

ICR TREATMENT STUDY ANALYSIS

Base Analysis and Data Review Comments

Treatment Study ID	1014
Study Protocol	Membrane Pilot-Scale treatment study
Plant ICR Number	1074
PWS Name	City of Daytona Beach
City, State, Zip	Daytona Beach, FL 32115-2451

General Comments:

1. One conceptual design for expansion of the existing 24 MGD lime softening plant is to provide additional capacity with a membrane treatment train. Effluent from the lime softening and membrane trains would be blended prior to distribution. Concentrate disposal options include: “1.) blending directly into a wastewater treatment system, 2.) discharge to a 15 MGD wastewater treatment plant, or 3.) routing to a permitted discharge point (Class III marine waterway).”
2. In addition to chlorine/chloramine disinfection, the plant uses pre-ozonation prior to lime softening and post-ozonation after recarbonation. See Figure 1 in the Summary Report.
3. The operational start time for this study is 1746 hours. Prior to this start time, the system was run to smooth out operational issues.

Water Quality Comments:

1. Twelve water quality outliers were identified and removed prior to base analysis.
2. A constant SDS incubation time of 27 hours was used throughout the study. Per utility, all samples were taken down at 27 hours plus or minus 15 minutes. All SDS incubation times are reported as 27 hours. SDS incubation temperature of 22°C was used during October – March and 26°C during April – September. Samples were held in an incubator maintained at the target temperature. SDS pH ranged from 7.8 to 8.3.
3. The Stage 2 Influent water quality parameters were reported incorrectly for weeks 2 through 10; however the utility verified these values. The values reported for the Stage 2 Influent concentrations are equal to the System Concentrate concentrations in violation of mass balance relationships. The Stage 2 Influent data should not be used.

Productivity Comments:

1. Zero productivity outliers were identified.
2. During EPA data analysis, the average sustained system flux and specific flux were 14.16 ± 0.57 gfd and 0.085 ± 0.009 gfd/psi, respectively. The projected cleaning interval for this membrane system was 140 ± 62 days, based on the calculated slope of the flux decline curve and a 15% decrease in specific flux.

ICR Information

ID / ICR#: FL3640275 / 1074
 ICR Contact: James C. Thurrott
 Phone No.: 904-258-3143
 Period: 1/5/98 - 3/16/98 (70 days)

Membrane Information

Manufacturer: Film Tec Corporation
 Trade Name: FILMTEC
 Membrane Model: BW30-4040
 MWCO: 100 Daltons
 Element Size: 4" x 40"
 Element Area: 80.0 ft²
 Design Flux: 27.8 gfd
 Mfr. NDP: 225.0 psi
 Mfr. MTC_w: 0.124 (gfd/psi)
 Mfr. Temp: 25.0 °C
 Maximum Flow: 18.0 gpm
 Minimum Flow: 4.0 gpm
 Total Width: 12.6 ft
 Feed Spacer Thickness: 0.0023 ft
 840 Element Area: 400.0 ft²
 840 Purchase Price: \$650

Design Parameters

Norm Temp: 21.7 °C
 Temp Norm MTC-w: 0.112 TavGC
 Design Recovery: 0.71
 Avg Sys Flux F_w: 14.7 gfd
 # of Elem in P.V.: 3
 # Pres Ves in Stg 1: 2
 # Pres Ves in Stg 2: 1
 Pres Ves in Stg 3: NA
 Design Flux: 14.7 gfd
 Recycle Ratio: 0.27
 Osmotic P Stage 1: 0.0 psi
 Osmotic P Stage 2: 0.0 psi
 Osmotic P Stage 3: NA

Water Quality Summary

Feed (System)					Permeate (System)				Concentrate (System)				
Summary	Mean	SD	Count	Min/Max	Mean	SD	Count	Min/Max	Mean	SD	Count	Min/Max	
pH	6.7	0.4	5	6.2 - 7.0	5.0	0.0	5	5.0 - 5.1	7.0	0.1	5	6.9 - 7.1	
Temp	21.8	0.5	5	21.1 - 22.4	21.3	1.7	5	19.4 - 24.0	21.4	1.4	5	20.2 - 23.8	
Alk	245	53	5	150 - 273	2	2	5	0 - 4	883	55	5	788 - 925	
TDS	359	40	5	330 - 408	6	1	5	5 - 8	1108	169	5	1014 - 1404	
TotHard	304	10	5	290 - 316	5	9	5	0 - 20	1056	103	5	900 - 1170	
CaHard	274	2	5	272 - 276	3	4	5	0 - 8	908	59	5	810 - 960	
Turb	0.11	0.2	5	0.00 - 0.32	0.00	0.0	5	0.00 - 0.00	7.78	3.4	5	5.10 - 12.00	
Amm	0.28	0.03	5	0.25 - 0.32	0.05	0.01	5	0.04 - 0.07	0.80	0.09	5	0.7 - 0.9	
TOC	9.4	0.8	5	8.4 - 10.5	0.5	0.5	5	0.3 - 1.4	30.5	3.2	5	26.4 - 33.9	
UV254	0.286	0.0	5	0.270 - 0.308	0.005	0.0	5	0.005 - 0.005	0.969	0.1	5	0.854 - 1.090	
SUVA	3.03	0.14	5	2.88 - 3.20	1.50	0.66	5	0.32 - 1.80	3.18	0.14	5	2.95 - 3.32	
Bromide	93	2	5	90 - 94	10	0	5	10 - 10					
TOX	1320	130	5	1100 - 1400	24	17	5	13 - 48					
CHCl3	175.0	48.0	5	145.0 - 260.0	0.0	0.0	5	0.0 - 0.0	Mass Balance Closure Errors (%)				
BDCM	25.5	4.2	5	22.5 - 33.0	0.0	0.0	5	0.0 - 0.0					
DBCM	2.7	0.6	5	1.7 - 3.3	0.0	0.0	5	0.0 - 0.0	WQP	Count	Avg	SD/RD	
CHBr3	0.0	0.0	5	0.0 - 0.0	0.0	0.0	5	0.0 - 0.0	Alk	2	20	23	
THM4	203.2	52.5	5	170.5 - 296.3	0.0	0.0	5	0.0 - 0.0	TDS	5	-12	15	
MCAA	4.5	0.7	5	3.3 - 5.0	0.0	0.0	5	0.0 - 0.0	TotHard	2	8	1	
DCAA	59.1	5.3	5	50.5 - 64.0	0.0	0.0	5	0.0 - 0.0	CaHard	2	0	4	
TCAA	72.7	15.2	5	60.0 - 98.0	0.0	0.0	5	0.0 - 0.0	Turb	0	n/a	n/a	
MBAA	0.8	0.7	5	0.0 - 1.5	0.0	0.0	5	0.0 - 0.0	Amm	5	-6	7	
DBAA	0.0	0.0	5	0.0 - 0.0	0.0	0.0	5	0.0 - 0.0	TOC	1	10	n/a	
BCAA	1.3	2.0	5	0.0 - 4.4	0.0	0.0	5	0.0 - 0.0	UV254	1	1	n/a	
TBAA	NA	NA	0	NA	NA	NA	0	NA	TDS _t	70	-1	4	
CDBAA	NA	NA	0	NA	NA	NA	0	NA					
DCBAA	NA	NA	0	NA	NA	NA	0	NA					
HAA5	137.0	18.9	5	117.9 - 167.0	0.0	0.0	5	0.0 - 0.0	Comments:				
HAA6	138.3	18.5	5	117.9 - 167.0	0.0	0.0	5	0.0 - 0.0					
HAA9	NA	NA	0	NA	NA	NA	0	NA					
SDS Conditions					Pretreatment Information								
WQP	Avg	SD	Count	Min - Max	Process		Description					Scale	
Res (0)	0.69	0.16	10	0.50 - 0.90	Antiscalant Addition		Polyacrylic Acid / Antiscalant 3 mg/l					Pilot	
Temp (°C)	22.0	0.0	10	22.0 - 22.0	Acid Addition		66 Deg. Baume / Sulfuric Acid 30.8 mg/l					Pilot	
pH (unit)	8.0	0.1	10	7.8 - 8.2	Cartridge Filtration							Pilot	
Time (hr)	27.0	0.0	10	27.0 - 27.0									

Mass Balance Errors

Pressure	RPD	SD	Flow	RPD	SD	TDS	RPD	SD
System Inf - Stg 1 Inf	0.0%	0.0%	System Inf - Stg 1 Inf	0.0%	0.0%	System Inf - Stg 1 Inf	-41.4%	0.0%
Sys Conc - Stg 2 Conc	0.0%	1.1%	Sys Conc - Stg 2 Conc	0.0%	0.0%	Sys Conc - Stg 2 Conc	0.0%	0.0%
Stg 1 Conc - Stg 2 Inf	-0.2%	1.7%	Stg 1 Conc - Stg 2 Inf	0.0%	0.0%	Stg 1 Conc - Stg 2 Inf	0.3%	1.4%
Sys Perm - Avg Stg Perm	0.2%	0.9%	Sys Perm - Sum Stg Per	0.0%	0.0%	Sys Perm - Avg Stg Perm	19.5%	14.0%

Stage Summary

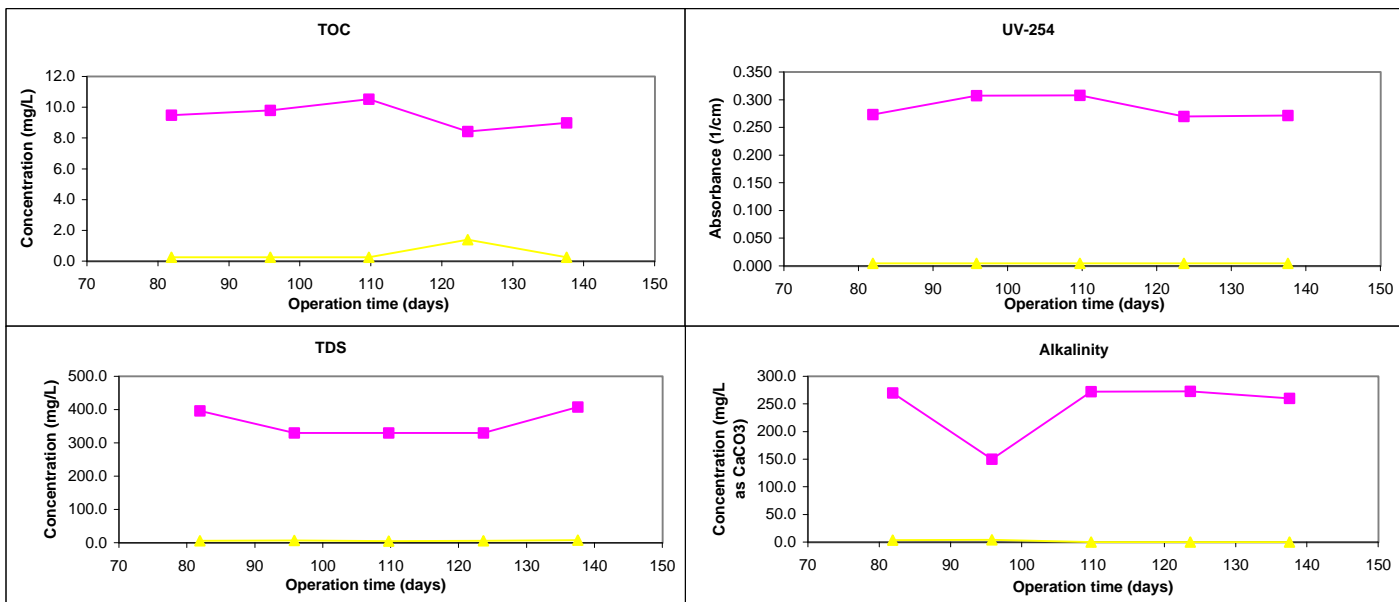
	Stage 1 Influent						Stage 1 Permeate				
WQP	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.48	0.00	5	0.48 - 0.48					
pH	6.7	7.0	6.9	0.1	5	6.8 - 7.1	5.0	7.5	0.2	5	7.3 - 7.7
Temp	21.8	21.4	21.1	0.7	5	20.4 - 22.0	21.3	23.2	0.6	5	22.4 - 24.0
Alk	245	883	388	18	5	360 - 400	2	0	0	5	0 - 0
TDS	359	1108	621	0	5	621 - 621	6	4	0	5	4 - 5
TotHard	304	1056	435	20	5	420 - 468	5	0	0	5	0 - 0
CaHard	274	908	407	23	5	368 - 426	3	4	4	5	0 - 8
Turb	0.11	7.78	0.94	0	5	0.44 - 1.68	0.00	0.09	0.12	5	0 - 0
TOC	9.4	30.5	13.3	1.4	5	11.8 - 15.1	0.5	0.5	0.4	5	0.3 - 1.1
UV254	0.286	0.969	0.426	0.033	5	0.398 - 0.471	0.005	0.005	0.000	5	0.005 - 0.005
SUVA	3.03	3.18	3.20	0.14	5	2.98 - 3.37	1.50	1.34	0.65	5	0.42 - 1.80
	Stage 2 Influent						Stage 2 Permeate				
WQP	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.36	0.00	5	0.36 - 0.36					
pH	6.7	7.0	7.5	0.2	5	7.3 - 7.7	5.0	5.7	0.0	5	5.7 - 5.7
Temp	21.8	21.4	19.5	0.6	5	18.9 - 20.0	21.3	20.9	0.7	5	20.2 - 21.7
Alk	245	883	883	55	5	788 - 925	2	77	167	5	0 - 375
TDS	359	1108	1061	45	5	1014 - 1110	6	6	1	5	5 - 6
TotHard	304	1056	1056	103	5	900 - 1170	5	0	0	5	0 - 0
CaHard	274	908	906	63	5	800 - 960	3	4	5	5	0 - 10
Turb	0.11	7.78	7.78	3	5	5.10 - 12.00	0.00	0.00	0.00	5	0 - 0
TOC	9.4	30.5	28.5	3.9	5	23.5 - 33.9	0.5	0.3	0.1	5	0.3 - 0.6
UV254	0.286	0.969	0.962	0.097	5	0.855 - 1.063	0.005	0.005	0.000	5	0.005 - 0.005
SUVA	3.03	3.18	3.43	0.62	5.00	2.95 - 4.52	1.50	1.60	0.45	5.00	0.80 - 1.80
	Stage 3 Influent						Stage 3 Permeate				
WQP	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery											
pH											
Temp											
Alk											
TDS											
TotHard											
CaHard											
Turb											
TOC											
UV254											
SUVA											

This was only a two stage study.

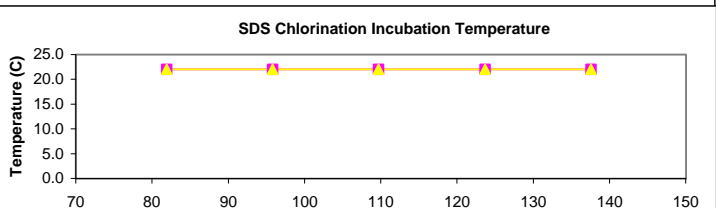
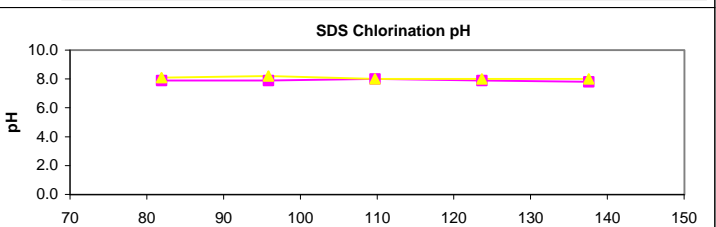
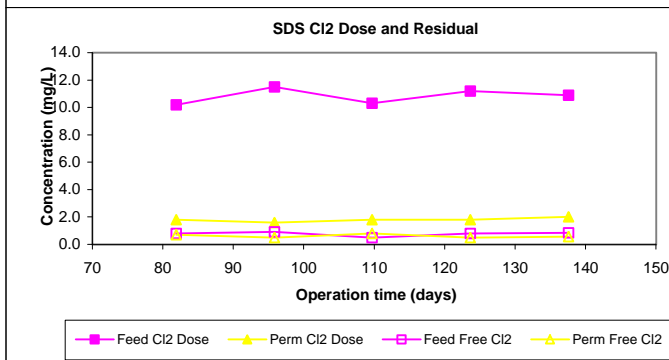
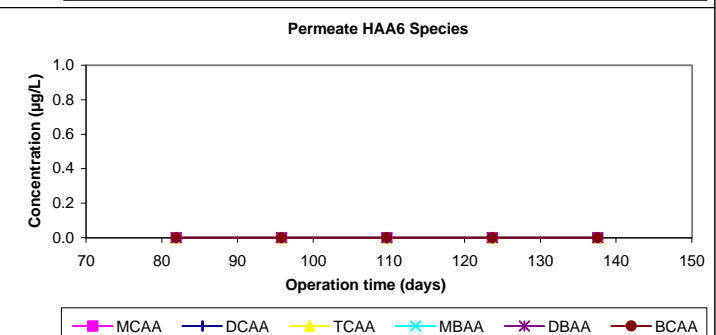
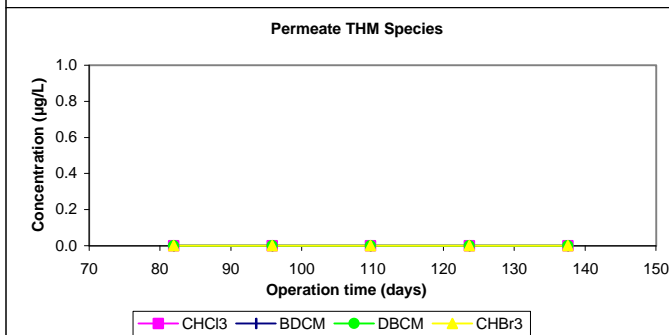
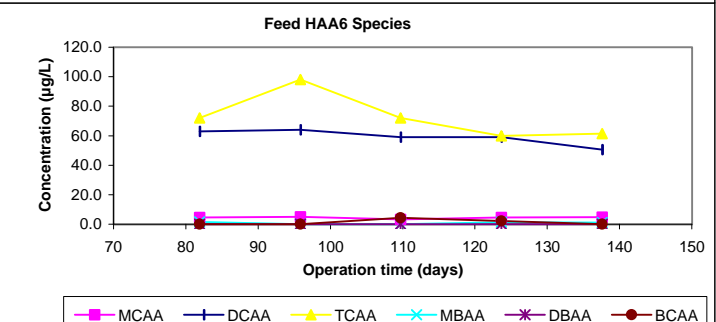
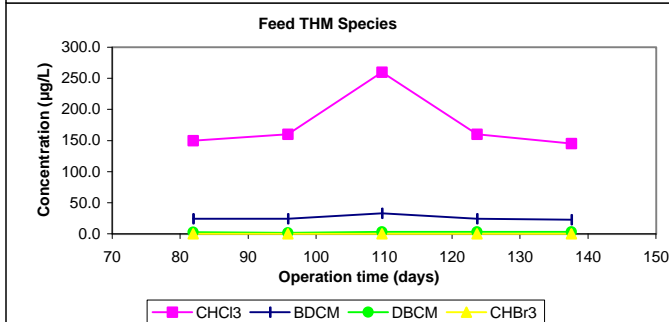
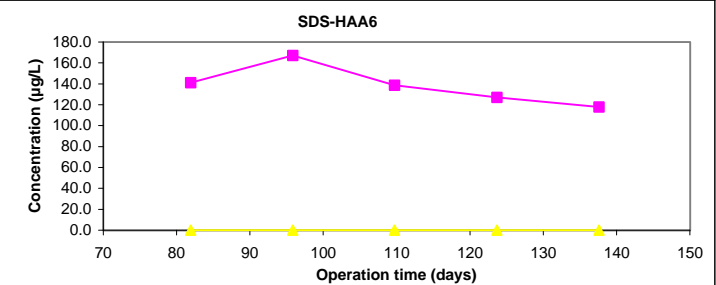
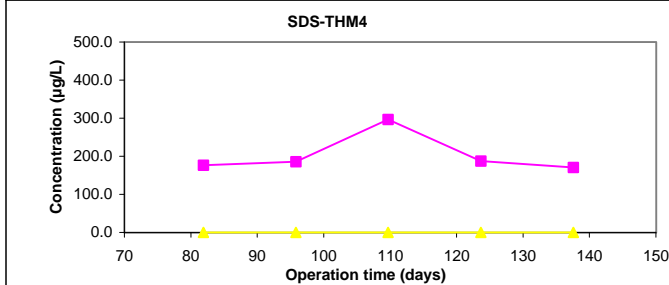
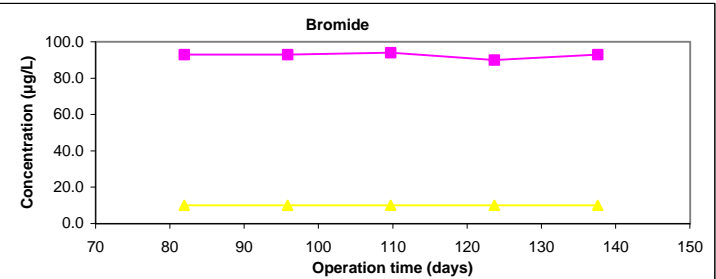
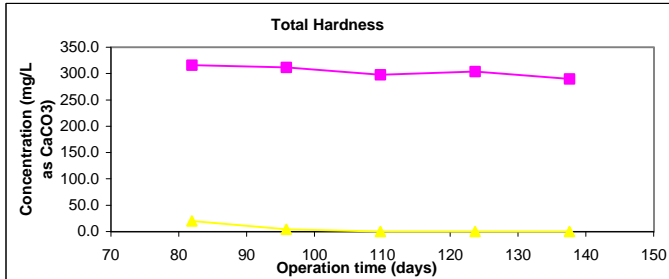
Chart Legend:

- Feed (System)
- Permeate (System)

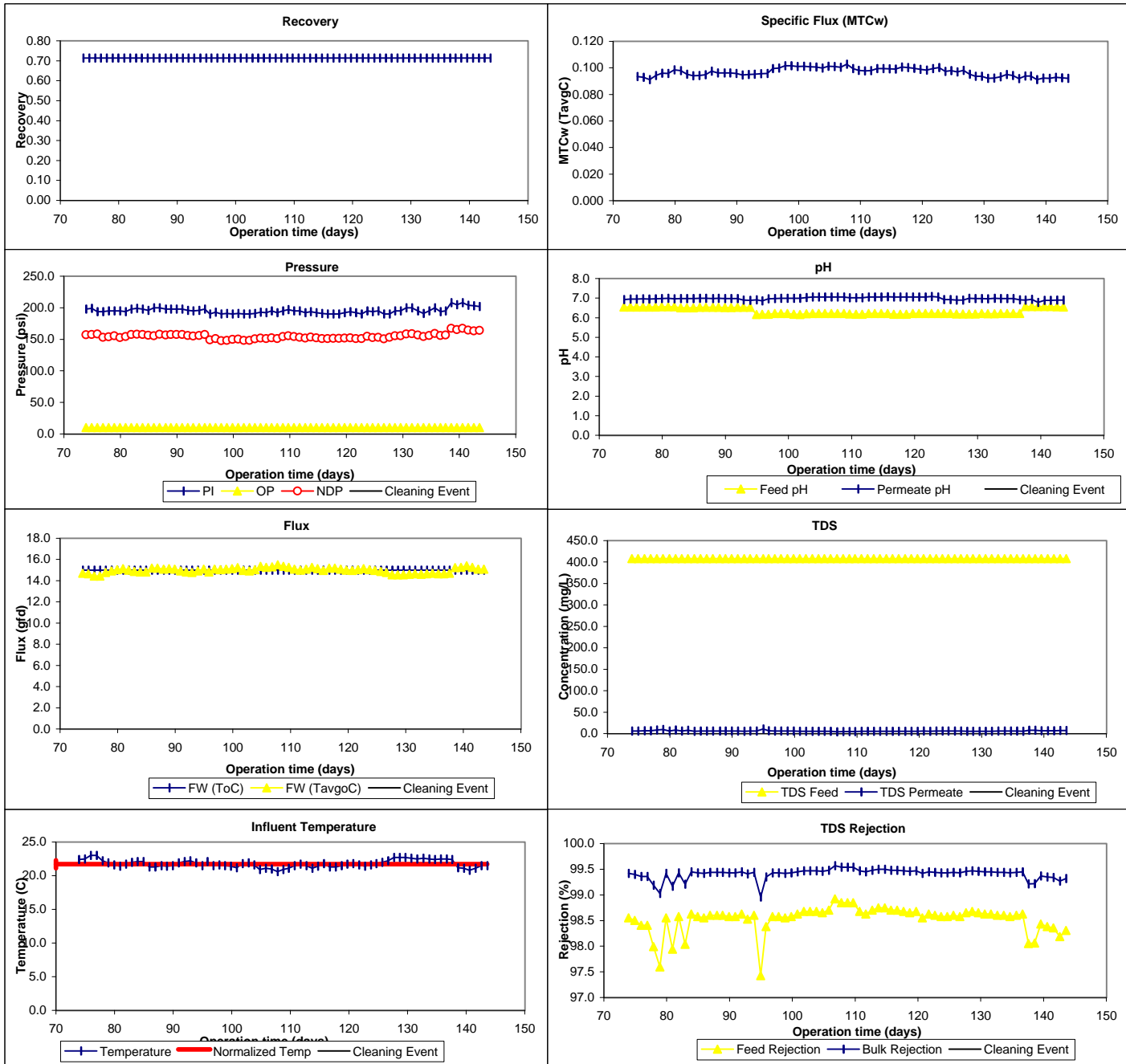
Water Quality Parameter Graphs



Water Quality Graphs (Continued)



Productivity Graphs



ICR Information

ID / ICR#: FL3640275 / 1074
 ICR Contact: James C. Thurrott
 Phone No.: 904-258-3143
 Period: 3/17/98 - 5/26/98 (70 days)

Membrane Information

Manufacturer: FilmTec Corporation
 Trade Name: FilmTec Corporation
 Membrane Model: BW30-4040
 MWCO: 100 Daltons
 Element Size: 4" x 40"
 Element Area: 80.0 ft²
 Design Flux: 27.8 gfd
 Mfr. NDP: 225.0 psi
 Mfr. MTC_w: 0.124 (gfd/psi)
 Mfr. Temp: 25.0 °C
 Maximum Flow: 18.0 gpm
 Minimum Flow: 4.0 gpm
 Total Width : 12.6 ft
 Feed Spacer Thickness: 0.0023 ft
 840 Element Area 400.0 ft²
 840 Purchase Price: \$650

Design Parameters

Norm Temp: 21.7 °C
 Temp Norm MTC-w: 0.112 TavGC
 Design Recovery: 0.71
 Avg Sys Flux F_w: 14.7 gfd
 # of Elem in P.V.: 3
 # Pres Ves in Stg 1: 2
 # Pres Ves in Stg 2: 1
 Pres Ves in Stg 3: NA
 Design Flux: 14.7 gfd
 Recycle Ratio: 0.27
 Osmotic P Stage 1: 0.0 psi
 Osmotic P Stage 2: 0.0 psi
 Osmotic P Stage 3: NA

Water Quality Summary

Feed (System)					Permeate (System)				Concentrate (System)			
Summary	Mean	SD	Count	Min/Max	Mean	SD	Count	Min/Max	Mean	SD	Count	Min/Max
pH	6.4	0.4	5	6.0 - 6.8	5.4	0.2	5	5.1 - 5.5	6.5	0.5	5	5.8 - 7.0
Temp	22.0	0.6	5	21.5 - 22.9	22.3	1.1	5	20.5 - 23.2	22.2	0.9	5	20.7 - 22.9
Alk	214	83	5	120 - 283	2	2	5	0 - 4	679	227	5	388 - 875
TDS	396	0	5	396 - 396	9	3	5	6 - 13	1574	248	5	1404 - 1950
TotHard	311	5	5	304 - 316	0	0	5	0 - 0	1132	173	5	1040 - 1440
CaHard	276	9	5	266 - 286	0	0	5	0 - 0	1036	161	5	950 - 1320
Turb	20.00	44.7	5	0.00 - 100.00	0.00	0.0	5	0.00 - 0.00	5.54	4.1	5	0.32 - 11.80
Amm	0.26	0.05	5	0.19 - 0.31	0.09	0.02	5	0.06 - 0.10	0.65	0.15	5	0.5 - 0.8
TOC	9.1	0.6	5	8.3 - 9.9	0.3	0.0	5	0.3 - 0.3	31.6	4.7	5	27.1 - 37.7
UV254	0.280	0.0	5	0.261 - 0.304	0.005	0.0	5	0.005 - 0.005	1.010	0.1	5	0.883 - 1.198
SUVA	3.09	0.19	5	2.81 - 3.29	1.80	0.00	5	1.80 - 1.80	3.21	0.27	5	2.85 - 3.60
Bromide	95	8	5	84 - 100	10	0	5	10 - 10				
TOX	1288	193	4	1100 - 1500	13	0	5	13 - 13				
CHCl3	171.0	14.3	5	160.0 - 195.0	0.9	0.9	5	0.0 - 2.2	Mass Balance Closure Errors (%)			
BDCM	25.1	2.2	5	22.0 - 27.5	0.0	0.0	5	0.0 - 0.0				
DBCM	2.8	0.3	5	2.3 - 3.1	0.0	0.0	5	0.0 - 0.0	WQP	Count	Avg	SD/RD
CHBr3	0.0	0.0	5	0.0 - 0.0	0.0	0.0	5	0.0 - 0.0	Alk	2	-19	0
THM4	198.9	15.6	5	185.0 - 225.3	0.9	0.9	5	0.0 - 2.2	TDS	5	6	3
MCAA	5.0	3.2	5	0.0 - 8.9	4.0	7.4	5	0.0 - 17.0	TotHard	0	n/a	n/a
DCAA	47.2	16.0	5	23.0 - 61.0	0.0	0.0	5	0.0 - 0.0	CaHard	0	n/a	n/a
TCAA	62.1	30.8	5	11.0 - 94.5	0.0	0.0	5	0.0 - 0.0	Turb	0	n/a	n/a
MBAA	0.9	0.5	5	0.0 - 1.2	0.0	0.0	5	0.0 - 0.0	Amm	5	-11	12
DBAA	0.3	0.7	5	0.0 - 1.6	0.0	0.0	5	0.0 - 0.0	TOC	0	n/a	n/a
BCAA	2.6	1.8	5	0.0 - 5.0	0.0	0.0	5	0.0 - 0.0	UV254	0	n/a	n/a
TBAA	NA	NA	0	NA	NA	NA	0	NA	TDS _t	69	0	8
CDBAA	NA	NA	0	NA	NA	NA	0	NA				
DCBAA	NA	NA	0	NA	NA	NA	0	NA				
HAA5	115.5	44.3	5	36.8 - 143.6	4.0	7.4	5	0.0 - 17.0	Comments:			
HAA6	118.1	43.0	5	41.8 - 146.4	4.0	7.4	5	0.0 - 17.0				
HAA9	NA	NA	0	NA	NA	NA	0	NA				
SDS Conditions					Pretreatment Information							
WQP	Avg	SD	Count	Min - Max	Process		Description		Scale			
Res (0)	0.98	0.84	10	0.20 - 3.10	Antiscalant Addition		Polyacrylic Acid / Antiscalant 3 mg/l		Pilot			
Temp (°C)	25.2	1.7	10	22.0 - 26.0	Acid Addition		66 Deg. Baume / Sulfuric Acid 30.8 mg/l		Pilot			
pH (unit)	8.1	0.1	10	7.9 - 8.3	Cartridge Filtration				Pilot			
Time (hr)	27.0	0.0	10	27.0 - 27.0								

Mass Balance Errors

Pressure	RPD	SD	Flow	RPD	SD	TDS	RPD	SD
System Inf - Stg 1 Inf	0.0%	0.0%	System Inf - Stg 1 Inf	0.0%	0.0%	System Inf - Stg 1 Inf	-44.6%	8.4%
Sys Conc - Stg 2 Conc	0.2%	1.3%	Sys Conc - Stg 2 Conc	-0.2%	0.9%	Sys Conc - Stg 2 Conc	0.0%	2.5%
Stg 1 Conc - Stg 2 Inf	-0.1%	0.2%	Stg 1 Conc - Stg 2 Inf	-0.2%	0.6%	Stg 1 Conc - Stg 2 Inf	0.4%	3.3%
Sys Perm - Avg Stg Perm	0.1%	1.6%	Sys Perm - Sum Stg Per	0.0%	0.0%	Sys Perm - Avg Stg Perm	19.2%	12.9%

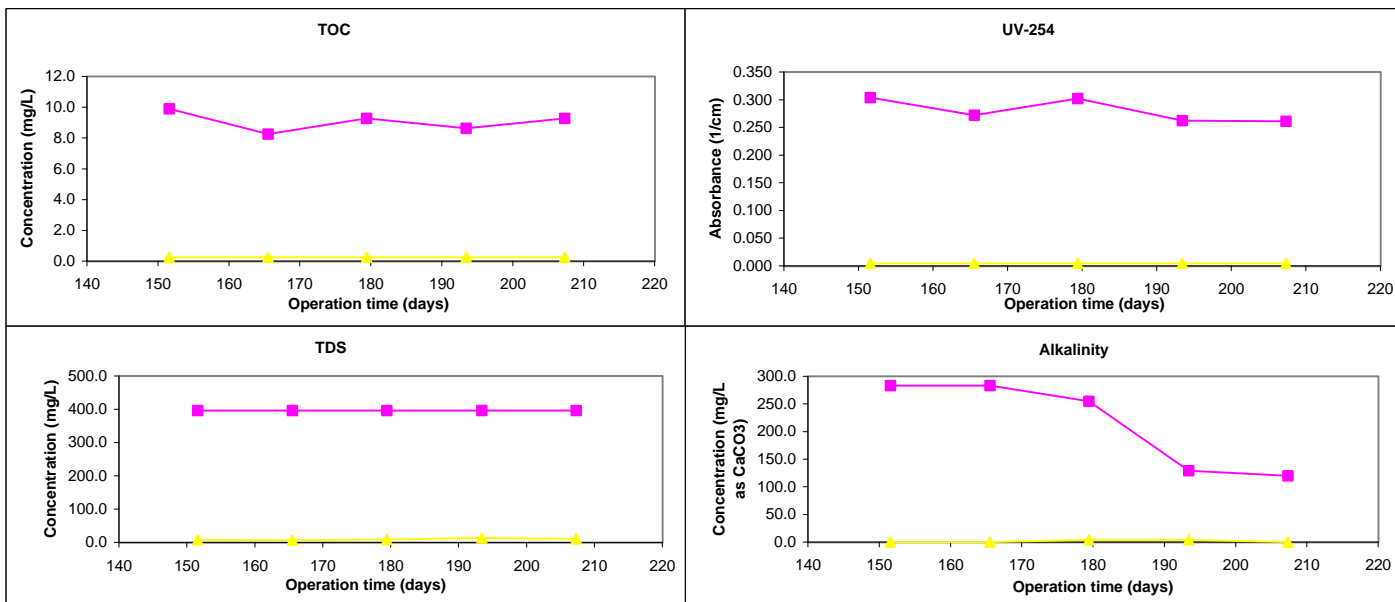
Stage Summary

	Stage 1 Influent						Stage 1 Permeate				
WQP	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.48	0.02	5	0.46 - 0.50					
pH	6.4	6.5	6.5	0.5	5	5.9 - 6.9	5.4	7.0	0.3	5	6.6 - 7.3
Temp	22.0	22.2	22.6	1.0	5	20.9 - 23.4	22.3	23.1	0.8	5	22.3 - 24.5
Alk	214	679	322	104	5	186 - 410	2	0	0	5	0 - 0
TDS	396	1574	634	135	5	408 - 759	9	6	2	5	4 - 9
TotHard	311	1132	467	64	5	424 - 580	0	0	0	5	0 - 0
CaHard	276	1036	438	53	5	408 - 532	0	0	0	5	0 - 0
Turb	20.00	5.54	0.64	0	5	0.00 - 1.10	0.00	0.00	0.00	5	0 - 0
TOC	9.1	31.6	14.2	1.1	5	12.6 - 15.5	0.3	0.3	0.0	5	0.3 - 0.3
UV254	0.280	1.010	0.455	0.047	5	0.409 - 0.505	0.005	0.005	0.000	5	0.005 - 0.005
SUVA	3.09	3.21	3.20	0.17	5	2.96 - 3.40	1.80	1.80	0.00	5	1.80 - 1.80
	Stage 2 Influent						Stage 2 Permeate				
WQP	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.41	0.05	5	0.36 - 0.46					
pH	6.4	6.5	7.0	0.3	5	6.6 - 7.3	5.4	5.7	0.1	5	5.5 - 5.8
Temp	22.0	22.2	21.8	1.7	5	19.4 - 23.2	22.3	22.3	1.1	5	20.5 - 23.2
Alk	214	679	680	228	5	388 - 875	2	1	2	5	0 - 4
TDS	396	1574	1302	265	5	1036 - 1628	9	8	2	5	6 - 11
TotHard	311	1132	1104	199	5	910 - 1440	0	0	0	5	0 - 0
CaHard	276	1036	1008	189	5	810 - 1320	0	0	0	5	0 - 0
Turb	20.00	5.54	4.22	2	5	0.32 - 5.60	0.00	0.00	0.00	5	0 - 0
TOC	9.1	31.6	31.2	4.8	5	27.1 - 37.7	0.3	0.3	0.0	5	0.3 - 0.3
UV254	0.280	1.010	1.017	0.145	5	0.883 - 1.198	0.005	0.005	0.000	5	0.005 - 0.005
SUVA	3.09	3.21	3.26	0.22	5.00	3.00 - 3.60	1.80	1.80	0.00	5.00	1.80 - 1.80
	Stage 3 Influent						Stage 3 Permeate				
WQP	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery											
pH											
Temp											
Alk											
TDS											
TotHard											
CaHard											
Turb											
TOC											
UV254											
SUVA											

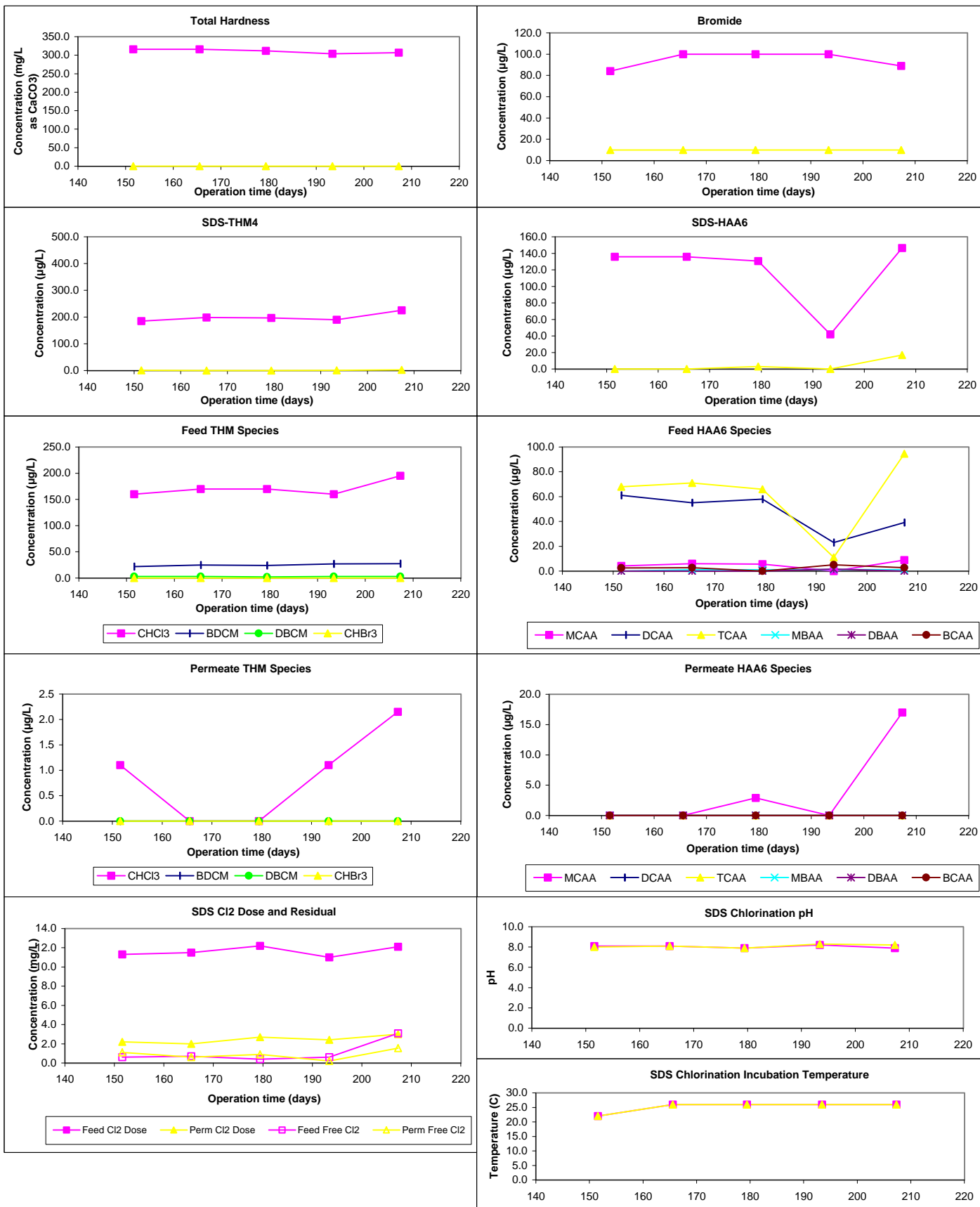
Chart Legend:

- Feed (System)
- Permeate (System)

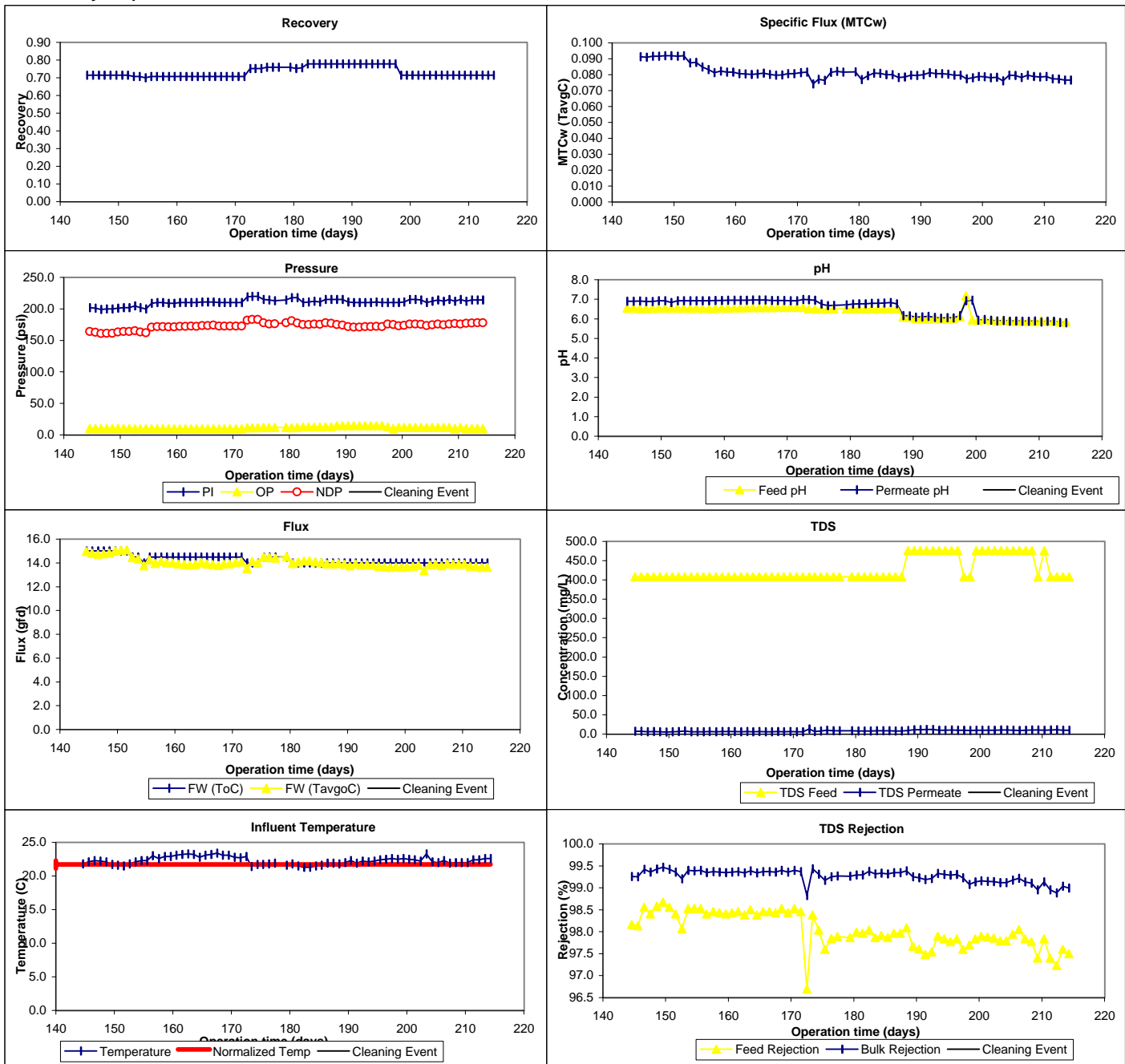
Water Quality Parameter Graphs



Water Quality Graphs (Continued)



Productivity Graphs



ICR Information

ID / ICR#: FL3640275 / 1074
 ICR Contact: James C. Thurrott
 Phone No.: 904-258-3143
 Period: 5/26/98 - 8/3/98 (69 days)

Membrane Information

Manufacturer: FilmTec Corporation
 Trade Name: FilmTec Corporation
 Membrane Model: BW30-4040
 MWCO: 100 Daltons
 Element Size: 4" x 40"
 Element Area: 80.0 ft²
 Design Flux: 27.8 gfd
 Mfr. NDP: 225.0 psi
 Mfr. MTC_w: 0.124 (gfd/psi)
 Mfr. Temp: 25.0 °C
 Maximum Flow: 18.0 gpm
 Minimum Flow: 4.0 gpm
 Total Width: 12.6 ft
 Feed Spacer Thickness: 0.0023 ft
 840 Element Area: 400.0 ft²
 840 Purchase Price: \$650

Design Parameters

Norm Temp: 21.7 °C
 Temp Norm MTC-w: 0.112 TavGC
 Design Recovery: 0.71
 Avg Sys Flux F_w: 14.7 gfd
 # of Elem in P.V.: 3
 # Pres Ves in Stg 1: 2
 # Pres Ves in Stg 2: 1
 Pres Ves in Stg 3: NA
 Design Flux: 14.7 gfd
 Recycle Ratio: 0.27
 Osmotic P Stage 1: 0.0 psi
 Osmotic P Stage 2: 0.0 psi
 Osmotic P Stage 3: NA

Water Quality Summary

Summary	Feed (System)				Permeate (System)				Concentrate (System)			
	Mean	SD	Count	Min/Max	Mean	SD	Count	Min/Max	Mean	SD	Count	Min/Max
pH	5.9	0.4	5	5.6 - 6.6	5.5	0.0	5	5.5 - 5.5	5.8	0.3	5	5.6 - 6.4
Temp	22.8	0.2	5	22.5 - 23.0	24.1	0.2	5	23.8 - 24.3	24.0	0.4	5	23.5 - 24.4
Alk	98	76	5	38 - 225	2	2	5	0 - 4	300	215	5	110 - 663
TDS	396	0	5	396 - 396	11	1	5	9 - 13	1513	89	5	1404 - 1638
TotHard	304	12	5	292 - 320	0	0	5	0 - 0	1060	150	5	860 - 1200
CaHard	271	7	5	262 - 278	0	0	5	0 - 0	930	108	5	780 - 1050
Turb	0.00	0.0	5	0.00 - 0.00	0.00	0.0	5	0.00 - 0.00	1.74	2.9	5	0.38 - 7.00
Amm	0.16	0.07	5	0.07 - 0.23	0.06	0.05	5	0.02 - 0.11	0.47	0.05	5	0.4 - 0.5
TOC	9.5	1.1	5	8.7 - 11.3	0.3	0.2	5	0.3 - 0.7	31.7	2.9	5	28.2 - 34.1
UV254	0.280	0.0	5	0.266 - 0.303	0.005	0.0	5	0.005 - 0.005	0.974	0.1	5	0.846 - 1.108
SUVA	2.97	0.37	5	2.39 - 3.27	1.57	0.52	5	0.64 - 1.80	3.09	0.35	5	2.53 - 3.39
Bromide	100	1	5	98 - 100	10	0	5	10 - 10				
TOX	240	NA	1	240 - 240	13	0	5	13 - 13				
CHCl3	181.0	33.6	5	160.0 - 240.0	1.1	0.6	5	0.0 - 1.7	Mass Balance			
BDCM	26.3	3.1	5	22.0 - 30.0	0.0	0.0	5	0.0 - 0.0	Closure Errors (%)			
DBCM	2.5	0.4	5	2.1 - 3.0	0.0	0.0	5	0.0 - 0.0	WQP	Count	Avg	SD/RD
CHBr3	0.0	0.0	5	0.0 - 0.0	0.0	0.0	5	0.0 - 0.0	Alk	2	-14	2
THM4	209.8	35.8	5	184.1 - 272.6	1.1	0.6	5	0.0 - 1.7	TDS	5	11	5
MCAA	5.5	0.5	5	5.0 - 6.3	0.0	0.0	5	0.0 - 0.0	TotHard	0	n/a	n/a
DCAA	59.2	6.8	5	49.0 - 66.0	0.0	0.0	5	0.0 - 0.0	CaHard	0	n/a	n/a
TCAA	79.4	7.6	5	70.0 - 89.0	0.0	0.0	5	0.0 - 0.0	Turb	0	n/a	n/a
MBAA	1.2	0.7	5	0.0 - 1.8	0.0	0.0	5	0.0 - 0.0	Amm	5	22	37
DBAA	0.0	0.0	5	0.0 - 0.0	0.0	0.0	5	0.0 - 0.0	TOC	1	-16	n/a
BCAA	2.4	1.7	5	1.3 - 5.3	0.0	0.0	5	0.0 - 0.0	UV254	0	n/a	n/a
TBAA	NA	NA	0	NA	NA	NA	0	NA	TDS	69	-4	8
CDBAA	NA	NA	0	NA	NA	NA	0	NA	Comments:			
DCBAA	NA	NA	0	NA	NA	NA	0	NA				
HAA5	145.3	12.4	5	130.6 - 158.1	0.0	0.0	5	0.0 - 0.0				
HAA6	147.6	13.3	5	132.1 - 163.4	0.0	0.0	5	0.0 - 0.0				
HAA9	NA	NA	0	NA	NA	NA	0	NA				
SDS Conditions					Pretreatment Information							
WQP	Avg	SD	Count	Min - Max	Process		Description		Scale			
Res (0)	0.89	0.26	10	0.60 - 1.45	Antiscalant Addition		Polyacrylic Acid / Antiscalant 3 mg/l		Pilot			
Temp (°C)	26.0	0.0	10	26.0 - 26.0	Acid Addition		66 Deg. Baume / Sulfuric Acid 30.8 mg/l		Pilot			
pH (unit)	8.0	0.1	10	7.8 - 8.1	Cartridge Filtration				Pilot			
Time (hr)	26.9	0.3	10	26.0 - 27.0								

Mass Balance Errors

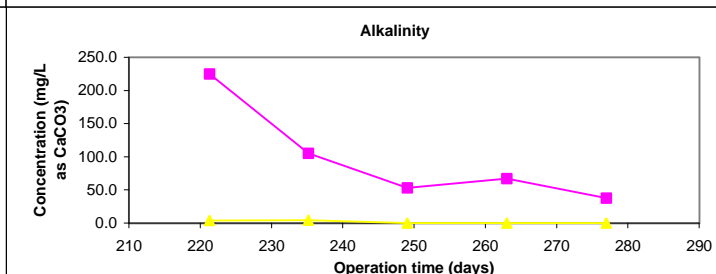
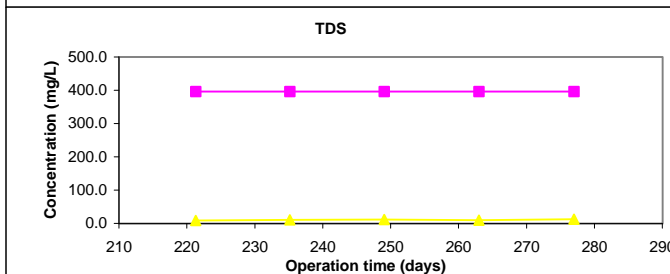
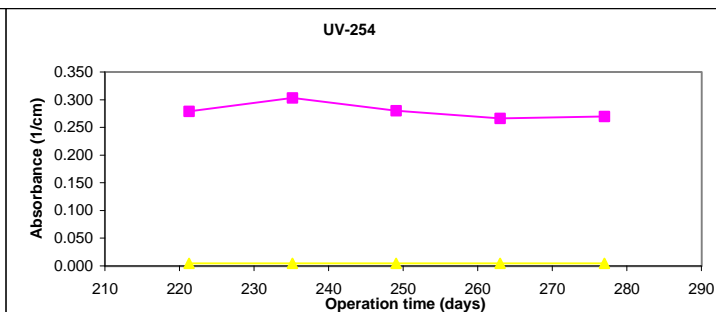
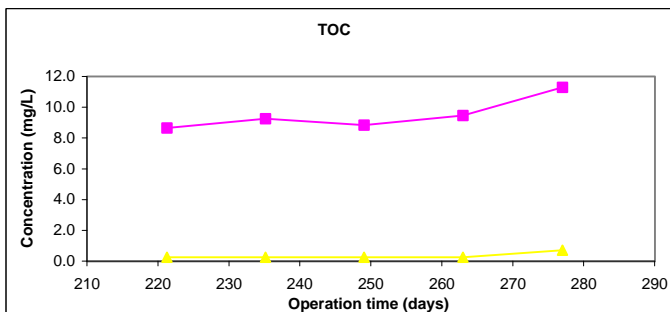
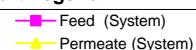
Pressure	RPD	SD	Flow	RPD	SD	TDS	RPD	SD
System Inf - Stg 1 Inf	0.0%	0.0%	System Inf - Stg 1 Inf	0.0%	0.0%	System Inf - Stg 1 Inf	-35.2%	6.5%
Sys Conc - Stg 2 Conc	0.1%	0.9%	Sys Conc - Stg 2 Conc	0.0%	0.0%	Sys Conc - Stg 2 Conc	0.0%	0.9%
Stg 1 Conc - Stg 2 Inf	0.0%	0.0%	Stg 1 Conc - Stg 2 Inf	0.0%	0.0%	Stg 1 Conc - Stg 2 Inf	-0.5%	2.5%
Sys Perm - Avg Stg Perm	0.2%	1.1%	Sys Perm - Sum Stg Per	0.0%	0.0%	Sys Perm - Avg Stg Perm	14.0%	13.3%

Stage Summary

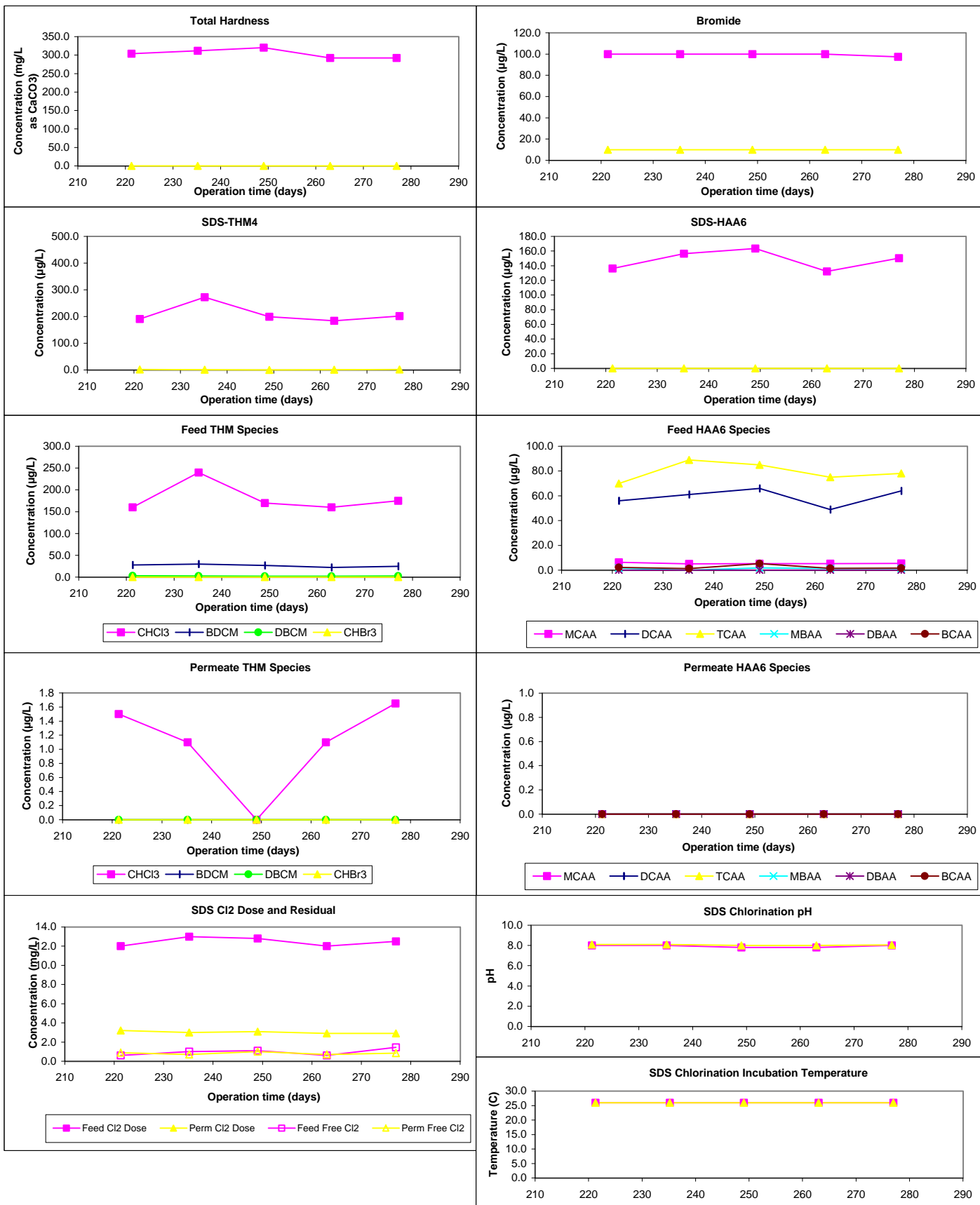
	Stage 1 Influent						Stage 1 Permeate				
WQP	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.46	0.00	5	0.46 - 0.46					
pH	5.9	5.8	5.9	0.4	5	5.6 - 6.6	5.5	6.4	0.7	5	5.6 - 7.5
Temp	22.8	24.0	24.2	0.2	5	24.0 - 24.5	24.1	23.8	0.2	5	23.6 - 24.1
Alk	98	300	152	106	5	66 - 328	2	1	2	5	0 - 4
TDS	396	1513	662	38	5	621 - 690	11	8	0	5	8 - 8
TotHard	304	1060	473	30	5	432 - 508	0	0	0	5	0 - 0
CaHard	271	930	417	31	5	388 - 464	0	0	0	5	0 - 0
Turb	0.00	1.74	0.88	1	5	0.23 - 2.60	0.00	0.00	0.00	5	0 - 0
TOC	9.5	31.7	13.7	1.0	5	13.0 - 15.4	0.3	0.3	0.0	5	0.3 - 0.3
UV254	0.280	0.974	0.412	0.083	5	0.270 - 0.486	0.005	0.005	0.000	5	0.005 - 0.005
SUVA	2.97	3.09	3.02	0.59	5	1.97 - 3.40	1.57	1.80	0.00	5	1.80 - 1.80
	Stage 2 Influent						Stage 2 Permeate				
WQP	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.38	0.00	5	0.38 - 0.38					
pH	5.9	5.8	6.4	0.7	5	5.6 - 7.5	5.5	5.7	0.0	5	5.7 - 5.8
Temp	22.8	24.0	24.1	0.1	5	24.0 - 24.2	24.1	24.0	0.2	5	23.8 - 24.3
Alk	98	300	300	215	5	110 - 663	2	2	3	5	0 - 6
TDS	396	1513	1347	62	5	1258 - 1406	11	9	1	5	8 - 10
TotHard	304	1060	1060	150	5	860 - 1200	0	0	0	5	0 - 0
CaHard	271	930	930	108	5	780 - 1050	0	0	0	5	0 - 0
Turb	0.00	1.74	1.74	3	5	0.38 - 7.00	0.00	0.00	0.00	5	0 - 0
TOC	9.5	31.7	31.5	4.0	5	28.2 - 37.3	0.3	0.3	0.1	5	0.3 - 0.5
UV254	0.280	0.974	0.974	0.094	5	0.846 - 1.108	0.005	0.005	0.000	5	0.005 - 0.005
SUVA	2.97	3.09	3.14	0.49	5.00	2.27 - 3.47	1.57	1.61	0.43	5.00	0.83 - 1.80
	Stage 3 Influent						Stage 3 Permeate				
WQP	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery											
pH											
Temp											
Alk											
TDS											
TotHard											
CaHard											
Turb											
TOC											
UV254											
SUVA											

Water Quality Parameter Graphs

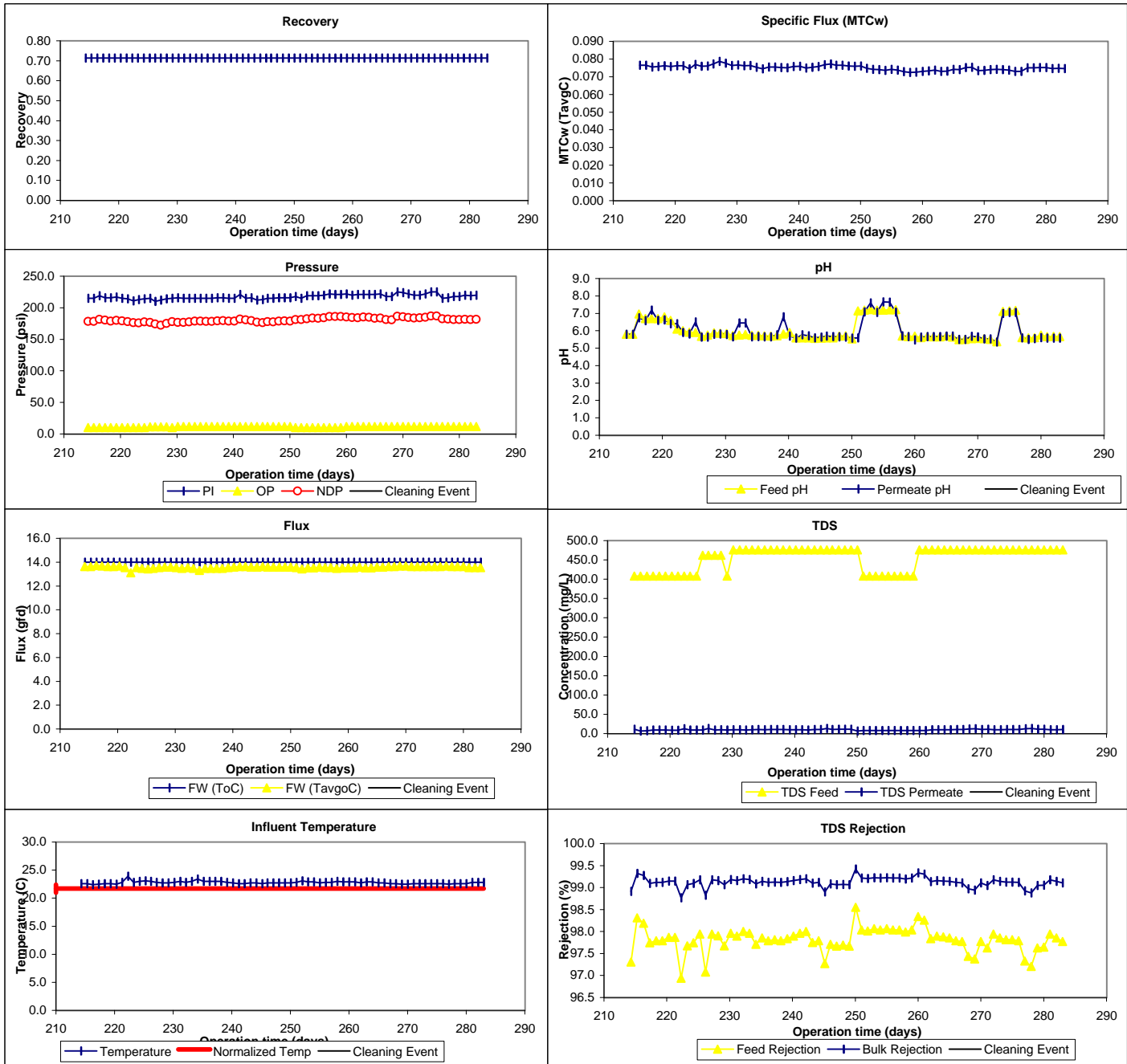
Chart Legend:



Water Quality Graphs (Continued)



Productivity Graphs



ICR Information

ID / ICR#: FL3640275 / 1074
 ICR Contact: James C. Thurrott
 Phone No.: 904-258-3143
 Period: 8/4/98 - 10/7/98 (64 days)

Membrane Information

Manufacturer: FilmTec Corporation
 Trade Name: FILMTEC
 Membrane Model: Bw30-4040
 MWCO: 100 Daltons
 Element Size: 4" x 40"
 Element Area: 80.0 ft²
 Design Flux: 27.8 gfd
 Mfr. NDP: 225.0 psi
 Mfr. MTC_w: 0.124 (gfd/psi)
 Mfr. Temp: 25.0 °C
 Maximum Flow: 18.0 gpm
 Minimum Flow: 4.0 gpm
 Total Width: 12.6 ft
 Feed Spacer Thickness: 0.0023 ft
 840 Element Area: 400.0 ft²
 840 Purchase Price: \$650

Design Parameters

Norm Temp: 21.7 °C
 Temp Norm MTC-w: 0.112 TavGC
 Design Recovery: 0.71
 Avg Sys Flux F_w: 14.7 gfd
 # of Elem in P.V.: 3
 # Pres Ves in Stg 1: 2
 # Pres Ves in Stg 2: 1
 Pres Ves in Stg 3: NA
 Design Flux: 14.7 gfd
 Recycle Ratio: 0.27
 Osmotic P Stage 1: 0.0 psi
 Osmotic P Stage 2: 0.0 psi
 Osmotic P Stage 3: NA

Water Quality Summary

Summary	Feed (System)				Permeate (System)				Concentrate (System)				
	Mean	SD	Count	Min/Max	Mean	SD	Count	Min/Max	Mean	SD	Count	Min/Max	
pH	6.4	0.4	5	6.1 - 7.1	5.3	0.3	5	4.8 - 5.5	6.3	0.2	5	6.2 - 6.6	
Temp	22.7	0.1	5	22.6 - 22.8	23.9	0.1	5	23.8 - 24.0	23.6	0.1	5	23.5 - 23.7	
Alk	175	103	5	80 - 296	2	3	5	0 - 7	512	308	5	238 - 970	
TDS	396	0	5	396 - 396	7	4	5	0 - 10	1482	0	5	1482 - 1482	
TotHard	310	24	5	280 - 342	1	3	5	0 - 6	1092	86	5	970 - 1200	
CaHard	270	8	5	262 - 280	0	1	5	0 - 2	980	110	5	880 - 1130	
Turb	0.16	0.2	5	0.00 - 0.37	0.00	0.0	5	0.00 - 0.00	1.70	2.2	5	0.26 - 5.40	
Amm	0.26	0.08	5	0.12 - 0.31	0.12	0.05	5	0.04 - 0.19	0.66	0.10	5	0.6 - 0.8	
TOC	8.6	0.8	5	7.7 - 9.5	0.3	0.0	5	0.3 - 0.3	30.2	3.1	5	27.2 - 34.2	
UV254	0.278	0.0	5	0.262 - 0.305	0.005	0.0	5	0.005 - 0.005	0.950	0.0	5	0.903 - 1.029	
SUVA	3.24	0.25	5	2.91 - 3.60	1.80	0.00	5	1.80 - 1.80	3.16	0.26	5	2.72 - 3.40	
Bromide	91	5	5	88 - 100	10	0	5	10 - 10					
TOX	758	375	5	240 - 1200	23	23	5	13 - 64					
CHCl3	162.0	27.7	5	130.0 - 200.0	0.0	0.0	5	0.0 - 0.0	Mass Balance Closure Errors (%)				
BDCM	27.2	1.3	5	25.0 - 28.0	0.0	0.0	5	0.0 - 0.0					
DBCM	2.5	0.3	5	2.2 - 2.8	0.0	0.0	5	0.0 - 0.0	WQP	Count	Avg	SD/RD	
CHBr3	0.0	0.0	5	0.0 - 0.0	0.0	0.0	5	0.0 - 0.0	Alk	2	-77	45	
THM4	191.7	28.7	5	157.8 - 230.3	0.0	0.0	5	0.0 - 0.0	TDS	4	6	0	
MCAA	5.0	0.9	5	3.8 - 5.9	0.0	0.0	5	0.0 - 0.0	TotHard	1	4	n/a	
DCAA	61.8	3.7	5	57.0 - 67.0	0.0	0.0	5	0.0 - 0.0	CaHard	0	n/a	n/a	
TCAA	75.3	7.5	5	67.0 - 84.0	0.0	0.0	5	0.0 - 0.0	Turb	0	n/a	n/a	
MBAA	0.4	0.6	5	0.0 - 1.1	0.0	0.0	5	0.0 - 0.0	Amm	5	7	51	
DBAA	0.0	0.0	5	0.0 - 0.0	0.0	0.0	5	0.0 - 0.0	TOC	0	n/a	n/a	
BCAA	5.2	0.6	5	4.7 - 6.2	0.0	0.0	5	0.0 - 0.0	UV254	0	n/a	n/a	
TBAA	NA	NA	0	NA	NA	NA	0	NA	TDS _t	64	2	5	
CDBAA	NA	NA	0	NA	NA	NA	0	NA					
DCBAA	NA	NA	0	NA	NA	NA	0	NA					
HAA5	142.5	7.3	5	135.6 - 153.0	0.0	0.0	5	0.0 - 0.0	Comments:				
HAA6	147.7	7.2	5	140.8 - 157.7	0.0	0.0	5	0.0 - 0.0					
HAA9	NA	NA	0	NA	NA	NA	0	NA					
SDS Conditions					Pretreatment Information								
WQP	Avg	SD	Count	Min - Max	Process		Description					Scale	
Res (0)	1.07	0.37	10	0.50 - 1.60	Antiscalant Addition		Polyacrylic Acid / Antiscalant 3 mg/l					Pilot	
Temp (°C)	26.0	0.0	10	26.0 - 26.0	Acid Addition		66 Deg. Baume / Sulfuric Acid 30.8 mg/l					Pilot	
pH (unit)	8.1	0.1	10	8.0 - 8.3	Cartridge Filtration							Pilot	
Time (hr)	27.0	0.0	10	27.0 - 27.0									

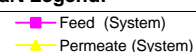
Mass Balance Errors

Pressure	RPD	SD	Flow	RPD	SD	TDS	RPD	SD
System Inf - Stg 1 Inf	0.0%	0.0%	System Inf - Stg 1 Inf	0.0%	0.0%	System Inf - Stg 1 Inf	-40.9%	2.6%
Sys Conc - Stg 2 Conc	-0.6%	1.3%	Sys Conc - Stg 2 Conc	0.0%	0.0%	Sys Conc - Stg 2 Conc	0.0%	0.0%
Stg 1 Conc - Stg 2 Inf	0.0%	0.7%	Stg 1 Conc - Stg 2 Inf	0.0%	0.0%	Stg 1 Conc - Stg 2 Inf	0.4%	2.1%
Sys Perm - Avg Stg Perm	0.2%	1.1%	Sys Perm - Sum Stg Per	0.0%	0.0%	Sys Perm - Avg Stg Perm	13.4%	12.8%

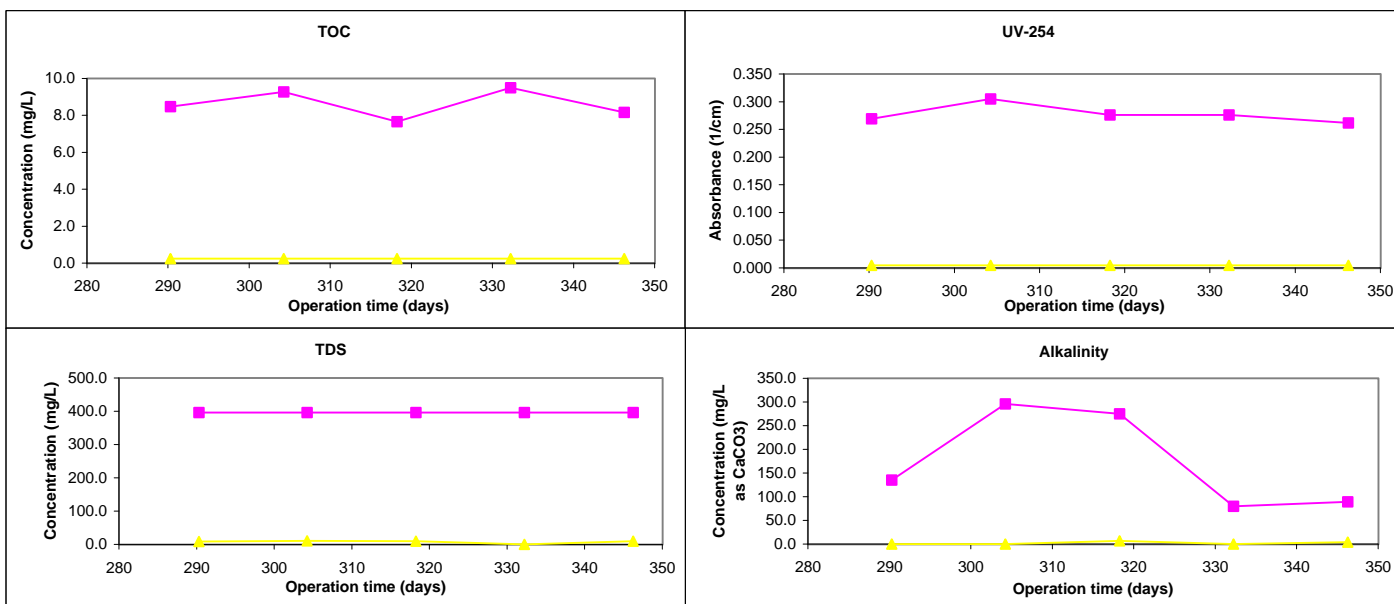
Stage Summary

	Stage 1 Influent						Stage 1 Permeate				
WQP	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.50	0.00	5	0.50 - 0.50					
pH	6.4	6.3	6.5	0.6	5	6.2 - 7.5	5.3	6.2	0.7	5	5.0 - 6.8
Temp	22.7	23.6	23.9	0.7	5	22.7 - 24.3	23.9	23.7	0.2	5	23.5 - 23.9
Alk	175	512	277	150	5	110 - 452	2	2	2	5	0 - 5
TDS	396	1482	621	0	5	621 - 621	7	6	4	5	0 - 8
TotHard	310	1092	443	16	5	416 - 456	1	0	1	5	0 - 2
CaHard	270	980	420	24	5	384 - 444	0	0	0	5	0 - 0
Turb	0.16	1.70	2.33	3	5	0.48 - 6.60	0.00	0.00	0.00	5	0 - 0
TOC	8.6	30.2	13.5	1.1	5	12.2 - 14.8	0.3	0.3	0.2	5	0.3 - 0.6
UV254	0.278	0.950	0.437	0.033	5	0.399 - 0.478	0.005	0.005	0.000	5	0.005 - 0.005
SUVA	3.24	3.16	3.25	0.19	5	3.09 - 3.56	1.80	1.59	0.46	5	0.76 - 1.80
	Stage 2 Influent						Stage 2 Permeate				
WQP	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.45	0.00	5	0.45 - 0.45					
pH	6.4	6.3	6.8	0.5	5	6.4 - 7.7	5.3	5.4	0.4	5	4.9 - 5.7
Temp	22.7	23.6	23.8	0.1	5	23.8 - 23.9	23.9	24.0	0.1	5	23.9 - 24.2
Alk	175	512	512	308	5	238 - 970	2	4	2	5	0 - 6
TDS	396	1482	1152	402	5	434 - 1332	7	9	2	5	5 - 10
TotHard	310	1092	1092	86	5	970 - 1200	1	2	2	5	0 - 5
CaHard	270	980	982	112	5	880 - 1130	0	0	0	5	0 - 0
Turb	0.16	1.70	1.69	2	5	0.21 - 5.40	0.00	0.00	0.00	5	0 - 0
TOC	8.6	30.2	28.4	5.5	5	20.1 - 34.2	0.3	0.3	0.2	5	0.3 - 0.6
UV254	0.278	0.950	0.918	0.165	5	0.653 - 1.080	0.005	0.005	0.000	5	0.005 - 0.005
SUVA	3.24	3.16	3.24	0.10	5.00	3.15 - 3.40	1.80	1.59	0.47	5.00	0.75 - 1.80
	Stage 3 Influent						Stage 3 Permeate				
WQP	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery											
pH											
Temp											
Alk											
TDS											
TotHard											
CaHard											
Turb											
TOC											
UV254											
SUVA											

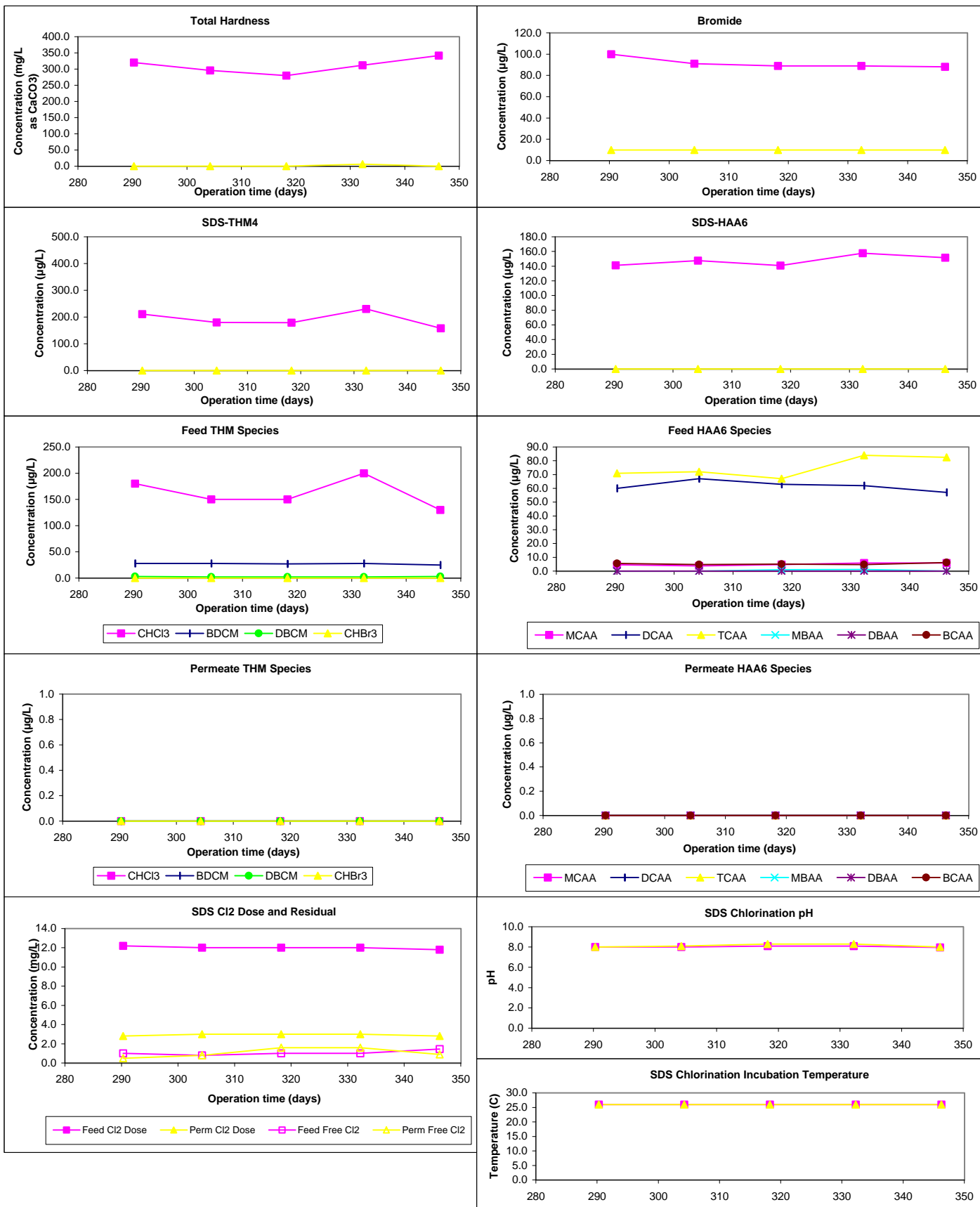
Chart Legend:



Water Quality Parameter Graphs



Water Quality Graphs (Continued)



Productivity Graphs

