0	12	20.7 - 23.9

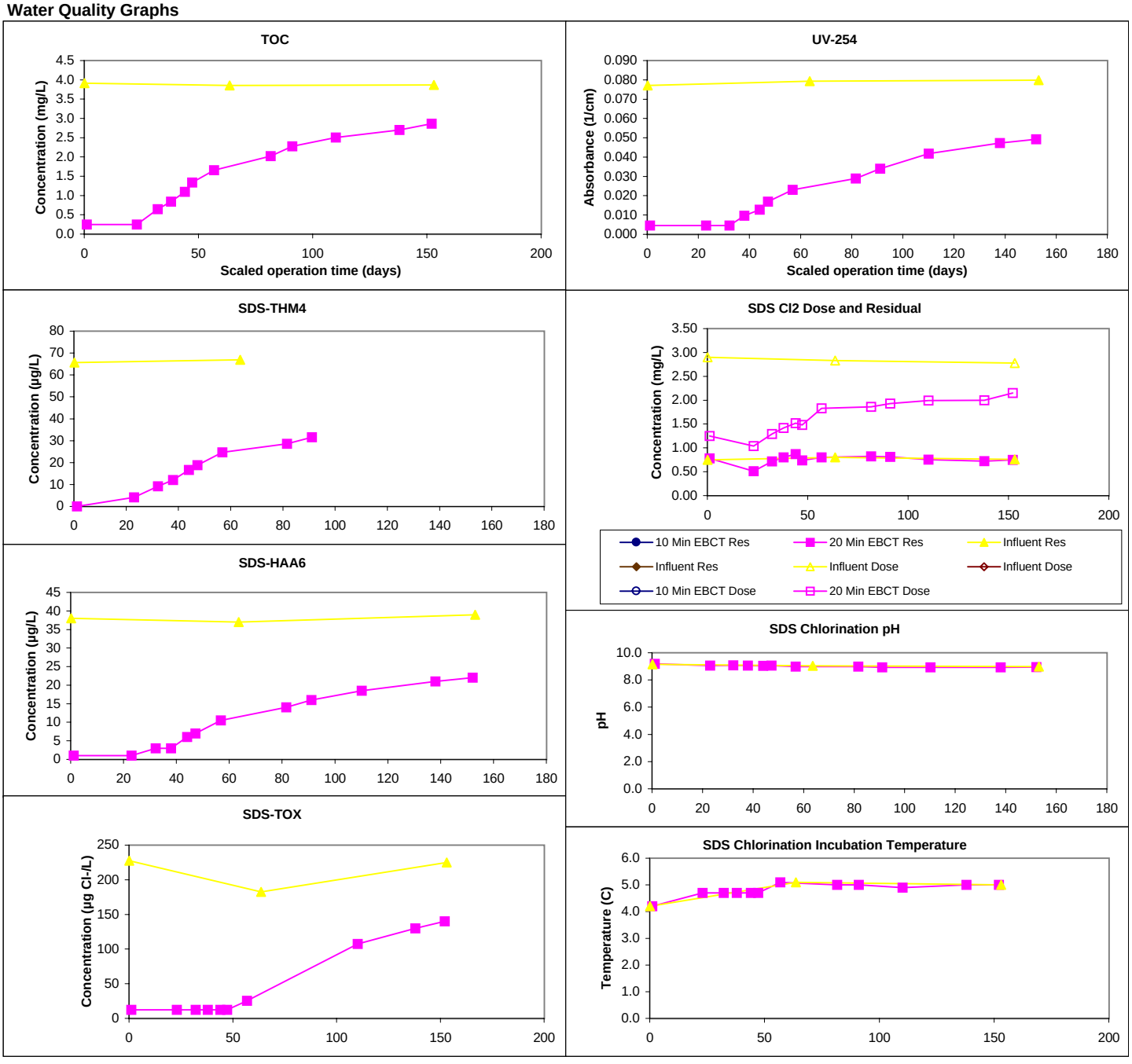
Cumulative SDS Conditions

	Mean	SD	Count	Min/Max
Res (0)	0.76	0.08	15	0.51 - 0.87
Temp	4.8	0.3	15	4.2 - 5.1
pH	9.0	0.1	15	8.9 - 9.2
Time	24.2	0.2	15	23.9 - 24.5

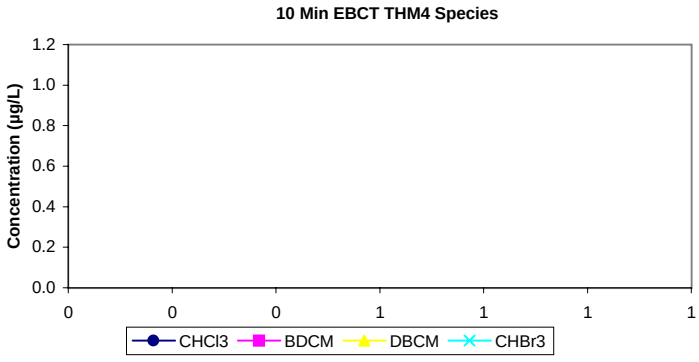
Comments:

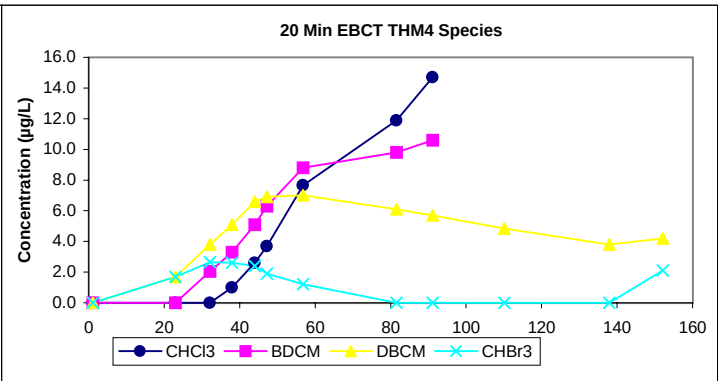
Chart Legend: 10 Min EBCT; 20 Min EBCT; Influent; Influent

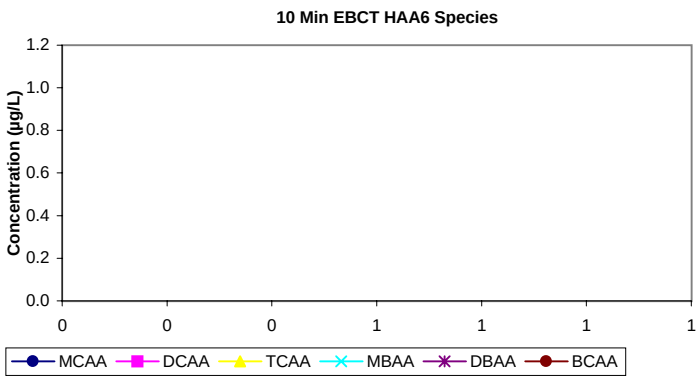
Water Quality Graphs

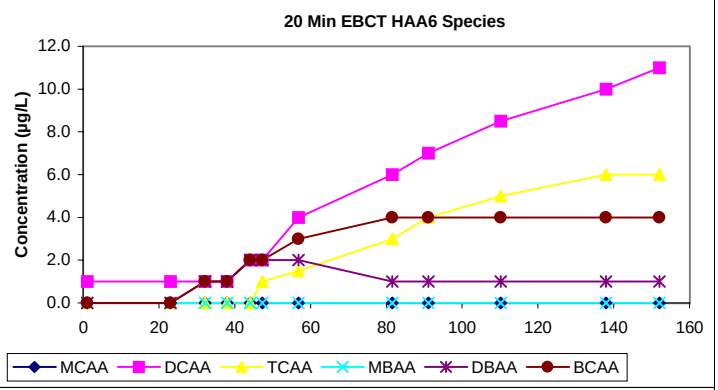


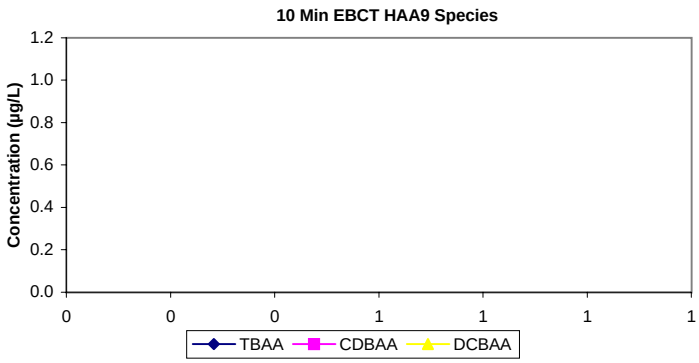
Water Quality Graphs (Continued)

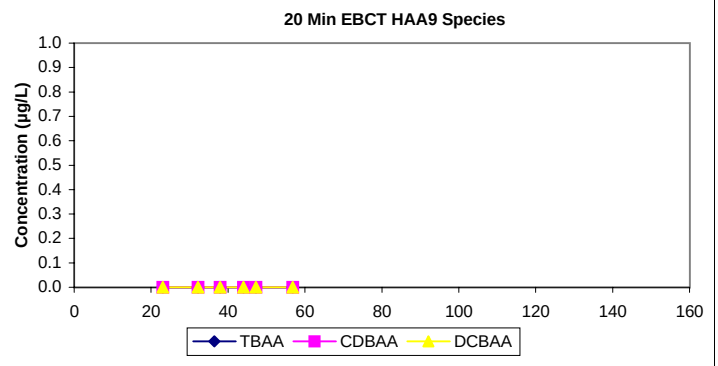


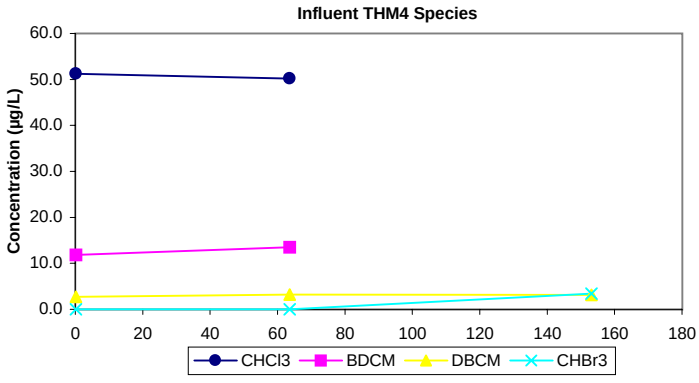


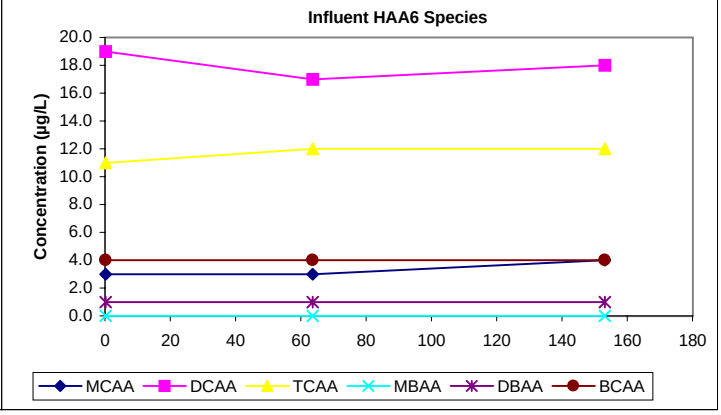












Mahoning Valley Sanitary District | **Bench-Scale RSSCT Treatment Study Summary** | **Quarter:** 2

ICR Information

ID / ICR#: OH7801811 / 539
ICR Contact: John Zackasee, Superintendent-Purification
Phone No.: (330) 652-3614
Period: 4/15/97 - 5/3/97 (18 B-S days)

Design Information

Design TOC:	3.2 mg/L	**Full-Scale GAC Size:**	12x40 Bituminous
Col Diameter:	9.0 mm	**Bench-Scale GAC Size:**	100x200
Min Reynolds#:	0.38	**Scaling Factor:**	9.44
Full-Scale Temp:	10.0 C	**Meas Dry Bed Density:**	0.50 g/cm3

Water Quality Summary

	Influent				Influent			
Influent	Mean	SD/RD	Count	Min/Max	Mean	SD/RD	Count	Min/Max
TOC	3.2	0.1	3	3.1 - 3.4				
pH	8.9	0.0	3	8.9 - 9.0				
UV254	0.066	0.001	3	0.065 - 0.066				
SUVA	2.03	0.06	3	1.96 - 2.07				
Bromide	40	1	2	39 - 40				
SDS-TOX	225	4	3	221 - 230				
SDS-THM4	60	1	2	59 - 60				
SDS-HAA6	38	3	3	35 - 41				
Effluent	**10 Min EBCT**			(9 B-S days)	**20 Min EBCT**			(18 B-S days)
Effluent pH	8.6	0.2	13	8.1 - 9.2	8.6	0.2	13	8.4 - 9.2
Effluent Temp	22.1	0.6	13	21.2 - 23.1	22.2	0.9	13	20.5 - 23.7

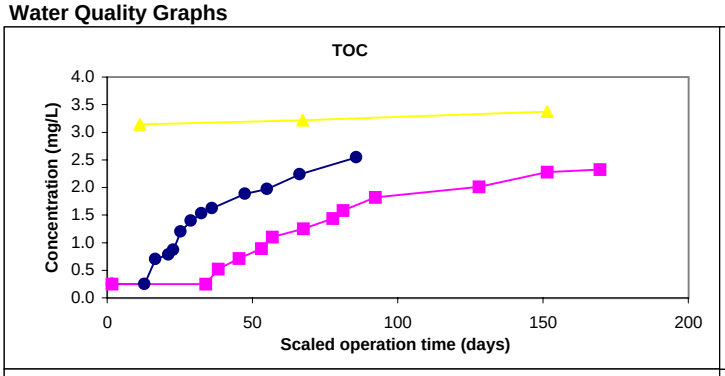
Cumulative SDS Conditions

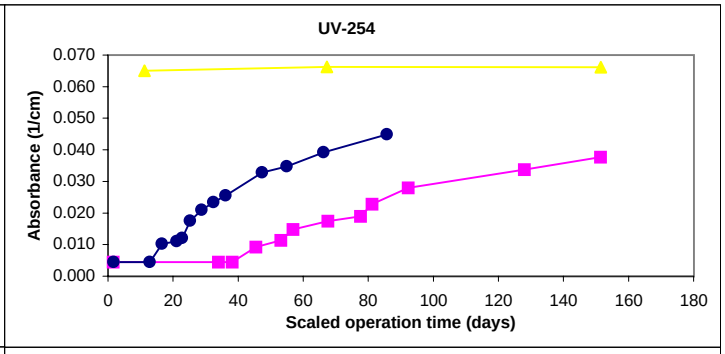
	Mean	SD	Count	Min/Max
Res (0)	0.80	0.08	27	0.68 - 0.98
Temp	10.0	0.1	27	9.8 - 10.2
pH	9.0	0.0	27	8.9 - 9.0
Time	24.1	0.3	27	23.9 - 25.0

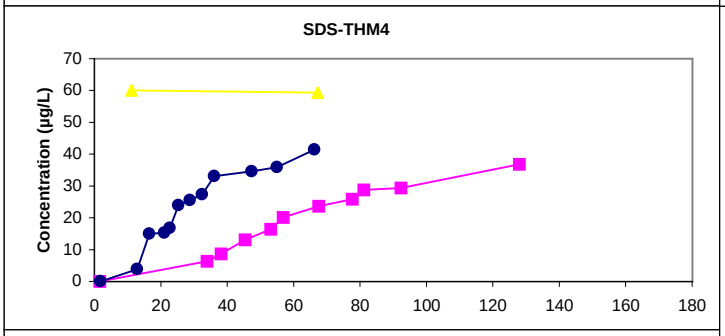
Comments:

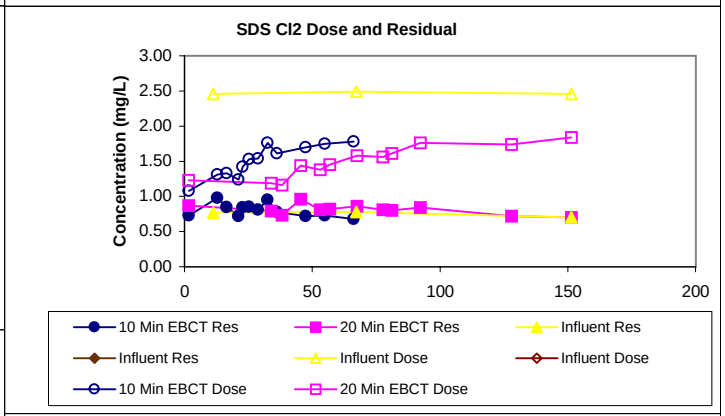
Chart Legend: 10 Min EBCT; 20 Min EBCT; Influent; Influent

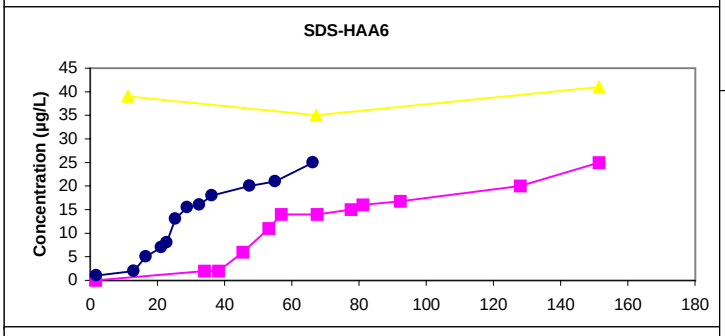
Water Quality Graphs

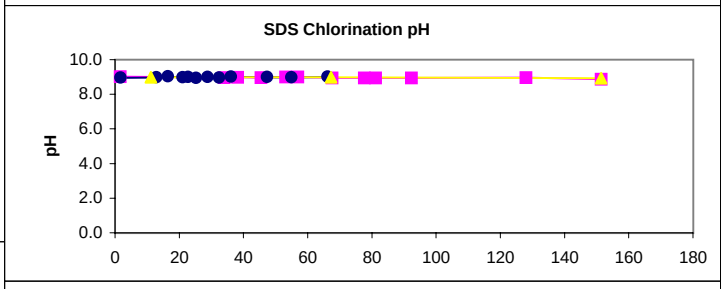


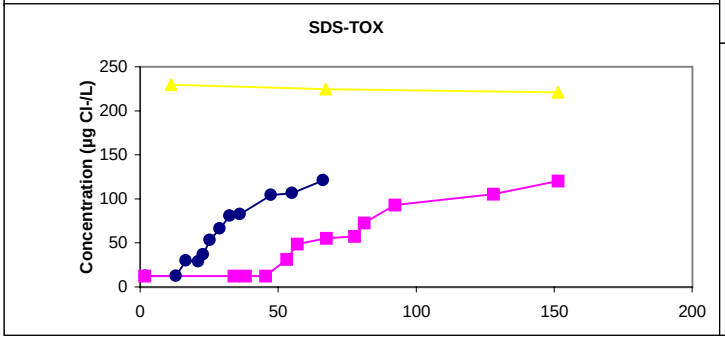


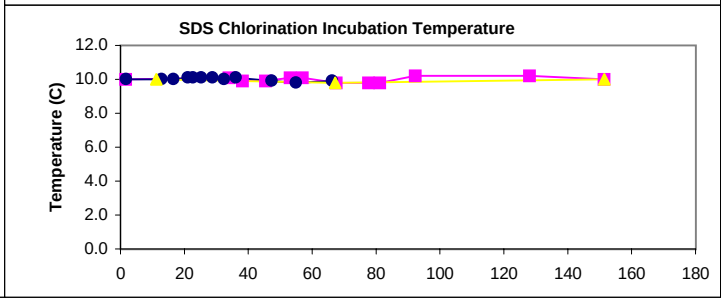




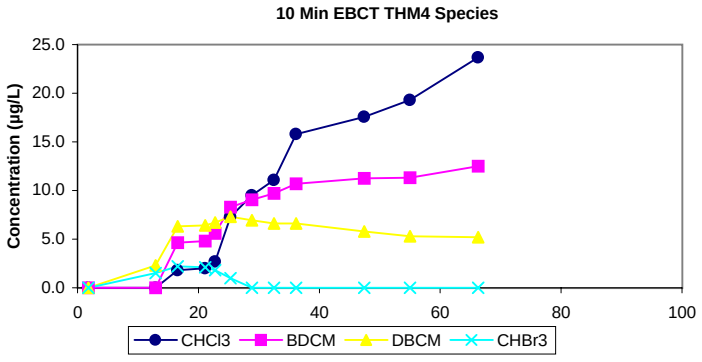


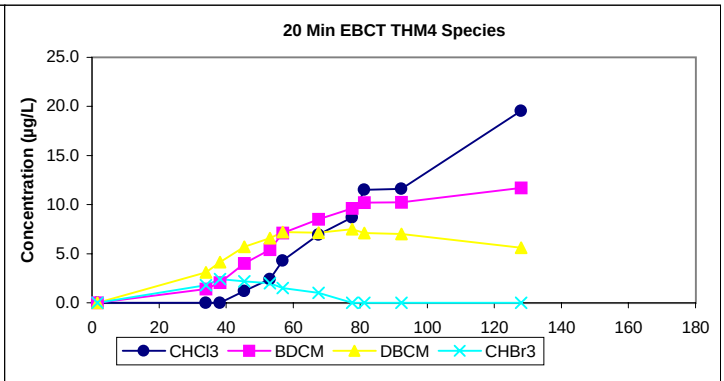


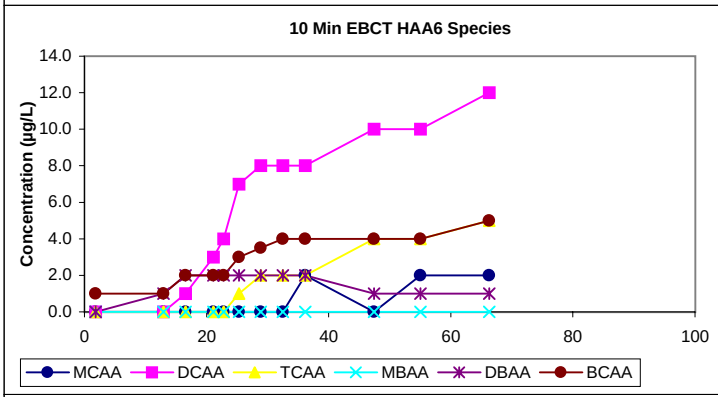


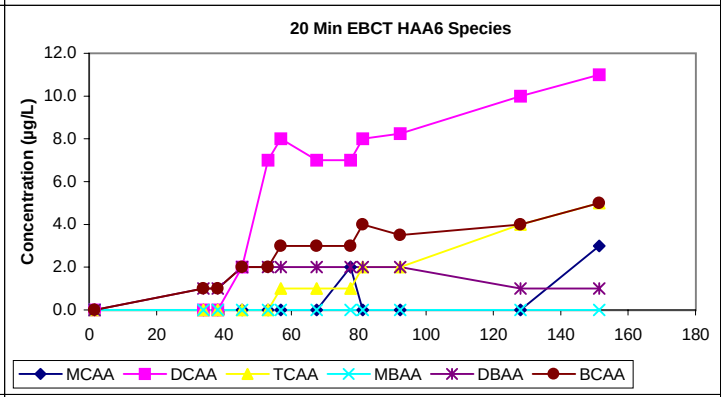


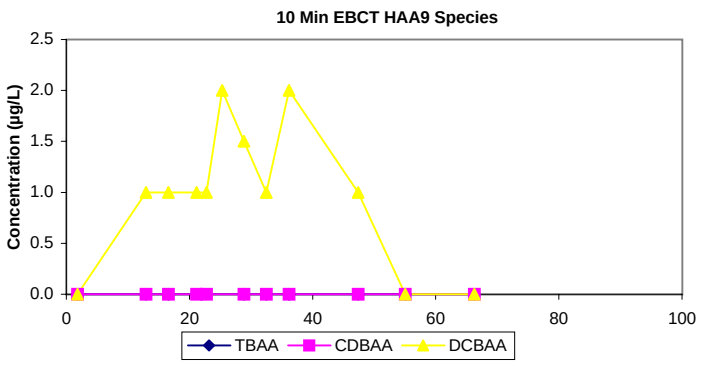
Water Quality Graphs (Continued)

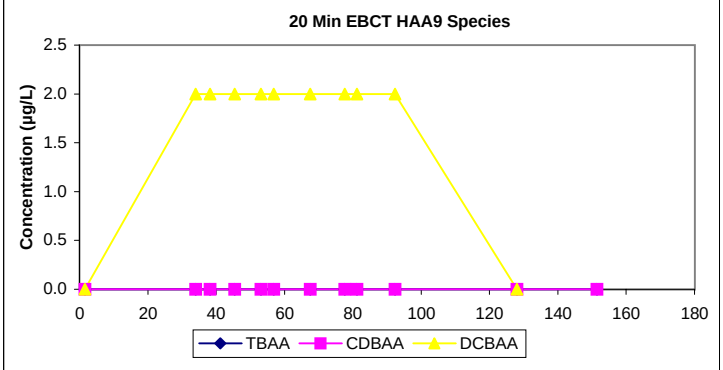


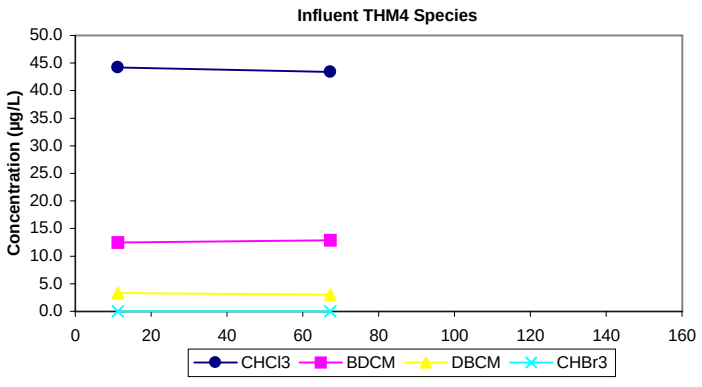


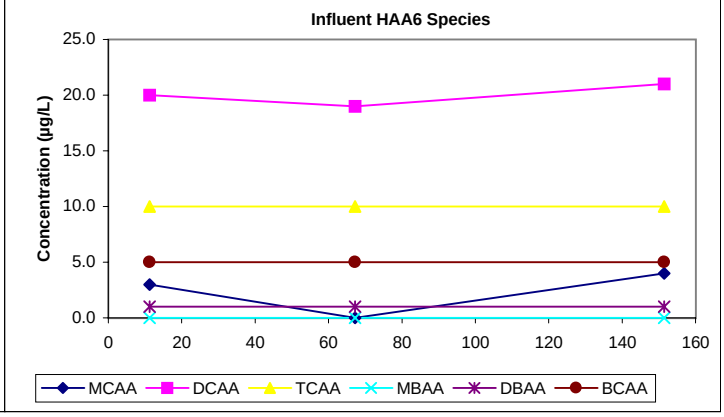












Mahoning Valley Sanitary District | **Bench-Scale RSSCT Treatment Study Summary** | **Quarter:** 3

ICR Information

ID / ICR#: OH7801811 / 539
ICR Contact: John Zackasee, Superintendent-Purification
Phone No.: (330) 652-3614
Period: 7/30/97 - 8/17/97 (18 B-S days)

Design Information

Design TOC:	3.4 mg/L	**Full-Scale GAC Size:**	12x40 Bituminous
Col Diameter:	8.0 mm	**Bench-Scale GAC Size:**	100x200
Min Reynolds#:	0.41	**Scaling Factor:**	9.44
Full-Scale Temp:	20.0 C	**Meas Dry Bed Density:**	0.49 g/cm3

Water Quality Summary

	Influent				Influent			
Influent	Mean	SD/RD	Count	Min/Max	Mean	SD/RD	Count	Min/Max
TOC	3.4	0.1	3	3.4 - 3.5				
pH	9.0	0.0	3	9.0 - 9.1				
UV254	0.066	0.001	2	0.066 - 0.067				
SUVA	1.94	0.05	2	1.91 - 1.96				
Bromide	40	1	2	39 - 40				
SDS-TOX	271	11	3	261 - 283				
SDS-THM4	120	8	3	115 - 129				
SDS-HAA6	42	2	3	40 - 44				
Effluent	**10 Min EBCT**			(8 B-S days)	**20 Min EBCT**			(18 B-S days)
Effluent pH	8.5	0.1	12	8.3 - 8.8	8.2	0.3	12	7.9 - 8.8
Effluent Temp	21.6	0.3	12	21.1 - 22.2	22.5	0.4	12	22.0 - 23.1

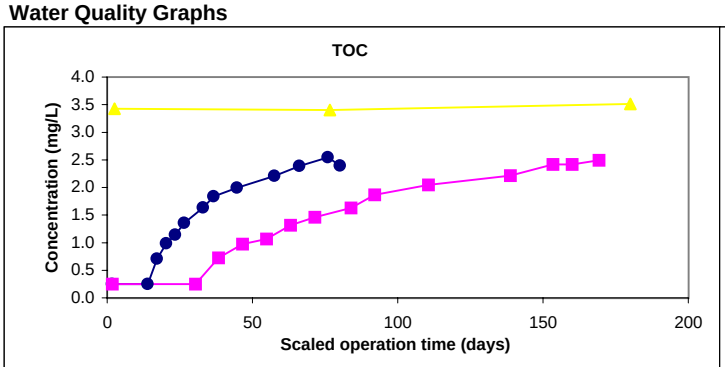
Cumulative SDS Conditions

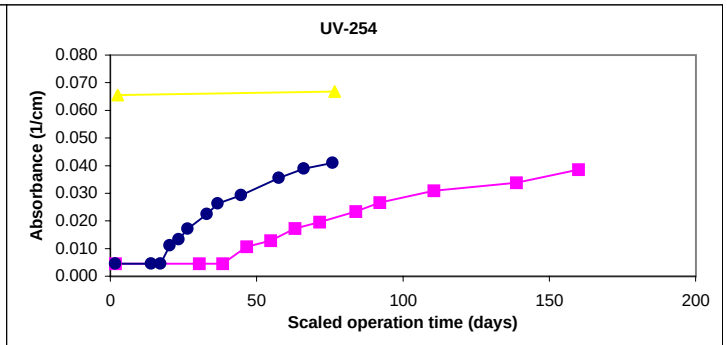
	Mean	SD	Count	Min/Max
Res (0)	0.75	0.06	27	0.61 - 0.85
Temp	20.2	0.3	27	19.8 - 20.6
pH	9.0	0.0	27	9.0 - 9.1
Time	24.0	0.1	27	23.9 - 24.3

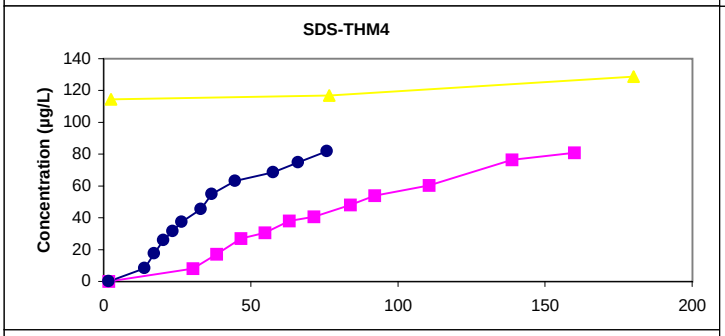
Comments:

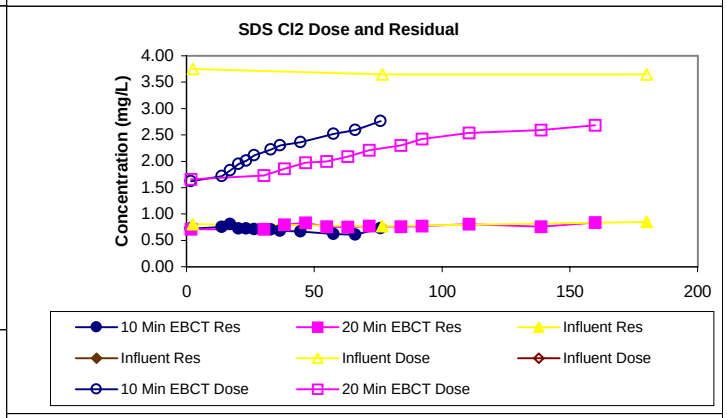
Chart Legend: 10 Min EBCT; 20 Min EBCT; Influent; Influent

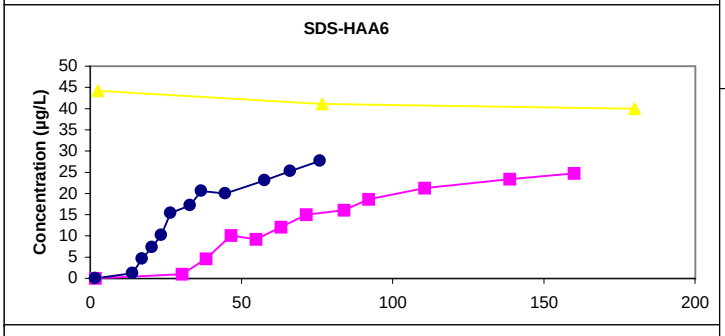
Water Quality Graphs

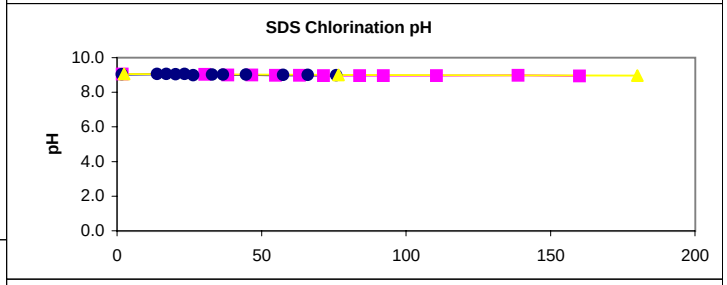


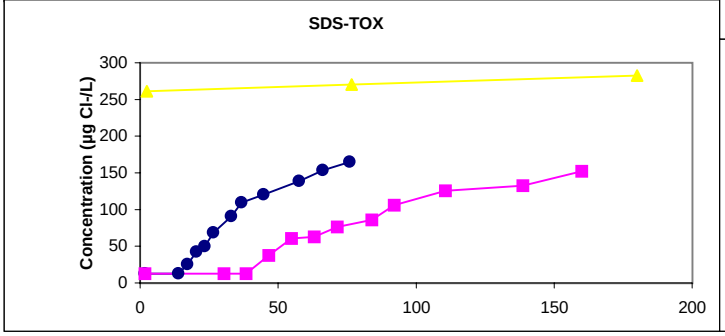


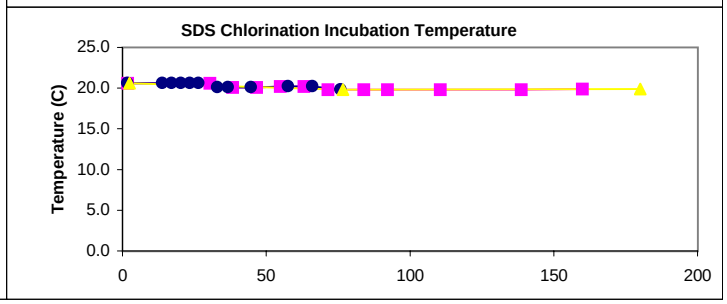




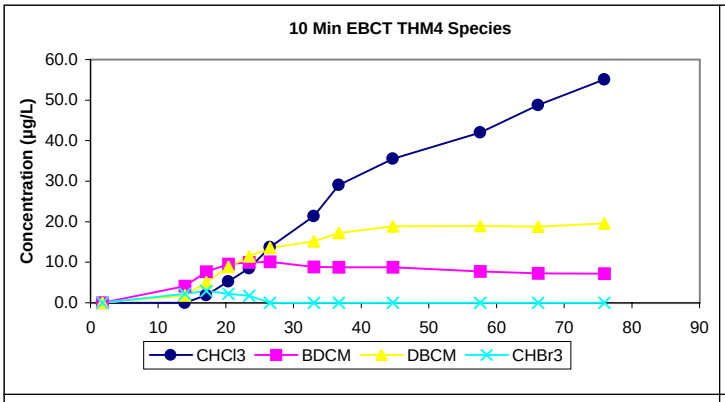


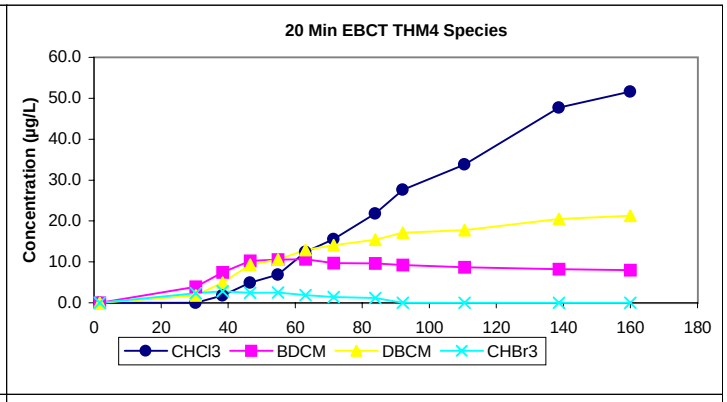


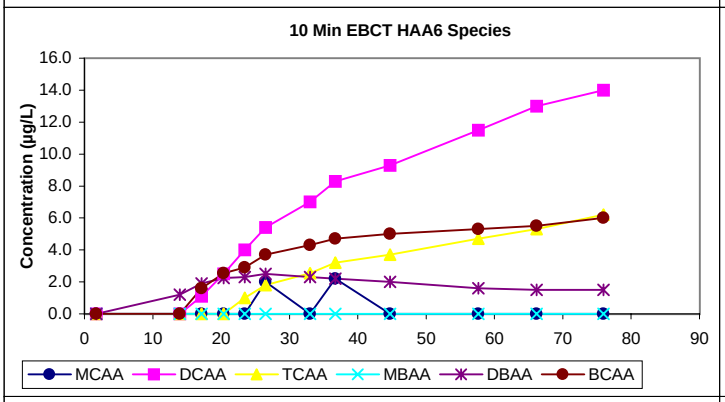


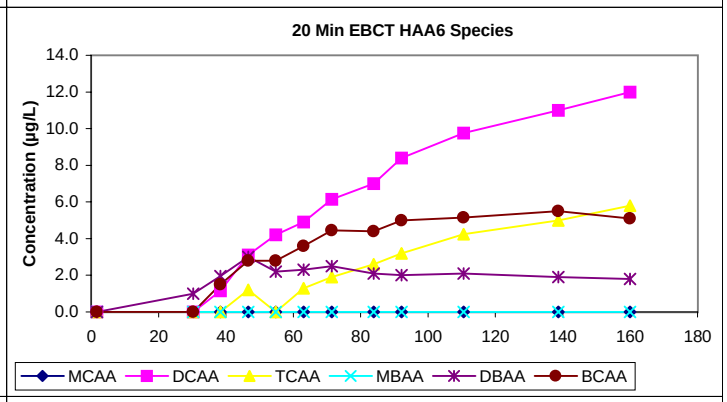


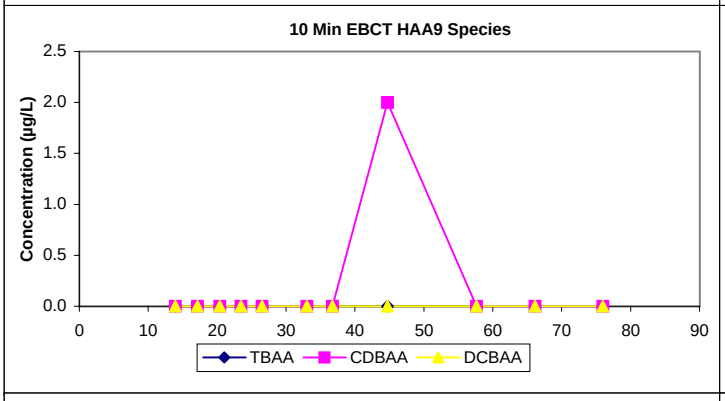
Water Quality Graphs (Continued)

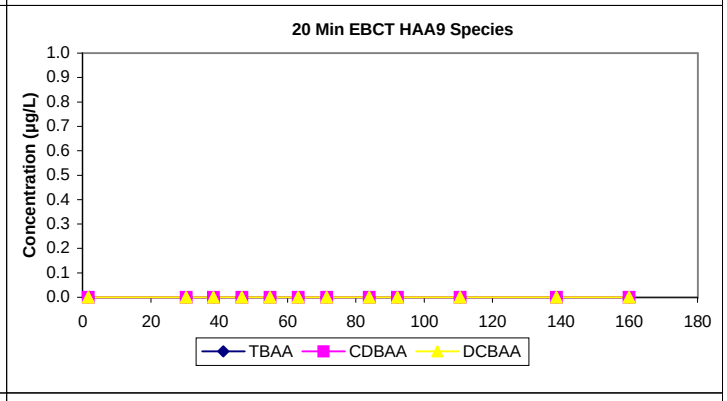


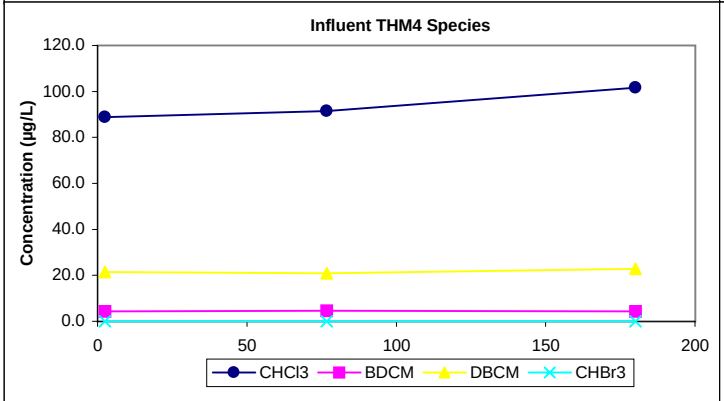


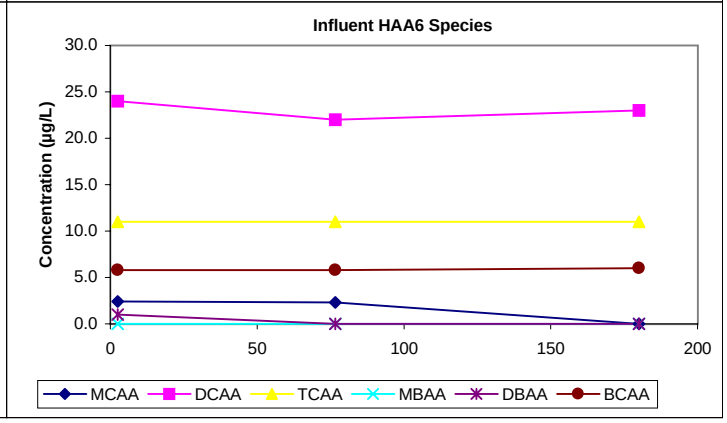












Mahoning Valley Sanitary District | **Bench-Scale RSSCT Treatment Study Summary** | **Quarter:** 4

ICR Information

ID / ICR#: OH7801811 / 539
ICR Contact: John Zackasee, Superintendent-Purification
Phone No.: (330) 652-3614
Period: 10/31/97 - 11/18/97 (18 B-S days)

Design Information

Design TOC:	3.4 mg/L	**Full-Scale GAC Size:**	12x40 Bituminous
Col Diameter:	9.0 mm	**Bench-Scale GAC Size:**	100x200
Min Reynolds#:	0.50	**Scaling Factor:**	9.44
Full-Scale Temp:	15.0 C	**Meas Dry Bed Density:**	0.49 g/cm3

Water Quality Summary

	Influent				Influent			
Influent	Mean	SD/RD	Count	Min/Max	Mean	SD/RD	Count	Min/Max
TOC	3.4	0.1	3	3.3 - 3.5				
pH	9.0	0.1	3	9.0 - 9.1				
UV254	0.063	0.000	3	0.063 - 0.063				
SUVA	1.87	0.07	3	1.79 - 1.92				
Bromide	42	3	2	40 - 43				
SDS-TOX	232	4	3	227 - 235				
SDS-THM4	99	5	3	93 - 102				
SDS-HAA6	35	3	3	32 - 38				
Effluent	**10 Min EBCT**			(8 B-S days)	**20 Min EBCT**			(18 B-S days)
Effluent pH	8.3	0.1	13	8.2 - 8.6	8.3	0.1	13	8.0 - 8.6
Effluent Temp	21.6	1.0	13	20.8 - 24.5	21.8	0.9	13	20.8 - 24.5

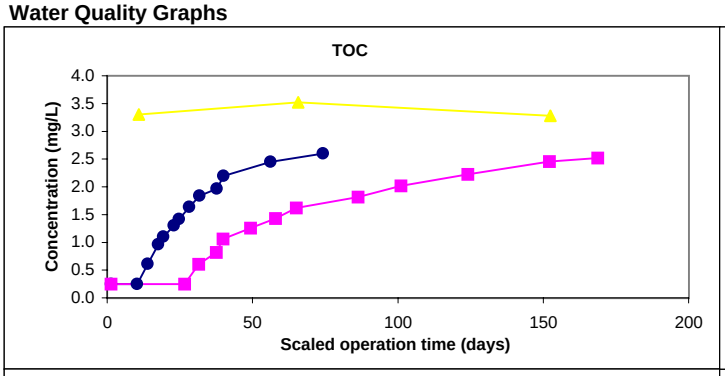
Cumulative SDS Conditions

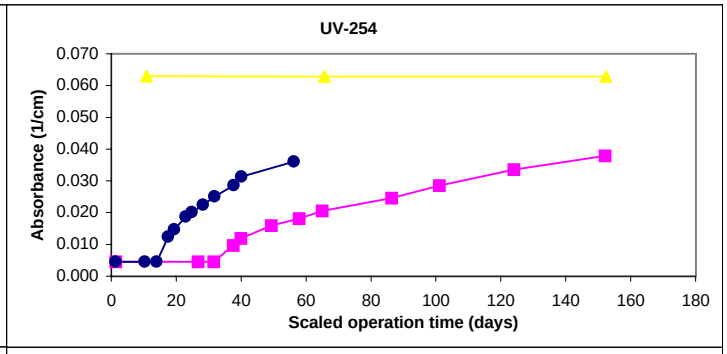
	Mean	SD	Count	Min/Max
Res (0)	0.69	0.07	27	0.55 - 0.84
Temp	15.0	0.2	27	14.6 - 15.3
pH	9.0	0.0	27	9.0 - 9.1
Time	24.2	0.2	27	23.9 - 24.7

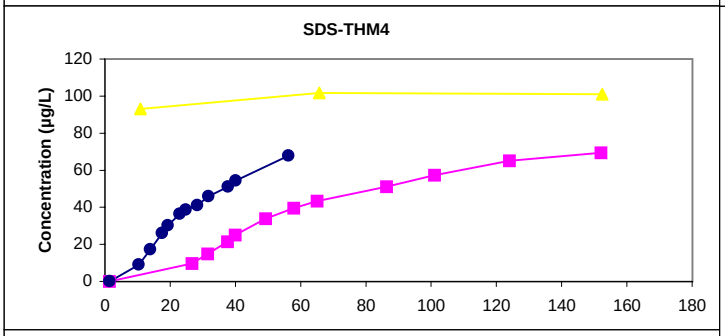
Comments:

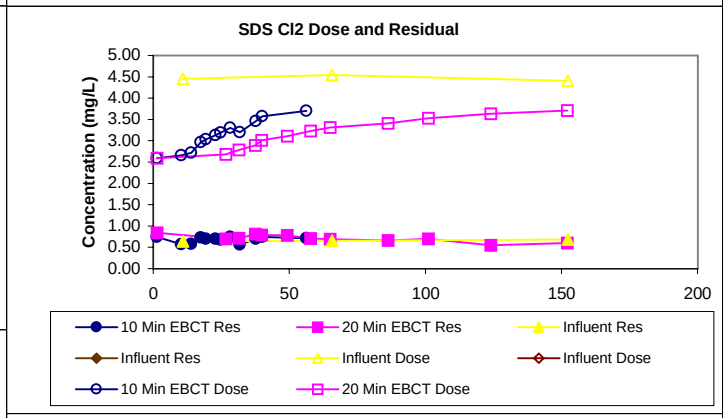
Chart Legend: 10 Min EBCT; 20 Min EBCT; Influent; Influent

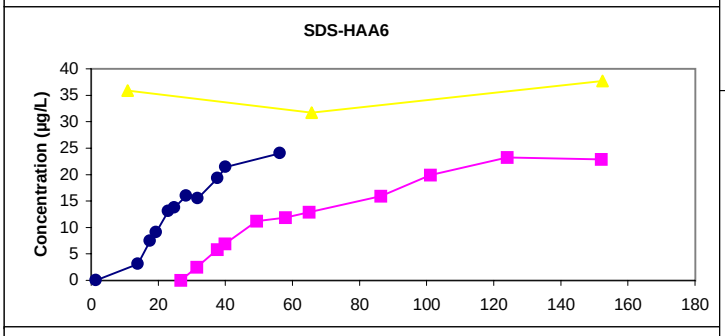
Water Quality Graphs

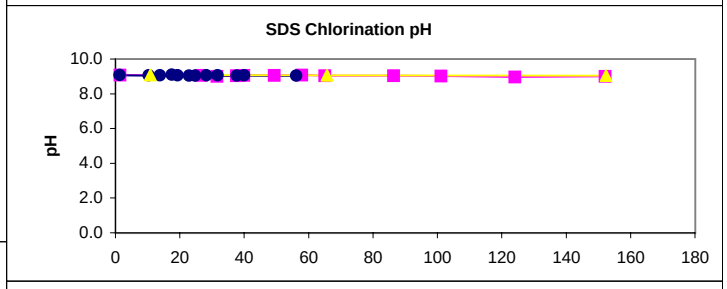


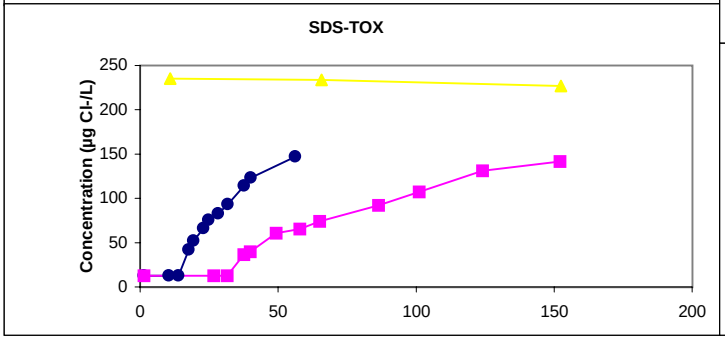


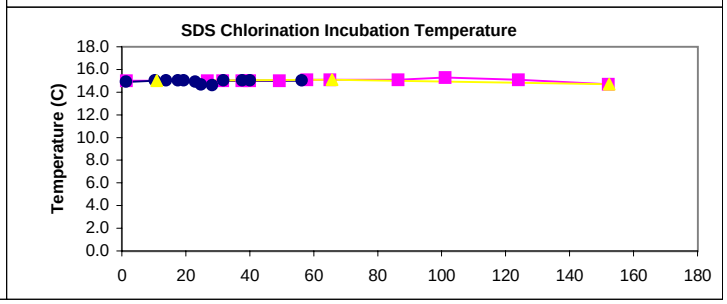












Water Quality Graphs (Continued)