

ICR TREATMENT STUDY ANALYSIS

Base Analysis and Data Review Comments

Treatment Study ID	4015
Study Protocol	GAC bench-scale treatment study
Plant ICR Number	476
PWS Name	Passaic Valley Water Commission
City, State, Zip	Clifton, NJ 07011

General comments:

1. This bench-scale study examined DBP precursor removal by F-400, a bituminous coal-based GAC, over four quarterly sessions at a 10 minute EBCT. In a parallel study, a pilot-scale study was conducted to examine DBP precursor removal at a 20 minute EBCT; the results of pilot-scale testing are summarized as study 4016. A bench-scale 20 minute EBCT contactor was examined only during the first quarter (for comparison against pilot-scale results) and not included during the remainder of this study because this EBCT was examined during pilot-scale testing. This study was conducted prior to the availability of the final version of the *ICR Manual for Bench- and Pilot-Scale Treatment Studies*, so some requirements (such as duplicate analyses) were not initially performed. However, these requirements were adopted as part of the study as they became known.
2. Uniform formation conditions (UFC) were utilized to assess DBP formation during this study (1.0 mg/L free chlorine residual after 24 hours, pH 8.0, and 20°C).

Outlier Data:

No outliers were removed.

Cell: A1

Comment: 4015-SAS.xls 3/2/00 17:52

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

3/6/00 12:22

Although all comments refer to 4016, they are applicable to the curve fits for 4015.

Cell: C5

Comment: 4016-10-01 - Run 1 (CHBr3) 3/2/00 17:33

Original value (CoefA0) = 0.3049 New value = -0.5139

Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: D5

Comment: 4016-10-01 - Run 1 (CHBr3) 3/2/00 17:33

Original value (CoefAf) = 5.1912 New value = 31.2933

Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: E5

Comment: 4016-10-01 - Run 1 (CHBr3) 3/2/00 17:33

Original value (CoefB) = 14.4722 New value = 43.0734

Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: F5

Comment: 4016-10-01 - Run 1 (CHBr3) 3/2/00 17:33

Original value (CoefD) = 0.0886 New value = 0.0615

Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: J5

Comment: 4016-10-01 - Run 1 (CHBr3) 3/2/00 17:33

Original value (S) = -0.0316 New value = -0.0508

Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: C8

Comment: 4016-10-01 - Run 1 (DBAA) 3/2/00 17:36

Original value (CoefA0) = 0.3448 New value = 1.0916

Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: D8

Comment: 4016-10-01 - Run 1 (DBAA) 3/2/00 17:36

Original value (CoefAf) = 5.7369 New value = 6.288

Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: E8

Comment: 4016-10-01 - Run 1 (DBAA) 3/2/00 17:36

Original value (CoefB) = 12.7678 New value = 54.5951

Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: F8

Comment: 4016-10-01 - Run 1 (DBAA) 3/2/00 17:36

Original value (CoefD) = 0.0868 New value = 0.1366
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: J8

Comment: 4016-10-01 - Run 1 (DBAA) 3/2/00 17:36
Original value (S) = -0.0239 New value = -0.0401
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: C15

Comment: 4016-10-01 - Run 1 (MBAA) 3/2/00 17:31
Original value (CoefA0) = 0 New value = 0
Fewer than 6 points above MRL. Peak curve/step function combination applied.

Cell: D15

Comment: 4016-10-01 - Run 1 (MBAA) 3/2/00 17:31
Original value (CoefAf) = 0 New value = 2
Fewer than 6 points above MRL. Peak curve/step function combination applied.

Cell: E15

Comment: 4016-10-01 - Run 1 (MBAA) 3/2/00 17:31
Original value (CoefB) = 0 New value = 0
Fewer than 6 points above MRL. Peak curve/step function combination applied.

Cell: F15

Comment: 4016-10-01 - Run 1 (MBAA) 3/2/00 17:31
Original value (CoefD) = 0 New value = 0
Fewer than 6 points above MRL. Peak curve/step function combination applied.

Cell: J15

Comment: 4016-10-01 - Run 1 (MBAA) 3/2/00 17:31
Original value (S) = 0 New value = -0.1666
Fewer than 6 points above MRL. Peak curve/step function combination applied.

Cell: C16

Comment: 4016-10-01 - Run 1 (MCAA) 3/2/00 17:34
Original value (CoefA0) = 0 New value = 0
Fewer than 6 points above MRL. Peak curve/step function combination applied.

Cell: D16

Comment: 4016-10-01 - Run 1 (MCAA) 3/2/00 17:34
Original value (CoefAf) = 0 New value = 2
Fewer than 6 points above MRL. Peak curve/step function combination applied.

Cell: E16

Comment: 4016-10-01 - Run 1 (MCAA) 3/2/00 17:34
Original value (CoefB) = 0 New value = 0
Fewer than 6 points above MRL. Peak curve/step function combination applied.

Cell: F16

Comment: 4016-10-01 - Run 1 (MCAA) 3/2/00 17:34
Original value (CoefD) = 0 New value = 0

Fewer than 6 points above MRL. Peak curve/step function combination applied.

Cell: J16

Comment: 4016-10-01 - Run 1 (MCAA) 3/2/00 17:34

Original value (S) = 0 New value = -0.1666

Fewer than 6 points above MRL. Peak curve/step function combination applied.

Cell: C49

Comment: 4016-10-03 - Run 5 (CHBr3) 3/2/00 17:42

Original value (CoefA0) = -0.1138 New value = -0.4847

Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: D49

Comment: 4016-10-03 - Run 5 (CHBr3) 3/2/00 17:42

Original value (CoefAf) = 4 New value = 3.7379

Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: E49

Comment: 4016-10-03 - Run 5 (CHBr3) 3/2/00 17:42

Original value (CoefB) = 10 New value = 19.4983

Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: F49

Comment: 4016-10-03 - Run 5 (CHBr3) 3/2/00 17:42

Original value (CoefD) = 0.1442 New value = 1.0308

Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: J49

Comment: 4016-10-03 - Run 5 (CHBr3) 3/2/00 17:42

Original value (S) = -0.0387 New value = -0.0528

Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: C52

Comment: 4016-10-03 - Run 5 (DBAA) 3/2/00 17:43

Original value (CoefA0) = -2.5 New value = -0.3258

Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: D52

Comment: 4016-10-03 - Run 5 (DBAA) 3/2/00 17:43

Original value (CoefAf) = 7.5 New value = 5.1797

Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: E52

Comment: 4016-10-03 - Run 5 (DBAA) 3/2/00 17:43

Original value (CoefB) = 0.9338 New value = 19.947

Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: F52

Comment: 4016-10-03 - Run 5 (DBAA) 3/2/00 17:43

Original value (CoefD) = 0.0411 New value = 0.3133

Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: J52

Comment: 4016-10-03 - Run 5 (DBAA) 3/2/00 17:43
Original value (S) = 0 New value = -0.0566
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: C60

Comment: 4016-10-03 - Run 5 (MCAA) 3/2/00 17:26
Original value (CoefA0) = 0 New value = 2.1
Fewer than 6 points above MRL. Step function applied.

Cell: D60

Comment: 4016-10-03 - Run 5 (MCAA) 3/2/00 17:26
Original value (CoefAf) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: E60

Comment: 4016-10-03 - Run 5 (MCAA) 3/2/00 17:26
Original value (CoefB) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: F60

Comment: 4016-10-03 - Run 5 (MCAA) 3/2/00 17:26
Original value (CoefD) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: J60

Comment: 4016-10-03 - Run 5 (MCAA) 3/2/00 17:26
Original value (S) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: K60

Comment: 4016-10-03 - Run 5 (MCAA) 3/2/00 17:26
Original value (t0) = 0 New value = 39.9386
Fewer than 6 points above MRL. Step function applied.

Cell: C81

Comment: 4016-10-04 - Run 7 (MBAA) 3/2/00 17:27
Original value (CoefA0) = 0 New value = 2
Fewer than 6 points above MRL. Step function applied.

Cell: D81

Comment: 4016-10-04 - Run 7 (MBAA) 3/2/00 17:27
Original value (CoefAf) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: E81

Comment: 4016-10-04 - Run 7 (MBAA) 3/2/00 17:27
Original value (CoefB) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: F81

Comment: 4016-10-04 - Run 7 (MBAA) 3/2/00 17:27
Original value (CoefD) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: J81

Comment: 4016-10-04 - Run 7 (MBAA) 3/2/00 17:27
Original value (S) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: K81

Comment: 4016-10-04 - Run 7 (MBAA) 3/2/00 17:27
Original value (t0) = 0 New value = 99.455
Fewer than 6 points above MRL. Step function applied.

Cell: C93

Comment: 4016-20-01 - Run 2 (CHBr3) 3/2/00 17:37
Original value (CoefA0) = 0.2283 New value = 0.6457
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: D93

Comment: 4016-20-01 - Run 2 (CHBr3) 3/2/00 17:37
Original value (CoefAf) = 4.014 New value = 4.9047
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: E93

Comment: 4016-20-01 - Run 2 (CHBr3) 3/2/00 17:37
Original value (CoefB) = 59.7529 New value = 860.2461
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: F93

Comment: 4016-20-01 - Run 2 (CHBr3) 3/2/00 17:37
Original value (CoefD) = 0.0706 New value = 0.1213
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: J93

Comment: 4016-20-01 - Run 2 (CHBr3) 3/2/00 17:37
Original value (S) = -0.0183 New value = -0.0285
Poor peak curve fit. Data was refit by iterative curve fit procedure.

ID / ICR#: NJ1605002 / 476

Design TOC: 3.2 mg/L

Full-Scale GAC Size: 12x40 Bituminous coal

ICR Contact: Mr. Joseph Bella

Col Diameter: 8.0 mm

Bench-Scale GAC Size: 140x230

Phone No.: (973) 340-4307

Min Reynolds#: 0.50

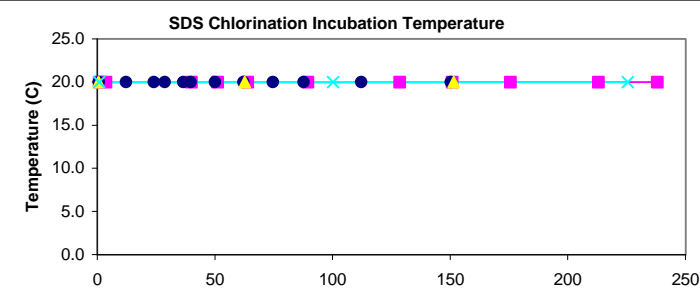
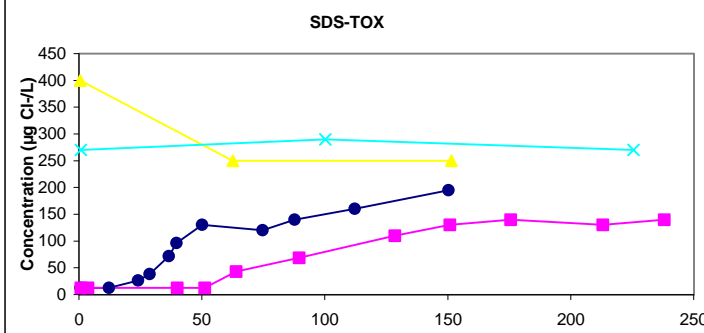
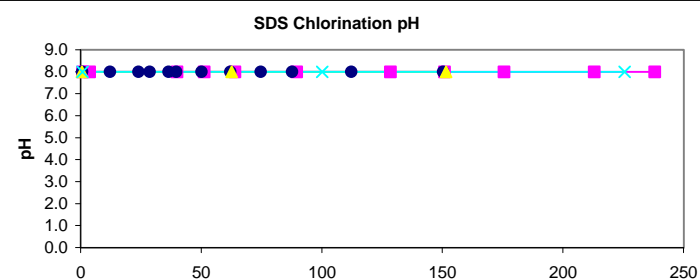
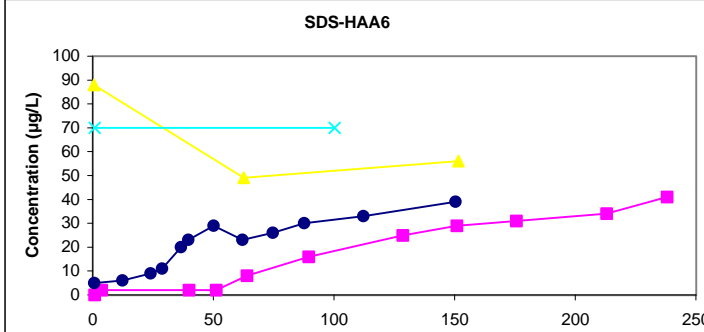
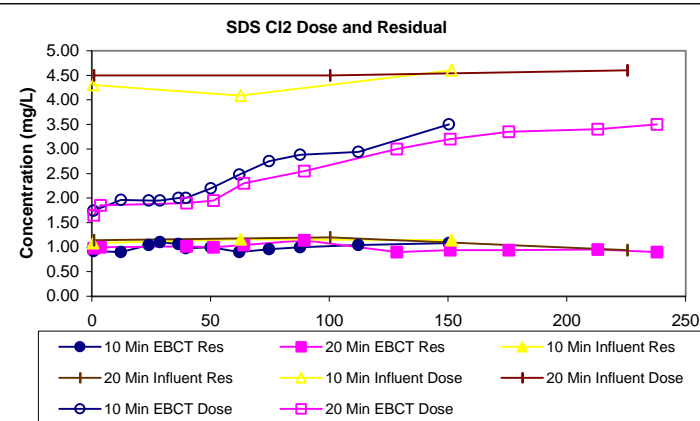
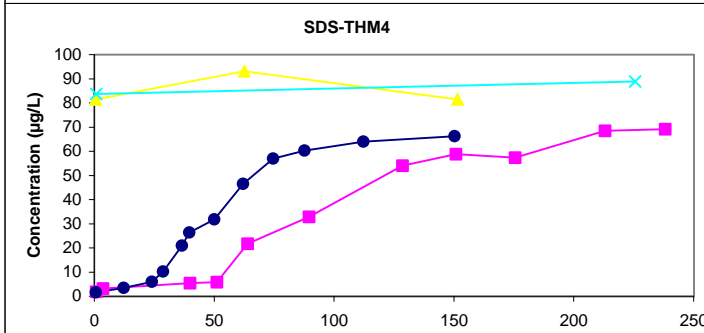
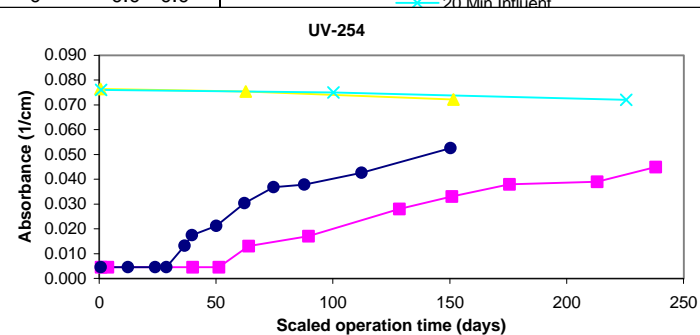
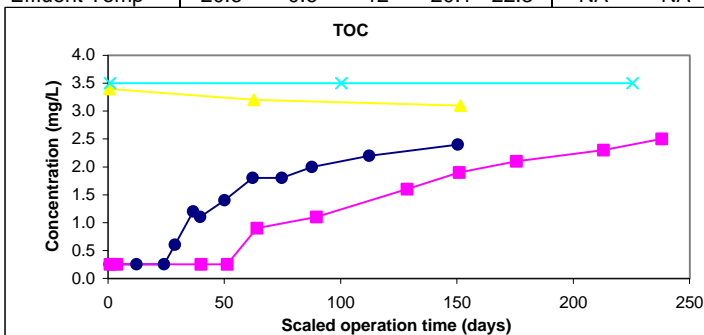
Scaling Factor: 12.53

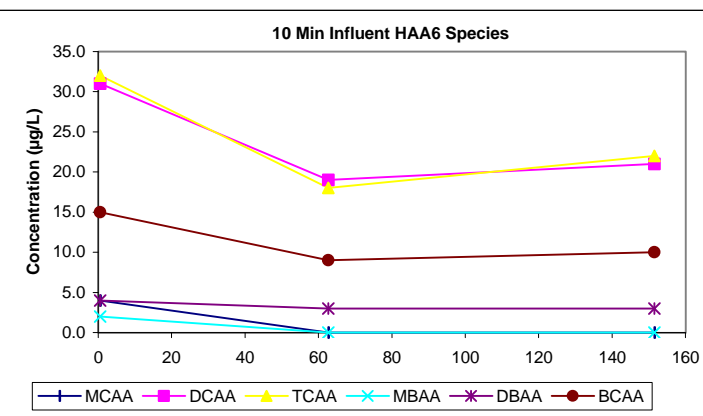
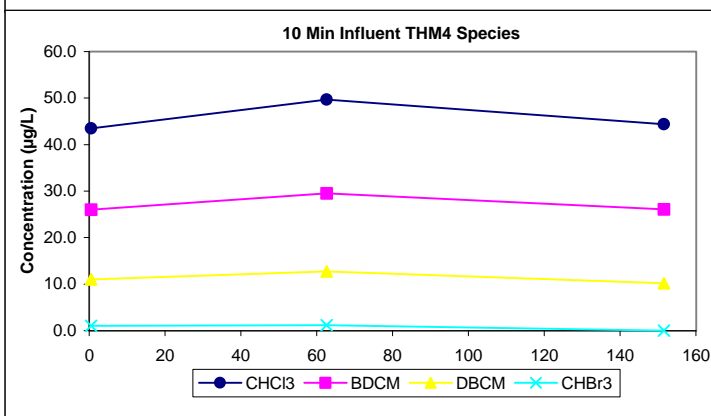
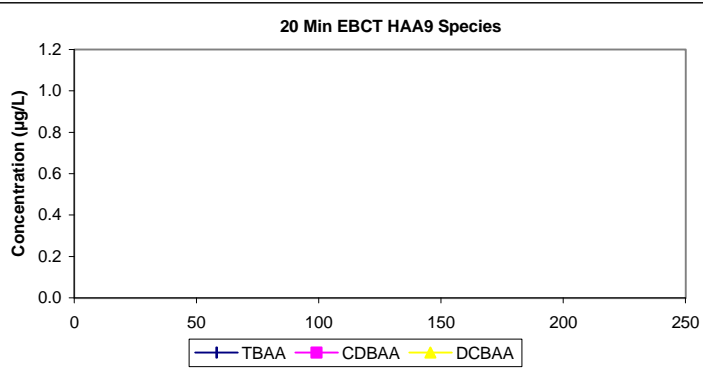
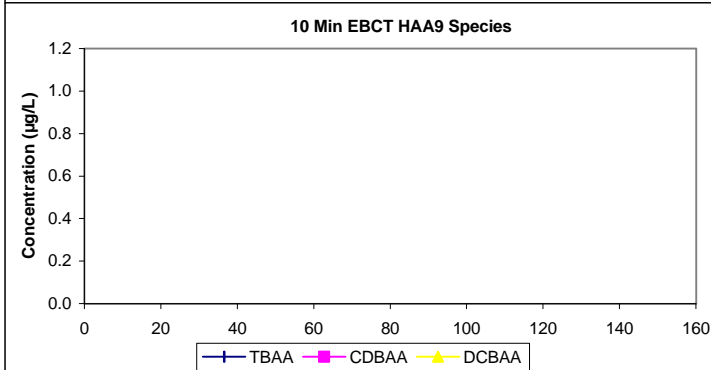
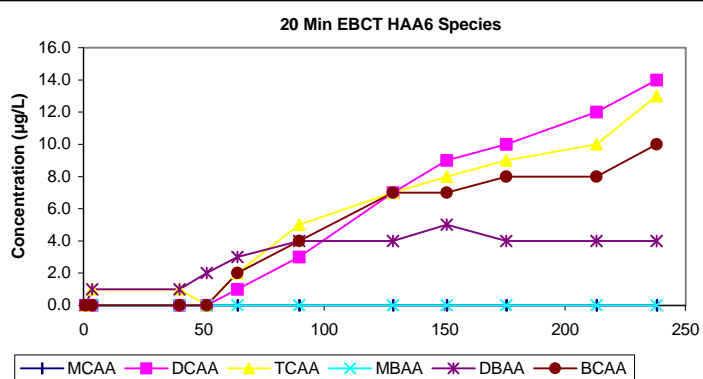
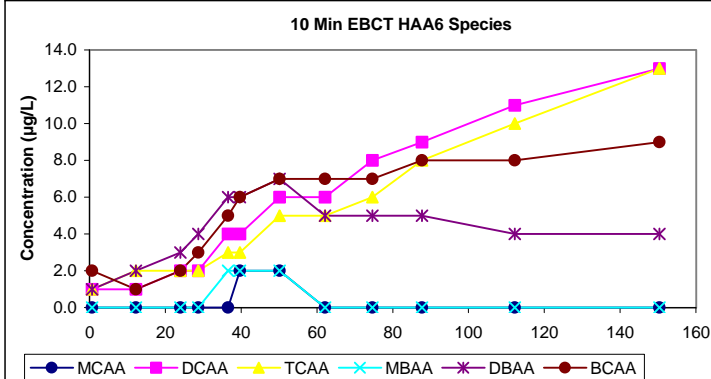
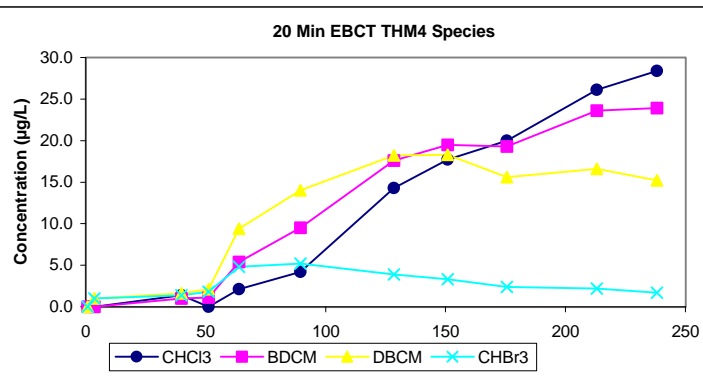
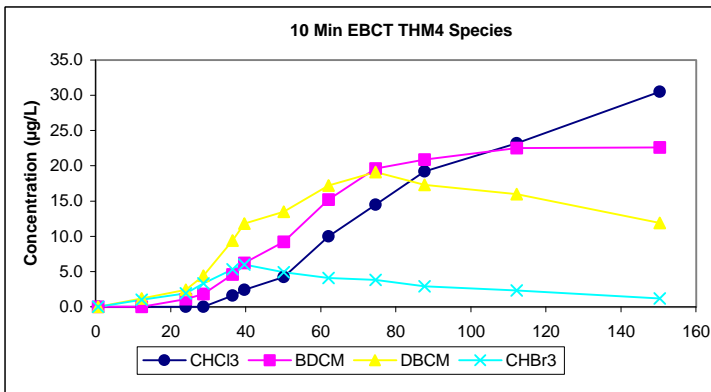
Period: 1/11/95 - 1/23/95 (12 B-S days)

Full-Scale Temp: 7 C

Meas Dry Bed Density: 0.49 g/cm3

Influent	10 Min Influent				20 Min Influent				Cumulative SDS Conditions				
	Mean	SD/RD	Count	Min/Max	Mean	SD/RD	Count	Min/Max		Mean	SD	Count	Min/Max
TOC	3.2	0.2	3	3.1 - 3.4	3.5	0.0	3	3.5 - 3.5	Res (0)	1.02	0.09	29	0.90 - 1.20
pH	7.8	0.1	3	7.7 - 7.8	NA	0.0	0	0.0 - 0.0	Temp	20.0	0.0	29	20.0 - 20.0
UV254	0.075	0.002	3	0.072 - 0.077	0.074	0.002	3	0.072 - 0.076	pH	8.0	0.0	29	8.0 - 8.0
SUVA	2.31	0.06	3	2.25 - 2.36	2.12	0.06	3	2.06 - 2.17	Time	24.0	0.0	29	24.0 - 24.0
Bromide	0.09	0.00	3	0.09 - 0.09	NA	0.00	0	0.00 - 0.00	Comments:				
SDS-TOX	300	87	3	250 - 400	277	12	3	270 - 290					
SDS-THM4	85	7	3	81 - 93	86	5	2	84 - 89					
SDS-HAA6	64	21	3	49 - 88	70	0	2	70 - 70	Chart Legend:				
Effluent	10 Min EBCT (12 B-S days)				20 Min EBCT (19 B-S days)								
Effluent pH	7.8	0.1	12	7.8 - 8.1	NA	NA	0	0.0 - 0.0					
Effluent Temp	20.6	0.6	12	20.1 - 22.3	NA	NA	0	0.0 - 0.0					





ID / ICR#: NJ1605002 / 476

Design TOC: 2.3 mg/L

Full-Scale GAC Size: 12x40 Bituminous coal

ICR Contact: Mr. Joseph Bella

Col Diameter: 8.0 mm

Bench-Scale GAC Size: 140x230

Phone No.: (973) 340-4307

Min Reynolds#: 0.50

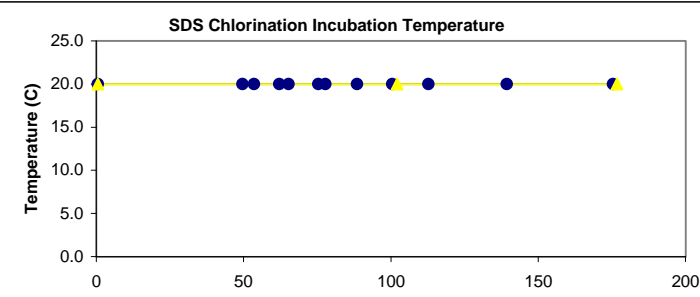
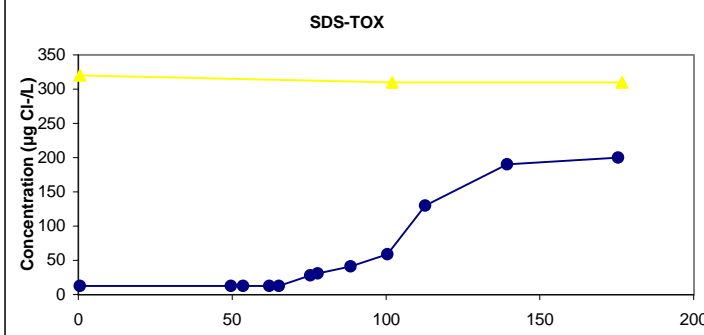
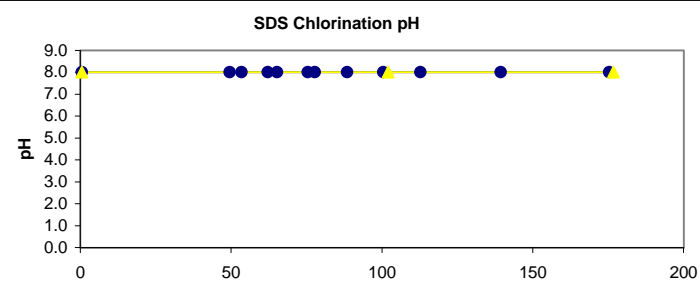
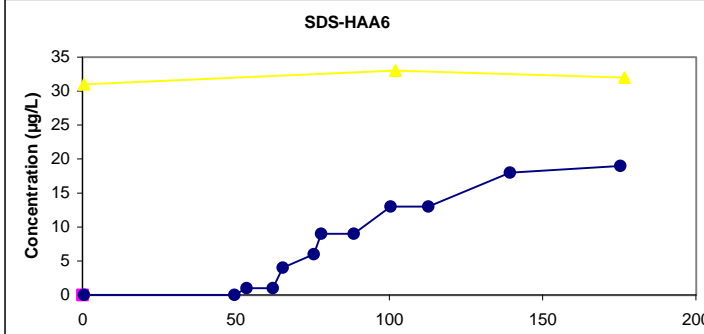
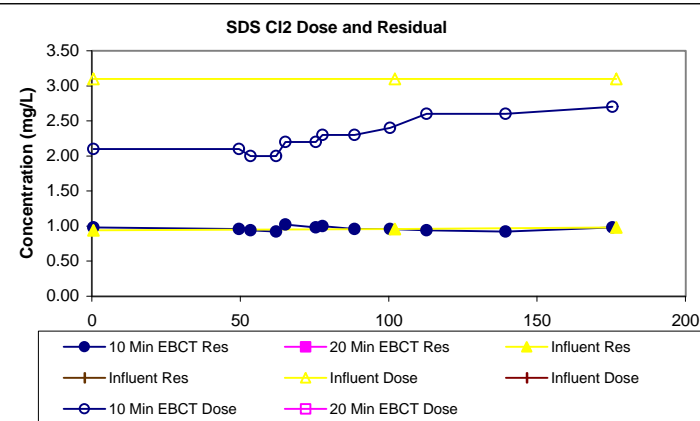
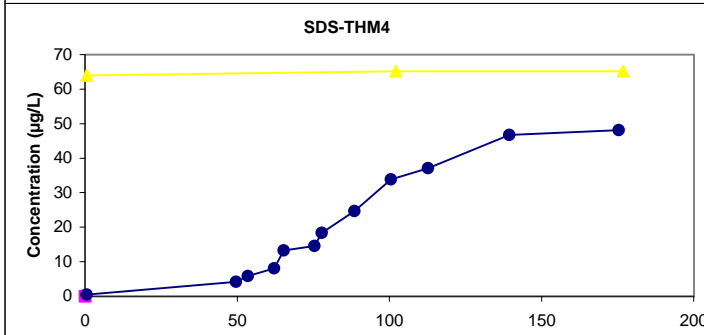
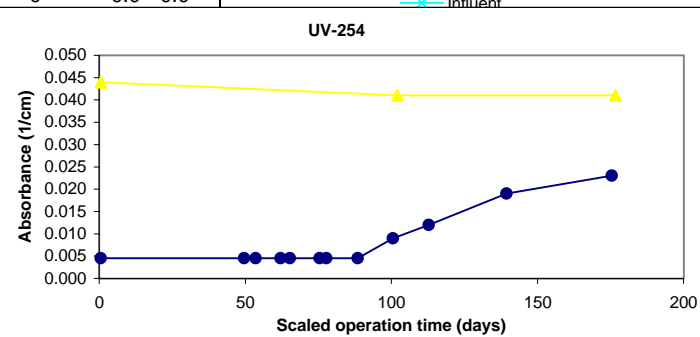
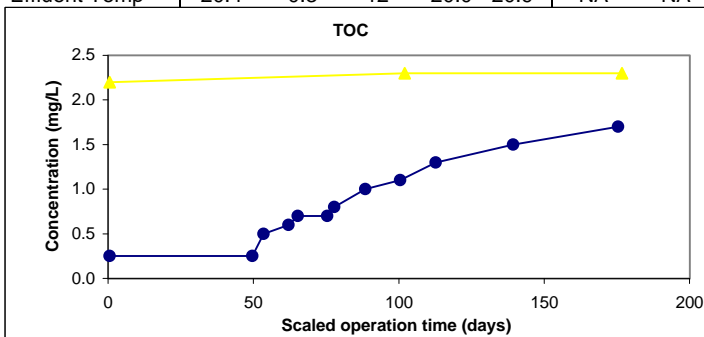
Scaling Factor: 12.53

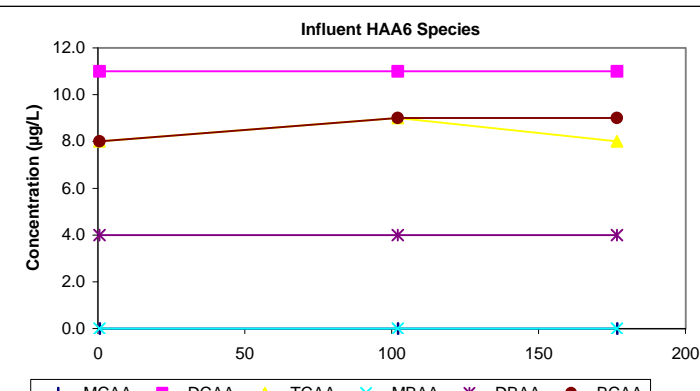
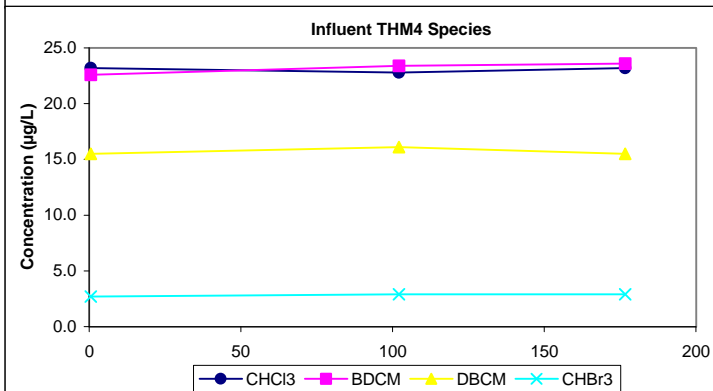
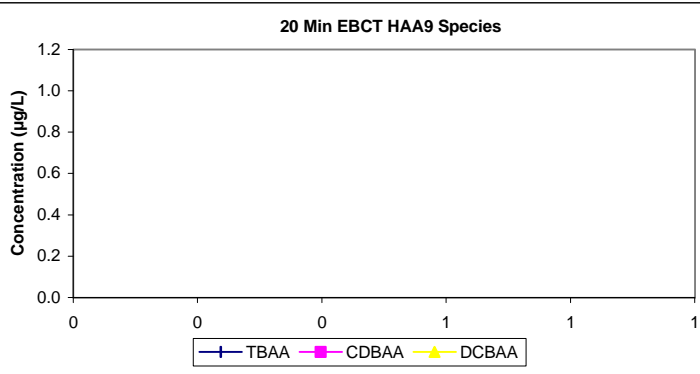
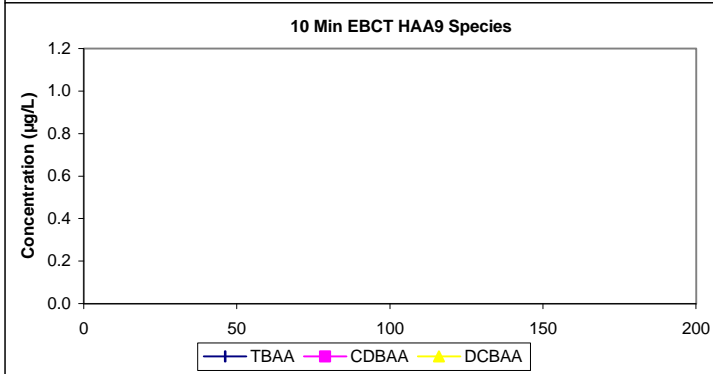
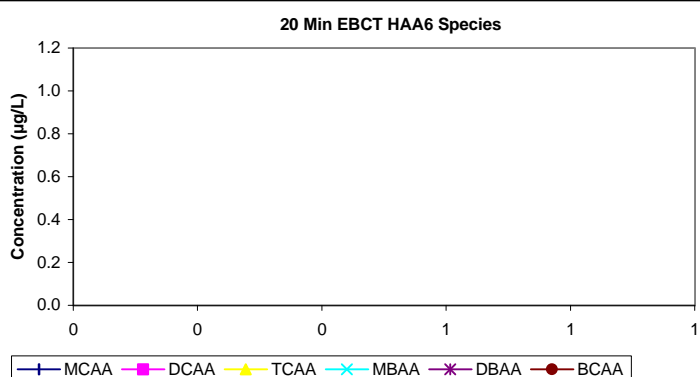
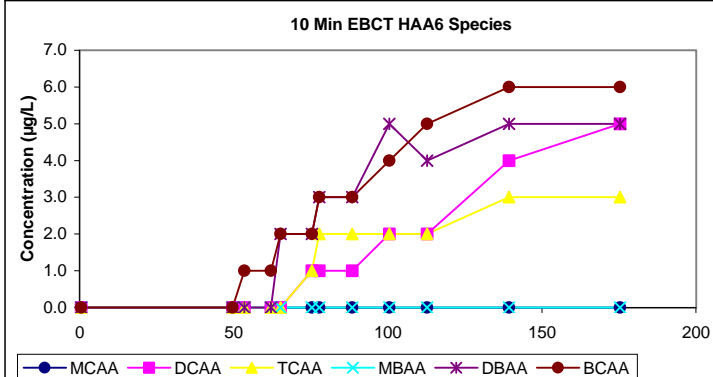
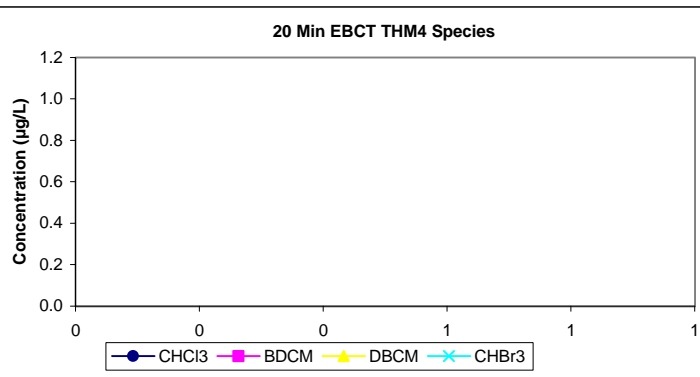
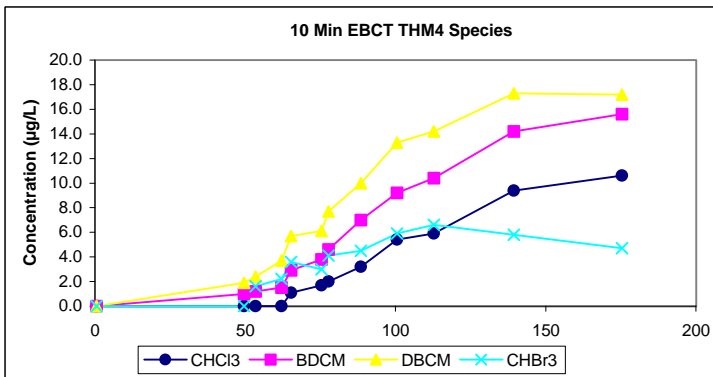
Period: 3/12/95 - 3/26/95 (14 B-S days)

Full-Scale Temp: 11 C

Meas Dry Bed Density: 0.49 g/cm3

Influent	Influent				Influent	Cumulative SDS Conditions			
	Mean	SD/RD	Count	Min/Max		Mean	SD	Count	Min/Max
TOC	2.3	0.1	3	2.2 - 2.3		Res (0)	0.96	0.03	15 0.92 - 1.02
pH	7.8	0.1	3	7.8 - 7.9		Temp	20.0	0.0	15 20.0 - 20.0
UV254	0.042	0.002	3	0.041 - 0.044		pH	8.0	0.0	15 8.0 - 8.0
SUVA	1.27	0.64	3	0.90 - 2.00		Time	24.0	0.0	15 24.0 - 24.0
Bromide	0.09	0.00	3	0.09 - 0.09		Comments:			
SDS-TOX	313	6	3	310 - 320					
SDS-THM4	65	1	3	64 - 65		Chart Legend:			
SDS-HAA6	32	1	3	31 - 33					
Effluent	10 Min EBCT (14 B-S days)				20 Min EBCT (0 B-S days)				
Effluent pH	7.9	0.1	12	7.7 - 8.2	NA	NA	0	0.0 - 0.0	
Effluent Temp	20.4	0.3	12	20.0 - 20.9	NA	NA	0	0.0 - 0.0	





ID / ICR#: NJ1605002 / 476

Design TOC: 3.7 mg/L

Full-Scale GAC Size: 12x40 Bituminous coal

ICR Contact: Mr. Joseph Bella

Col Diameter: 8.0 mm

Bench-Scale GAC Size: 140x230

Phone No.: (973) 340-4307

Min Reynolds#: 0.50

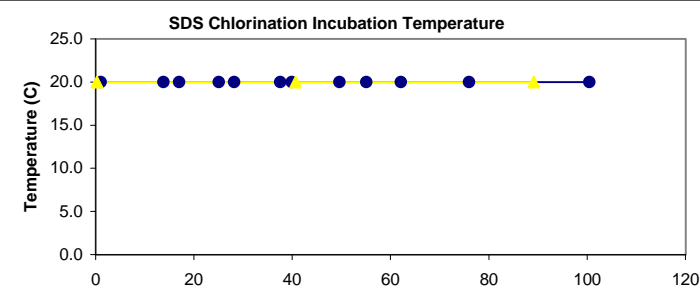
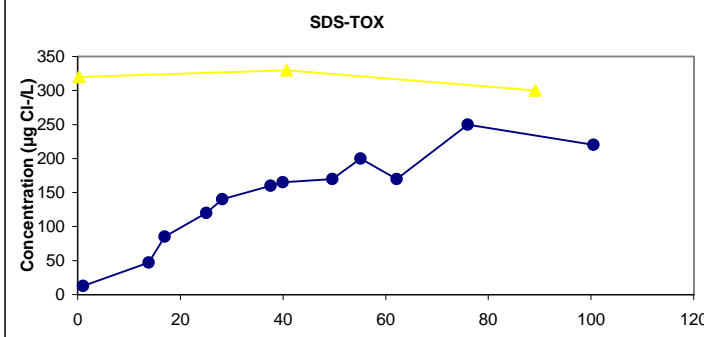
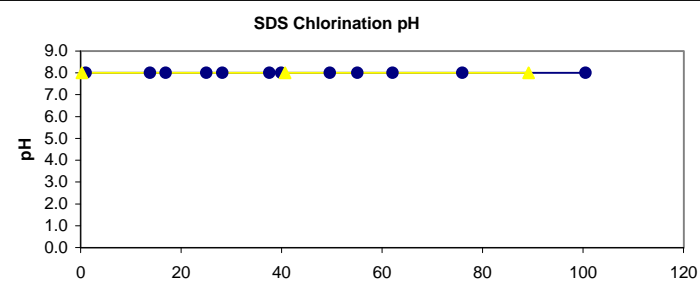
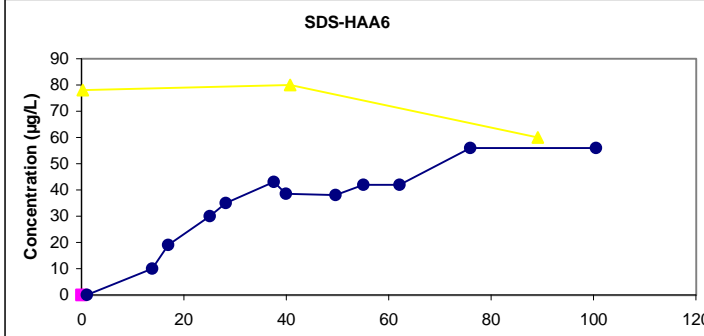
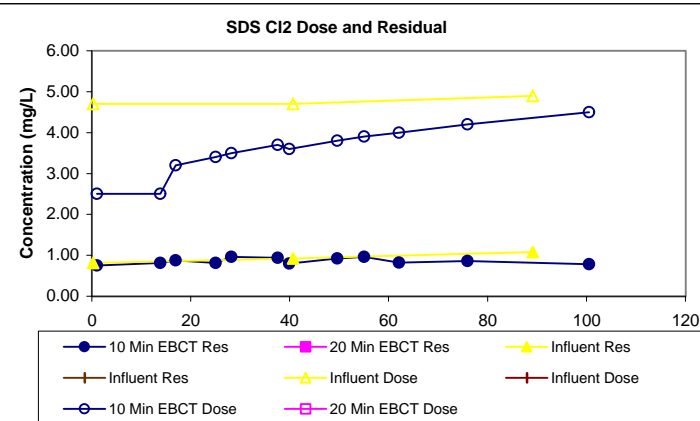
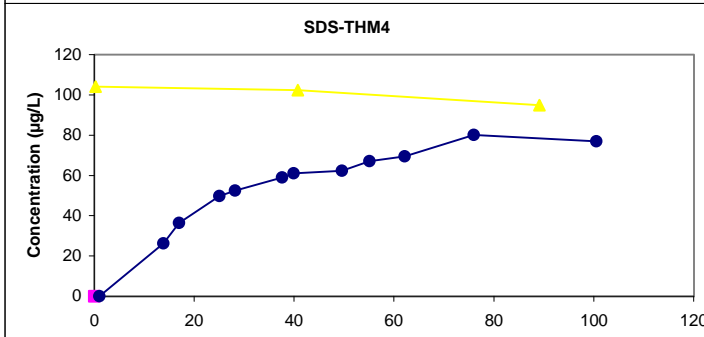
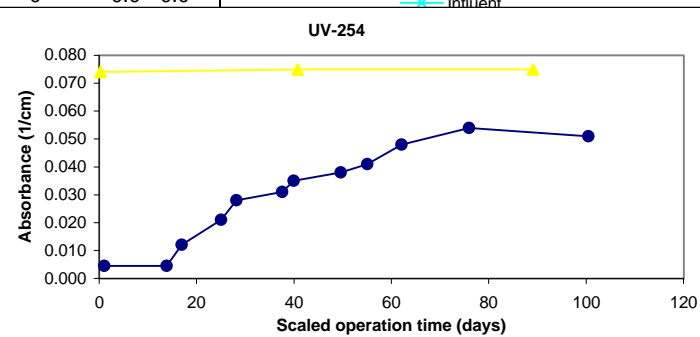
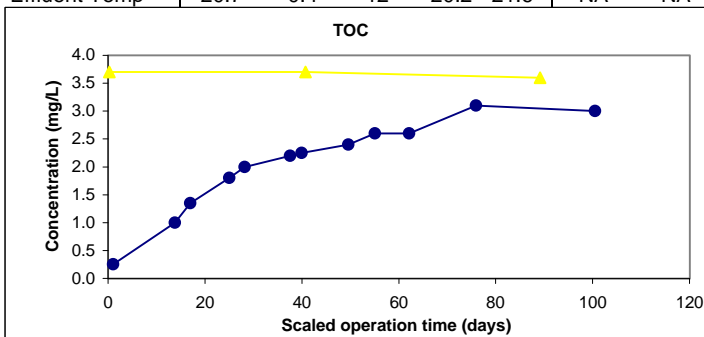
Scaling Factor: 12.53

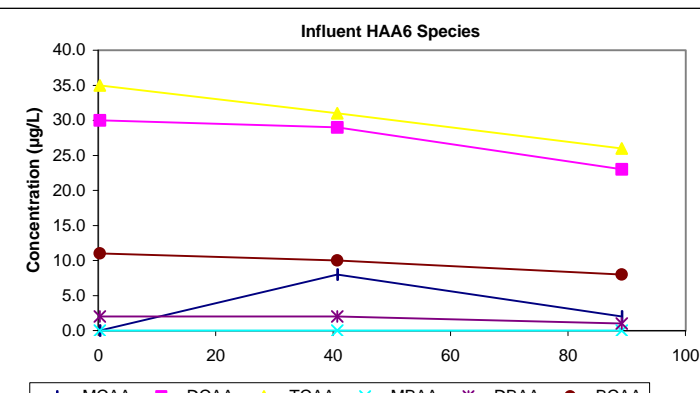
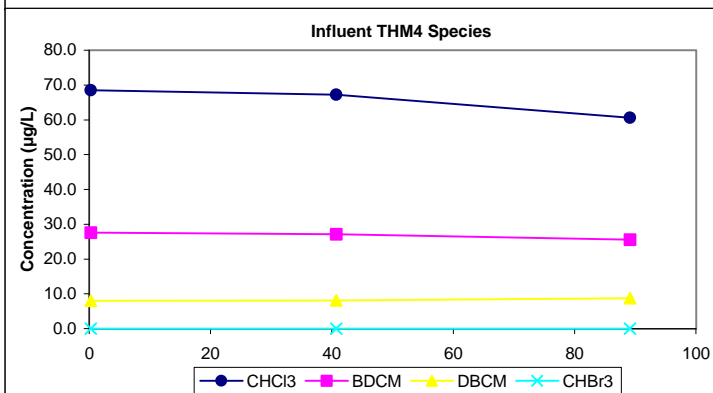
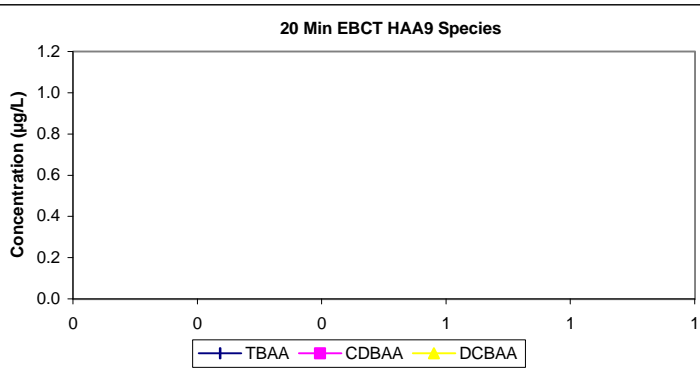
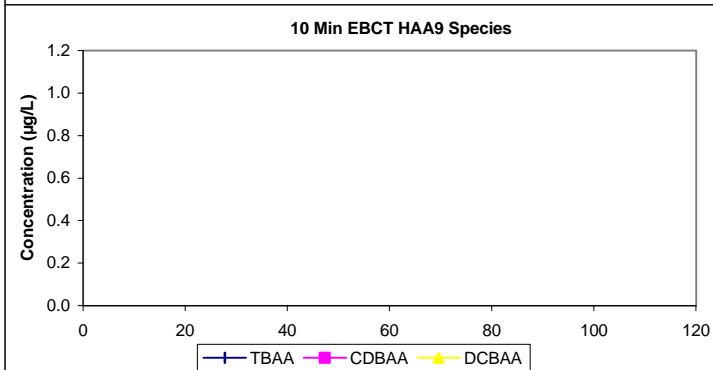
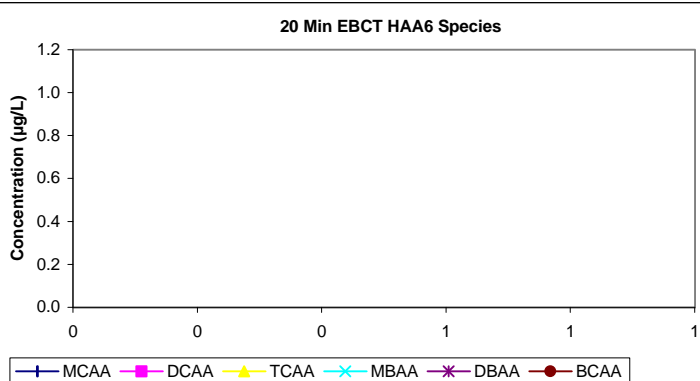
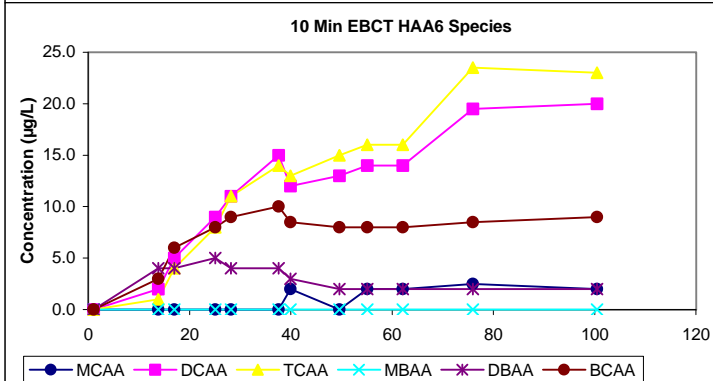
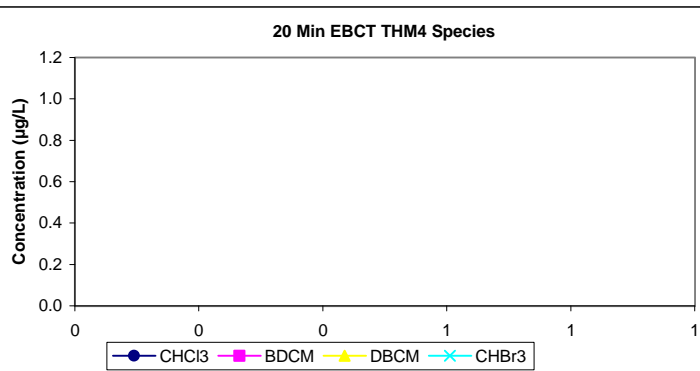
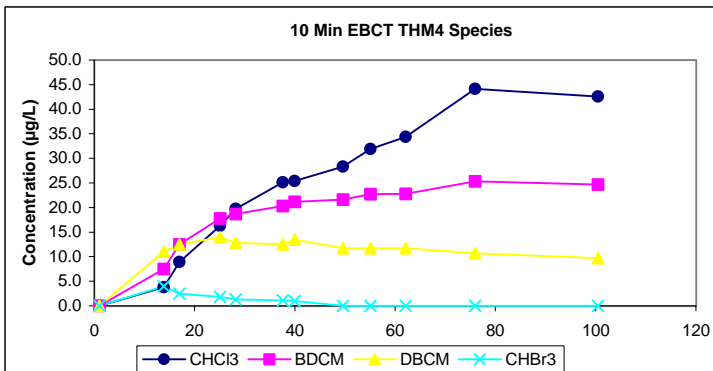
Period: 5/30/95 - 6/7/95 (8 B-S days)

Full-Scale Temp: 20 C

Meas Dry Bed Density: 0.49 g/cm3

Influent	Influent				Influent	Cumulative SDS Conditions			
	Mean	SD/RD	Count	Min/Max		Mean	SD	Count	Min/Max
TOC	3.7	0.1	3	3.6 - 3.7		Res (0)	0.87	0.09	15 0.75 - 1.08
pH	7.3	0.1	3	7.2 - 7.3		Temp	20.0	0.0	15 20.0 - 20.0
UV254	0.075	0.001	3	0.074 - 0.075		pH	8.0	0.0	15 8.0 - 8.0
SUVA	2.04	0.04	3	2.00 - 2.08		Time	24.0	0.0	15 24.0 - 24.0
Bromide	0.07	0.00	3	0.07 - 0.07		Comments:			
SDS-TOX	317	15	3	300 - 330					
SDS-THM4	100	5	3	95 - 104		Chart			
SDS-HAA6	73	11	3	60 - 80					
Effluent	10 Min EBCT (8 B-S days)				20 Min EBCT (0 B-S days)				Legend:
	Mean	SD/RD	Count	Min/Max	Mean	SD/RD	Count	Min/Max	
Effluent pH	7.4	0.3	12	7.2 - 7.9	NA	NA	0	0.0 - 0.0	10 Min EBCT
Effluent Temp	20.7	0.4	12	20.2 - 21.6	NA	NA	0	0.0 - 0.0	20 Min EBCT





ID / ICR#: NJ1605002 / 476

Design TOC: 3.0 mg/L

Full-Scale GAC Size: 12x40 Bituminous coal

ICR Contact: Mr. Joseph Bella

Col Diameter: 8.0 mm

Bench-Scale GAC Size: 140x230

Phone No.: (973) 340-4307

Min Reynolds#: 0.50

Scaling Factor: 12.53

Period: 8/11/95 - 8/25/95 (14 B-S days)

Full-Scale Temp: 24 C

Meas Dry Bed Density: 0.49 g/cm3

Influent	Influent				Influent	Cumulative SDS Conditions			
	Mean	SD/RD	Count	Min/Max		Mean	SD	Count	Min/Max
TOC	3.0	0.3	2	2.8 - 3.1		Res (0)	1.03	0.05	15 0.92 - 1.10
pH	7.6	0.0	3	7.6 - 7.6		Temp	20.0	0.0	15 20.0 - 20.0
UV254	0.049	0.002	3	0.048 - 0.051		pH	8.0	0.0	15 8.0 - 8.0
SUVA	0.90	0.00	2	0.90 - 0.90		Time	24.0	0.0	15 24.0 - 24.0
Bromide	0.08	0.00	3	0.08 - 0.08		Comments:			
SDS-TOX	210	17	3	190 - 220					
SDS-THM4	77	1	3	76 - 78		Chart Legend:			
SDS-HAA6	46	0	3	46 - 46					
Effluent	10 Min EBCT (14 B-S days)				20 Min EBCT (0 B-S days)				
Effluent pH	7.7	0.2	12	7.5 - 8.0	NA	NA	0	0.0 - 0.0	
Effluent Temp	22.3	0.2	12	22.0 - 22.7	NA	NA	0	0.0 - 0.0	

