ICR TREATMENT STUDY ANALYSIS

Base Analysis and Data Review Comments

Treatment Study ID 3001

Study Protocol Bench-Scale GAC Treatment Study

Plant ICR Number 654

PWS Name City of Austin

City, State, Zip Austin, TX 78767

Reviewer Comments (7/30/99)

Major comments:

1. GAC influent water was batch treated during each quarter. It is not clear whether one large volume of water was batch treated and then used for the entire quarterly study, or whether the water was batch treated sequentially, in smaller batches, i.e., as the water was needed for the RSSCTs. TOC and UV_{254} are usually fairly constant across all three influent samples taken, but influent SDS-DBPs increases greatly across all 4 quarters.

   Response: The influent water was all made at the same time (in one big batch) and then transferred from there into carboys and stored in a acold room until needed. The water wasn't stirred in the big tank it was batched in, so perhaps there was an inadequate mixing problem.

2. A series of breakthrough curves are presented in an appendix to the report. Note that the x-axis used for plotting these curves was set incorrectly - the 20 minute EBCT run scaled operation time was used, but plotted in even increments, and the 10 minute EBCT run data points were set to the 20 minute EBCT sample points. These graphs should not be used as indicators of 10 minute vs. 20 minute EBCT contactor performance.

3. SDS-THM4 breakthrough reached very high levels (80 - >100% in some cases) relative to influent concentration during all four quarters. SDS-HAA6 breakthrough reached very high levels (80 - 100%) during the Spring and Fall runs. TOC breakthrough reached normal (70%) levels, as did UV_{254} breakthrough (60 - 70%).

4. Quarter 1 (Spring) - effluent SDS-DCAA reached influent levels after 20 full-scale days of operation for the 10 minute EBCT run. This may be an indicator of formed DCAA and other DBPs in influent water. GAC effluent SDS-DCAA levels then decreased to about 75% of influent concentration by the end of the 10 minute run. During the 20 minute run, effluent

SDS-DCAA exceeded influent levels after 50 days of operation, then decreased to about 10% of influent levels by 100 days of operation. Possible explanations: (a) DCAA may have been present in batch influent initially, but not in a new batch influent prepared after 100 days of operation (if new batches were prepared, which is not clear), or (b) DCAA was present in influent water, but biodegradation of DCAA had an impact after 100 days of operation of the 20 minute EBCT contactor. During remaining 3 quarters, relative breakthrough of SDS-DCAA was "normal". Note also that during Quarter 1 THM4 reached and exceeded influent concentrations after about 80 days (10 minute EBCT) and 150 days (20 minute EBCT).

Response: I don't have an explanation as to why the effluent DCAA would match or surpass the influent DCAA a t the beginning of both the 10 and 20 minute runs. The influent water was all made at the same time (in one big batch) and then transferred from there into carboys and stored in a acold room until needed. The water wasn't stirred in the big tank it was batched in, so perhaps there was an inadequate mixing problem.

5. Influent SDS-TOX during all 4 quarters increased greatly as study progressed. Q1: 225 - 490 / Q2: 120 - 780 / Q3: 130 - 1,830 /Q4: 140 - 390. Bromide concentration during all 3 runs was similar, about 200 µg/L, chlorine demand on influent water sample for all quarters was typically 1.6 - 1.9 mg/L, nothing to indicate why TOX should be increasing. There was no correlation with greater chlorine demand. Where is the TOX coming from? Formed THM and HAA levels were in normal ranges, THMs around 80 - 120 µg/L, HAA6 around 20 - 40 µg/L (in some cases, very low when compared to TOX). Quarters 2 and 3 showed substantial increases in GAC influent formed THM4 and HAA6 over the course of the run (roughly a doubling), but not to the extent seen for TOX. Are the initial low SDS-TOX values outliers, <u>for all four studies</u>? This is a systematic problem. Also, if influent SDS-TOX values are correct, then breakthrough is occurring to very high levels, 90 - >100 % of influent TOX levels. This could indicate breakthrough of preformed DBPs

   Response: The TOX value(s have) been verified. I don't know why (they are) so high.

General Comments:

1. GAC influent pH ranged from 9.4 to 10.0, due to lime softening pretreatment. Normal treated plant water pH is 9.6.

2. Table on page 5 indicates incorrect units for bromide. Should say "mg/L" not "µg/L." Also, table is referred to as "influent water quality" - note they mean source water, not "GAC influent."

3. GAC influent water quality (table on page 10) - very high TOX concentration relative to THM and HAA during Autumn quarter (TOX is almost 10 times THM4 value, and about 30 times HAA6 value). During other 4 quarters difference is not as great.

4. Table in section 4 - text says parenthesis refers to standard deviation, values are actually relative standard deviation, taken straight from gacrssct.xls

5. Seasonal variability in influent TOC - values are about 2.0 mg/L during summer, autumn, and winter, 3.2 mg/L in spring. Report mentions that they expected higher treated water TOC concentrations during spring due to higher raw water concentrations.

6. Treatment study spreadsheets indicate Calgon "P300" carbon used - should read "F-300"

7. Full-Scale operating temperature used for all 4 quarters was 20°C, although actual temperature probably ranged between 18 and 26°C. Please provide average full-scale temperature at the time of sampling.

8. The samples duplicated for chlorination are not actually process duplicates - they are basically sampling duplicates, as a larger volume of water was chlorinated instead of two separate bottles being chlorinated. DBPs were analyzed in duplicate, but these are closer to sampling or analytical duplicates than process duplicates. (This was described in the response to reviewer's comments dated July 1, 1999.)

Outlier data:

Q1 2 outlier data points, including one HAA9 outlier data point.

Q4 2 outlier data points.

Cell: A1
Comment: 3001-SAS.xls 2/12/00 16:07

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

Cell: C10
Comment: 3001-10-01 - Run 1 (DCAA) 2/12/00 15:33
Original value (CoefA0) = 0 New value = -17.423
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: D10
Comment: 3001-10-01 - Run 1 (DCAA) 2/12/00 15:33
Original value (CoefAf) = 42 New value = 62.0753
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: E10
Comment: 3001-10-01 - Run 1 (DCAA) 2/12/00 15:33
Original value (CoefB) = 10.2025 New value = 34.9385
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: F10
Comment: 3001-10-01 - Run 1 (DCAA) 2/12/00 15:33
Original value (CoefD) = 0.1512 New value = 0.2838
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: J10
Comment: 3001-10-01 - Run 1 (DCAA) 2/12/00 15:33
Original value (S) = -0.0097 New value = -0.1247
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: C11
Comment: 3001-10-01 - Run 1 (DCBAA) 2/12/00 15:39
Original value (CoefA0) = -0.1119 New value = -0.4094
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: D11
Comment: 3001-10-01 - Run 1 (DCBAA) 2/12/00 15:39
Original value (CoefAf) = 6.45 New value = 14.6816
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: E11
Comment: 3001-10-01 - Run 1 (DCBAA) 2/12/00 15:39
Original value (CoefB) = 11.8509 New value = 20.0155
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: F11
Comment: 3001-10-01 - Run 1 (DCBAA) 2/12/00 15:39
Original value (CoefD) = 0.0371 New value = 0.0281
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: J11
Comment: 3001-10-01 - Run 1 (DCBAA) 2/12/00 15:39
Original value (S) = 0 New value = -0.0099
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: C15
Comment: 3001-10-01 - Run 1 (MBAA) 2/12/00 15:16
Original value (CoefA0) = 0 New value = 1.2875
Fewer than 6 points above MRL. Step function applied.

Cell: D15
Comment: 3001-10-01 - Run 1 (MBAA) 2/12/00 15:16
Original value (CoefAf) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: E15
Comment: 3001-10-01 - Run 1 (MBAA) 2/12/00 15:16
Original value (CoefB) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: F15
Comment: 3001-10-01 - Run 1 (MBAA) 2/12/00 15:16
Original value (CoefD) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: J15
Comment: 3001-10-01 - Run 1 (MBAA) 2/12/00 15:16
Original value (S) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: K15
Comment: 3001-10-01 - Run 1 (MBAA) 2/12/00 15:16
Original value (t0) = 0 New value = 37.8222
Fewer than 6 points above MRL. Step function applied.

Cell: C17
Comment: 3001-10-01 - Run 1 (TBAA) 2/12/00 15:46
Original value (CoefA0) = 0 New value = 2.2079
Fewer than 6 points above MRL. Data was fit to peak curve by iterative curve fit procedure.

Cell: D17
Comment: 3001-10-01 - Run 1 (TBAA) 2/12/00 15:46
Original value (CoefAf) = 0 New value = 6.3137
Fewer than 6 points above MRL. Data was fit to peak curve by iterative curve fit procedure.

Cell: E17
Comment: 3001-10-01 - Run 1 (TBAA) 2/12/00 15:46
Original value (CoefB) = 0 New value = 19.5807
Fewer than 6 points above MRL. Data was fit to peak curve by iterative curve fit procedure.

Cell: F17
Comment: 3001-10-01 - Run 1 (TBAA) 2/12/00 15:46
Original value (CoefD) = 0 New value = 0.1967
Fewer than 6 points above MRL. Data was fit to peak curve by iterative curve fit procedure.

Cell: J17
Comment: 3001-10-01 - Run 1 (TBAA) 2/12/00 15:46
Original value (S) = 0 New value = -0.08
Fewer than 6 points above MRL. Data was fit to peak curve by iterative curve fit procedure.

Cell: C33
Comment: 3001-10-02 - Run 3 (DCBAA) 2/12/00 15:23
Original value (CoefA0) = 0 New value = 1.175
Fewer than 6 points above MRL. Step function applied.

Cell: D33
Comment: 3001-10-02 - Run 3 (DCBAA) 2/12/00 15:23
Original value (CoefAf) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: E33
Comment: 3001-10-02 - Run 3 (DCBAA) 2/12/00 15:23

Original value (CoefB) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: F33
Comment: 3001-10-02 - Run 3 (DCBAA) 2/12/00 15:23
Original value (CoefD) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: J33
Comment: 3001-10-02 - Run 3 (DCBAA) 2/12/00 15:23
Original value (S) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: K33
Comment: 3001-10-02 - Run 3 (DCBAA) 2/12/00 15:23
Original value (t0) = 0 New value = 92.3173
Fewer than 6 points above MRL. Step function applied.

Cell: C37
Comment: 3001-10-02 - Run 3 (MBAA) 2/12/00 15:23
Original value (CoefA0) = 0 New value = 1.12
Fewer than 6 points above MRL. Step function applied.

Cell: D37
Comment: 3001-10-02 - Run 3 (MBAA) 2/12/00 15:23
Original value (CoefAf) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: E37
Comment: 3001-10-02 - Run 3 (MBAA) 2/12/00 15:23
Original value (CoefB) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: F37
Comment: 3001-10-02 - Run 3 (MBAA) 2/12/00 15:23
Original value (CoefD) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: J37
Comment: 3001-10-02 - Run 3 (MBAA) 2/12/00 15:23
Original value (S) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: K37
Comment: 3001-10-02 - Run 3 (MBAA) 2/12/00 15:23
Original value (t0) = 0 New value = 26.1284
Fewer than 6 points above MRL. Step function applied.

Cell: C40
Comment: 3001-10-02 - Run 3 (TCAA) 2/12/00 15:23
Original value (CoefA0) = 0 New value = 1.15
Fewer than 6 points above MRL. Step function applied.

Cell: D40
Comment: 3001-10-02 - Run 3 (TCAA) 2/12/00 15:23
Original value (CoefAf) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: E40
Comment: 3001-10-02 - Run 3 (TCAA) 2/12/00 15:23
Original value (CoefB) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: F40
Comment: 3001-10-02 - Run 3 (TCAA) 2/12/00 15:23
Original value (CoefD) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: J40
Comment: 3001-10-02 - Run 3 (TCAA) 2/12/00 15:23
Original value (S) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: K40
Comment: 3001-10-02 - Run 3 (TCAA) 2/12/00 15:23
Original value (t0) = 0 New value = 122.3284
Fewer than 6 points above MRL. Step function applied.

Cell: C44
Comment: 3001-10-02 - Run 3 (TSUVA) 2/12/00 15:47
Original value (CoefA0) = 0 New value = -0.1984
Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

Cell: D44
Comment: 3001-10-02 - Run 3 (TSUVA) 2/12/00 15:47
Original value (CoefAf) = 2.1429 New value = 1.823
Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

Cell: E44
Comment: 3001-10-02 - Run 3 (TSUVA) 2/12/00 15:47
Original value (CoefB) = 10 New value = 20.0032
Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

Cell: F44
Comment: 3001-10-02 - Run 3 (TSUVA) 2/12/00 15:47
Original value (CoefD) = 0.13 New value = 0.294
Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

Cell: J44
Comment: 3001-10-02 - Run 3 (TSUVA) 2/12/00 15:47
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: C48
Comment: 3001-10-03 - Run 5 (CDBAA) 2/12/00 15:51
Original value (CoefA0) = 0 New value = -0.2201
Fewer than 6 points above MRL. Logistic function (type 1) applied.

Cell: D48
Comment: 3001-10-03 - Run 5 (CDBAA) 2/12/00 15:51
Original value (CoefAf) = 0 New value = 4.8748
Fewer than 6 points above MRL. Logistic function (type 1) applied.

Cell: E48
Comment: 3001-10-03 - Run 5 (CDBAA) 2/12/00 15:51
Original value (CoefB) = 0 New value = 19.8184
Fewer than 6 points above MRL. Logistic function (type 1) applied.

Cell: F48
Comment: 3001-10-03 - Run 5 (CDBAA) 2/12/00 15:51
Original value (CoefD) = 0 New value = 0.0283
Fewer than 6 points above MRL. Logistic function (type 1) applied.

Cell: J48
Comment: 3001-10-03 - Run 5 (CDBAA) 2/12/00 15:51

Original value (S) = 0 New value = 0
Fewer than 6 points above MRL. Logistic function (type 1) applied.

Cell: C55
Comment: 3001-10-03 - Run 5 (DCBAA) 2/12/00 15:27
Original value (CoefA0) = 0 New value = 1.39
Fewer than 6 points above MRL. Step function applied.

Cell: D55
Comment: 3001-10-03 - Run 5 (DCBAA) 2/12/00 15:28
Original value (CoefAf) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: E55
Comment: 3001-10-03 - Run 5 (DCBAA) 2/12/00 15:28
Original value (CoefB) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: F55
Comment: 3001-10-03 - Run 5 (DCBAA) 2/12/00 15:28
Original value (CoefD) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: J55
Comment: 3001-10-03 - Run 5 (DCBAA) 2/12/00 15:28
Original value (S) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: K55
Comment: 3001-10-03 - Run 5 (DCBAA) 2/12/00 15:28
Original value (t0) = 0 New value = 16.1704
Fewer than 6 points above MRL. Step function applied.

Cell: C77
Comment: 3001-10-04 - Run 7 (DCBAA) 2/12/00 15:30
Original value (CoefA0) = 0 New value = 1.12
Fewer than 6 points above MRL. Step function applied.

Cell: D77
Comment: 3001-10-04 - Run 7 (DCBAA) 2/12/00 15:30
Original value (CoefAf) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: E77
Comment: 3001-10-04 - Run 7 (DCBAA) 2/12/00 15:30
Original value (CoefB) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: F77
Comment: 3001-10-04 - Run 7 (DCBAA) 2/12/00 15:30
Original value (CoefD) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: J77
Comment: 3001-10-04 - Run 7 (DCBAA) 2/12/00 15:30
Original value (S) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: K77
Comment: 3001-10-04 - Run 7 (DCBAA) 2/12/00 15:30
Original value (t0) = 0 New value = 50.4296
Fewer than 6 points above MRL. Step function applied.

Cell: C114
Comment: 3001-20-02 - Run 4 (CDBAA) 2/12/00 15:50
Original value (CoefA0) = 0 New value = 0
Fewer than 6 points above MRL. Peak curve/step function combination applied.

Cell: D114
Comment: 3001-20-02 - Run 4 (CDBAA) 2/12/00 15:50
Original value (CoefAf) = 0 New value = 2.2
Fewer than 6 points above MRL. Peak curve/step function combination applied.

Cell: E114
Comment: 3001-20-02 - Run 4 (CDBAA) 2/12/00 15:50
Original value (CoefB) = 0 New value = 0
Fewer than 6 points above MRL. Peak curve/step function combination applied.

Cell: F114
Comment: 3001-20-02 - Run 4 (CDBAA) 2/12/00 15:50
Original value (CoefD) = 0 New value = 0
Fewer than 6 points above MRL. Peak curve/step function combination applied.

Cell: J114
Comment: 3001-20-02 - Run 4 (CDBAA) 2/12/00 15:50
Original value (S) = 0 New value = -0.0539
Fewer than 6 points above MRL. Peak curve/step function combination applied.

Cell: C121
Comment: 3001-20-02 - Run 4 (DCBAA) 2/12/00 15:24
Original value (CoefA0) = 0 New value = 1.28
Fewer than 6 points above MRL. Step function applied.

Cell: D121
Comment: 3001-20-02 - Run 4 (DCBAA) 2/12/00 15:24
Original value (CoefAf) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: E121
Comment: 3001-20-02 - Run 4 (DCBAA) 2/12/00 15:24
Original value (CoefB) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: F121
Comment: 3001-20-02 - Run 4 (DCBAA) 2/12/00 15:24
Original value (CoefD) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: J121
Comment: 3001-20-02 - Run 4 (DCBAA) 2/12/00 15:24
Original value (S) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: K121
Comment: 3001-20-02 - Run 4 (DCBAA) 2/12/00 15:24
Original value (t0) = 0 New value = 184.9543
Fewer than 6 points above MRL. Step function applied.

Cell: C125
Comment: 3001-20-02 - Run 4 (MBAA) 2/12/00 15:48
Original value (CoefA0) = 0 New value = 0
Fewer than 6 points above MRL. Peak curve/step function combination applied.

Cell: D125
Comment: 3001-20-02 - Run 4 (MBAA) 2/12/00 15:48

Original value (CoefAf) = 0 New value = 1
Fewer than 6 points above MRL. Peak curve/step function combination applied.

Cell: E125
Comment: 3001-20-02 - Run 4 (MBAA) 2/12/00 15:48
Original value (CoefB) = 0 New value = 0
Fewer than 6 points above MRL. Peak curve/step function combination applied.

Cell: F125
Comment: 3001-20-02 - Run 4 (MBAA) 2/12/00 15:48
Original value (CoefD) = 0 New value = 0
Fewer than 6 points above MRL. Peak curve/step function combination applied.

Cell: J125
Comment: 3001-20-02 - Run 4 (MBAA) 2/12/00 15:48
Original value (S) = 0 New value = -0.076
Fewer than 6 points above MRL. Peak curve/step function combination applied.

Cell: C128
Comment: 3001-20-02 - Run 4 (TCAA) 2/12/00 15:25
Original value (CoefA0) = 0 New value = 1.12
Fewer than 6 points above MRL. Step function applied.

Cell: D128
Comment: 3001-20-02 - Run 4 (TCAA) 2/12/00 15:25
Original value (CoefAf) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: E128
Comment: 3001-20-02 - Run 4 (TCAA) 2/12/00 15:25
Original value (CoefB) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: F128
Comment: 3001-20-02 - Run 4 (TCAA) 2/12/00 15:25
Original value (CoefD) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: J128
Comment: 3001-20-02 - Run 4 (TCAA) 2/12/00 15:25
Original value (S) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: K128
Comment: 3001-20-02 - Run 4 (TCAA) 2/12/00 15:25
Original value (t0) = 0 New value = 184.9543
Fewer than 6 points above MRL. Step function applied.

Cell: C165
Comment: 3001-20-04 - Run 8 (DCBAA) 2/12/00 15:53
Original value (CoefA0) = 0 New value = -0.3572
Fewer than 6 points above MRL. Data was fit to peak curve by iterative curve fit procedure.

Cell: D165
Comment: 3001-20-04 - Run 8 (DCBAA) 2/12/00 15:53
Original value (CoefAf) = 0 New value = 258.8061
Fewer than 6 points above MRL. Data was fit to peak curve by iterative curve fit procedure.

Cell: E165
Comment: 3001-20-04 - Run 8 (DCBAA) 2/12/00 15:53
Original value (CoefB) = 0 New value = 2640.6439
Fewer than 6 points above MRL. Data was fit to peak curve by iterative curve fit procedure.

Cell: F165
Comment: 3001-20-04 - Run 8 (DCBAA) 2/12/00 15:53
Original value (CoefD) = 0 New value = 0.0156
Fewer than 6 points above MRL. Data was fit to peak curve by iterative curve fit procedure.

Cell: J165
Comment: 3001-20-04 - Run 8 (DCBAA) 2/12/00 15:53
Original value (S) = 0 New value = -0.0297
Fewer than 6 points above MRL. Data was fit to peak curve by iterative curve fit procedure.

Cell: C171
Comment: 3001-20-04 - Run 8 (TBAA) 2/12/00 15:58
Original value (CoefA0) = 0 New value = 0
Fewer than 6 points above MRL. Peak curve/step function combination applied.

Cell: D171
Comment: 3001-20-04 - Run 8 (TBAA) 2/12/00 15:58
Original value (CoefAf) = 0 New value = 4.65
Fewer than 6 points above MRL. Peak curve/step function combination applied.

Cell: E171
Comment: 3001-20-04 - Run 8 (TBAA) 2/12/00 15:58
Original value (CoefB) = 0 New value = 0
Fewer than 6 points above MRL. Peak curve/step function combination applied.

Cell: F171
Comment: 3001-20-04 - Run 8 (TBAA) 2/12/00 15:58
Original value (CoefD) = 0 New value = 0
Fewer than 6 points above MRL. Peak curve/step function combination applied.

Cell: J171
Comment: 3001-20-04 - Run 8 (TBAA) 2/12/00 15:58
Original value (S) = 0 New value = -0.1095
Fewer than 6 points above MRL. Peak curve/step function combination applied.

City of Austin Water and Wastewater Utility **Bench-Scale RSSCT Treatment Study Summary** **Quarter:** 1

ICR Information

ID / ICR#:	TX2270001 / 654
ICR Contact:	Judy Musgrove
Phone No.:	512-322-2819
Period:	5/4/98 - 5/25/98 (20 B-S days)

Design Information

Design TOC:	3.2 mg/L	**Full-Scale GAC Size:**	8x30 Bituminous Coa
Col Diameter:	8.0 mm	**Bench-Scale GAC Size:**	200x100
Min Reynolds#:	0.512	**Scaling Factor:**	13.16
Full-Scale Temp:	21.0 C	**Meas Dry Bed Density:**	0.53 g/cm3

Water Quality Summary

	Influent				Influent			
Influent	Mean	SD/RD	Count	Min/Max	Mean	SD/RD	Count	Min/Max
TOC	3.2	0.3	3	3.0 - 3.5				
pH	9.4	0.1	3	9.3 - 9.4				
UV254	0.060	0.001	3	0.059 - 0.061				
SUVA	1.87	0.15	3	1.70 - 2.01				
Bromide	200	0	1	200 - 200				
SDS-TOX	392	**145**	3	225 - 490				
SDS-THM4	121	9	3	113 - 130				
SDS-HAA6	81	3	3	77 - 84				
Effluent	**10 Min EBCT**			(13 B-S days)	**20 Min EBCT**			(20 B-S days)
Effluent pH	9.1	0.1	10	9.0 - 9.2	9.1	0.1	15	9.0 - 9.2
Effluent Temp	21.9	0.3	10	21.5 - 22.4	21.8	0.2	15	21.5 - 22.1

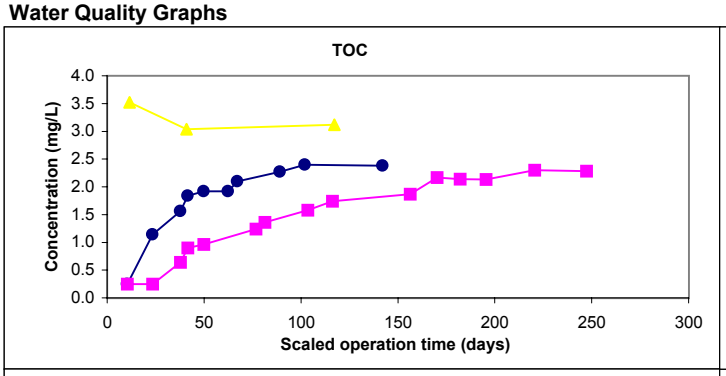
Cumulative SDS Conditions

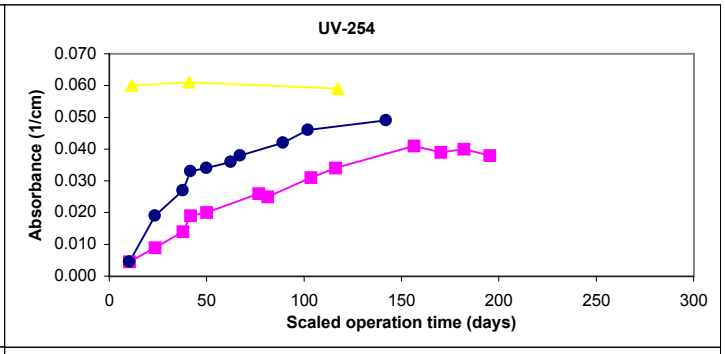
	Mean	SD	Count	Min/Max
Res (5)	0.81	0.69	28	0.00 - 2.20
Temp	21.7	0.4	28	20.9 - 22.5
pH	9.1	0.1	28	9.0 - 9.2
Time	24.0	1.5	28	18.1 - 25.5

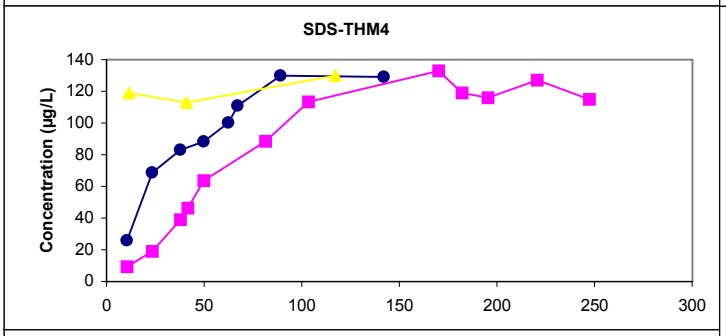
Comments:

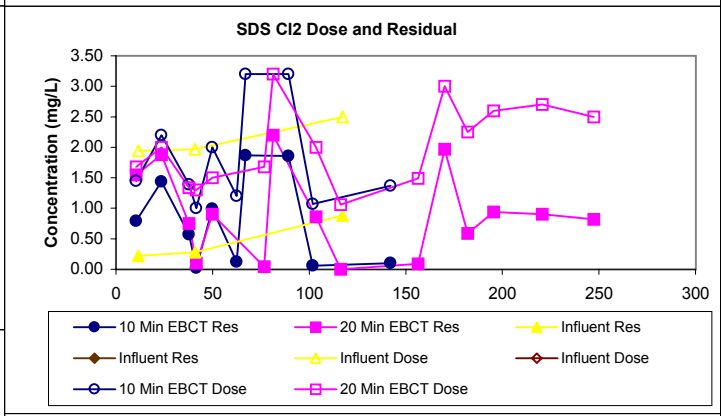
Chart Legend: 10 Min EBCT; 20 Min EBCT; Influent; Influent

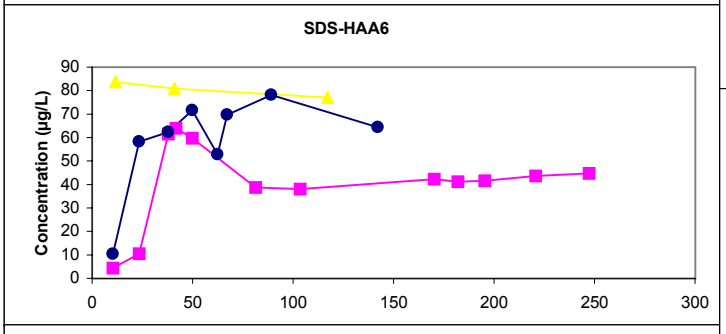
Water Quality Graphs

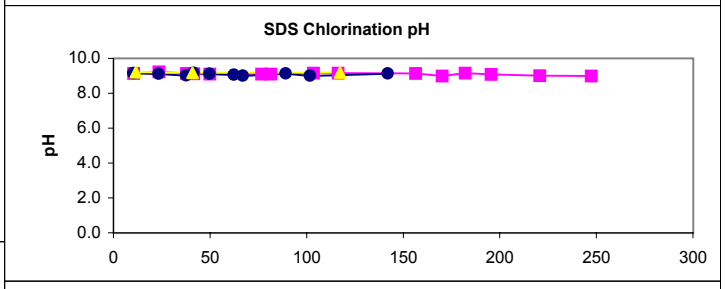


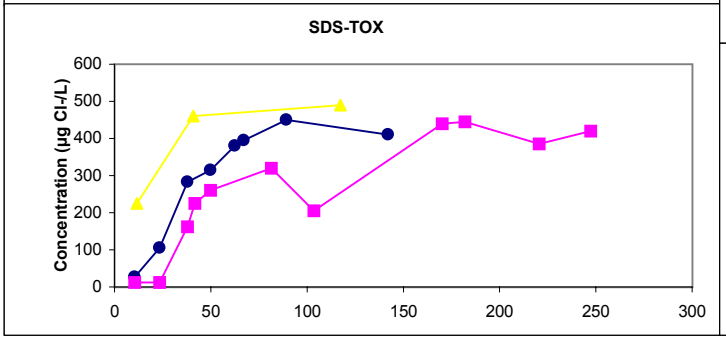


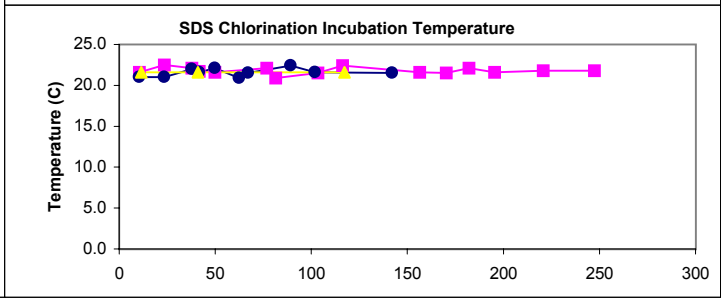




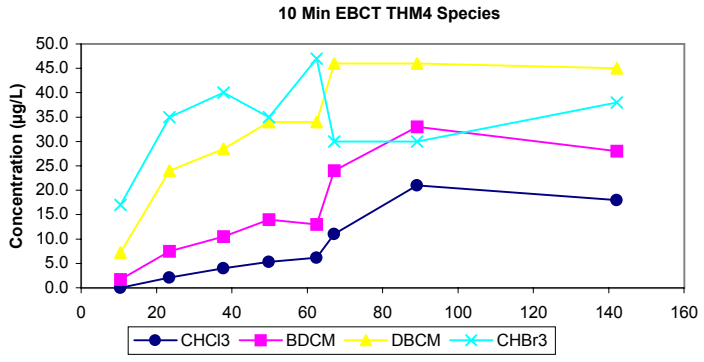


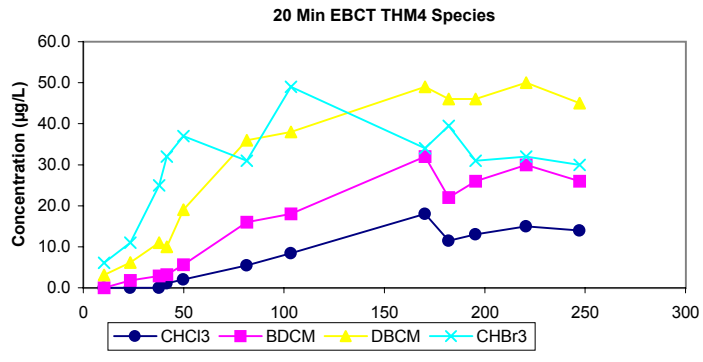


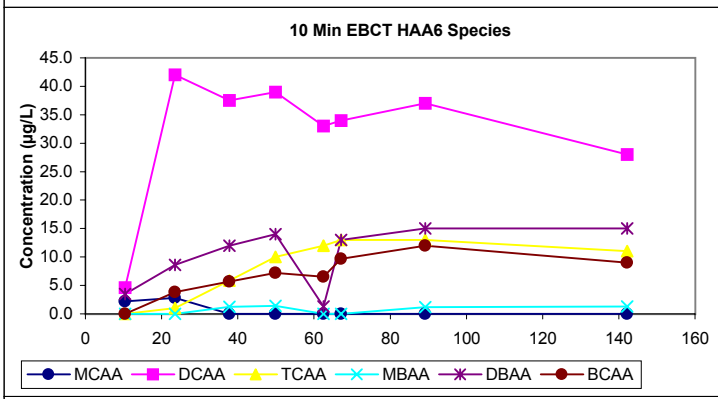


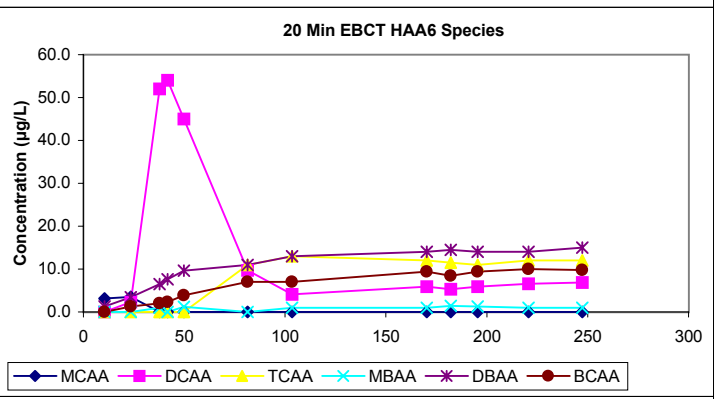


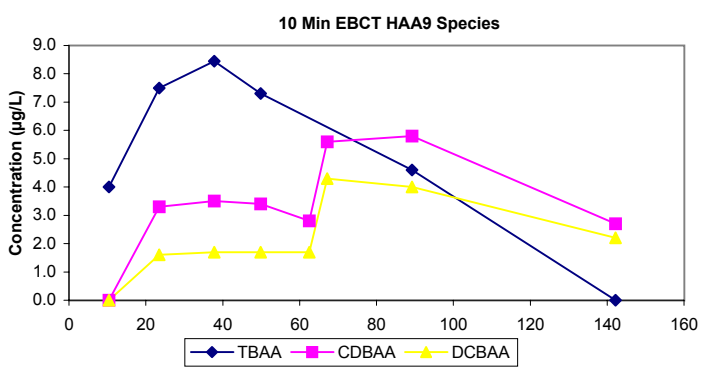
Water Quality Graphs (Continued)

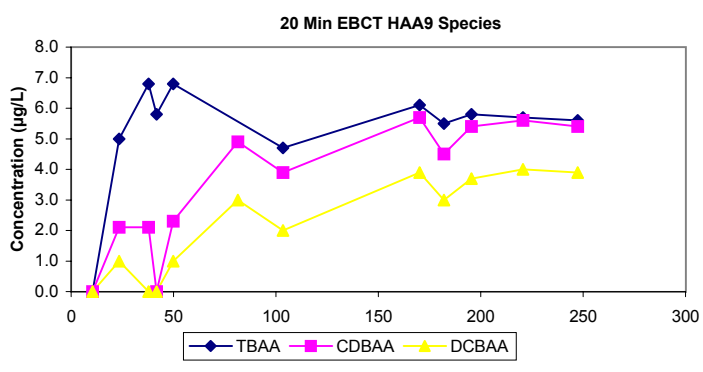


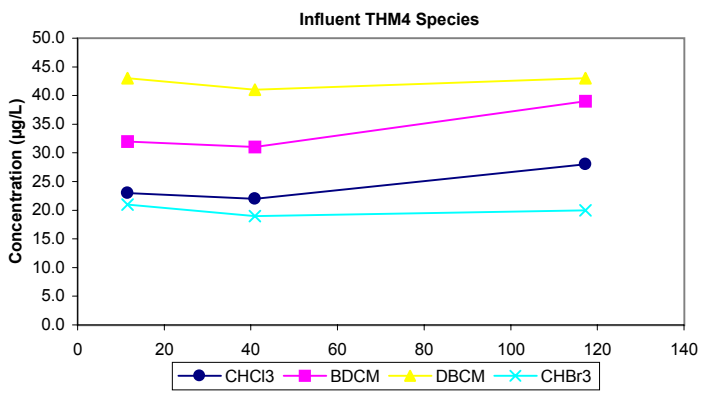


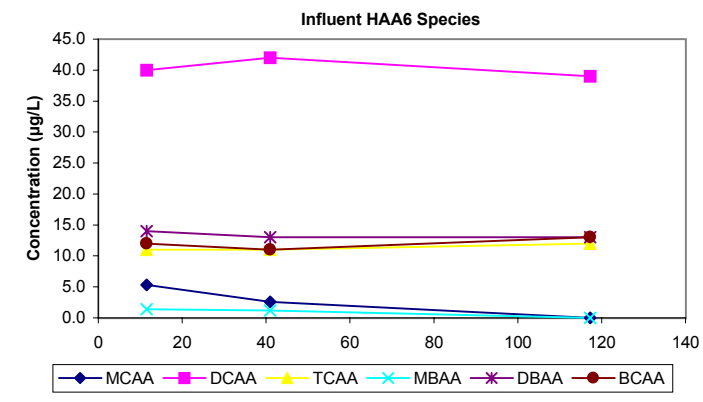












City of Austin Water and Wastewater Utility **Bench-Scale RSSCT Treatment Study Summary** **Quarter:** 2

ICR Information

ID / ICR#:	TX2270001 / 654
ICR Contact:	Judy Musgrove
Phone No.:	512-322-2819
Period:	8/10/98 - 8/30/98 (20 B-S days)

Design Information

Design TOC:	3.2 mg/L	**Full-Scale GAC Size:**	8x30 Bituminous Coa
Col Diameter:	8.0 mm	**Bench-Scale GAC Size:**	100x200
Min Reynolds#:	0.551	**Scaling Factor:**	13.16
Full-Scale Temp:	24.0 C	**Meas Dry Bed Density:**	0.53 g/cm3

Water Quality Summary

Influent	Influent Mean	SD/RD	Count	Min/Max	Influent Mean	SD/RD	Count	Min/Max
TOC	2.0	0.0	3	1.9 - 2.0				
pH	10.0	0.1	3	9.9 - 10.0				
UV254	0.036	0.004	3	0.032 - 0.039				
SUVA	1.83	0.20	3	1.60 - 1.97				
Bromide	200	3	2	198 - 201				
SDS-TOX	547	370	3	120 - 780				
SDS-THM4	101	19	3	79 - 114				
SDS-HAA6	29	3	3	25 - 31				
Effluent	**10 Min EBCT**			(10 B-S days)	**20 Min EBCT**			(20 B-S days)
Effluent pH	9.9	0.0	11	9.8 - 9.9	9.8	0.0	14	9.8 - 9.9
Effluent Temp	25.4	0.5	11	25.0 - 26.0	25.1	0.4	14	25.0 - 26.0

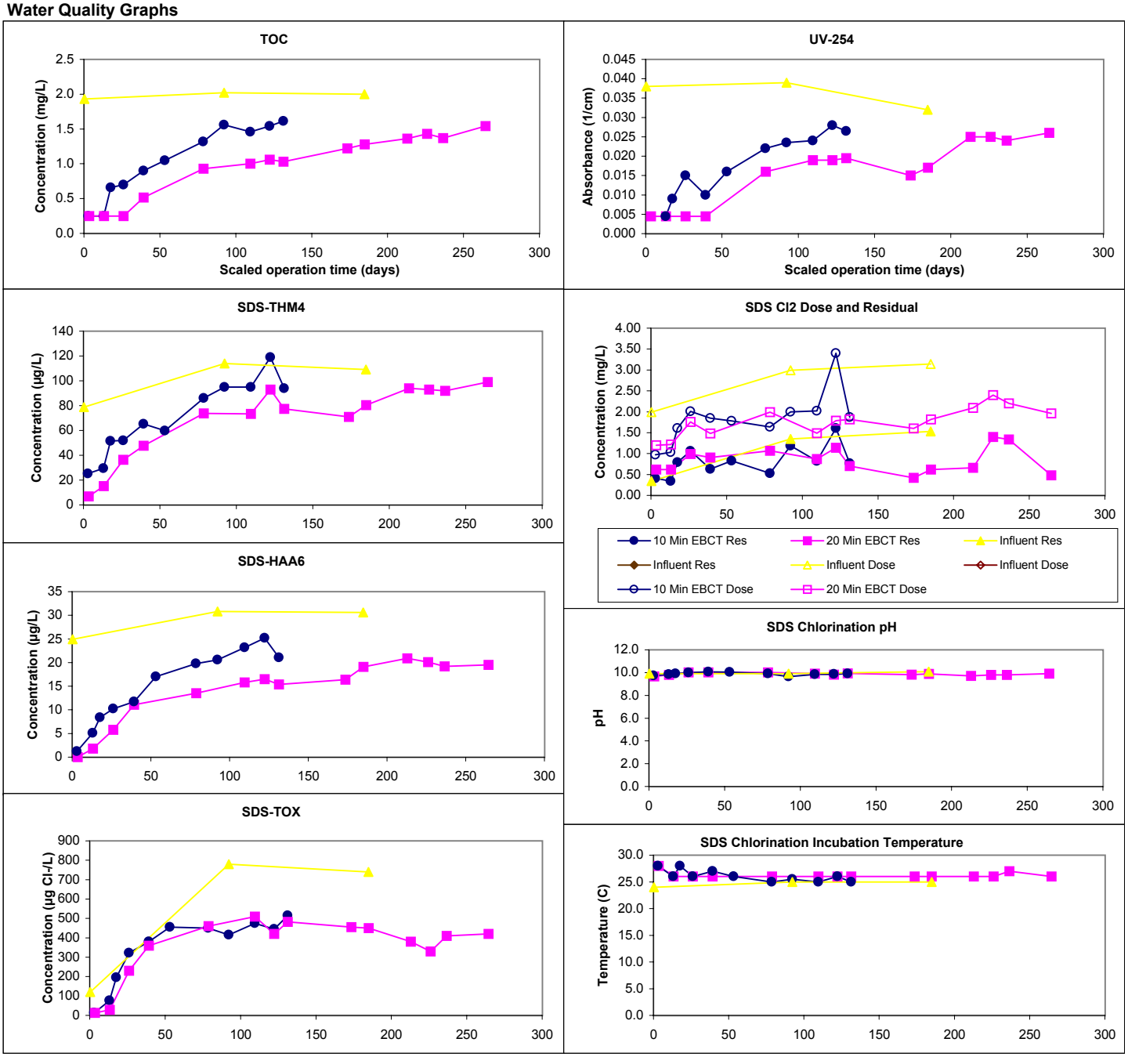
Cumulative SDS Conditions

	Mean	SD	Count	Min/Max
Res (0)	0.86	0.36	28	0.34 - 1.61
Temp	26.0	0.9	28	24.0 - 28.0
pH	9.9	0.1	28	9.7 - 10.1
Time	24.0	0.4	28	23.0 - 24.5

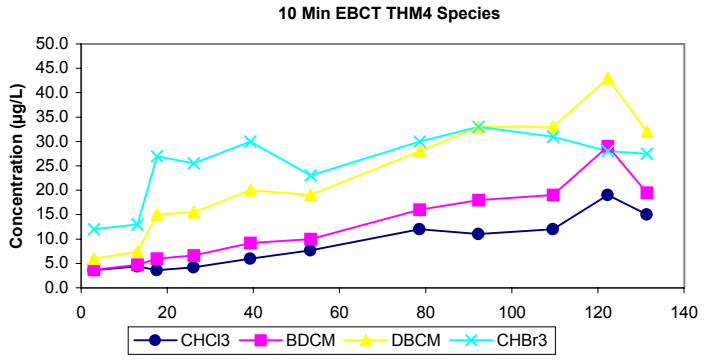
Comments:

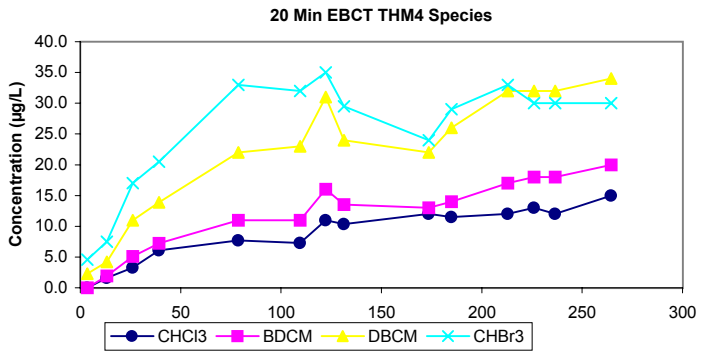
Chart Legend: 10 Min EBCT; 20 Min EBCT; Influent; Influent

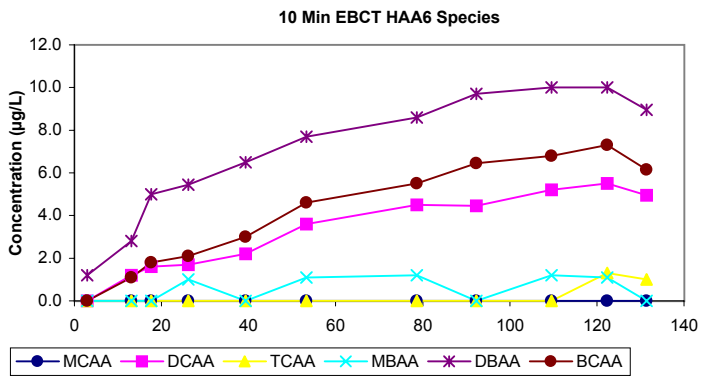
Water Quality Graphs

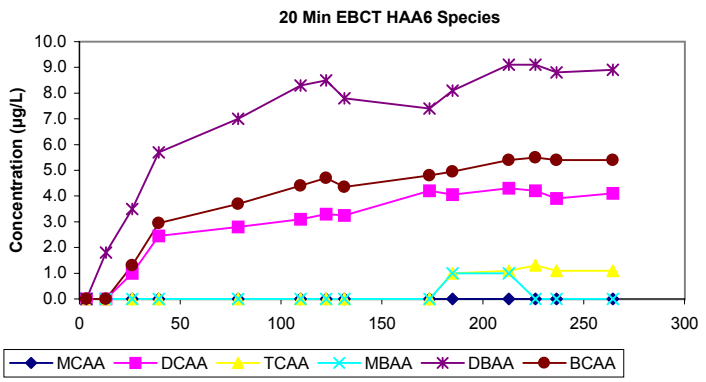


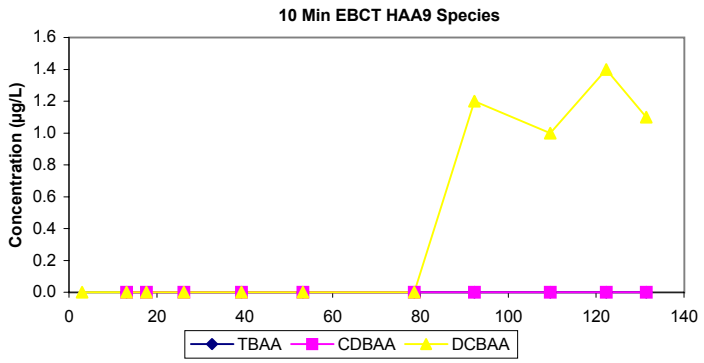
Water Quality Graphs (Continued)

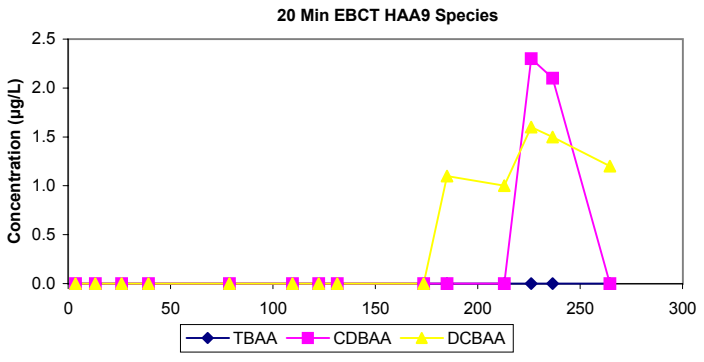


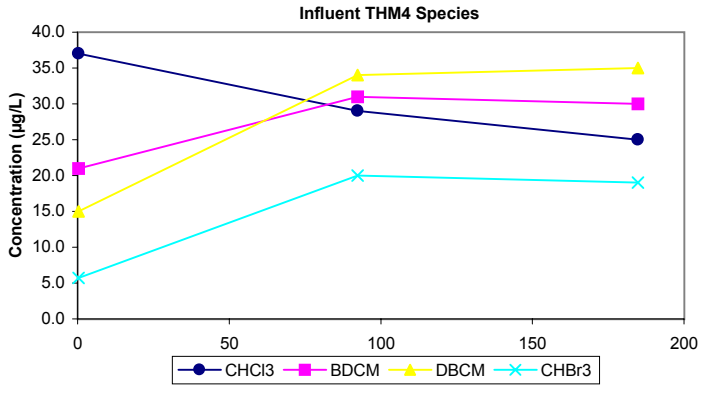


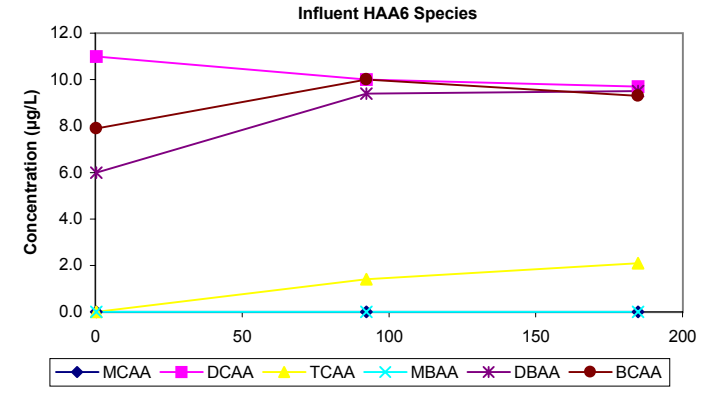












City of Austin Water and Wastewater Utility **Bench-Scale RSSCT Treatment Study Summary** **Quarter:** 3

ICR Information

ID / ICR#: TX2270001 / 654
ICR Contact: Judy Musgrove
Phone No.: 512-322-2819
Period: 10/19/98 - 11/5/98 (17 B-S days)

Design Information

Design TOC:	3.2 mg/L	**Full-Scale GAC Size:**	8x30 Bituminous Coa
Col Diameter:	8.0 mm	**Bench-Scale GAC Size:**	100x200
Min Reynolds#:	0.525	**Scaling Factor:**	13.16
Full-Scale Temp:	22.0 C	**Meas Dry Bed Density:**	0.53 g/cm3

Water Quality Summary

	Influent				Influent			
Influent	Mean	SD/RD	Count	Min/Max	Mean	SD/RD	Count	Min/Max
TOC	2.2	0.1	3	2.2 - 2.3				
pH	9.8	0.1	3	9.7 - 9.9				
UV254	0.045	0.003	3	0.043 - 0.048				
SUVA	2.02	0.16	3	1.85 - 2.18				
Bromide	207	5	2	204 - 209				
SDS-TOX	887	**865**	3	130 - 1830				
SDS-THM4	92	**33**	3	56 - 122				
SDS-HAA6	29	5	3	24 - 34				
Effluent	**10 Min EBCT**			(9 B-S days)	**20 Min EBCT**			(17 B-S days)
Effluent pH	9.7	0.1	10	9.6 - 9.8	9.7	0.0	14	9.6 - 9.8
Effluent Temp	22.7	0.1	10	22.5 - 22.7	22.6	0.1	14	22.4 - 22.7

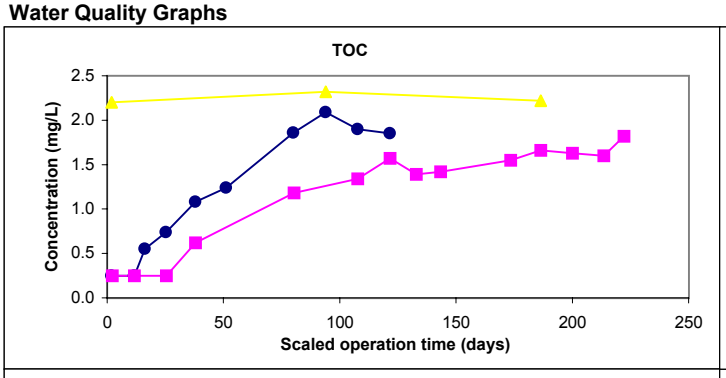
Cumulative SDS Conditions

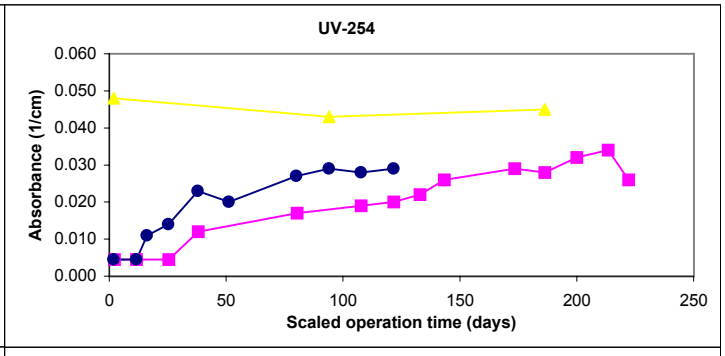
	Mean	SD	Count	Min/Max
Res (0)	0.63	0.32	27	0.11 - 1.36
Temp	22.5	0.2	27	21.8 - 22.7
pH	9.7	0.1	27	9.6 - 9.9
Time	24.1	0.4	27	23.0 - 24.5

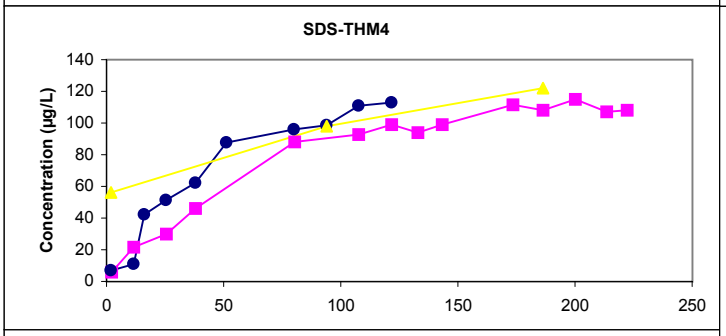
Comments:

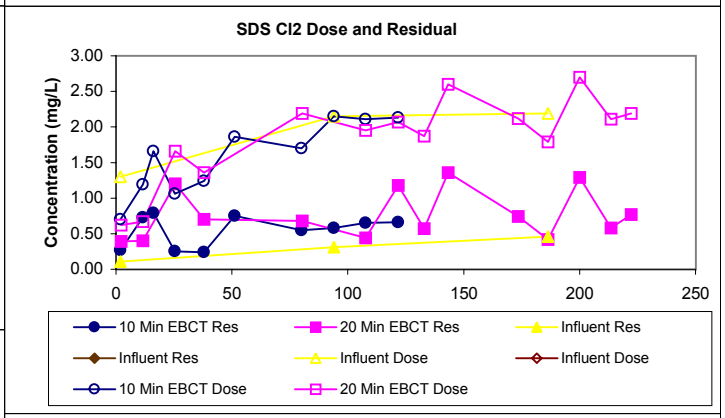
Chart Legend: 10 Min EBCT; 20 Min EBCT; Influent; Influent

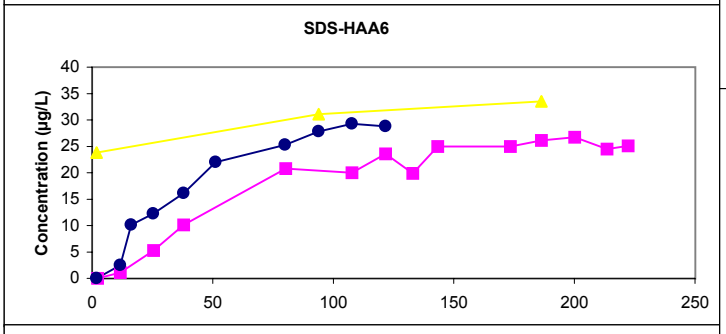
Water Quality Graphs

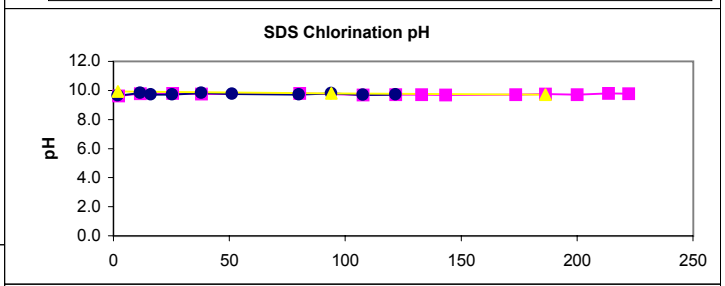


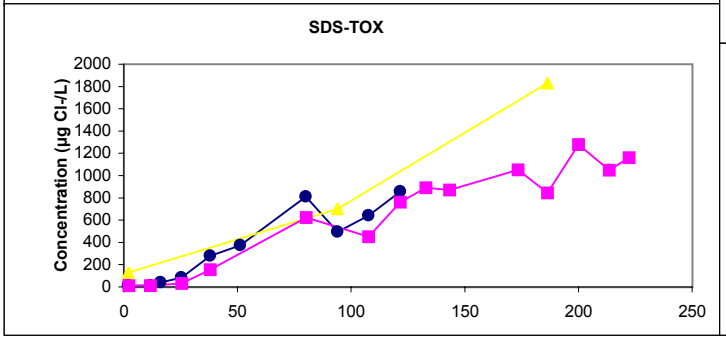


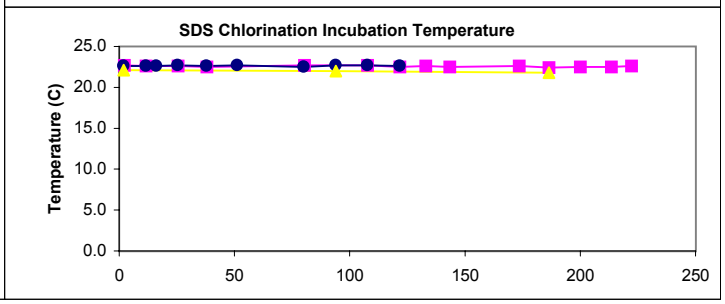




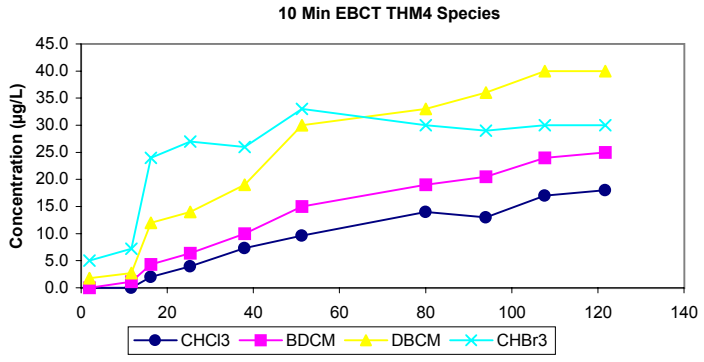


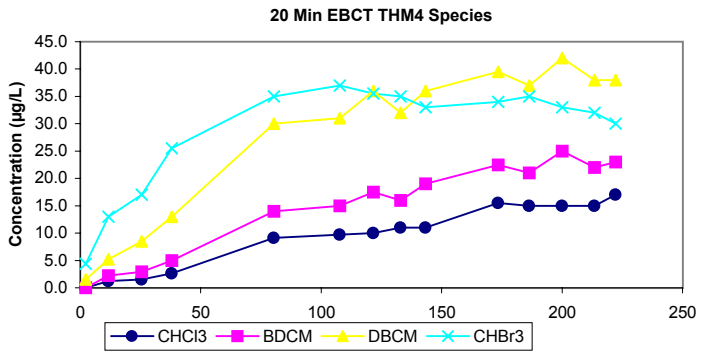


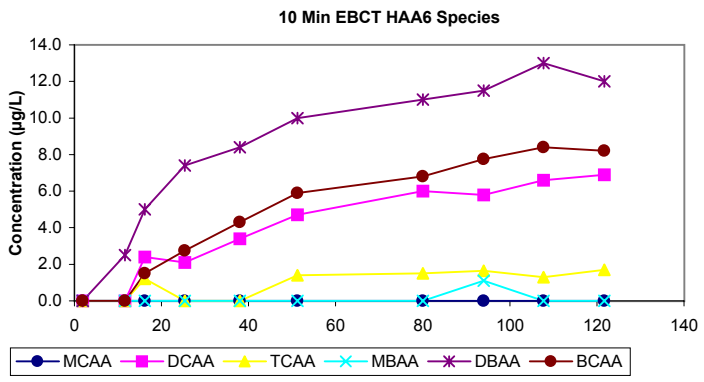


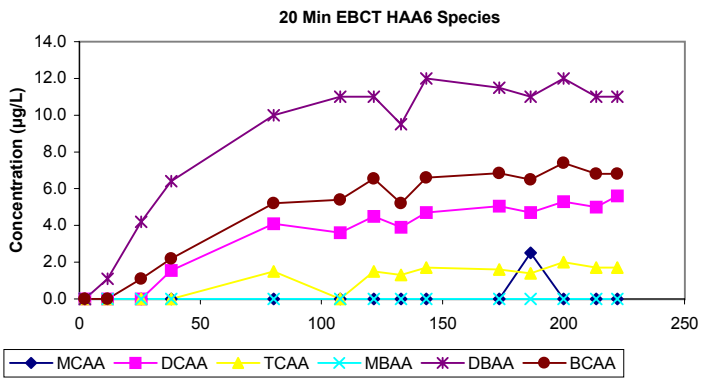


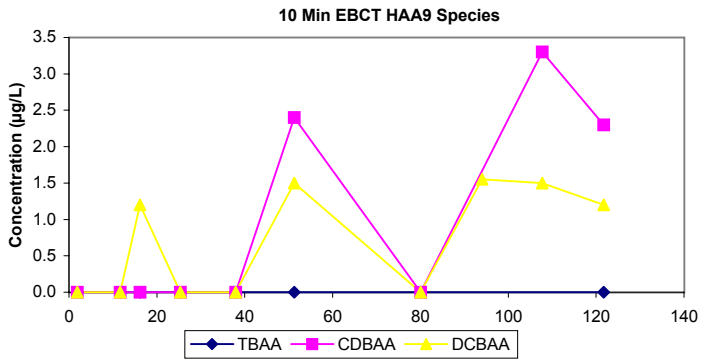
Water Quality Graphs (Continued)

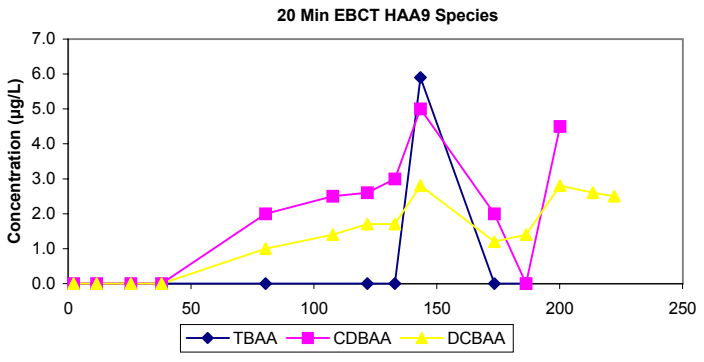


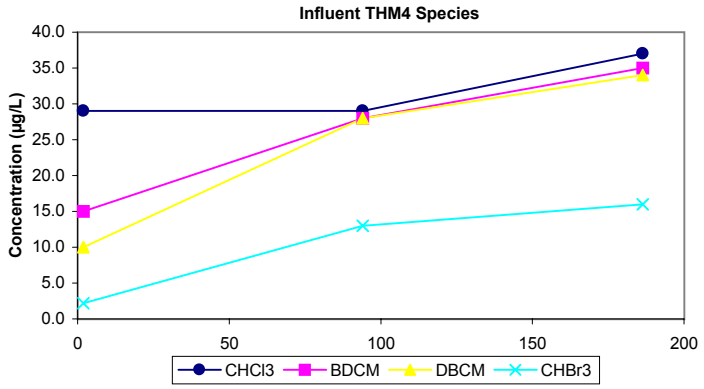


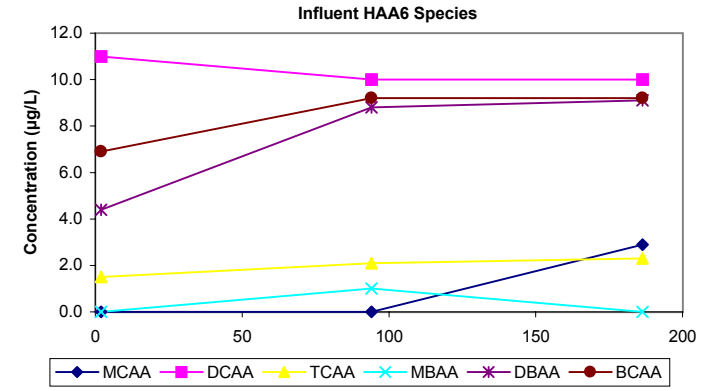












City of Austin Water and Wastewater Utility **Bench-Scale RSSCT Treatment Study Summary** **Quarter:** 4

ICR Information

ID / ICR#: TX2270001 / 654
ICR Contact: Judy Musgrove
Phone No.: 512-322-2819
Period: 1/25/99 - 2/11/99 (16 B-S days)

Design Information

Design TOC:	3.2 mg/L	**Full-Scale GAC Size:**	8x30 Bituminous Coa
Col Diameter:	8.0 mm	**Bench-Scale GAC Size:**	100x200
Min Reynolds#:	0.459	**Scaling Factor:**	13.16
Full-Scale Temp:	16.5 C	**Meas Dry Bed Density:**	0.53 g/cm3

Water Quality Summary

	Influent				Influent			
Influent	Mean	SD/RD	Count	Min/Max	Mean	SD/RD	Count	Min/Max
TOC	2.1	0.0	3	2.1 - 2.1				
pH	9.6	0.0	3	9.6 - 9.6				
UV254	0.036	0.001	3	0.035 - 0.037				
SUVA	1.72	0.06	3	1.65 - 1.76				
Bromide	198	21	2	187 - 208				
SDS-TOX	292	133	3	140 - 390				
SDS-THM4	99	7	3	94 - 107				
SDS-HAA6	28	2	3	26 - 30				
Effluent	**10 Min EBCT**			(10 B-S days)	**20 Min EBCT**			(17 B-S days)
Effluent pH	9.6	0.0	11	9.5 - 9.6	9.5	0.0	14	9.5 - 9.6
Effluent Temp	19.9	0.2	11	19.7 - 20.3	19.4	0.3	14	19.0 - 19.9

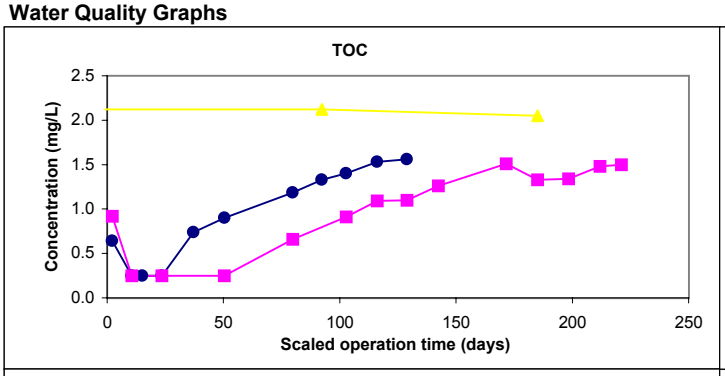
Cumulative SDS Conditions

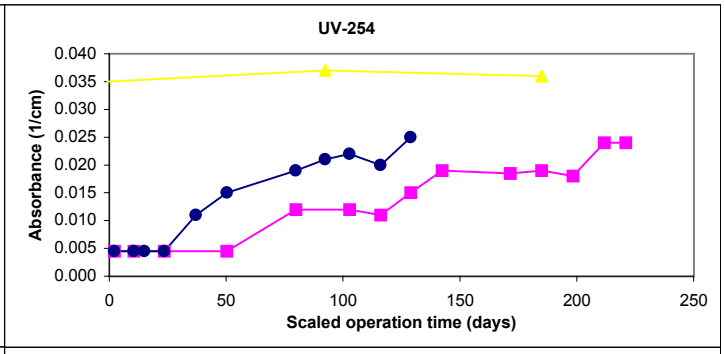
	Mean	SD	Count	Min/Max
Res (0)	0.62	0.30	28	0.14 - 1.35
Temp	19.8	0.2	28	19.4 - 20.1
pH	9.5	0.0	28	9.4 - 9.6
Time	24.1	0.2	28	23.8 - 24.5

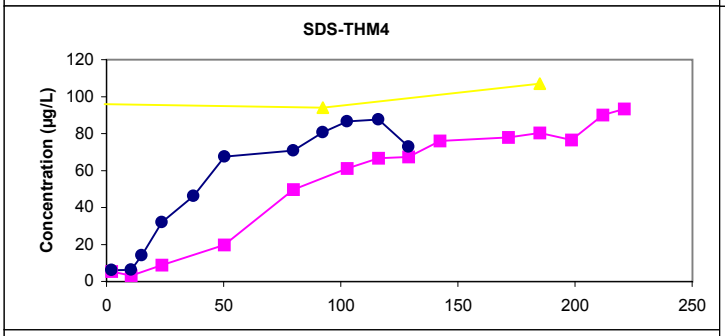
Comments:

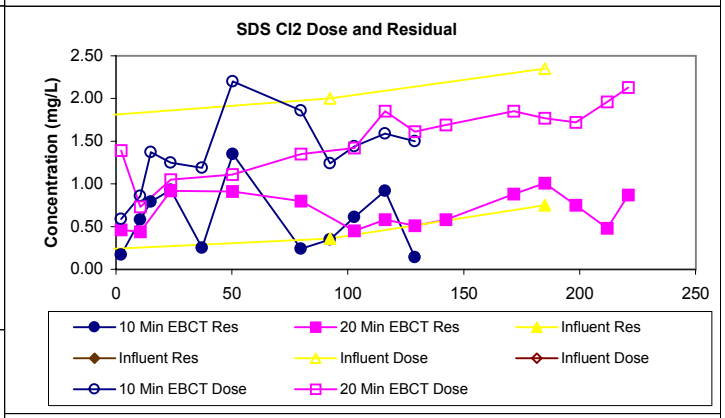
Chart Legend: 10 Min EBCT; 20 Min EBCT; Influent; Influent

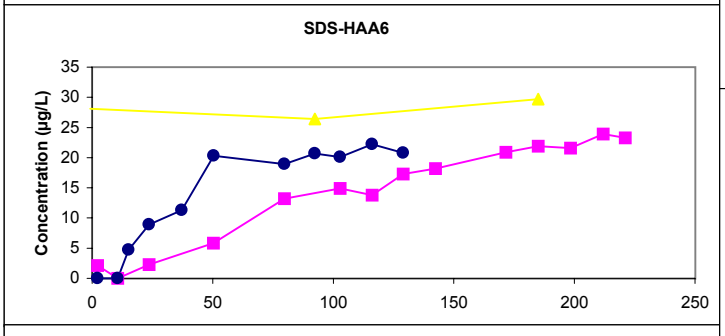
Water Quality Graphs

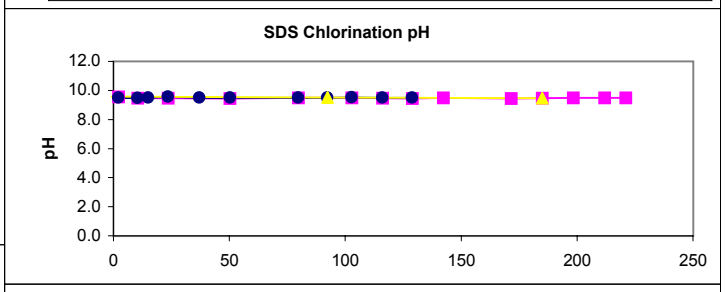


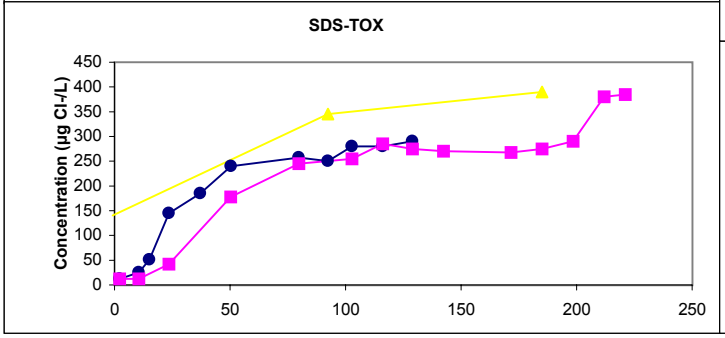


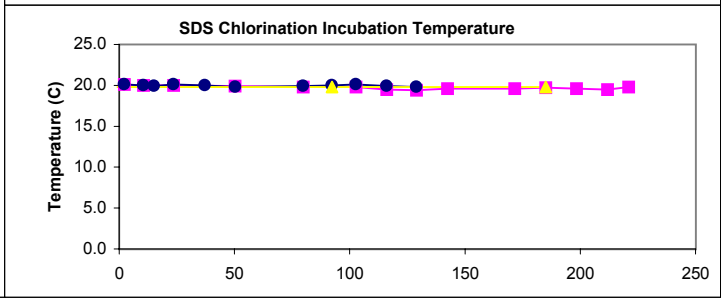












Water Quality Graphs (Continued)