ICR TREATMENT STUDY ANALYSIS

Base Analysis and Data Review Comments

Treatment Study ID 1072

Study Protocol GAC pilot-scale treatment study

Plant ICR Number 646

PWS Name Fort Worth Water Department

City, State, Zip Fort Worth, TX 76101-0870

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

Major comments:

None.

General Comments:

1. As explained in Section 4.1 of the Summary Report, three sources were blended at different ratios throughout the pilot study. The study began using 100% Richland Chambers Reservoir (RCR) water. After 5 days, Cedar Creek Reservoir (CCR) water was blended with RCR water. This blend fluctuated between 80/20 and 60/40 RCR to CCR water over the next 103 days of the pilot run. From August 27 to September 7, the blend was 48% RCR, 25% CCR, and 27% Lake Benbrook water.

2. As explained in Section 4.1 of the Summary Report, the ferric feed rate was held constant throughout most of the pilot study at 24 mg/L. On August 1 (about 2500 hours or 104 days of operation time) the source water feed was switched to 100% CCR, increasing the influent turbidity levels to the plant. The ferric dosage was not changed for two days, during which time spikes in turbidity, TOC, and UV-254 occurred. The ferric feed rates were increased above 24 mg/L for 5 days to yield better turbidity removal of this source water.

3. As explained in Section 4.1 of the Summary Report, the actual average EBCTs, based on actual bed volume and average flow, were approximately 10.3 and 20.7 minutes. Since these values are within 5 percent of the target EBCTs of 10 and 20 minutes, these target values can be applied to the data generated by the study.

4. As explained in Section 4.1 of the Summary Report, 9 days into the run the flocculation basin ruptured. The GAC contactors went dry before the break was discovered. The plant was down for 72 hours.

5. For the 10 minute EBCT contactor, a peak curve occurred for SDS-DCAA breakthrough, which is unusual, since this is not a brominated compound. Analysis, of SDS-DCAA influent data shows that levels of about 25 µg/L decreased to 15 µg/L sharply at 50 days of operation, which is near the peak observed for GAC effluent SDS-DCAA (45 days). The decrease in influent levels is likely a reason for the peak breakthrough behavior observed. GAC effluent SDS-TCAA also showed a peak breakthrough, with the peak again approximately coinciding with a peak in the influent SDS-TCAA data.

6. The SDS free chlorine residual target was 0.5 to 1.0 mg/L. However, the average free chlorine residual for all samples analyzed was 0.4 mg/L. Ten samples yielded a free chlorine residual less than 0.10 mg/L.

7. Due to slow TOC analysis turnaround time, GAC effluent sampling was determined based on breakthrough of UV-254. This method worked well, end of run criteria based on TOC were reached for both EBCT columns. Later in the run, when UV-254 effluent data was more variable, the last few samples were taken based on spacing in time to capture breakthrough.

Outlier Data:

No outliers were removed.

Cell: A1
Comment: 1072-SAS.xls 2/12/00 19:25

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

Cell: C11
Comment: 1072-10-01 - Run 1 (DCBAA) 2/12/00 19:14
Original value (CoefA0) = -1.1019 New value = -3.2304
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: D11
Comment: 1072-10-01 - Run 1 (DCBAA) 2/12/00 19:14
Original value (CoefAf) = 9.5543 New value = 13.9093
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: E11
Comment: 1072-10-01 - Run 1 (DCBAA) 2/12/00 19:14
Original value (CoefB) = 5.3822 New value = 3.35
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: F11
Comment: 1072-10-01 - Run 1 (DCBAA) 2/12/00 19:14
Original value (CoefD) = 0.0782 New value = 0.0568
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: J11
Comment: 1072-10-01 - Run 1 (DCBAA) 2/12/00 19:14
Original value (S) = 0 New value = -0.0294
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: C12
Comment: 1072-10-01 - Run 1 (HAA5) 2/12/00 19:15
Original value (CoefA0) = -11.0745 New value = -21.7488
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: D12
Comment: 1072-10-01 - Run 1 (HAA5) 2/12/00 19:15
Original value (CoefAf) = 41.1 New value = 56.9729
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: E12
Comment: 1072-10-01 - Run 1 (HAA5) 2/12/00 19:15
Original value (CoefB) = 1.992 New value = 1.5981
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: F12
Comment: 1072-10-01 - Run 1 (HAA5) 2/12/00 19:15
Original value (CoefD) = 0.0432 New value = 0.0405
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: J12
Comment: 1072-10-01 - Run 1 (HAA5) 2/12/00 19:15
Original value (S) = 0 New value = -0.1138
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: C13
Comment: 1072-10-01 - Run 1 (HAA6) 2/12/00 19:19
Original value (CoefA0) = -15.7361 New value = -27.8126
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: D13
Comment: 1072-10-01 - Run 1 (HAA6) 2/12/00 19:19
Original value (CoefAf) = 52.65 New value = 70.1902
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: E13
Comment: 1072-10-01 - Run 1 (HAA6) 2/12/00 19:19
Original value (CoefB) = 1.8036 New value = 1.5237
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: F13
Comment: 1072-10-01 - Run 1 (HAA6) 2/12/00 19:19
Original value (CoefD) = 0.048 New value = 0.0463
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: J13
Comment: 1072-10-01 - Run 1 (HAA6) 2/12/00 19:19
Original value (S) = 0 New value = -0.1319
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: C18
Comment: 1072-10-01 - Run 1 (TCAA) 2/12/00 19:17
Original value (CoefA0) = 0 New value = -3.4375
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: D18
Comment: 1072-10-01 - Run 1 (TCAA) 2/12/00 19:17
Original value (CoefAf) = 12 New value = 43.6488
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: E18
Comment: 1072-10-01 - Run 1 (TCAA) 2/12/00 19:17
Original value (CoefB) = 10 New value = 10.9735
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: F18
Comment: 1072-10-01 - Run 1 (TCAA) 2/12/00 19:17
Original value (CoefD) = 0.07 New value = 0.0346
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: J18

Comment: 1072-10-01 - Run 1 (TCAA) 2/12/00 19:17
Original value (S) = 0 New value = -0.0906
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: C92
Comment: 1072-20-01 - Run 2 (CDBAA) 2/12/00 19:11
Original value (CoefA0) = 0 New value = 2.58
Fewer than 6 points above MRL. Step function applied.

Cell: D92
Comment: 1072-20-01 - Run 2 (CDBAA) 2/12/00 19:11
Original value (CoefAf) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: E92
Comment: 1072-20-01 - Run 2 (CDBAA) 2/12/00 19:11
Original value (CoefB) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: F92
Comment: 1072-20-01 - Run 2 (CDBAA) 2/12/00 19:11
Original value (CoefD) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: J92
Comment: 1072-20-01 - Run 2 (CDBAA) 2/12/00 19:11
Original value (S) = 0 New value = 0
Fewer than 6 points above MRL. Step function applied.

Cell: K92
Comment: 1072-20-01 - Run 2 (CDBAA) 2/12/00 19:11
Original value (t0) = 0 New value = 47.4583
Fewer than 6 points above MRL. Step function applied.

Cell: C95
Comment: 1072-20-01 - Run 2 (Cl2-D) 2/12/00 19:22
Original value (CoefA0) = 0.4236 New value = 0.3102
Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

Cell: D95
Comment: 1072-20-01 - Run 2 (Cl2-D) 2/12/00 19:22
Original value (CoefAf) = 2.49 New value = 1.1242
Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

Cell: E95
Comment: 1072-20-01 - Run 2 (Cl2-D) 2/12/00 19:22
Original value (CoefB) = 57.9391 New value = 12.979
Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

Cell: F95
Comment: 1072-20-01 - Run 2 (Cl2-D) 2/12/00 19:22

Original value (CoefD) = 0.0336 New value = 0.0416
Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

Cell: J95
Comment: 1072-20-01 - Run 2 (Cl2-D) 2/12/00 19:22
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: C99
Comment: 1072-20-01 - Run 2 (DCBAA) 2/12/00 19:21
Original value (CoefA0) = -1.321 New value = -0.2323
Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

Cell: D99
Comment: 1072-20-01 - Run 2 (DCBAA) 2/12/00 19:21
Original value (CoefAf) = 6.6 New value = 3.5526
Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

Cell: E99
Comment: 1072-20-01 - Run 2 (DCBAA) 2/12/00 19:22
Original value (CoefB) = 48.822 New value = 8559.6957
Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

Cell: F99
Comment: 1072-20-01 - Run 2 (DCBAA) 2/12/00 19:22
Original value (CoefD) = 0.097 New value = 0.2386
Peak curve fit with S = 0. Refit to type 1 curve fit by iterative curve fit procedure.

Cell: J99
Comment: 1072-20-01 - Run 2 (DCBAA) 2/12/00 19:22
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: C110
Comment: 1072-20-01 - Run 2 (TSUVA) 2/12/00 19:20
Original value (CoefA0) = -0.0808 New value = -1.0963
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: D110
Comment: 1072-20-01 - Run 2 (TSUVA) 2/12/00 19:20
Original value (CoefAf) = 2.3643 New value = 4.2547
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: E110
Comment: 1072-20-01 - Run 2 (TSUVA) 2/12/00 19:20
Original value (CoefB) = 10.3502 New value = 2.898
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Cell: F110
Comment: 1072-20-01 - Run 2 (TSUVA) 2/12/00 19:20
Original value (CoefD) = 0.0671 New value = 0.041

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

Cell: J110
Comment: 1072-20-01 - Run 2 (TSUVA) 2/12/00 19:20
Original value (S) = 0 New value = -0.0074
Poor peak curve fit. Data was refit by iterative curve fit procedure.

Fort Worth Water Department | **Pilot-Scale GAC Treatment Study Summary** | **Session:** 1

ICR Information

ID / ICR#: TX2200012 / 646
ICR Contact: Mr. Richard S. Talley
Phone No.: 817/572-7008
Period: 4/14/98 - 11/14/98 (214 days)

Design Information

Design TOC: 3.6 mg/L
Col Diameter: 76.2 mm
Full-Scale GAC Size: 8x20 US Std Mesh
Full-Scale particle dia.: 1.605 mm
Meas Dry Bed Density: 505.7 kg/m3

Water Quality Summary

Influent	Mean	SD	Count	Min/Max
TOC	3.6	0.6	15	2.8 - 4.9
pH	7.5	0.2	15	7.2 - 8.1
UV254	0.078	0.017	14	0.049 - 0.117
SUVA	2.15	0.25	14	1.8 - 2.6
Bromide	63	14	14	49 - 100
SDS-TOX	258	38	9	196 - 320
SDS-THM4	95	17	9	77 - 134
SDS-HAA6	45	9	9	32 - 63
Ammonia	0.02	0.04	15	0.00 - 0.10

Effluent	10 Min EBCT			(139 days)	20 Min EBCT			(214 days)
Effluent pH	7.5	0.3	15	7.2 - 8.2	7.4	0.4	15	6.9 - 8.5
Effluent Temp	24.0	1.2	15	21.0 - 26.6	24.5	1.7	15	21.0 - 27.5

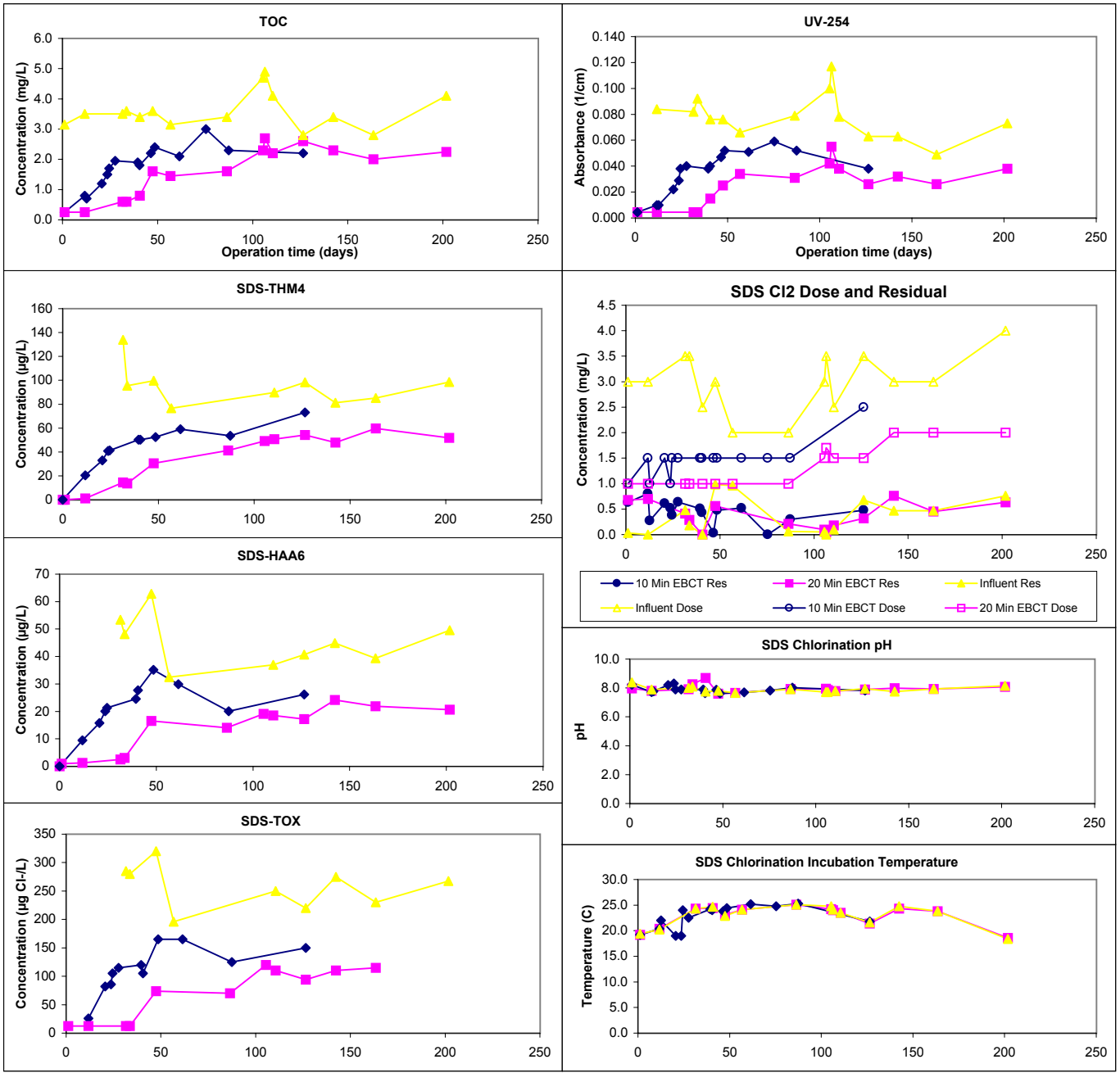
Cumulative SDS Conditions

	Mean	SD	Count	Min/Max
Res (10)	0.39	0.28	44	0.00 - 0.98
Temp	22.8	2.2	43	18.4 - 25.3
pH	7.9	0.2	45	7.6 - 8.7
Time	24.0	0.0	45	24.0 - 24.0

Comments:

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

Water Quality Parameter Graphs



Water Quality Parameter Graphs (Continued)