

# ICR TREATMENT STUDY ANALYSIS

## Base Analysis and Data Review Comments

<b>Treatment Study ID</b>	1005
<b>Study Protocol</b>	2-Stage Full-Scale Membrane Plant
<b>Plant ICR Number</b>	1085
<b>PWS Name</b>	City of Boynton Beach
<b>City, State, Zip</b>	Boynton Beach, FL 33437

### General Comments:

1. This utility was originally required to conduct a treatment study at a larger lime softening plant. However, they were granted permission to monitor and sample across their full-scale NF plant (at a smaller facility) to satisfy their ICR treatment study requirement. This treatment study started in November 1997 and was conducted for one full year. The NF plant has been operating for 5.5 years. Recently this plant was expanded from 4 to 8 MGD, with plans to eventually expand to 16 MGD, replacing the existing lime softening facility. The history of the existing NF plant and associated costs are discussed in the Summary Report.

### Water Quality Comments:

1. 125 water quality outliers were identified and removed prior to base analysis.
2. None of the bromide data was used during data analysis. The reported feed bromide concentrations ranged from BMRL to 6450 µg/L, while the reported permeate concentrations ranged from BMRL to 1200 µg/L. In an independent membrane blending study done at the U.S. EPA, using this same feed and permeate water source (sampled 2/99), the bromide concentrations were 150 and 99 µg/L, in the feed and permeate, respectively.
3. This utility had difficulty with dosing the feed and permeate samples to achieve desired residuals due to the varying demand and source water quality of the feed and permeate samples. Therefore, DBP data from samples with reported free chlorine residuals above 5 mg/L were not included during data analysis.
4. In general, the permeate and feed SDS samples were incubated for 96 hours at a pH between 8.7 and 8.9 at 21 to 29°C. It is not clear what the target SDS residuals were during this study; however, the reported free chlorine residuals ranged from 0.15 to 11.2 mg/L.

## **Productivity Comments:**

1. Two productivity outliers were identified and removed prior to base analysis.
2. Little information about the membrane cleaning procedure is provided in the Summary Report.
3. The projected cleaning interval for the entire membrane system was  $273 \pm 11$  days. The projected stage 1 cleaning interval exceeded one year, thus the upper-bound of 365 days was used as the cleaning interval for stage 1. This upper-bound of one year serves as the minimum cleaning frequency necessary to mitigate problems beyond flux loss that can result from membrane fouling.

## ICR Information

ID / ICR#: FL4500145 / 1085  
 ICR Contact: Steven Evans  
 Phone No.: (561) 742-6464  
 Period: 11/1/97 - 1/9/98 (69 days)

## Membrane Information

Manufacturer: Film Tec Corporation  
 Trade Name: FILMTEC  
 Membrane Model: NF70-345  
 MWCO: 200 Daltons  
 Element Size: 8" X 40"  
 Element Area: 345.0 ft<sup>2</sup>  
 Design Flux: 24.1 gfd  
 Mfr. NDP: 70.0 psi  
 Mfr. MTC<sub>w</sub>: 0.357 (gfd/psi)  
 Mfr. Temp: 25.0 °C  
 Maximum Flow: 60.0 gpm  
 Minimum Flow: 16.0 gpm  
 Total Width : 59 ft. ft  
 Feed Spacer Thickness: 0.0028 ft  
 840 Element Area 345.0 ft<sup>2</sup>  
 840 Purchase Price: \$600

## Design Parameters

Norm Temp: 23.9 °C  
 Temp Norm MTC-w: 0.346 TavGC  
 Design Recovery: 0.85  
 Avg Sys Flux F<sub>w</sub>: 25.0 gfd  
 # of Elem in P.V.: 6  
 # Pres Ves in Stg 1: 26  
 # Pres Ves in Stg 2: 10  
 Pres Ves in Stg 3: NA  
 Design Flux: 25.0 gfd  
 Recycle Ratio: 0.00  
 Osmotic P Stage 1: 50.0 psi  
 Osmotic P Stage 2: 14.0 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	6.0	0.1	5	5.9 - 6.1	5.8	0.1	5	5.7 - 6.0	6.7	0.1	5	6.6 - 6.7
Temp	24.6	0.0	2	24.6 - 24.6	24.6	0.0	2	24.6 - 24.6	24.8	0.1	2	24.7 - 24.8
Alk	65	8	4	55 - 75	37	2	4	35 - 40	234	28	4	198 - 264
TDS	601	5	5	596 - 610	159	1	5	158 - 160	2432	28	5	2390 - 2460
TotHard	244	2	4	242 - 246	46	3	4	43 - 49	1382	28	4	1354 - 1412
CaHard	243	3	4	240 - 247	44	2	4	42 - 46	1358	34	4	1324 - 1394
Turb	0.47	0.4	4	0.09 - 1.01	0.16	0.2	4	0.06 - 0.38	0.26	0.0	4	0.22 - 0.30
Amm	0.64	NA	1	0.64 - 0.64	0.35	NA	1	0.35 - 0.35	2.21	NA	1	2.2 - 2.2
TOC	NA	NA	0	0.0 - 0.0	NA	NA	0	0.0 - 0.0	NA	NA	0	0.0 - 0.0
UV254	0.388	0.0	2	0.382 - 0.394	0.010	0.0	2	0.005 - 0.016	2.231	0.4	2	1.922 - 2.540
SUVA	NA	NA	0	NA	NA	NA	0	NA	NA	NA	0	NA
Bromide	NA	NA	0	0 - 0	NA	NA	0	0 - 0				
TOX	NA	NA	0	0 - 0	NA	NA	0	0 - 0				
CHCl3	261.0	NA	1	261.0 - 261.0	4.4	0.4	4	4.0 - 5.0	Mass Balance			
BDCM	68.9	NA	1	68.9 - 68.9	6.9	0.4	4	6.5 - 7.3	Closure Errors (%)			
DBCM	11.2	NA	1	11.2 - 11.2	8.0	0.8	4	7.0 - 8.7	WQP	Count	Avg	SD/RD
CHBr3	1.5	NA	1	1.5 - 1.5	3.8	0.6	4	3.2 - 4.5	Alk	4	8	8
THM4	342.6	NA	1	342.6 - 342.6	23.1	1.3	4	21.1 - 23.8	TDS	5	-25	3
MCAA	0.0	NA	1	0.0 - 0.0	4.0	4.5	4	0.0 - 10.5	TotHard	4	4	3
DCAA	203.5	NA	1	203.5 - 203.5	7.3	1.8	4	5.8 - 9.6	CaHard	4	2	2
TCAA	149.0	NA	1	149.0 - 149.0	2.1	1.6	4	1.1 - 4.5	Turb	4	-842	1474
MBAA	0.0	NA	1	0.0 - 0.0	1.3	2.6	4	0.0 - 5.1	Amm	1	2	n/a
DBAA	4.4	NA	1	4.4 - 4.4	4.9	0.8	4	3.9 - 5.8	TOC	0	n/a	n/a
BCAA	27.7	NA	1	27.7 - 27.7	4.6	2.9	4	2.7 - 8.9	UV254	2	-13	19
TBAA	NA	NA	0	NA	NA	NA	0	NA	TDS	68	-26	5
CDBAA	NA	NA	0	NA	NA	NA	0	NA				
DCBAA	NA	NA	0	NA	NA	NA	0	NA				
HAA5	356.9	NA	1	356.9 - 356.9	19.5	6.9	4	13.6 - 27.9	Comments:			
HAA6	384.6	NA	1	384.6 - 384.6	24.1	8.3	4	16.3 - 31.5				
HAA9	NA	NA	0	NA	NA	NA	0	NA				
SDS Conditions					Pretreatment Information							
WQP	Avg	SD	Count	Min - Max	Process	Description						Scale
Res (3)	2.71	2.36	8	0.00 - 5.30	pH reduction	Addition of Sulfuric Acid at an average dose of 204 mg/l. Target pH = 5.9						Full-Scale
Temp (°C)	24.0	0.1	4	23.9 - 24.1								
pH (unit)	8.7	0.1	10	8.7 - 8.9								
Time (hr)	96.0	0.0	10	96.0 - 96.0								
					Sand and silt removed e Filters 5 micron						Full-Scale	

## Mass Balance Errors

Pressure	RPD	SD	Flow	RPD	SD	TDS	RPD	SD
System Inf - Stg 1 Inf	0.0%	0.1%	System Inf - Stg 1 Inf	0.0%	0.3%	System Inf - Stg 1 Inf	0.0%	0.0%
Sys Conc - Stg 2 Conc	0.0%	0.3%	Sys Conc - Stg 2 Conc	0.0%	0.3%	Sys Conc - Stg 2 Conc	0.0%	0.0%
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	0.0%	0.0%
Sys Perm - Avg Stg Perr	0.0%	0.0%	Sys Perm - Sum Stg Per	0.0%	0.3%	Sys Perm - Avg Stg Perm	-2.6%	5.4%

## Stage Summary

WQP	Stage 1 Influent						Stage 1 Permeate				
	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.80	0.01	5	0.79 - 0.81					
pH	6.0	6.7	6.0	0.1	5	5.9 - 6.1	5.8	5.9	0.1	4	5.8 - 6.0
Temp	24.6	24.8	24.6	0.0	2	24.6 - 24.6	24.6	24.6	0.0	2	24.6 - 24.6
Alk	65	234	65	8	4	55 - 75	37	46	14	4	37 - 67
TDS	601	2432	601	5	5	596 - 610	159	149	1	5	148 - 151
TotHard	244	1382	245	1	4	244 - 247	46	47	5	4	42 - 54
CaHard	243	1358	242	2	4	240 - 244	44	44	4	4	40 - 50
Turb	0.47	0.26	0.73	1	5	0.09 - 1.75	0.16	0.99	1.86	5	0 - 4
TOC	NA	NA	NA	NA	0	0.0 - 0.0	NA	NA	NA	0	0.0 - 0.0
UV254	0.388	2.231	0.388	0.008	2	0.382 - 0.394	0.010	0.005	0.000	2	0.005 - 0.005
SUVA	NA	NA	NA	NA	0	NA	NA	NA	NA	0	NA

WQP	Stage 2 Influent						Stage 2 Permeate				
	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.58	0.01	5	0.56 - 0.59					
pH	6.0	6.7	6.3	0.1	4	6.2 - 6.4	5.8	5.9	0.1	4	5.7 - 6.0
Temp	24.6	24.8	24.6	0.0	2	24.6 - 24.6	24.6	24.6	0.0	2	24.6 - 24.6
Alk	65	234	104	14	4	86 - 119	37	36	3	4	32 - 39
TDS	601	2432	1087	13	5	1065 - 1096	159	177	2	5	174 - 180
TotHard	244	1382	458	147	4	241 - 560	46	48	2	4	44 - 49
CaHard	243	1358	445	137	4	240 - 517	44	45	2	4	43 - 47
Turb	0.47	0.26	0.35	0	4	0.25 - 0.58	0.16	0.10	0.04	4	0 - 0
TOC	NA	NA	NA	NA	0	0.0 - 0.0	NA	NA	NA	0	0.0 - 0.0
UV254	0.388	2.231	0.898	0.013	2	0.889 - 0.907	0.010	0.005	0.000	2	0.005 - 0.005
SUVA	NA	NA	NA	NA	0.00	NA	NA	NA	NA	0.00	NA

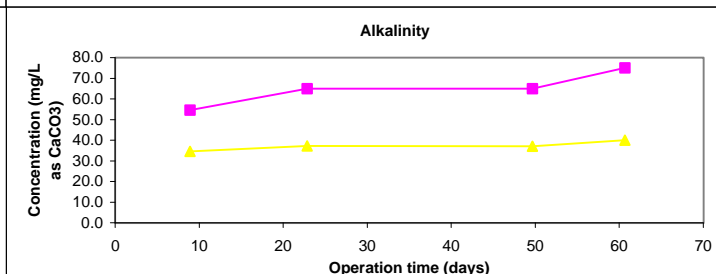
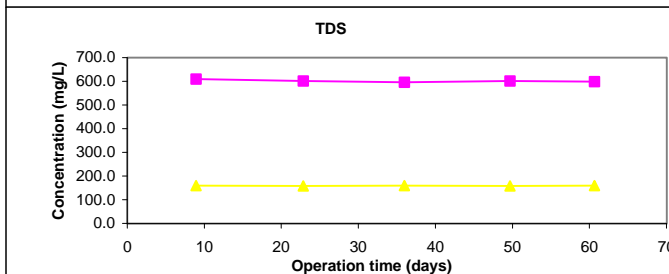
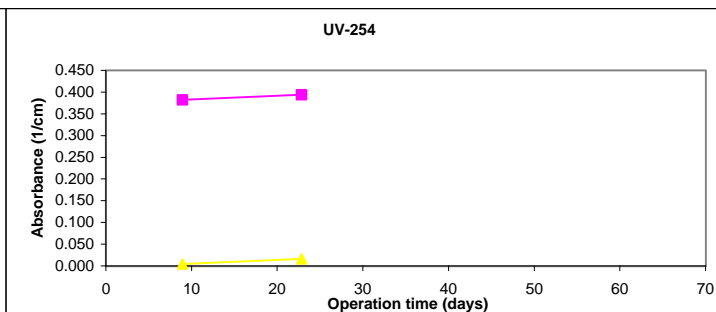
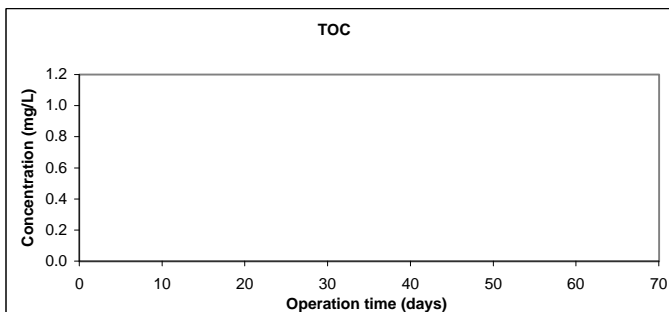
  

WQP	Stage 3 Influent						Stage 3 Permeate				
	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery											
pH											
Temp											
Alk											
TDS											
TotHard											
CaHard											
Turb											
TOC											
UV254											
SUVA											

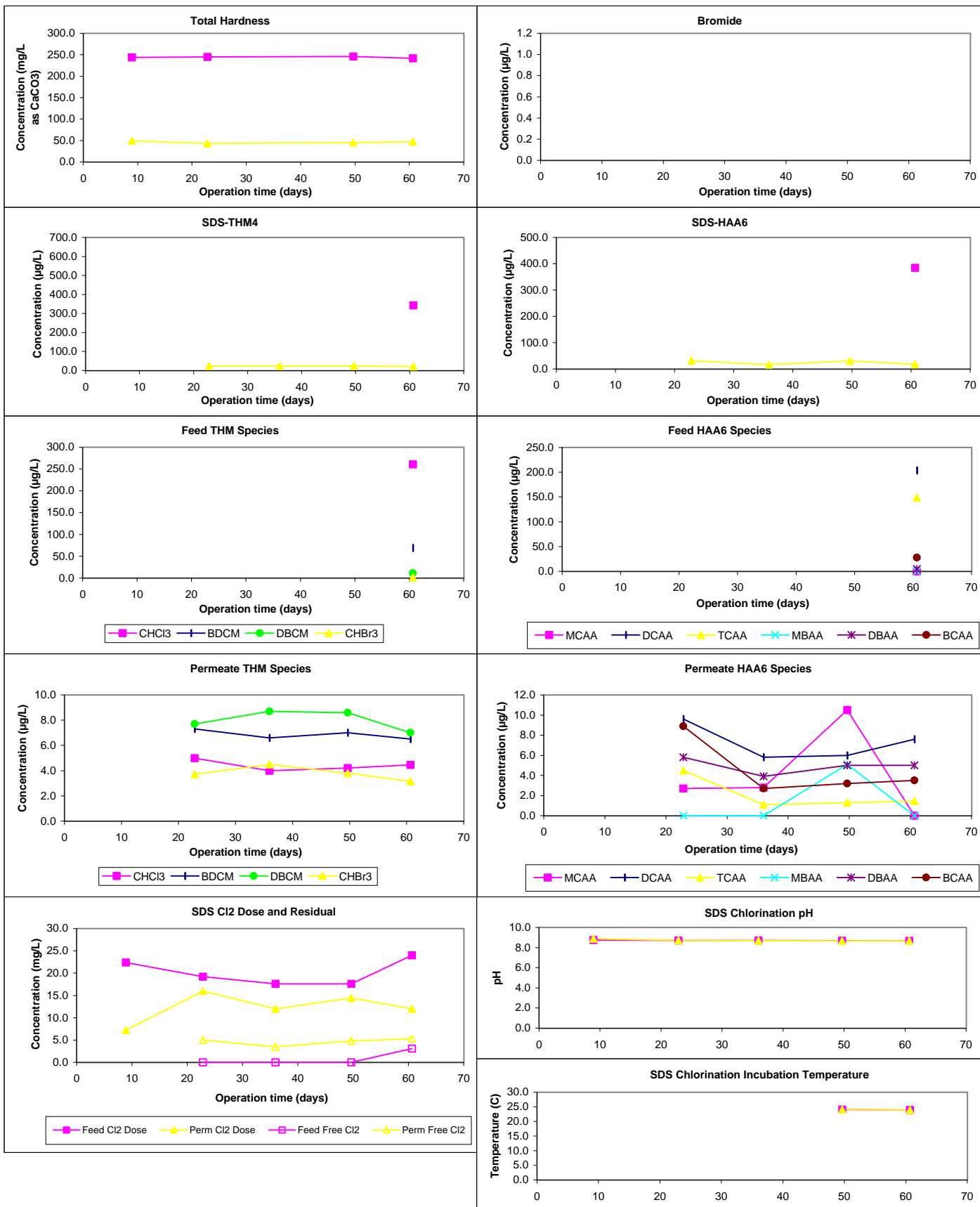
## Water Quality Parameter Graphs

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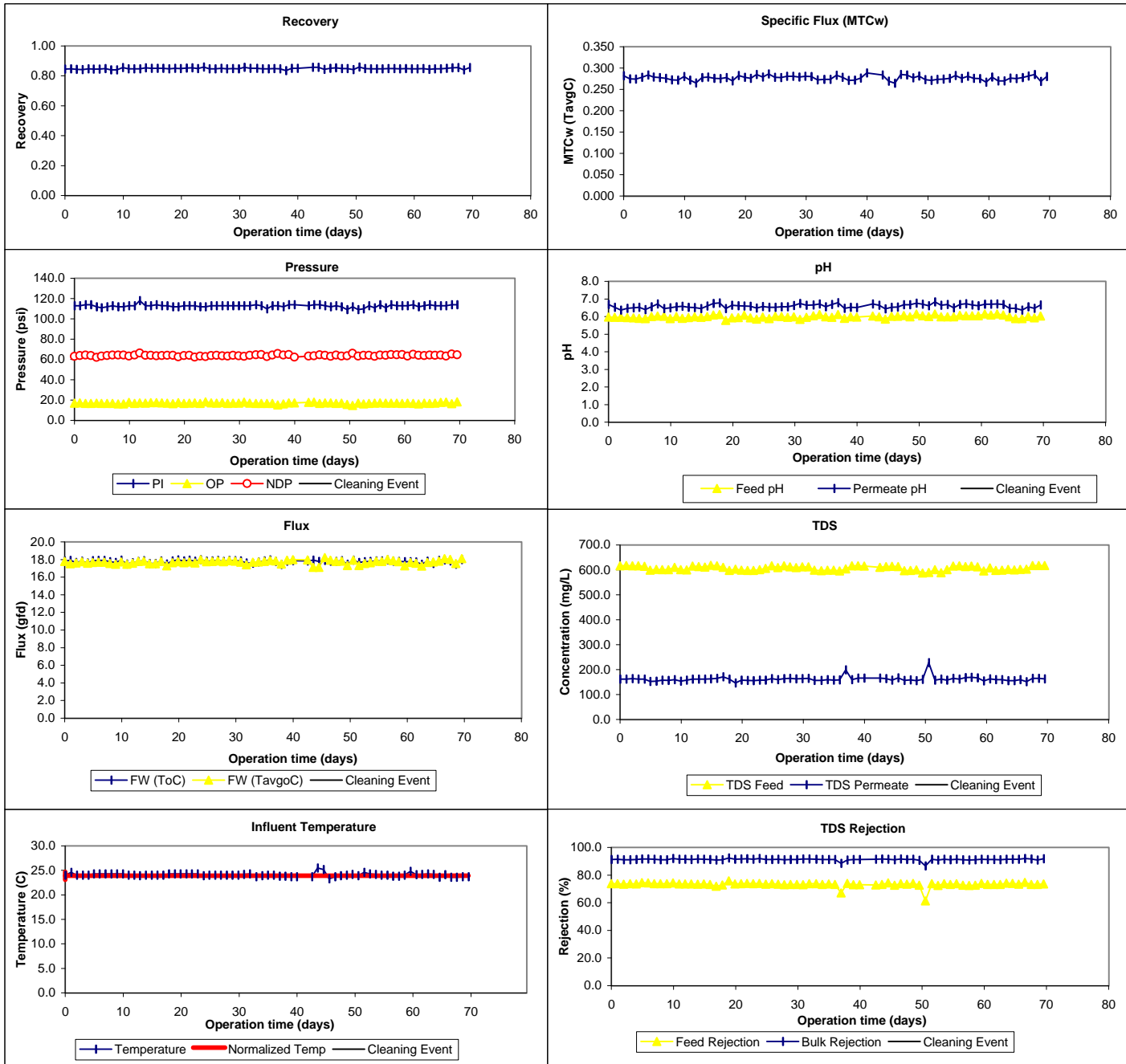
- Feed (System)
- Permeate (System)



## Water Quality Graphs (Continued)



## Productivity Graphs



## ICR Information

ID / ICR#: FL4500145 / 1085  
 ICR Contact: Steven Evans  
 Phone No.: (561) 742-6464  
 Period: 1/10/98 - 3/19/98 (68 days)

## Membrane Information

Manufacturer: Film Tec Corporation  
 Trade Name: FILMTEC  
 Membrane Model: NF70-345  
 MWCO: 200 Daltons  
 Element Size: 8" X 40"  
 Element Area: 345.0 ft<sup>2</sup>  
 Design Flux: 24.1 gfd  
 Mfr. NDP: 70.0 psi  
 Mfr. MTC<sub>w</sub>: 0.357 (gfd/psi)  
 Mfr. Temp: 25.0 °C  
 Maximum Flow: 60.0 gpm  
 Minimum Flow: 16.0 gpm  
 Total Width : 59 ft.  
 Feed Spacer Thickness: 0.0028 ft  
 840 Element Area 345.0 ft<sup>2</sup>  
 840 Purchase Price: \$600

## Design Parameters

Norm Temp: 23.9 °C  
 Temp Norm MTC-w: 0.346 TavGC  
 Design Recovery: 0.85  
 Avg Sys Flux F<sub>w</sub>: 25.0 gfd  
 # of Elem in P.V.: 6  
 # Pres Ves in Stg 1: 26  
 # Pres Ves in Stg 2: 10  
 Pres Ves in Stg 3: NA  
 Design Flux: 25.0 gfd  
 Recycle Ratio: 0.00  
 Osmotic P Stage 1: 50.0 psi  
 Osmotic P Stage 2: 14.0 psi  
 Osmotic P Stage 3: NA

## Water Quality Summary

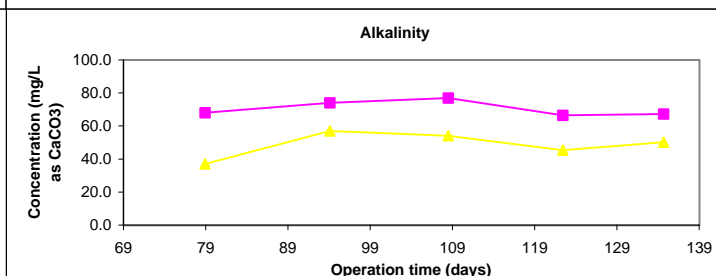
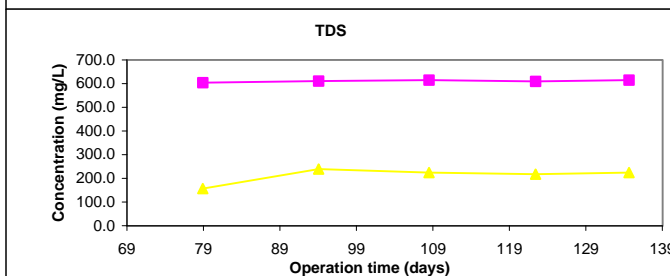
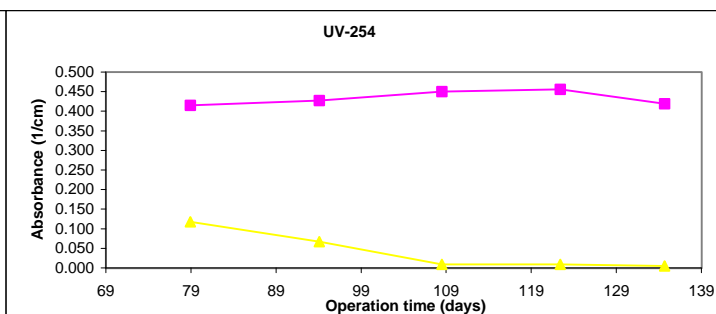
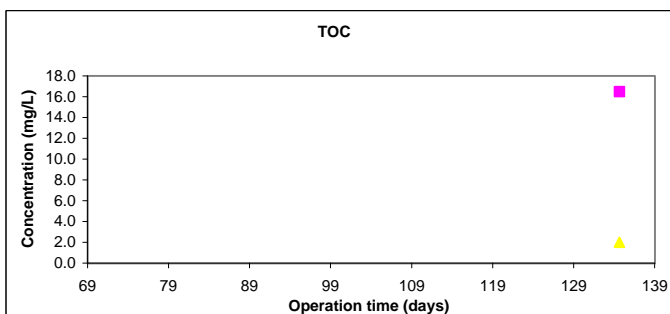
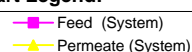
Feed (System)					Permeate (System)				Concentrate (System)			
Summary	Mean	SD	Count	Min/Max	Mean	SD	Count	Min/Max	Mean	SD	Count	Min/Max
pH	6.0	0.1	5	5.9 - 6.0	5.9	0.1	5	5.8 - 6.0	6.5	0.2	5	6.2 - 6.7
Temp	23.7	1.3	5	21.4 - 24.6	24.2	0.2	5	24.0 - 24.6	24.4	0.2	5	24.3 - 24.8
Alk	71	5	5	67 - 77	49	8	5	37 - 57	210	27	5	179 - 239
TDS	611	5	5	604 - 615	213	32	5	157 - 239	2280	105	5	2190 - 2460
TotHard	252	5	5	247 - 256	68	15	5	42 - 78	1252	75	5	1126 - 1317
CaHard	251	5	5	245 - 257	63	15	5	37 - 75	1157	124	5	966 - 1282
Turb	0.20	0.1	5	0.12 - 0.27	0.15	0.1	5	0.10 - 0.23	0.56	0.2	5	0.35 - 0.93
Amm	0.62	0.07	4	0.55 - 0.72	0.40	0.02	4	0.38 - 0.42	1.81	0.21	4	1.7 - 2.1
TOC	16.5	NA	1	16.5 - 16.5	2.0	NA	1	2.0 - 2.0	86.0	NA	1	86.0 - 86.0
UV254	0.433	0.0	5	0.415 - 0.456	0.042	0.0	5	0.005 - 0.118	2.542	0.4	5	2.102 - 2.857
SUVA	NA	NA	1	NA	NA	NA	1	NA	NA	NA	1	NA
Bromide	3300	NA	1	3300 - 3300	780	NA	1	780 - 780				
TOX	1620	NA	1	1620 - 1620	65	NA	1	65 - 65				
CHCl3	433.9	143.1	5	262.2 - 592.0	2.7	1.0	5	1.6 - 4.2	Mass Balance			
BDCM	67.7	7.6	5	55.4 - 75.1	5.4	1.6	5	3.6 - 7.9	Closure Errors (%)			
DBCM	12.9	10.8	5	5.1 - 30.6	8.7	1.8	5	6.3 - 10.7	WQP	Count	Avg	SD/RD
CHBr3	0.4	0.9	5	0.0 - 2.1	5.6	2.0	5	2.9 - 8.2	Alk	5	6	16
THM4	514.9	152.7	5	324.8 - 675.7	22.5	3.8	5	17.6 - 27.2	TDS	5	-27	3
MCAA	11.2	7.4	5	0.0 - 20.0	5.7	3.9	4	0.0 - 8.9	TotHard	5	-5	4
DCAA	151.0	36.2	4	102.0 - 188.0	5.2	5.0	4	1.7 - 12.4	CaHard	5	-16	7
TCAA	102.6	38.5	5	61.9 - 158.0	0.9	1.1	4	0.0 - 2.1	Turb	5	0	128
MBAA	11.4	19.0	5	0.0 - 44.5	11.6	12.7	4	2.2 - 30.3	Amm	4	-5	13
DBAA	2.5	1.5	5	1.6 - 5.1	4.1	0.7	4	3.4 - 4.9	TOC	1	-26	n/a
BCAA	15.8	7.9	5	2.4 - 23.3	3.6	1.4	4	2.7 - 5.6	UV254	5	-7	11
TBAA	NA	NA	0	NA	NA	NA	0	NA	TDS	60	-25	2
CDBAA	NA	NA	0	NA	NA	NA	0	NA				
DCBAA	NA	NA	0	NA	NA	NA	0	NA	Comments:			
HAA5	274.1	76.0	4	192.2 - 362.8	27.5	20.3	4	7.5 - 55.5				
HAA6	293.2	74.4	4	211.1 - 380.4	31.0	20.5	4	10.2 - 58.7				
HAA9	NA	NA	0	NA	NA	NA	0	NA				
SDS Conditions					Pretreatment Information							
WQP	Avg	SD	Count	Min - Max	Process	Description						Scale
Res (0)	1.93	1.46	10	0.40 - 5.00	pH reduction	Addition of Sulfuric Acid at an average dose of 204 mg/l. Target pH = 5.9						Full-Scale
Temp (°C)	22.5	1.0	10	21.3 - 23.8								
pH (unit)	8.7	0.0	10	8.7 - 8.8								
Time (hr)	96.0	0.0	10	96.0 - 96.0								
						Sand and silt removed e Filters 5 micron						Full-Scale

## 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			<b>0.81</b>	<b>0.00</b>	<b>5</b>	<b>0.80 - 0.81</b>					
pH	6.0	6.5	6.1	0.1	5	6.0 - 6.3	5.9	6.0	0.1	5	5.8 - 6.1
Temp	23.7	24.4	23.7	1.3	5	21.4 - 24.6	24.2	24.3	0.2	5	24.1 - 24.6
Alk	71	210	71	5	5	67 - 77	49	49	7	5	38 - 57
<b>TDS</b>	<b>611</b>	<b>2280</b>	<b>611</b>	<b>5</b>	<b>5</b>	<b>604 - 615</b>	<b>213</b>	<b>190</b>	<b>23</b>	<b>5</b>	<b>151 - 213</b>
TotHard	252	1252	252	5	5	247 - 256	68	70	15	5	45 - 80
CaHard	251	1157	251	6	5	245 - 257	63	62	12	5	41 - 69
Turb	0.20	0.56	0.20	0	5	0.12 - 0.27	0.15	0.31	0.20	5	0 - 1
<b>TOC</b>	<b>16.5</b>	<b>86.0</b>	<b>18.0</b>	<b>NA</b>	<b>1</b>	<b>18.0 - 18.0</b>	<b>2.0</b>	<b>0.3</b>	<b>NA</b>	<b>1</b>	<b>0.3 - 0.3</b>
UV254	0.433	<b>2.542</b>	0.434	0.018	5	0.415 - 0.456	0.042	0.016	0.017	5	0.005 - 0.042
SUVA	NA	<b>NA</b>	NA	NA	1	NA	NA	NA	NA	1	NA
	Stage 2 Influent						Stage 2 Permeate				
WQP	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			<b>0.59</b>	<b>0.01</b>	<b>5</b>	<b>0.58 - 0.61</b>					
pH	6.0	6.5	6.2	0.1	5	6.1 - 6.3	5.9	5.9	0.1	5	5.8 - 6.0
Temp	23.7	24.4	24.2	0.3	5	23.9 - 24.6	24.2	24.2	0.3	5	24.0 - 24.7
Alk	71	210	104	7	5	93 - 110	49	54	11	5	36 - 63
<b>TDS</b>	<b>611</b>	<b>2280</b>	<b>1069</b>	<b>27</b>	<b>5</b>	<b>1034 - 1109</b>	<b>213</b>	<b>255</b>	<b>44</b>	<b>5</b>	<b>178 - 288</b>
TotHard	252	1252	510	14	5	488 - 524	68	82	21	5	45 - 94
CaHard	251	1157	505	11	5	488 - 518	63	77	18	5	45 - 90
Turb	0.20	0.56	0.37	0	5	0.22 - 0.53	0.15	0.24	0.17	5	0 - 0
<b>TOC</b>	<b>16.5</b>	<b>86.0</b>	<b>30.0</b>	<b>NA</b>	<b>1</b>	<b>30.0 - 30.0</b>	<b>2.0</b>	<b>0.3</b>	<b>NA</b>	<b>1</b>	<b>0.3 - 0.3</b>
UV254	0.433	<b>2.542</b>	0.980	0.040	5	0.940 - 1.031	0.042	0.010	0.003	5	0.005 - 0.013
SUVA	NA	<b>NA</b>	NA	NA	1.00	NA	NA	NA	NA	1.00	NA
	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											
<b>TDS</b>											
TotHard											
CaHard											
Turb											
<b>TOC</b>											
UV254											
SUVA											

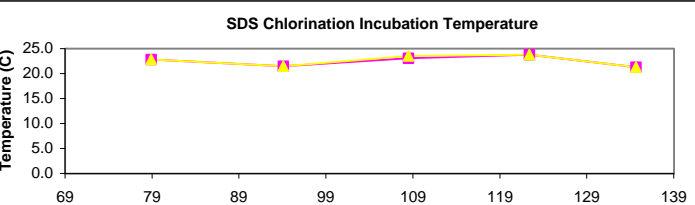
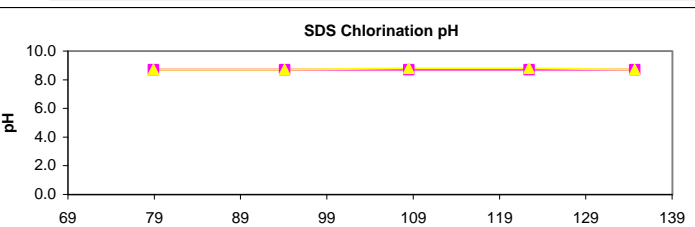
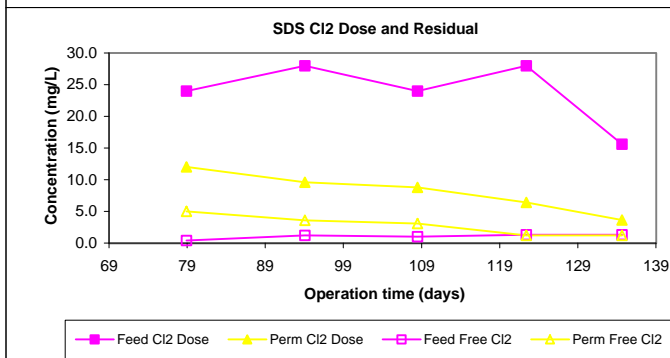
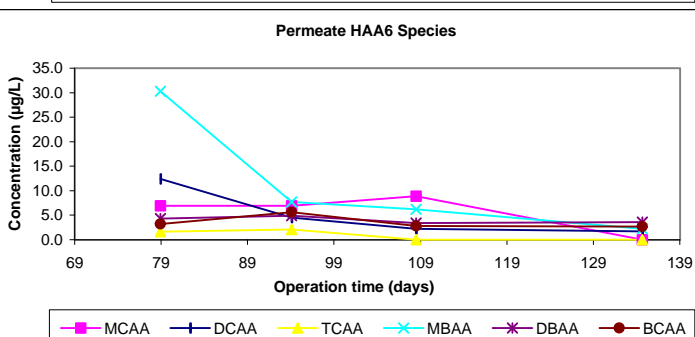
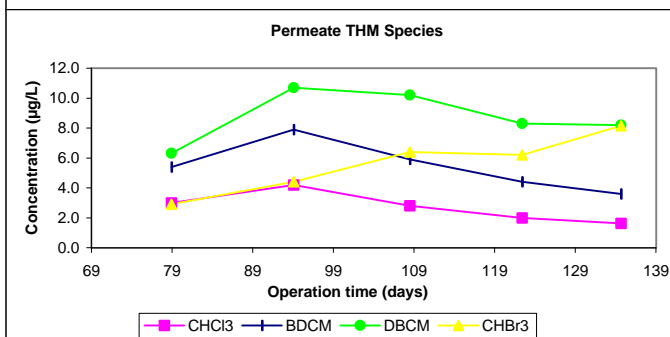
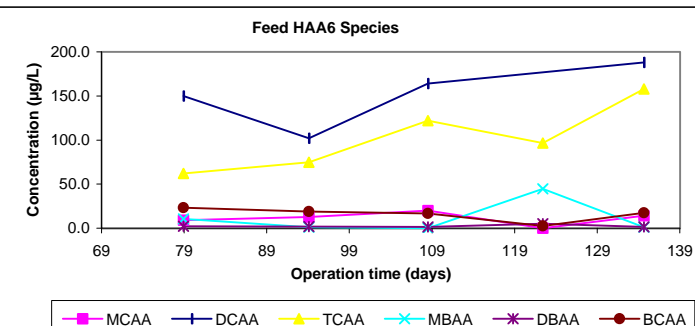
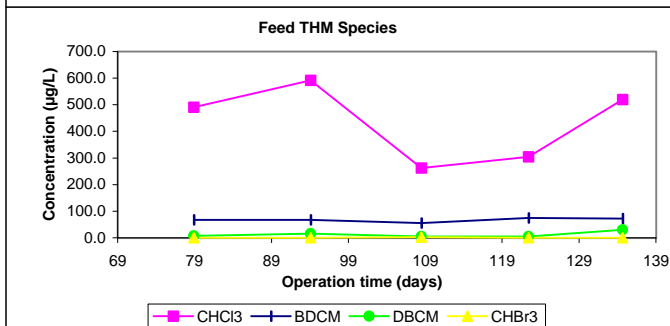
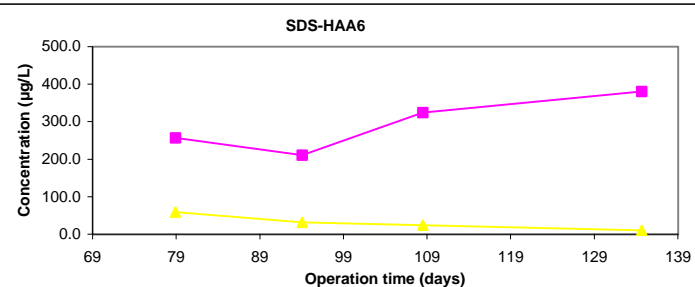
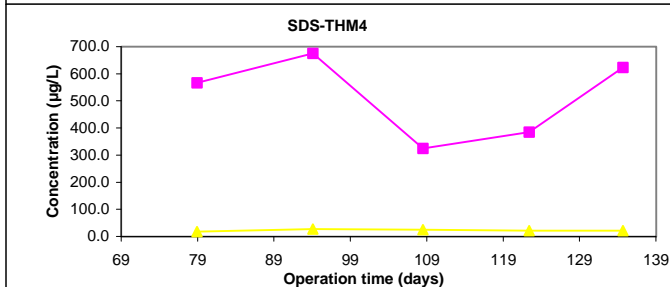
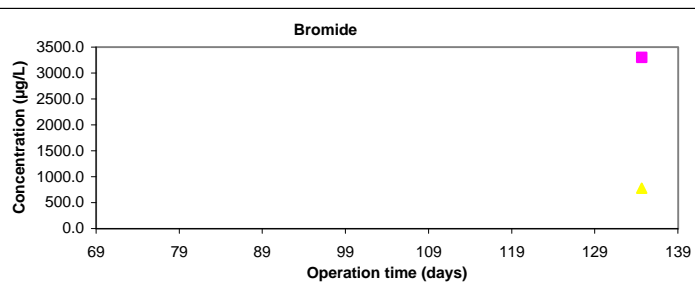
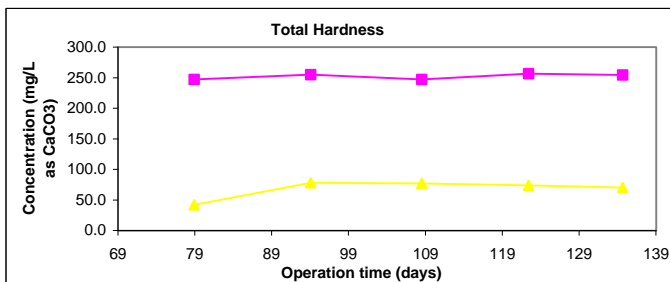
## Water Quality Parameter Graphs

## Chart Legend:

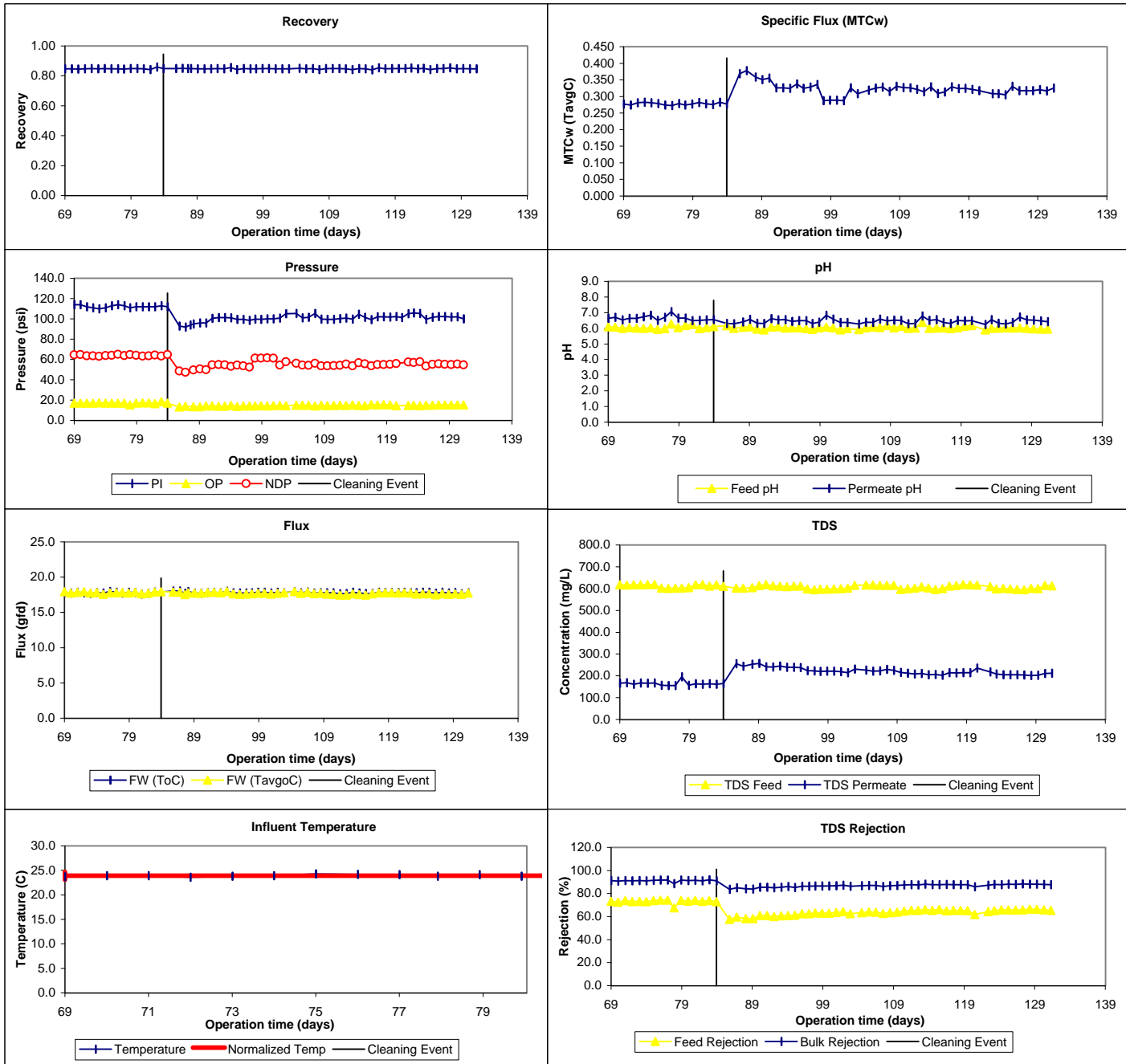




## Water Quality Graphs (Continued)



## Productivity Graphs



## ICR Information

ID / ICR#: FL4500145 / 1085  
 ICR Contact: Steven Evans  
 Phone No.: (561) 742-6464  
 Period: 3/21/98 - 5/26/98 (66 days)

## Membrane Information

Manufacturer: Film Tec Corporation  
 Trade Name: FILMTEC  
 Membrane Model: NF70-345  
 MWCO: 200 Daltons  
 Element Size: 8" X 40"  
 Element Area: 345.0 ft<sup>2</sup>  
 Design Flux: 24.1 gfd  
 Mfr. NDP: 70.0 psi  
 Mfr. MTC<sub>w</sub>: 0.357 (gfd/psi)  
 Mfr. Temp: 25.0 °C  
 Maximum Flow: 60.0 gpm  
 Minimum Flow: 16.0 gpm  
 Total Width : 59 ft. ft  
 Feed Spacer Thickness: 0.0028 ft  
 840 Element Area 345.0 ft<sup>2</sup>  
 840 Purchase Price: \$600

## Design Parameters

Norm Temp: 23.9 °C  
 Temp Norm MTC-w: 0.346 TavGC  
 Design Recovery: 0.85  
 Avg Sys Flux F<sub>w</sub>: 25.0 gfd  
 # of Elem in P.V.: 6  
 # Pres Ves in Stg 1: 26  
 # Pres Ves in Stg 2: 10  
 Pres Ves in Stg 3: NA  
 Design Flux: 25.0 gfd  
 Recycle Ratio: 0.00  
 Osmotic P Stage 1: 50.0 psi  
 Osmotic P Stage 2: 14.0 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	6.1	0.1	5	6.0 - 6.2	6.0	0.0	5	6.0 - 6.1	6.7	0.1	5	6.6 - 6.8
Temp	24.8	0.2	5	24.5 - 25.0	24.8	0.1	5	24.6 - 25.0	24.9	0.1	5	24.8 - 25.1
Alk	72	13	5	50 - 84	54	4	5	49 - 59	246	33	5	221 - 301
TDS	613	4	5	607 - 617	218	6	5	213 - 228	2318	77	5	2240 - 2410
TotHard	257	2	5	255 - 259	76	5	5	69 - 82	1255	55	5	1203 - 1335
CaHard	255	1	5	253 - 257	70	5	5	65 - 76	1181	61	5	1130 - 1280
Turb	0.17	0.1	5	0.08 - 0.29	0.13	0.1	5	0.07 - 0.22	0.42	0.0	5	0.40 - 0.46
Amm	0.60	0.03	4	0.58 - 0.65	0.38	0.02	4	0.36 - 0.41	1.88	0.12	4	1.7 - 2.0
TOC	13.4	2.5	5	11.0 - 17.0	1.2	2.1	5	0.3 - 5.0	77.8	11.5	5	69.0 - 98.0
UV254	0.432	0.0	4	0.369 - 0.458	0.008	0.0	4	0.005 - 0.012	2.712	0.2	4	2.457 - 2.910
SUVA	NA	NA	4	NA	NA	NA	4	NA	NA	NA	4	NA
Bromide	52	94	5	10 - 220	10	0	5	10 - 10				
TOX	1668	163	5	1590 - 1960	69	26	5	34 - 91				
CHCl3	643.5	104.7	5	500.0 - 780.0	2.6	1.7	5	1.6 - 5.7	Mass Balance			
BDCM	74.3	7.4	5	63.6 - 82.0	5.5	2.2	5	3.9 - 9.4	Closure Errors (%)			
DBCM	37.3	9.5	5	30.0 - 53.7	10.1	1.5	5	8.2 - 12.2	WQP	Count	Avg	SD/RD
CHBr3	4.4	9.8	5	0.0 - 22.0	8.2	3.6	5	5.7 - 14.6	Alk	5	31	37
THM4	759.5	115.8	5	595.0 - 897.6	26.4	5.4	5	20.0 - 33.4	TDS	5	-23	4
MCAA	12.2	2.7	5	10.0 - 16.7	1.6	2.2	5	0.0 - 4.4	TotHard	5	-1	4
DCAA	189.0	23.0	5	168.0 - 228.0	1.9	0.6	5	1.5 - 2.9	CaHard	5	-11	6
TCAA	134.8	43.2	5	84.0 - 194.0	0.3	0.6	5	0.0 - 1.3	Turb	5	-2	64
MBAA	1.1	1.3	5	0.0 - 3.1	3.1	2.4	5	0.0 - 6.3	Amm	4	1	7
DBAA	1.5	0.4	5	1.2 - 2.1	3.6	0.7	5	2.8 - 4.6	TOC	1	11	n/a
BCAA	19.4	1.0	5	18.2 - 20.3	3.0	0.8	5	2.2 - 4.3	UV254	4	-4	7
TBAA	NA	NA	0	NA	NA	NA	0	NA	TDS <sub>t</sub>	63	-25	4
CDBAA	NA	NA	0	NA	NA	NA	0	NA				
DCBAA	NA	NA	0	NA	NA	NA	0	NA				
HAA5	338.6	67.0	5	264.3 - 443.3	10.5	5.7	5	5.0 - 17.3	Comments:			
HAA6	358.0	67.2	5	282.6 - 463.2	13.5	6.2	5	7.8 - 20.3				
HAA9	NA	NA	0	NA	NA	NA	0	NA				
SDS Conditions					Pretreatment Information							
WQP	Avg	SD	Count	Min - Max	Process	Description						Scale
Res (0)	1.11	1.15	10	0.20 - 3.70	pH reduction	Addition of Sulfuric Acid at an average dose of 204 mg/l. Target pH = 5.9						Full-Scale
Temp (°C)	25.0	1.4	10	22.8 - 26.6								
pH (unit)	8.7	0.0	10	8.7 - 8.8								
Time (hr)	96.0	0.0	10	96.0 - 96.0								
					Sand and silt removed e Filters 5 micron						Full-Scale	

## Mass Balance Errors

Pressure	RPD	SD	Flow	RPD	SD	TDS	RPD	SD
System Inf - Stg 1 Inf	0.0%	0.1%	System Inf - Stg 1 Inf	0.0%	0.2%	System Inf - Stg 1 Inf	0.0%	0.0%
Sys Conc - Stg 2 Conc	0.0%	0.2%	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%	0.0%	Stg 1 Conc - Stg 2 Inf	0.0%	0.0%	Stg 1 Conc - Stg 2 Inf	0.0%	0.0%
Sys Perm - Avg Stg Perr	0.0%	0.0%	Sys Perm - Sum Stg Per	0.0%	0.2%	Sys Perm - Avg Stg Perm	-5.4%	1.1%

## Stage Summary

WQP	Stage 1 Influent						Stage 1 Permeate				
	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.81	0.00	5	0.80 - 0.81					
pH	6.1	6.7	6.1	0.1	5	6.0 - 6.2	6.0	6.0	0.0	5	6.0 - 6.1
Temp	24.8	24.9	24.8	0.1	5	24.6 - 25.0	24.8	24.8	0.1	5	24.6 - 24.9
Alk	72	246	72	13	5	50 - 84	54	51	2	5	49 - 53
TDS	613	2318	614	4	5	607 - 617	218	197	11	5	186 - 214
TotHard	257	1255	255	3	5	250 - 259	76	76	5	5	69 - 82
CaHard	255	1181	255	1	5	253 - 257	70	65	5	5	59 - 71
Turb	0.17	0.42	0.17	0	5	0.08 - 0.27	0.13	0.16	0.03	5	0 - 0
TOC	13.4	77.8	12.6	1.9	5	10.0 - 14.0	1.2	1.9	2.1	5	0.3 - 5.0
UV254	0.432	2.712	0.432	0.042	4	0.369 - 0.458	0.008	0.012	0.009	4	0.005 - 0.022
SUVA	NA	NA	NA	NA	4	NA	NA	NA	NA	4	NA

WQP	Stage 2 Influent						Stage 2 Permeate				
	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.59	0.00	5	0.59 - 0.59					
pH	6.1	6.7	6.4	0.1	5	6.2 - 6.5	6.0	6.0	0.1	5	6.0 - 6.1
Temp	24.8	24.9	24.8	0.2	5	24.5 - 25.1	24.8	24.8	0.1	5	24.6 - 24.9
Alk	72	246	112	9	5	103 - 126	54	61	3	5	58 - 66
TDS	613	2318	1078	11	5	1064 - 1095	218	266	8	5	259 - 279
TotHard	257	1255	513	6	5	507 - 522	76	88	6	5	82 - 97
CaHard	255	1181	499	9	5	488 - 513	70	80	6	5	72 - 89
Turb	0.17	0.42	0.38	0	5	0.17 - 0.78	0.13	0.19	0.11	5	0 - 0
TOC	13.4	77.8	33.4	10.9	5	26.0 - 52.0	1.2	1.8	2.2	5	0.3 - 5.1
UV254	0.432	2.712	0.964	0.075	4	0.894 - 1.035	0.008	0.012	0.002	4	0.010 - 0.014
SUVA	NA	NA	NA	NA	4.00	NA	NA	NA	NA	4.00	NA

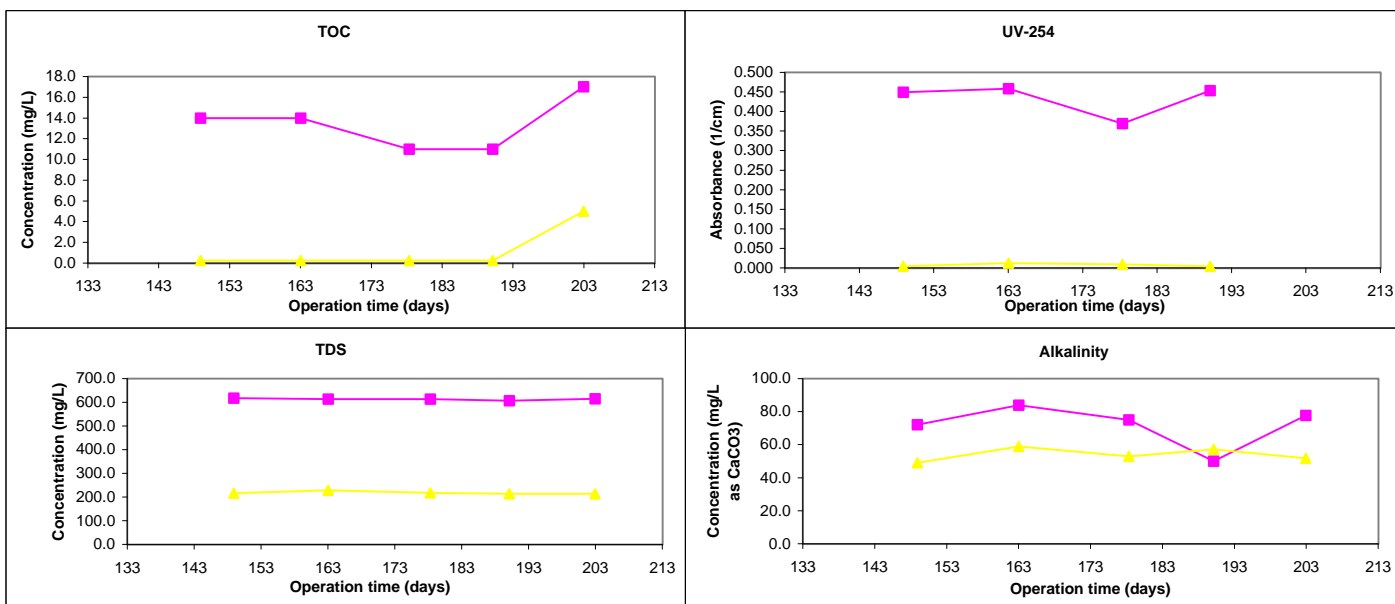
WQP	Stage 3 Influent						Stage 3 Permeate				
	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery											
pH											
Temp											
Alk											
TDS											
TotHard											
CaHard											
Turb											
TOC											
UV254											
SUVA											

This was only a two stage study.

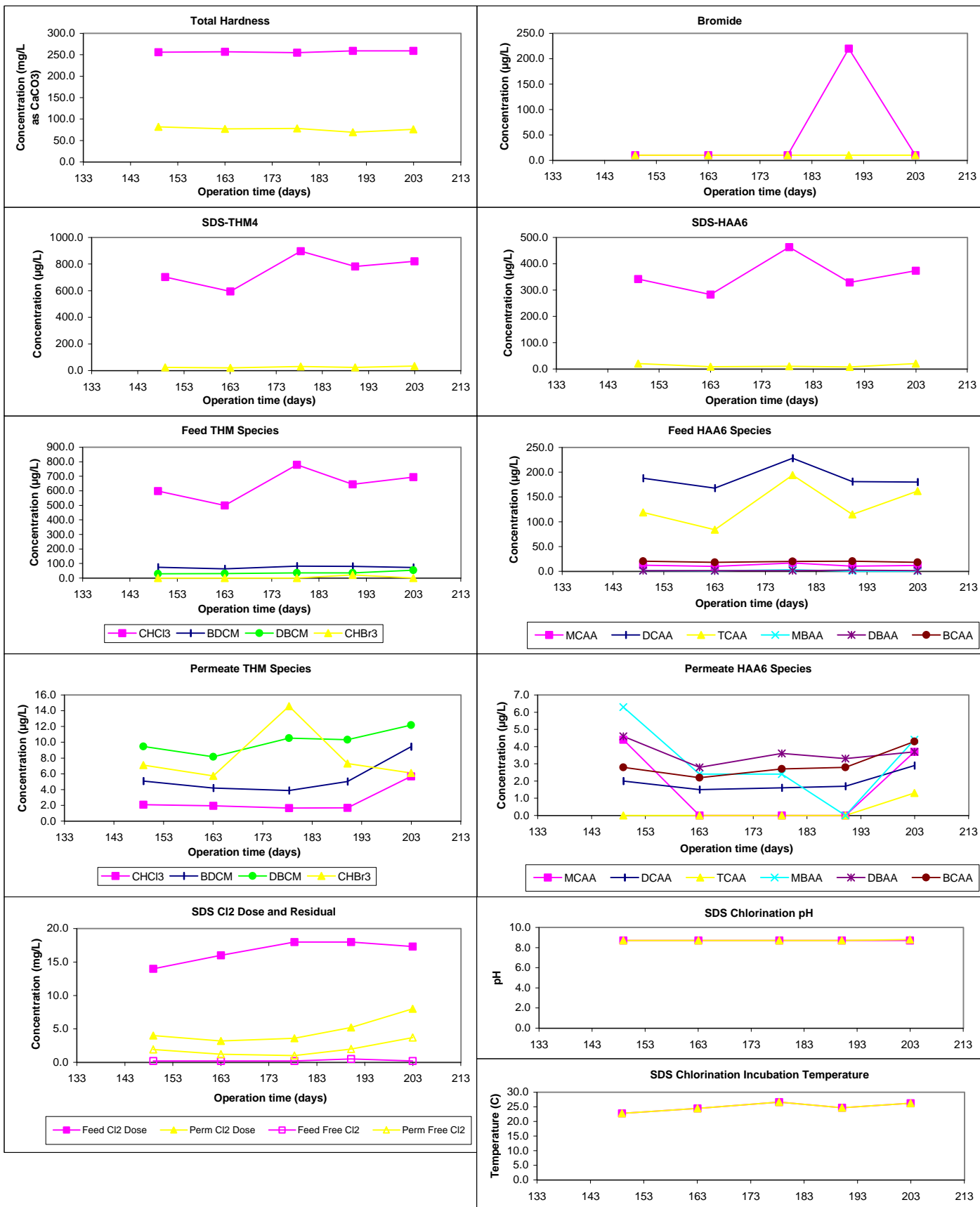
## Chart Legend:

- Feed (System)
- Permeate (System)

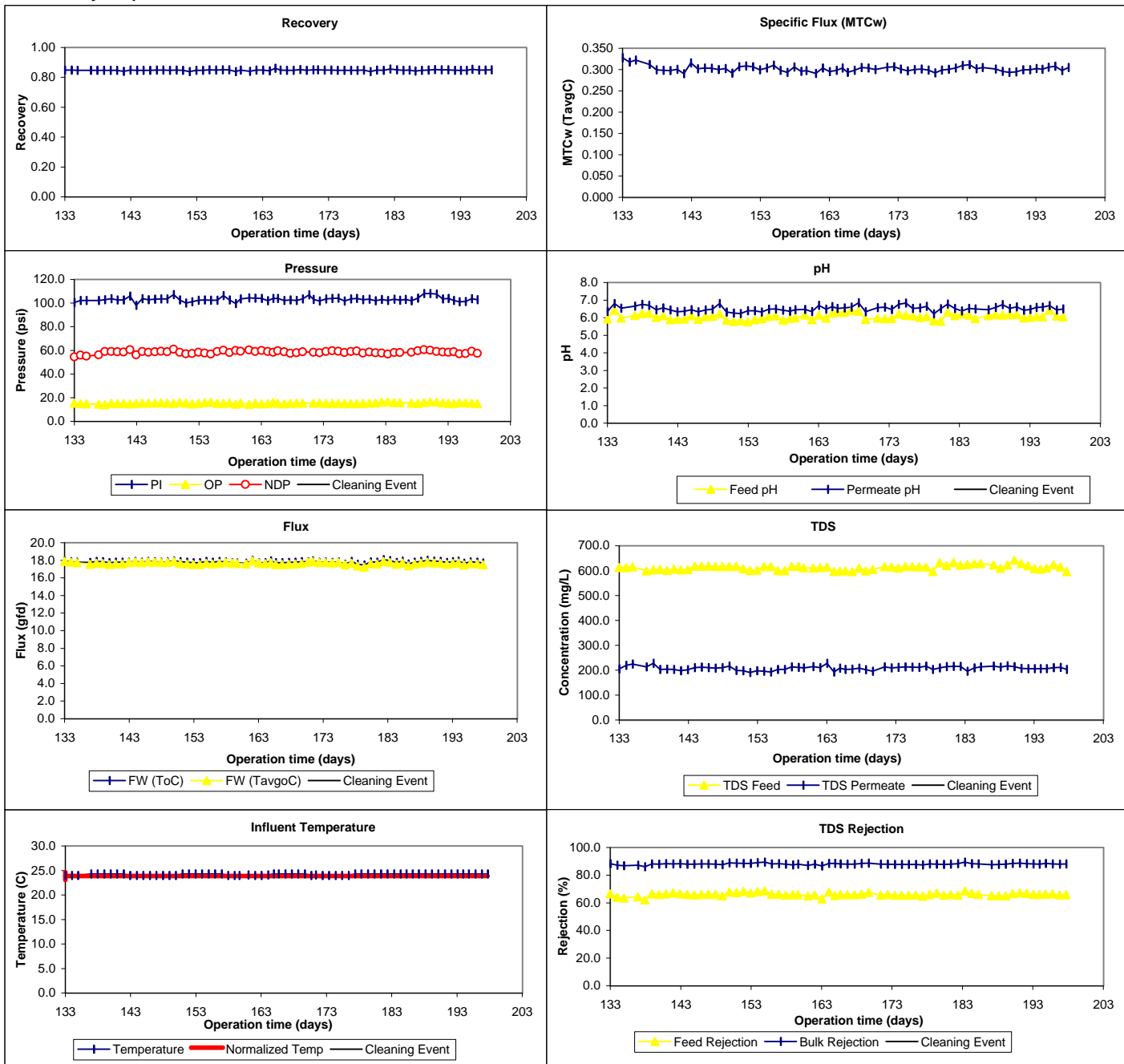
## Water Quality Parameter Graphs



## Water Quality Graphs (Continued)



## Productivity Graphs



## ICR Information

ID / ICR#: FL4500145 / 1085  
 ICR Contact: Steven Evans  
 Phone No.: (561) 742-6464  
 Period: 6/3/98 - 8/7/98 (65 days)

## Membrane Information

Manufacturer: Film Tec Corporation  
 Trade Name: FILMTEC  
 Membrane Model: NF70-345  
 MWCO: 200 Daltons  
 Element Size: 8" X 40"  
 Element Area: 345.0 ft<sup>2</sup>  
 Design Flux: 24.1 gfd  
 Mfr. NDP: 70.0 psi  
 Mfr. MTC<sub>w</sub>: 0.357 (gfd/psi)  
 Mfr. Temp: 25.0 °C  
 Maximum Flow: 60.0 gpm  
 Minimum Flow: 16.0 gpm  
 Total Width : 59 ft.  
 Feed Spacer Thickness: 0.0028 ft  
 840 Element Area 345.0 ft<sup>2</sup>  
 840 Purchase Price: \$600

## Design Parameters

Norm Temp: 23.9 °C  
 Temp Norm MTC-w: 0.346 TavGC  
 Design Recovery: 0.85  
 Avg Sys Flux F<sub>w</sub>: 25.0 gfd  
 # of Elem in P.V.: 6  
 # Pres Ves in Stg 1: 26  
 # Pres Ves in Stg 2: 10  
 Pres Ves in Stg 3: NA  
 Design Flux: 25.0 gfd  
 Recycle Ratio: 0.00  
 Osmotic P Stage 1: 50.0 psi  
 Osmotic P Stage 2: 14.0 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	6.3	0.1	5	6.1 - 6.5	6.1	0.1	5	6.0 - 6.2	6.7	0.2	5	6.5 - 7.0
Temp	25.0	0.1	5	24.9 - 25.2	25.0	0.2	5	24.8 - 25.2	25.1	0.1	5	24.9 - 25.3
Alk	93	5	5	87 - 100	59	6	5	52 - 65	301	27	5	274 - 345
TDS	604	9	5	595 - 615	223	5	5	218 - 229	2234	71	5	2120 - 2290
TotHard	264	17	5	248 - 288	75	5	5	70 - 81	1303	22	5	1274 - 1326
CaHard	252	8	5	243 - 263	71	4	5	66 - 78	1271	22	5	1247 - 1292
Turb	0.51	0.4	5	0.11 - 0.97	0.21	0.1	5	0.12 - 0.42	0.46	0.1	5	0.31 - 0.63
Amm	0.60	0.09	5	0.53 - 0.75	0.45	0.11	5	0.36 - 0.60	1.80	0.19	5	1.6 - 2.1
TOC	16.4	7.0	5	12.0 - 28.0	0.3	0.2	5	0.3 - 0.6	70.0	8.3	5	56.0 - 78.0
UV254	0.451	0.0	5	0.428 - 0.489	0.007	0.0	5	0.005 - 0.018	2.660	0.3	5	2.087 - 2.950
SUVA	3.09	1.04	5	1.55 - 4.08	2.66	2.56	5	0.72 - 7.16	3.84	0.65	5	2.94 - 4.79
Bromide	1298	2880	5	10 - 6450	248	532	5	10 - 1200				
TOX	2050	332	4	1700 - 2500	62	8	4	51 - 70				
CHCl3	681.3	149.9	5	466.2 - 880.7	2.6	1.2	5	1.5 - 4.7	Mass Balance			
BDCM	89.9	20.8	5	60.7 - 117.2	5.8	1.9	5	3.6 - 8.9	Closure Errors (%)			
DBCM	57.0	49.2	5	27.8 - 144.3	12.0	2.6	5	9.5 - 14.8	WQP	Count	Avg	SD/RD
CHBr3	2.0	4.5	5	0.0 - 10.0	10.9	3.4	5	6.5 - 15.6	Alk	5	6	8
THM4	830.2	183.0	5	559.4 - 1042.4	31.4	5.1	5	24.2 - 37.2	TDS	5	-21	4
MCAA	17.5	7.8	5	13.1 - 31.3	0.9	1.2	5	0.0 - 2.3	TotHard	5	0	7
DCAA	216.0	31.0	5	191.0 - 269.0	1.5	0.3	5	1.2 - 2.0	CaHard	5	2	3
TCAA	186.5	45.9	5	120.0 - 240.0	0.2	0.4	5	0.0 - 1.0	Turb	5	-296	577
MBAA	1.6	0.7	5	1.1 - 2.9	3.8	0.6	5	2.8 - 4.3	Amm	5	23	36
DBAA	2.5	1.2	5	1.4 - 4.5	3.6	0.2	5	3.3 - 3.9	TOC	0	n/a	n/a
BCAA	22.5	4.2	5	18.7 - 29.0	2.8	0.5	5	2.2 - 3.4	UV254	5	-11	23
TBAA	NA	NA	0	NA	NA	NA	0	NA	TDS			
CDBAA	NA	NA	0	NA	NA	NA	0	NA				
DCBAA	NA	NA	0	NA	NA	NA	0	NA	49 -23 6			
HAA5	424.1	63.1	5	346.8 - 512.7	10.0	1.7	5	7.4 - 11.7	Comments:			
HAA6	446.6	67.2	5	365.5 - 541.7	12.9	2.0	5	9.6 - 14.5				
HAA9	NA	NA	0	NA	NA	NA	0	NA				
SDS Conditions					Pretreatment Information							
WQP	Avg	SD	Count	Min - Max	Process	Description						Scale
Res (0)	1.39	0.98	10	0.15 - 3.60	pH reduction	Addition of Sulfuric Acid at an average dose of 204 mg/l. Target pH = 5.9						Full-Scale
Temp (°C)	26.0	1.6	10	24.2 - 28.6								
pH (unit)	8.7	0.0	10	8.7 - 8.8								
Time (hr)	91.2	10.1	10	72.0 - 96.0								
					Sand and silt removed e Filters 5 micron						Full-Scale	

## Mass Balance Errors

Pressure	RPD	SD	Flow	RPD	SD	TDS	RPD	SD
System Inf - Stg 1 Inf	0.0%	0.1%	System Inf - Stg 1 Inf	-0.1%	0.8%	System Inf - Stg 1 Inf	0.0%	0.0%
Sys Conc - Stg 2 Conc	0.0%	0.0%	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%	0.0%	Stg 1 Conc - Stg 2 Inf	0.0%	0.0%	Stg 1 Conc - Stg 2 Inf	0.0%	0.0%
Sys Perm - Avg Stg Perm	0.0%	0.0%	Sys Perm - Sum Stg Per	-0.2%	0.9%	Sys Perm - Avg Stg Perm	-5.7%	2.8%

## Stage Summary

WQP	Stage 1 Influent						Stage 1 Permeate				
	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.81	0.01	5	0.80 - 0.82					
pH	6.3	6.7	6.2	0.1	5	6.0 - 6.4	6.1	6.2	0.1	5	6.0 - 6.4
Temp	25.0	25.1	25.0	0.1	5	24.9 - 25.2	25.0	25.0	0.2	5	24.7 - 25.2
Alk	93	301	93	5	5	87 - 100	59	58	3	5	55 - 62
TDS	604	2234	604	10	5	595 - 615	223	190	13	5	168 - 199
TotHard	264	1303	264	17	5	248 - 288	75	69	5	5	65 - 76
CaHard	252	1271	252	8	5	243 - 263	71	62	8	5	55 - 76
Turb	0.51	0.46	0.51	0	5	0.11 - 0.97	0.21	0.29	0.12	5	0 - 0
TOC	16.4	70.0	16.2	7.2	5	11.0 - 28.0	0.3	3.3	5.0	5	0.3 - 12.0
UV254	0.451	2.660	0.449	0.029	4	0.424 - 0.489	0.007	0.008	0.007	4	0.005 - 0.018
SUVA	3.09	3.84	NA	NA	4	NA	2.66	NA	NA	4	NA

WQP	Stage 2 Influent						Stage 2 Permeate				
	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.57	0.02	5	0.54 - 0.59					
pH	6.3	6.7	6.4	0.1	5	6.2 - 6.6	6.1	6.3	0.2	5	6.0 - 6.6
Temp	25.0	25.1	25.0	0.1	5	24.8 - 25.2	25.0	25.0	0.1	5	24.8 - 25.2
Alk	93	301	139	15	5	122 - 154	59	70	7	5	62 - 77
TDS	604	2234	1081	18	5	1058 - 1096	223	271	22	5	234 - 289
TotHard	264	1303	521	19	5	500 - 538	75	91	3	5	87 - 95
CaHard	252	1271	495	25	5	456 - 521	71	85	5	5	78 - 91
Turb	0.51	0.46	0.50	0	5	0.27 - 1.29	0.21	0.15	0.06	5	0 - 0
TOC	16.4	70.0	35.0	10.2	5	28.0 - 52.0	0.3	10.4	15.6	5	1.1 - 38.0
UV254	0.451	2.660	0.835	0.433	5	0.061 - 1.063	0.007	0.010	0.011	5	0.005 - 0.029
SUVA	3.09	3.84	2.45	1.45	5.00	0.21 - 3.80	2.66	0.42	0.60	5.00	0.02 - 1.45

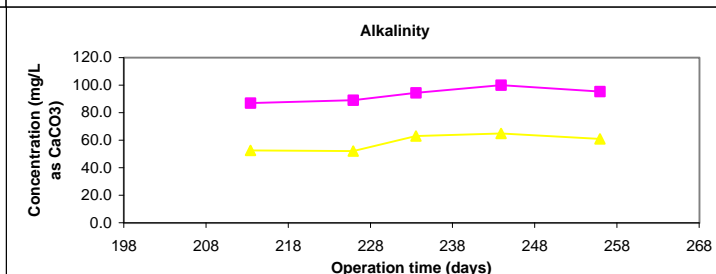
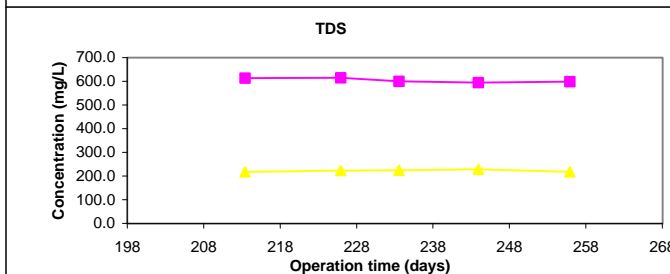
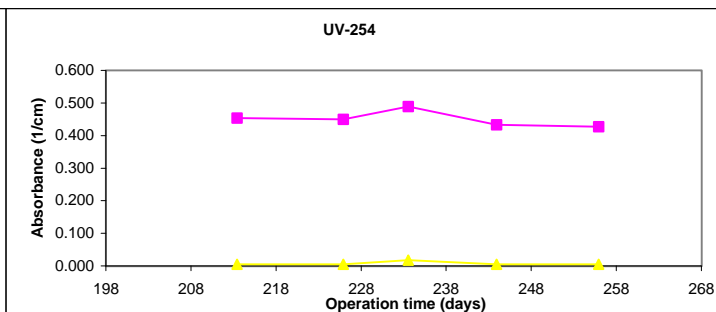
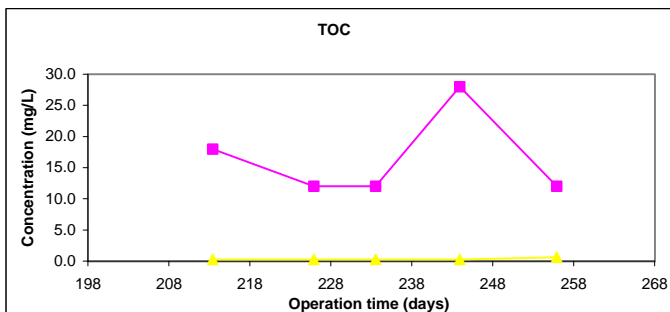
  

WQP	Stage 3 Influent						Stage 3 Permeate				
	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery											
pH											
Temp											
Alk											
TDS											
TotHard											
CaHard											
Turb											
TOC											
UV254											
SUVA											

## Water Quality Parameter Graphs

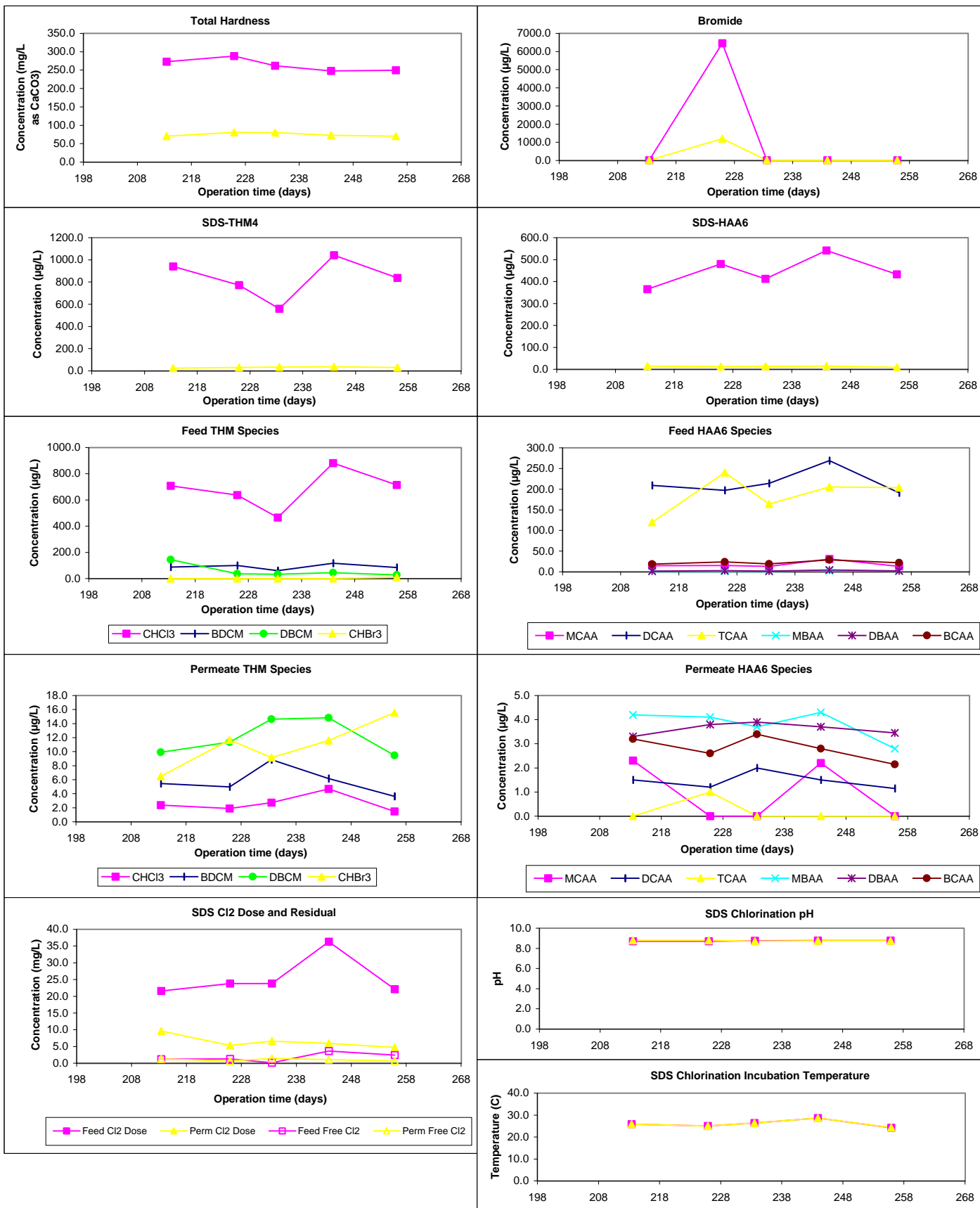
## Chart Legend:

- Feed (System)
- Permeate (System)

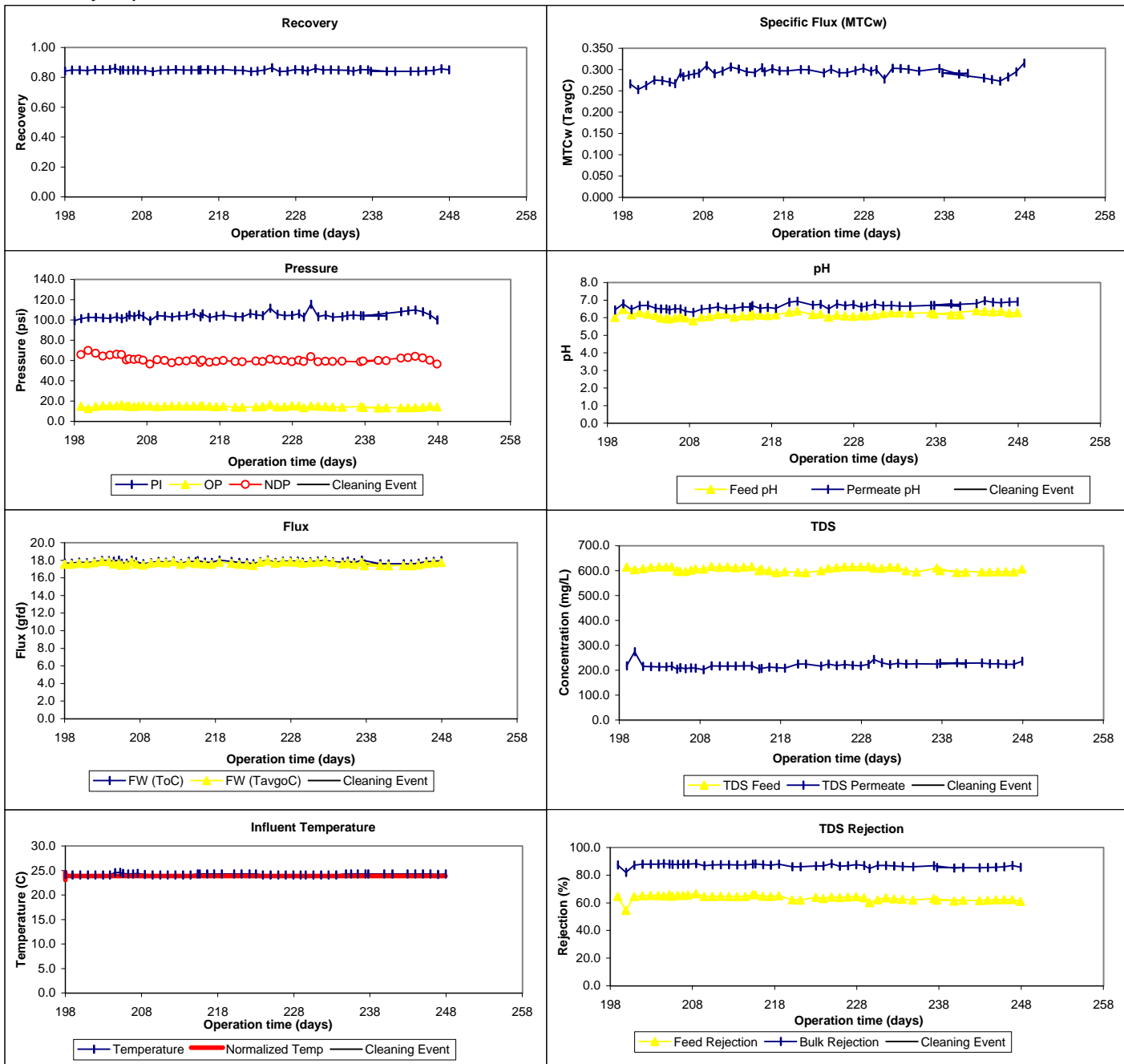




## Water Quality Graphs (Continued)



## Productivity Graphs



## ICR Information

ID / ICR#: FL4500145 / 1085  
 ICR Contact: Steven Evans  
 Phone No.: (561) 742-6464  
 Period: 8/10/98 - 11/30/98 (112 days)

## Membrane Information

Manufacturer: Film Tec Corporation  
 Trade Name: FILMTEC  
 Membrane Model: NF70-345  
 MWCO: 200 Daltons  
 Element Size: 8" X 40"  
 Element Area: 345.0 ft<sup>2</sup>  
 Design Flux: 24.1 gfd  
 Mfr. NDP: 70.0 psi  
 Mfr. MTC<sub>w</sub>: 0.357 (gfd/psi)  
 Mfr. Temp: 25.0 °C  
 Maximum Flow: 60.0 gpm  
 Minimum Flow: 16.0 gpm  
 Total Width : 59 ft. ft  
 Feed Spacer Thickness: 0.0028 ft  
 840 Element Area 345.0 ft<sup>2</sup>  
 840 Purchase Price: \$600

## Design Parameters

Norm Temp: 23.9 °C  
 Temp Norm MTC-w: 0.346 TavGC  
 Design Recovery: 0.85  
 Avg Sys Flux F<sub>w</sub>: 25.0 gfd  
 # of Elem in P.V.: 6  
 # Pres Ves in Stg 1: 26  
 # Pres Ves in Stg 2: 10  
 Pres Ves in Stg 3: NA  
 Design Flux: 25.0 gfd  
 Recycle Ratio: 0.00  
 Osmotic P Stage 1: 50.0 psi  
 Osmotic P Stage 2: 14.0 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	6.3	0.1	5	6.2 - 6.5	6.2	0.1	5	6.1 - 6.4	6.8	0.1	5	6.6 - 6.9
Temp	24.8	0.2	5	24.6 - 25.0	24.9	0.2	5	24.6 - 25.0	25.0	0.1	5	24.8 - 25.1
Alk	90	3	5	86 - 94	64	3	5	60 - 67	278	43	5	227 - 345
TDS	599	4	5	596 - 605	239	11	5	225 - 254	2154	34	5	2120 - 2200
TotHard	246	3	5	243 - 252	76	5	5	70 - 82	1196	69	5	1108 - 1250
CaHard	242	4	5	237 - 247	73	6	5	67 - 82	1167	77	5	1051 - 1230
Turb	0.24	0.1	5	0.15 - 0.45	0.15	0.1	5	0.08 - 0.24	0.31	0.1	5	0.22 - 0.49
Amm	0.58	0.10	4	0.45 - 0.67	0.37	0.11	4	0.21 - 0.45	1.49	0.72	4	0.4 - 1.9
TOC	18.4	4.0	4	13.0 - 22.5	1.1	0.9	3	0.3 - 2.0	77.0	8.5	4	71.0 - 89.0
UV254	0.431	0.0	5	0.405 - 0.462	0.006	0.0	5	0.005 - 0.009	2.782	0.0	5	2.751 - 2.845
SUVA	NA	NA	4	NA	NA	NA	3	NA	NA	NA	4	NA
Bromide	10	0	5	10 - 10	10	0	5	10 - 10				
TOX	2390	493	5	1700 - 3000	88	37	5	47 - 129				
CHCl3	782.7	310.3	4	561.6 - 1242.6	3.5	1.3	4	1.6 - 4.5	Mass Balance Closure Errors (%)			
BDCM	100.8	41.9	4	75.2 - 163.4	7.9	3.5	4	3.4 - 12.0				
DBCM	34.0	6.8	4	29.1 - 44.0	15.3	5.3	4	10.5 - 20.5	WQP	Count	Avg	SD/RD
CHBr3	13.8	17.4	4	0.0 - 36.1	12.5	8.0	4	4.6 - 23.3	Alk	5	15	7
THM4	931.3	344.4	4	668.0 - 1437.8	39.1	8.9	4	26.6 - 45.9	TDS	5	-21	3
MCAA	16.3	5.5	5	7.5 - 21.5	0.8	1.8	5	0.0 - 4.0	TotHard	5	0	5
DCAA	262.1	28.5	5	227.0 - 296.0	3.3	1.6	5	1.6 - 5.6	CaHard	5	-1	5
TCAA	254.7	56.0	5	169.0 - 307.0	1.4	0.9	5	0.0 - 2.5	Turb	5	-119	180
MBAA	1.5	1.8	5	0.0 - 4.3	4.1	2.4	5	2.0 - 7.2	Amm	4	-78	177
DBAA	4.4	1.6	5	3.4 - 7.3	5.8	1.1	5	4.7 - 7.6	TOC	1	2	n/a
BCAA	30.8	4.0	5	26.5 - 36.9	4.1	2.1	5	2.1 - 7.0	UV254	5	-1	5
TBAA	NA	NA	0	NA	NA	NA	0	NA	TDS			
CDBAA	NA	NA	0	NA	NA	NA	0	NA				
DCBAA	NA	NA	0	NA	NA	NA	0	NA	Comments:			
HAA5	539.1	89.6	5	408.2 - 626.9	15.3	6.7	5	8.9 - 23.1				
HAA6	569.8	92.5	5	437.3 - 663.8	19.4	8.6	5	11.7 - 28.9				
HAA9	NA	NA	0	NA	NA	NA	0	NA				
SDS Conditions					Pretreatment Information							
WQP	Avg	SD	Count	Min - Max	Process	Description						Scale
Res (0)	3.55	3.64	10	0.50 - 11.20	pH reduction	Addition of Sulfuric Acid at an average dose of 204 mg/l. Target pH = 5.9						Full-Scale
Temp (°C)	25.8	0.6	10	25.0 - 26.7								
pH (unit)	8.7	0.0	10	8.7 - 8.8								
Time (hr)	96.0	0.0	10	96.0 - 96.0								
					Sand and silt removed e Filters 5 micron						Full-Scale	

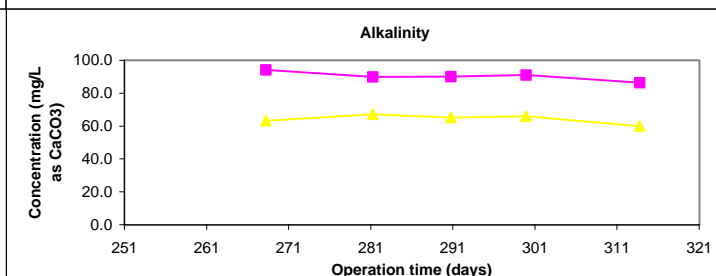
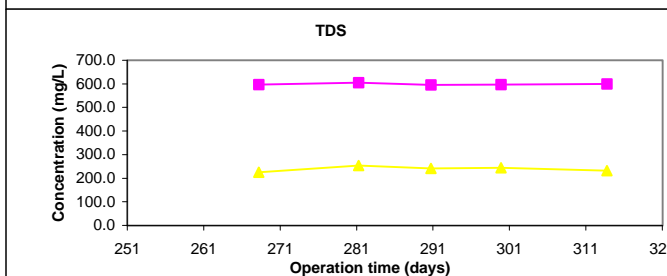
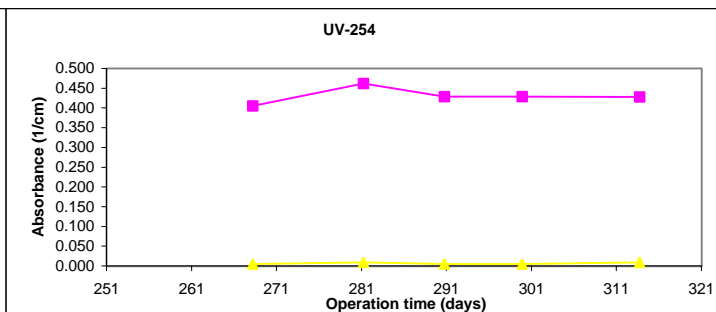
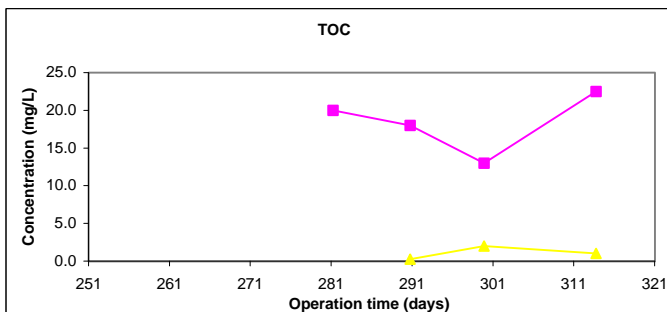
## Stage Summary

WQP	Stage 1 Influent						Stage 1 Permeate				
	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.82	0.02	5	0.80 - 0.85					
pH	6.3	6.8	6.3	0.1	5	6.2 - 6.5	6.2	6.2	0.1	5	6.0 - 6.3
Temp	24.8	25.0	24.8	0.2	5	24.6 - 25.0	24.9	78.8	120.6	5	24.9 - 294.6
Alk	90	278	90	3	5	87 - 94	64	56	5	5	51 - 63
TDS	599	2154	599	4	5	596 - 605	239	192	8	5	181 - 202
TotHard	246	1196	246	3	5	243 - 252	76	63	5	5	58 - 70
CaHard	242	1167	241	4	5	237 - 247	73	59	4	5	53 - 65
Turb	0.24	0.31	0.24	0	5	0.15 - 0.45	0.15	0.15	0.04	5	0 - 0
TOC	18.4	77.0	22.2	10.8	5	13.0 - 41.0	1.1	6.5	7.9	5	1.0 - 20.0
UV254	0.431	2.782	0.431	0.020	5	0.405 - 0.462	0.006	0.006	0.004	5	0.005 - 0.013
SUVA	NA	NA	2.25	0.82	5	0.99 - 3.30	NA	0.37	0.53	5	0.02 - 1.30
WQP	Stage 2 Influent						Stage 2 Permeate				
	Sys Feed	Sys Conc	Mean	SD	Count	Min/Max	Sys Perm	Mean	SD	Count	Min/Max
Recovery			0.60	0.02	5	0.58 - 0.63					
pH	6.3	6.8	6.5	0.1	5	6.3 - 6.6	6.2	6.3	0.0	5	6.3 - 6.4
Temp	24.8	25.0	24.9	0.2	5	24.6 - 25.0	24.9	24.9	0.1	5	24.7 - 25.0
Alk	90	278	140	7	5	134 - 152	64	82	6	5	73 - 90
TDS	599	2154	1053	8	5	1044 - 1063	239	330	30	5	280 - 360
TotHard	246	1196	490	6	5	481 - 496	76	107	12	5	88 - 120
CaHard	242	1167	481	11	5	466 - 494	73	104	12	5	86 - 119
Turb	0.24	0.31	0.36	0	5	0.21 - 0.77	0.15	0.16	0.07	5	0 - 0
TOC	18.4	77.0	27.8	1.1	5	26.0 - 29.0	1.1	20.6	36.3	5	1.0 - 85.0
UV254	0.431	2.782	0.997	0.024	5	0.979 - 1.039	0.006	0.013	0.001	5	0.012 - 0.015
SUVA	NA	NA	3.59	0.15	5.00	3.40 - 3.77	NA	0.59	0.60	5.00	0.01 - 1.50
WQP	Stage 3 Influent						Stage 3 Permeate				
	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											

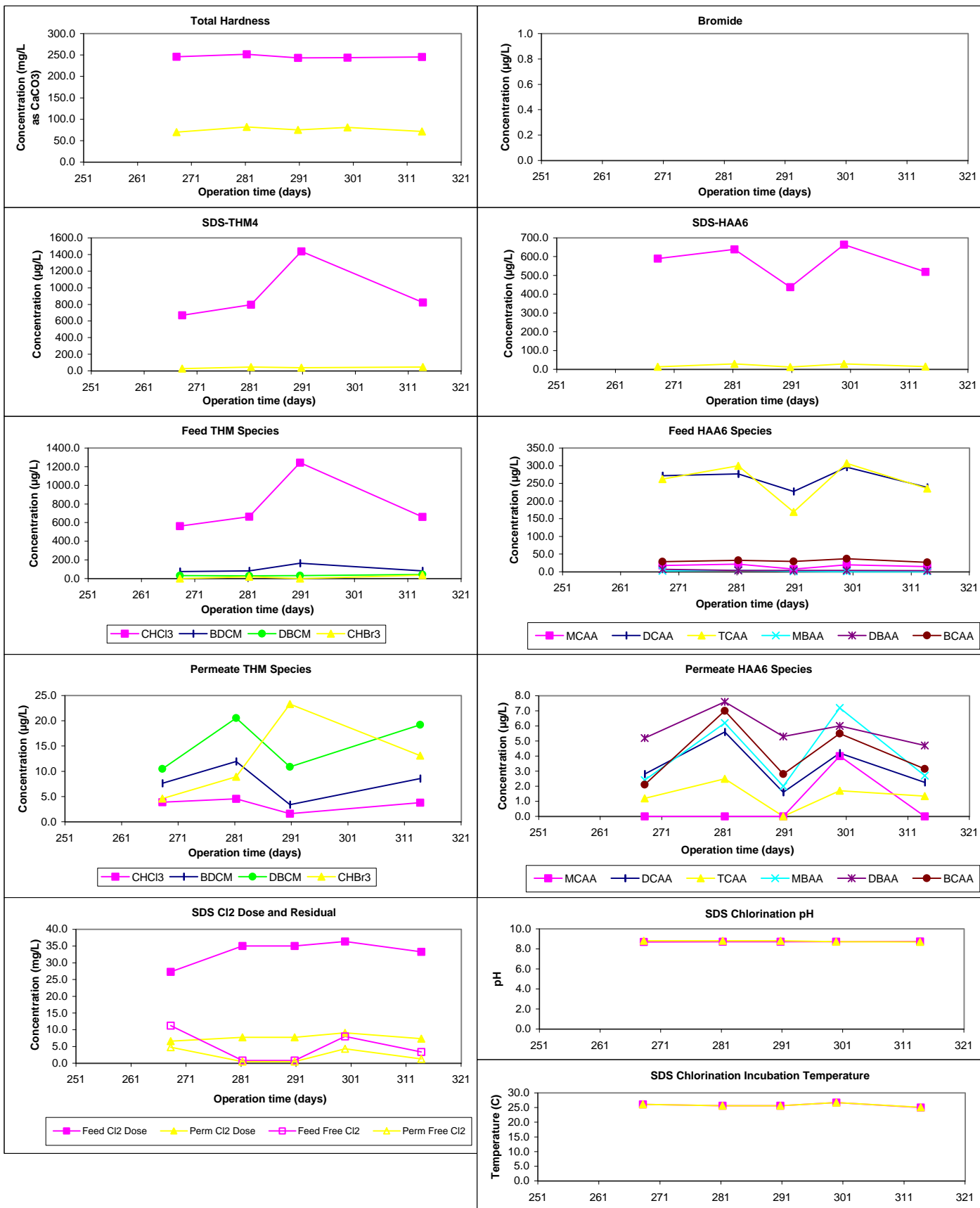
## Water Quality Parameter Graphs

## Chart Legend:

■ Feed (System)  
▲ Permeate (System)



## Water Quality Graphs (Continued)



## Productivity Graphs

