

# ICR TREATMENT STUDY ANALYSIS

## Base Analysis and Data Review Comments

<b>Treatment Study ID</b>	1041
<b>Study Protocol</b>	GAC pilot-scale treatment study
<b>Plant ICR Number</b>	545
<b>PWS Name</b>	Oklahoma City Water Department
<b>City, State, Zip</b>	Oklahoma City, OK 73120

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

### Major comments:

None.

### General Comments:

1. The immediate breakthrough of TOC in both EBCT contactors is about 50 percent of the influent TOC concentration. This is an unusually high immediate breakthrough level. Percent TOC breakthrough increases gradually to about 70 percent over the course of the both EBCT runs. Immediate breakthrough of SDS-THM4 occurs at about 80 to 90 percent of GAC influent SDS-THM4 and remains above 50 percent for both contactors during the entire run. There is a lot of variability in SDS-HAA6 data. Influent and effluent formation of HAA species is erratic and breakthrough curves are atypical.

### Outlier Data:

12 outliers were removed.

**Cell:** A1

**Comment:** 1041-SAS.xls 2/16/00 20:19

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

1041-SAS.xls 2/18/00 16:48

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

**Cell:** C2

**Comment:** 1041-10-01 - Run 1 (BCAA) 2/16/00 20:02  
Original value (CoefA0) = -2.01 New value = 0.1103  
Poor peak curve fit. Data was refit by iterative curve fit procedure.

**Cell:** D2

**Comment:** 1041-10-01 - Run 1 (BCAA) 2/16/00 20:02  
Original value (CoefAf) = 6.03 New value = 11.1943  
Poor peak curve fit. Data was refit by iterative curve fit procedure.

**Cell:** E2

**Comment:** 1041-10-01 - Run 1 (BCAA) 2/16/00 20:02  
Original value (CoefB) = 1.1604 New value = 22.4754  
Poor peak curve fit. Data was refit by iterative curve fit procedure.

**Cell:** F2

**Comment:** 1041-10-01 - Run 1 (BCAA) 2/16/00 20:02  
Original value (CoefD) = 0.0073 New value = 0.0181  
Poor peak curve fit. Data was refit by iterative curve fit procedure.

**Cell:** J2

**Comment:** 1041-10-01 - Run 1 (BCAA) 2/16/00 20:02  
Original value (S) = 0 New value = -0.009  
Poor peak curve fit. Data was refit by iterative curve fit procedure.

**Cell:** C3

**Comment:** 1041-10-01 - Run 1 (BDCM) 2/16/00 20:06  
Original value (CoefA0) = -4.825 New value = -2.7916  
Poor peak curve fit. Data was refit by iterative curve fit procedure.

**Cell:** D3

**Comment:** 1041-10-01 - Run 1 (BDCM) 2/16/00 20:06  
Original value (CoefAf) = 10.5453 New value = 29.1453  
Poor peak curve fit. Data was refit by iterative curve fit procedure.

**Cell:** E3

**Comment:** 1041-10-01 - Run 1 (BDCM) 2/16/00 20:06  
Original value (CoefB) = 0.6227 New value = 5.097

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

**Cell:** F3

**Comment:** 1041-10-01 - Run 1 (BDCM) 2/16/00 20:06

Original value (CoefD) = 0.0275 New value = 0.0108

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

**Cell:** J3

**Comment:** 1041-10-01 - Run 1 (BDCM) 2/16/00 20:06

Original value (S) = 0 New value = -0.0276

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

**Cell:** C10

**Comment:** 1041-10-01 - Run 1 (DCAA) 2/16/00 20:00

Original value (CoefA0) = 0.8042 New value = 0.3718

Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

**Cell:** D10

**Comment:** 1041-10-01 - Run 1 (DCAA) 2/16/00 20:00

Original value (CoefAf) = 7.62 New value = 4.3774

Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

**Cell:** E10

**Comment:** 1041-10-01 - Run 1 (DCAA) 2/16/00 20:01

Original value (CoefB) = 403762.988498245 New value = 12.2454

Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

**Cell:** F10

**Comment:** 1041-10-01 - Run 1 (DCAA) 2/16/00 20:01

Original value (CoefD) = 0.0603 New value = 0.0084

Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

**Cell:** J10

**Comment:** 1041-10-01 - Run 1 (DCAA) 2/16/00 20:01

Original value (S) = 0 New value = 0

Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

**Cell:** C12

**Comment:** 1041-10-01 - Run 1 (HAA5) 2/16/00 20:03

Original value (CoefA0) = 10.98 New value = 9.4337

Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

**Cell:** D12

**Comment:** 1041-10-01 - Run 1 (HAA5) 2/16/00 20:03

Original value (CoefAf) = 0 New value = 24.9886

Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

**Cell:** E12

**Comment:** 1041-10-01 - Run 1 (HAA5) 2/16/00 20:03

Original value (CoefB) = 26.3497 New value = 90.9798

Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

**Cell:** F12

**Comment:** 1041-10-01 - Run 1 (HAA5) 2/16/00 20:03  
Original value (CoefD) = 0.0536 New value = 0.0107  
Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

**Cell:** J12

**Comment:** 1041-10-01 - Run 1 (HAA5) 2/16/00 20:03  
Original value (S) = 0 New value = 0  
Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

**Cell:** C13

**Comment:** 1041-10-01 - Run 1 (HAA6) 2/16/00 20:07  
Original value (CoefA0) = 6.5755 New value = 10.7069  
Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

**Cell:** D13

**Comment:** 1041-10-01 - Run 1 (HAA6) 2/16/00 20:07  
Original value (CoefAf) = 6.5484 New value = 44.2718  
Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

**Cell:** E13

**Comment:** 1041-10-01 - Run 1 (HAA6) 2/16/00 20:07  
Original value (CoefB) = 0.8684 New value = 143.6229  
Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

**Cell:** F13

**Comment:** 1041-10-01 - Run 1 (HAA6) 2/16/00 20:07  
Original value (CoefD) = 0.0744 New value = 0.0104  
Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

**Cell:** J13

**Comment:** 1041-10-01 - Run 1 (HAA6) 2/16/00 20:07  
Original value (S) = 0 New value = 0  
Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

**Cell:** C15

**Comment:** 1041-10-01 - Run 1 (MBAA) 2/16/00 20:01  
Original value (CoefA0) = 0.3349 New value = 1.3329  
Poor peak curve fit. Data was refit by iterative curve fit procedure.

**Cell:** D15

**Comment:** 1041-10-01 - Run 1 (MBAA) 2/16/00 20:01  
Original value (CoefAf) = 10.17 New value = 9.4426  
Poor peak curve fit. Data was refit by iterative curve fit procedure.

**Cell:** E15

**Comment:** 1041-10-01 - Run 1 (MBAA) 2/16/00 20:01  
Original value (CoefB) = 6.088 New value = 21.4091  
Poor peak curve fit. Data was refit by iterative curve fit procedure.

**Cell:** F15

**Comment:** 1041-10-01 - Run 1 (MBAA) 2/16/00 20:01  
Original value (CoefD) = 0.005 New value = 0.0177  
Poor peak curve fit. Data was refit by iterative curve fit procedure.

**Cell:** J15

**Comment:** 1041-10-01 - Run 1 (MBAA) 2/16/00 20:01  
Original value (S) = 0 New value = -0.0129  
Poor peak curve fit. Data was refit by iterative curve fit procedure.

**Cell:** C20

**Comment:** 1041-10-01 - Run 1 (TOC) 2/16/00 19:59  
Original value (CoefA0) = 1.99 New value = -0.2111  
Poor type -1 or 1 curve fit. Data was refit by iterative curve fit procedure.

1041-10-01 - Run 1 (TOC) 2/16/00 20:11  
Original value (CoefA0) = -0.2111 New value = 0.0863  
Poor type -1 or 1 curve fit. Data was refit by iterative curve fit procedure.

1041-10-01 - Run 1 (TOC) 2/18/00 16:47  
Original value (CoefA0) = 0.0863 New value = 0.1348  
Poor type -1 or 1 curve fit. Data was refit by iterative curve fit procedure.

**Cell:** D20

**Comment:** 1041-10-01 - Run 1 (TOC) 2/16/00 19:59  
Original value (CoefAf) = 0.4871 New value = 2.6764  
Poor type -1 or 1 curve fit. Data was refit by iterative curve fit procedure.

1041-10-01 - Run 1 (TOC) 2/16/00 20:11  
Original value (CoefAf) = 2.6764 New value = 2.378  
Poor type -1 or 1 curve fit. Data was refit by iterative curve fit procedure.

1041-10-01 - Run 1 (TOC) 2/18/00 16:47  
Original value (CoefAf) = 2.378 New value = 2.3063  
Poor type -1 or 1 curve fit. Data was refit by iterative curve fit procedure.

**Cell:** E20

**Comment:** 1041-10-01 - Run 1 (TOC) 2/16/00 19:59  
Original value (CoefB) = 0.0219 New value = 20.8711  
Poor type -1 or 1 curve fit. Data was refit by iterative curve fit procedure.

1041-10-01 - Run 1 (TOC) 2/16/00 20:11  
Original value (CoefB) = 20.8711 New value = 20.3043  
Poor type -1 or 1 curve fit. Data was refit by iterative curve fit procedure.

1041-10-01 - Run 1 (TOC) 2/18/00 16:47  
Original value (CoefB) = 20.3043 New value = 0.07  
Poor type -1 or 1 curve fit. Data was refit by iterative curve fit procedure.

**Cell:** F20

**Comment:** 1041-10-01 - Run 1 (TOC) 2/16/00 19:59  
Original value (CoefD) = 0 New value = 0.1384

Poor type -1 or 1 curve fit. Data was refit by iterative curve fit procedure.

1041-10-01 - Run 1 (TOC) 2/16/00 20:11

Original value (CoefD) = 0.1384 New value = 0.1367

Poor type -1 or 1 curve fit. Data was refit by iterative curve fit procedure.

1041-10-01 - Run 1 (TOC) 2/18/00 16:47

Original value (CoefD) = 0.1367 New value = 0.024

Poor type -1 or 1 curve fit. Data was refit by iterative curve fit procedure.

**Cell:** J20

**Comment:** 1041-10-01 - Run 1 (TOC) 2/16/00 20:00

Original value (S) = 0 New value = 0

Poor type -1 or 1 curve fit. Data was refit by iterative curve fit procedure.

1041-10-01 - Run 1 (TOC) 2/16/00 20:11

Original value (S) = 0 New value = 0

Poor type -1 or 1 curve fit. Data was refit by iterative curve fit procedure.

1041-10-01 - Run 1 (TOC) 2/18/00 16:47

Original value (S) = 0 New value = 0

Poor type -1 or 1 curve fit. Data was refit by iterative curve fit procedure.

**Cell:** C93

**Comment:** 1041-20-01 - Run 2 (CHBr3) 2/16/00 20:15

Original value (CoefA0) = -12.75 New value = -22.9704

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

**Cell:** D93

**Comment:** 1041-20-01 - Run 2 (CHBr3) 2/16/00 20:15

Original value (CoefAf) = 38.25 New value = 102.0117

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

**Cell:** E93

**Comment:** 1041-20-01 - Run 2 (CHBr3) 2/16/00 20:15

Original value (CoefB) = 0.9418 New value = 2.6398

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

**Cell:** F93

**Comment:** 1041-20-01 - Run 2 (CHBr3) 2/16/00 20:15

Original value (CoefD) = 0.0063 New value = 0.0054

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

**Cell:** J93

**Comment:** 1041-20-01 - Run 2 (CHBr3) 2/16/00 20:15

Original value (S) = 0 New value = -0.0457

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

**Cell:** C95

**Comment:** 1041-20-01 - Run 2 (Cl2-D) 2/16/00 20:13

Original value (CoefA0) = 0.571 New value = 1.3951

Poor peak curve fit. Data was refit to type 1 curve fit by iterative curve fit procedure.

**Cell:** D95

**Comment:** 1041-20-01 - Run 2 (CI2-D) 2/16/00 20:13

Original value (CoefAf) = 1.5108 New value = 0.7529

Poor peak curve fit. Data was refit to type 1 curve fit by iterative curve fit procedure.

**Cell:** E95

**Comment:** 1041-20-01 - Run 2 (CI2-D) 2/16/00 20:13

Original value (CoefB) = 0.4814 New value = 35.8181

Poor peak curve fit. Data was refit to type 1 curve fit by iterative curve fit procedure.

**Cell:** F95

**Comment:** 1041-20-01 - Run 2 (CI2-D) 2/16/00 20:13

Original value (CoefD) = 0.0059 New value = 0.0317

Poor peak curve fit. Data was refit to type 1 curve fit by iterative curve fit procedure.

**Cell:** J95

**Comment:** 1041-20-01 - Run 2 (CI2-D) 2/16/00 20:13

Original value (S) = -0.0061 New value = 0

Poor peak curve fit. Data was refit to type 1 curve fit by iterative curve fit procedure.

**Cell:** C98

**Comment:** 1041-20-01 - Run 2 (DCAA) 2/16/00 20:12

Original value (CoefA0) = -1.3852 New value = -0.2035

Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

**Cell:** D98

**Comment:** 1041-20-01 - Run 2 (DCAA) 2/16/00 20:12

Original value (CoefAf) = 7.665 New value = 5.251

Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

**Cell:** E98

**Comment:** 1041-20-01 - Run 2 (DCAA) 2/16/00 20:12

Original value (CoefB) = 5.7521 New value = 13.0013

Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

**Cell:** F98

**Comment:** 1041-20-01 - Run 2 (DCAA) 2/16/00 20:12

Original value (CoefD) = 0.0066 New value = 0.0065

Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

**Cell:** J98

**Comment:** 1041-20-01 - Run 2 (DCAA) 2/16/00 20:12

Original value (S) = 0 New value = 0

Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

**Cell:** C108

**Comment:** 1041-20-01 - Run 2 (TOC) 2/16/00 20:09

Original value (CoefA0) = 2.0142 New value = 1.5516

Poor type -1 or 1 curve fit. Data was refit by iterative curve fit procedure.

**Cell:** D108

**Comment:** 1041-20-01 - Run 2 (TOC) 2/16/00 20:09  
Original value (CoefAf) = 0.2256 New value = 3.0813  
Poor type -1 or 1 curve fit. Data was refit by iterative curve fit procedure.

**Cell:** E108

**Comment:** 1041-20-01 - Run 2 (TOC) 2/16/00 20:09  
Original value (CoefB) = 289569962076.922 New value = 13.8222  
Poor type -1 or 1 curve fit. Data was refit by iterative curve fit procedure.

**Cell:** F108

**Comment:** 1041-20-01 - Run 2 (TOC) 2/16/00 20:09  
Original value (CoefD) = 0.3092 New value = 0.0045  
Poor type -1 or 1 curve fit. Data was refit by iterative curve fit procedure.

**Cell:** J108

**Comment:** 1041-20-01 - Run 2 (TOC) 2/16/00 20:09  
Original value (S) = 0 New value = 0  
Poor type -1 or 1 curve fit. Data was refit by iterative curve fit procedure.

**Cell:** C110

**Comment:** 1041-20-01 - Run 2 (TSUVA) 2/16/00 20:12  
Original value (CoefA0) = -0.5422 New value = -0.066  
Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

**Cell:** D110

**Comment:** 1041-20-01 - Run 2 (TSUVA) 2/16/00 20:12  
Original value (CoefAf) = 1.353 New value = 0.8907  
Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

**Cell:** E110

**Comment:** 1041-20-01 - Run 2 (TSUVA) 2/16/00 20:12  
Original value (CoefB) = 2.2131 New value = 19.9992  
Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

**Cell:** F110

**Comment:** 1041-20-01 - Run 2 (TSUVA) 2/16/00 20:12  
Original value (CoefD) = 0.4178 New value = 0.4744  
Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

**Cell:** J110

**Comment:** 1041-20-01 - Run 2 (TSUVA) 2/16/00 20:12  
Original value (S) = 0 New value = 0  
Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.



## ICR Information

ID / ICR#: OK1020802 / 545  
 ICR Contact: Ms. Geri Wellborn  
 Phone No.: 405-794-7778  
 Period: 5/4/98 - 12/8/98 (218 days)

## Design Information

Design TOC: 4 mg/L  
 Col Diameter: 50.8 mm

Full-Scale GAC Size: 8x20 US Std Mesh  
 Full-Scale particle dia.: 1.605 mm  
 Meas Dry Bed Density: 480.0 kg/m3

## Water Quality Summary

Influent	Mean	SD	Count	Min/Max
TOC	3.2	1.0	18	1.7 - 5.2
pH	9.0	0.2	23	8.6 - 9.4
UV254	0.027	0.005	22	0.013 - 0.042
SUVA	0.88	0.18	17	0.5 - 1.1
Bromide	147.45	56.18	10	0.0 - 190.0
SDS-TOX	82	34	19	13 - 178
SDS-THM4	45	19	16	21 - 76
SDS-HAA6	22	13	19	3 - 57
Ammonia	0.05	0.16	22	0.00 - 0.60

## Cumulative SDS Conditions

	Mean	SD	Count	Min/Max
Res (5)	0.55	0.39	54	0.00 - 1.60
Temp	20.5	5.9	54	6.5 - 27.2
pH	8.6	0.6	51	6.2 - 9.3
Time	4.0	0.0	54	4.0 - 4.0

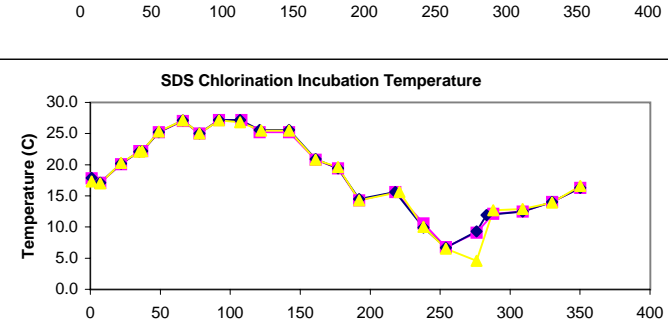
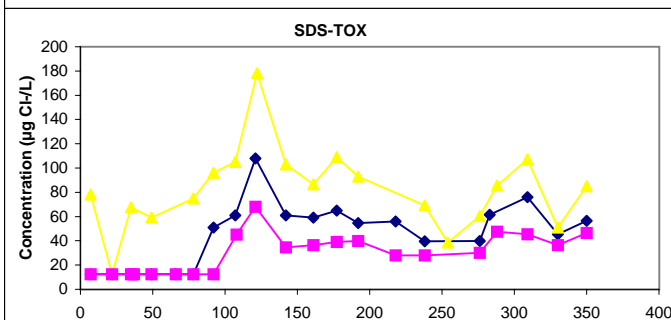
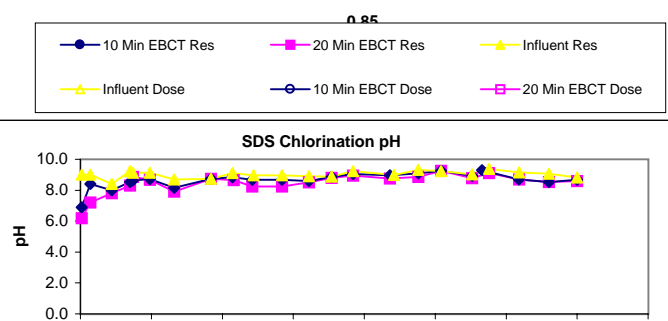
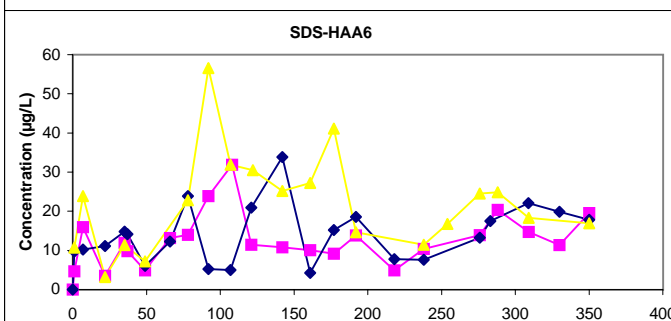
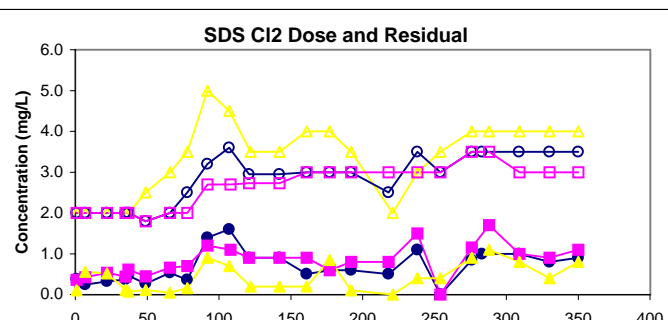
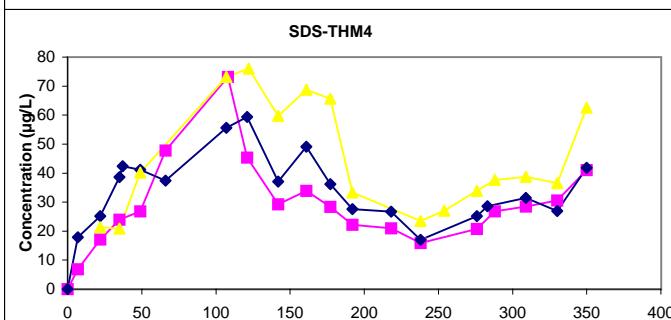
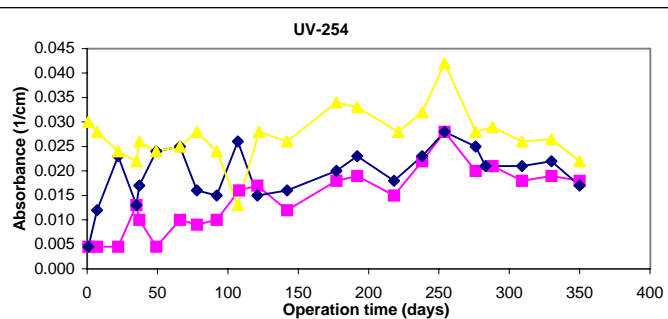
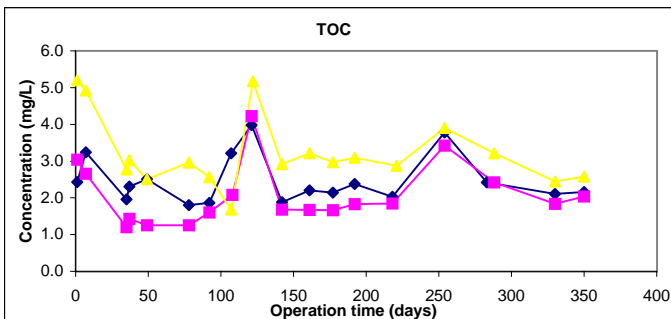
## Comments:

## Chart Legend:

10 Min EBCT  
 20 Min EBCT  
 Influent

Effluent	10 Min EBCT	(350 days)	20 Min EBCT	(350 days)
Effluent pH	8.6	0.6	23	6.5 - 9.3
Effluent Temp	19.4	5.0	23	5.9 - 27.0

## Water Quality Parameter Graphs



Water Quality Parameter Graphs (Continued)

