

# ICR TREATMENT STUDY ANALYSIS

## Base Analysis and Data Review Comments

<b>Treatment Study ID</b>	1050
<b>Study Protocol</b>	RBSMT
<b>Plant ICR Number</b>	381
<b>PWS Name</b>	Water District No. 1, Johnson County
<b>City, State, Zip</b>	Kansas City, KS 66106

### General Comments:

1. During this study, two nanofiltration membranes, the FilmTec BW30-XLE and the FilmTec NF200, were evaluated over four quarters to investigate seasonal variability.
2. Influent to the study was collected after the presedimentation basins, prior to the first chlorine addition point, as shown in Figure 1 of the Summary Report. Softening, coagulation, sedimentation, recarbonation and filtration were simulated at the bench-scale.
3. During data analysis, temperatures of 15°C, 26°C, 20°C, and 6°C for Spring, Summer, Autumn and Winter, were used, respectively. This was necessary to estimate the range of pressures required to maintain a constant production rate over the course of a calendar year. The temperatures were estimated using the range of full-scale influent water temperatures reported in the Summary Report. The temperatures in the Data Collection Spreadsheets are indicative of lab conditions.
4. No cost information was provided in the Summary Report

### Water Quality Comments:

1. 12 water quality outliers were removed from this study.
2. SDS conditions used during the study are summarized in Table 6 of the Summary Report. A constant pH of 9.5 and a constant free residual of 0.5 to 1.0 mg/L were used for all four quarters. The temperature and incubation time were varied to match seasonal trends. The temperature and time for each quarter were: 13°C and 40 hrs during quarter 1; 26°C and 24 hrs during quarter 2; 20°C and 31 hrs during quarter 3; and 6°C and 40 hrs during quarter 3.

This wide range of temperatures and times must be considered when evaluating the DBP data.

**Productivity Comments:**

1. 13 productivity outliers were removed from this study.
2. Acid addition for scale control was not used as pretreatment, rather the membranes were operated at the pH obtained after recarbonation (9.3 to 9.6); however, the pH did decrease over the course of the run as CO<sub>2</sub> was absorbed from the atmosphere. Operation at this high pH may have resulted in inorganic fouling.
3. The cleaning procedure utilized both phosphoric acid and sodium hydroxide cleaners and is described in Section 3B of the Summary Report.

## ICR Information

**ID / ICR#:** KS200910 / 381  
**ICR Contact:** Mr. Thomas F. Schremp  
**Phone No.:** (913) 895-5820  
**Period:** 5/6/98 - 5/15/98 (9 days)

## Membrane Information

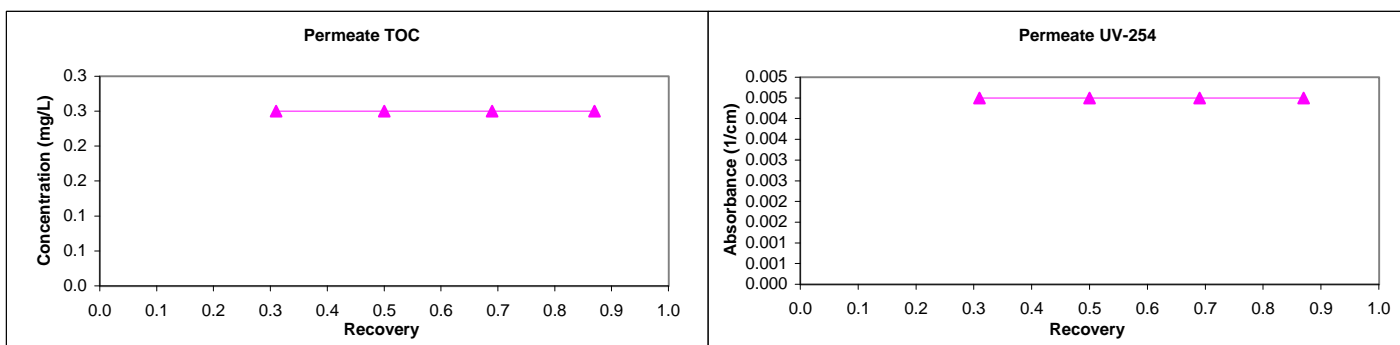
**Manufacturer:** Dow-Filmtec  
**Trade Name:** BW30-XLE  
**MWCO:** 100 Daltons  
**Mfr. Flux:** 30(15 av gfd)  
**Mfr. NDP:** 130.0 psi  
**Mfr. MTCw:** 0.231 gfd/psi

**Mfr. Temp:** 25.0 °C  
**840 Element Area:** 400.0 ft<sup>2</sup>  
**840 Purchase Price:** \$700  
**840 Maximum Flow:** 70.0 gpm  
**840 Minimum Flow:** 18.8 gpm  
**840 Total Width:** 70.6 ft  
**840 Feed Spacer Thickness:** 0.0026 ft

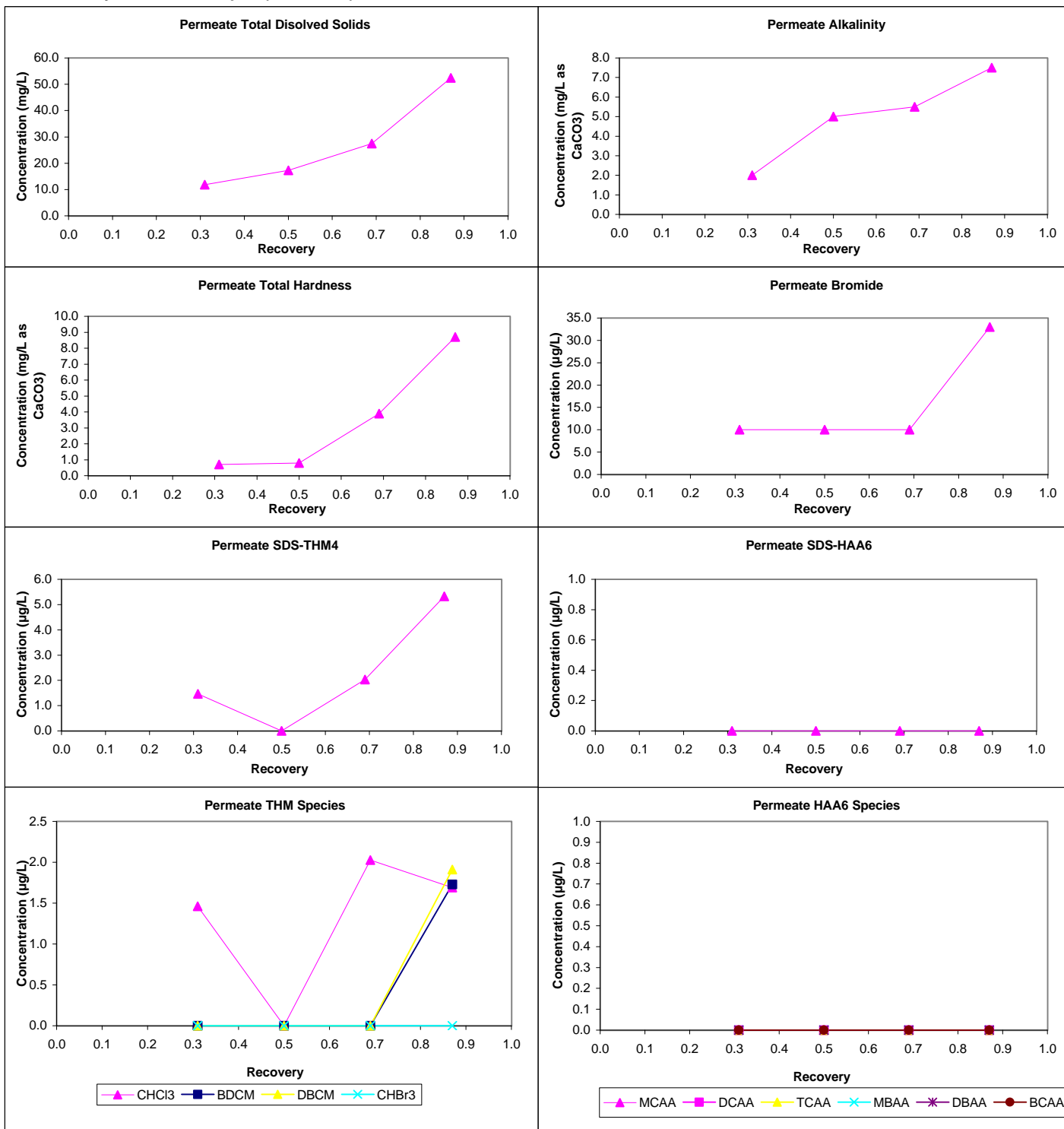
## Water Quality Summary

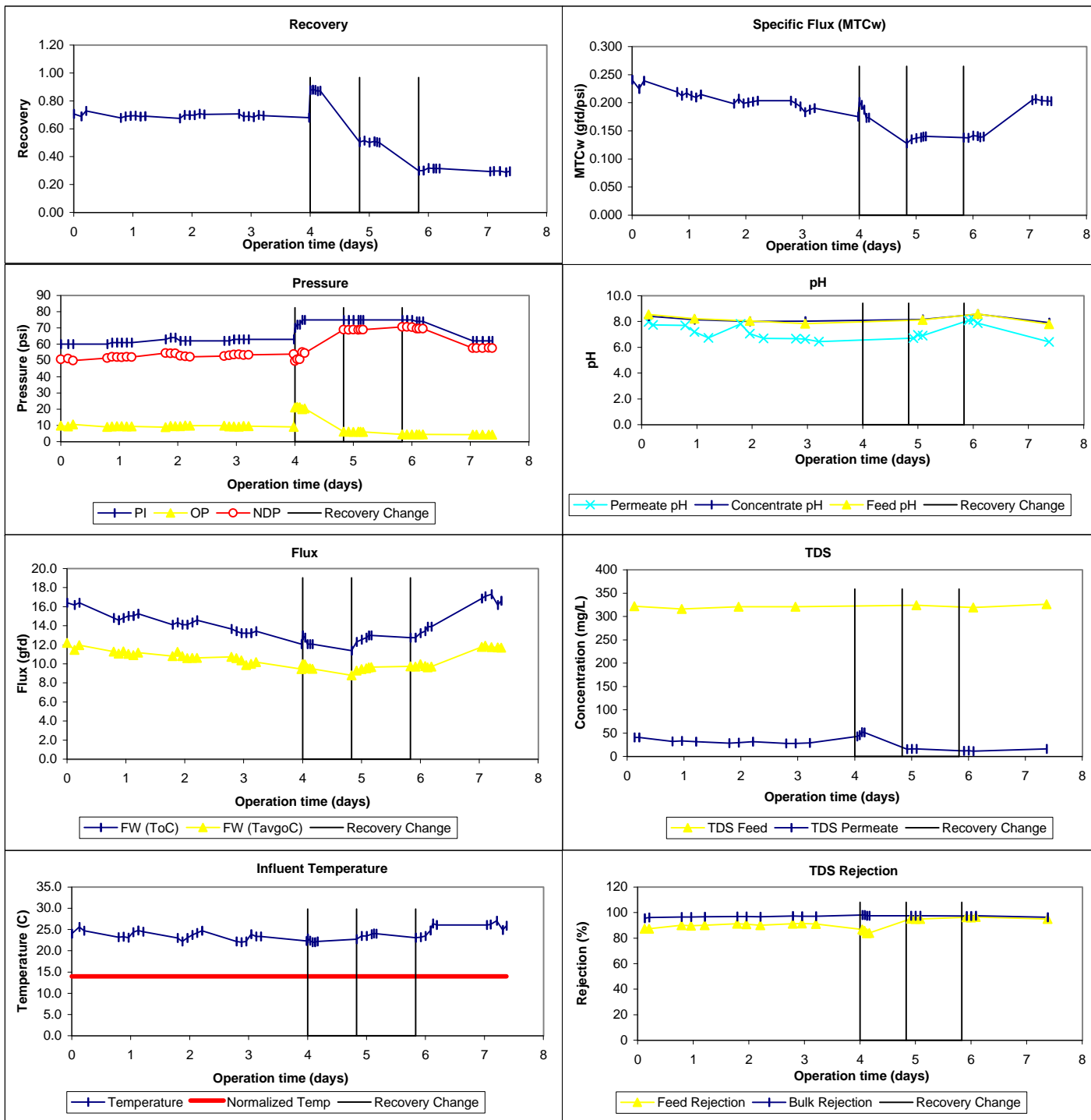
Source ->	Feed		Permeate				Concentrate				Mass Balance Closure Err (%)																														
Recovery ->	Avg	Diff	0.31	0.50	0.69	0.87	0.31	0.50	0.69	0.87	WQP	Count	Avg	SD																											
pH	8.6	0.0	6.5	6.6	7.0	7.0	8.3	8.0	8.4	8.4	TDS	8	-14	13																											
Temp	22.3	0.8	21.0	23.0	19.0	21.0	21.0	22.0	19.0	21.0	Alk	4	-9	17																											
Alk	55	1	2	5	6	8	59	109	162	353	TDS	4	-14	16																											
TDS	322	0	12	17	27	52	450	601	863	1556	TotHard	4	2	3																											
TotHard	117	1	1	1	4	9	168	248	379	851	CaHard	4	4	3																											
CaHard	97	2	1	1	4	8	140	207	322	722	Turb	4	-38	24																											
Turb	0.16	0.01	0.12	0.10	0.10	0.11	0.15	0.18	0.21	0.29	Amm	0	n/a	n/a																											
Amm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	TOC	0	n/a	n/a																											
TOC	3.2	0.0	0.3	0.3	0.3	0.3	4.4	6.2	9.7	21.0	UV254	4	0	5																											
UV254	0.053	0.001	0.005	0.005	0.005	0.005	0.077	0.107	0.166	0.359	<div>Pretreatment Information</div> <table><thead><tr><th>Process</th><th>Description</th><th>Scale</th></tr></thead><tbody><tr><td>Presedimentation</td><td>3 Basins</td><td>Full-scale</td></tr><tr><td>Softening Lime</td><td>200 mg/L as Ca(OH)2</td><td>Bench-scale</td></tr><tr><td>Coagulation im:</td><td>Al2(SO4)3.14H2O, 15 mg/L</td><td>Bench-scale</td></tr><tr><td>Sedimentation</td><td>Gravity settling in test drums</td><td>Bench-scale</td></tr><tr><td>Recarbonation</td><td>CO2 gas added to pH 9.4</td><td>Bench-scale</td></tr><tr><td>Cartridge filtration</td><td>1 um size exclusion</td><td>Bench-scale</td></tr><tr><td>Antiscalant</td><td>4 mg/L Hypersperse 400UL</td><td>Bench-scale</td></tr></tbody></table>				Process	Description	Scale	Presedimentation	3 Basins	Full-scale	Softening Lime	200 mg/L as Ca(OH)2	Bench-scale	Coagulation im:	Al2(SO4)3.14H2O, 15 mg/L	Bench-scale	Sedimentation	Gravity settling in test drums	Bench-scale	Recarbonation	CO2 gas added to pH 9.4	Bench-scale	Cartridge filtration	1 um size exclusion	Bench-scale	Antiscalant	4 mg/L Hypersperse 400UL	Bench-scale			
Process	Description	Scale																																							
Presedimentation	3 Basins	Full-scale																																							
Softening Lime	200 mg/L as Ca(OH)2	Bench-scale																																							
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Recarbonation	CO2 gas added to pH 9.4	Bench-scale																																							
Cartridge filtration	1 um size exclusion	Bench-scale																																							
Antiscalant	4 mg/L Hypersperse 400UL	Bench-scale																																							
SUVA	1.67	0.04	1.80	1.80	1.80	1.80	1.75	1.73	1.71	1.71																															
Bromide	114	17	10	10	10	33	<div>Design Parameters</div> <table><tr><td>Active memb area:</td><td>0.167 ft<sup>2</sup></td><td rowspan="2">ID#</td><td rowspan="2">Recov (dec.)</td><td rowspan="2">F<sub>W-des</sub> (gfd)</td></tr><tr><td>Active width:</td><td>0.333 ft</td></tr><tr><td>Norm Temp:</td><td>14.0 °C</td><td>1</td><td>0.70</td><td>15.0</td></tr><tr><td>Feed TDS:</td><td>322.0 mg/L</td><td>2</td><td>0.90</td><td>15.0</td></tr><tr><td>Manuf rep TDS rej:</td><td>98%</td><td>3</td><td>0.50</td><td>15.0</td></tr><tr><td>Temp Norm MTC-w:</td><td>0.167 gfd/psi</td><td>4</td><td>0.30</td><td>15.0</td></tr></table>								Active memb area:	0.167 ft <sup>2</sup>	ID#	Recov (dec.)	F <sub>W-des</sub> (gfd)	Active width:	0.333 ft	Norm Temp:	14.0 °C	1	0.70	15.0	Feed TDS:	322.0 mg/L	2	0.90	15.0	Manuf rep TDS rej:	98%	3	0.50	15.0	Temp Norm MTC-w:	0.167 gfd/psi	4	0.30	15.0
Active memb area:	0.167 ft <sup>2</sup>	ID#	Recov (dec.)	F <sub>W-des</sub> (gfd)																																					
Active width:	0.333 ft																																								
Norm Temp:	14.0 °C	1	0.70	15.0																																					
Feed TDS:	322.0 mg/L	2	0.90	15.0																																					
Manuf rep TDS rej:	98%	3	0.50	15.0																																					
Temp Norm MTC-w:	0.167 gfd/psi	4	0.30	15.0																																					
TOX	180	30	13	13	13	13																																			
CHCl3	50.6	8.8	1.5	0.0	2.0	1.7																																			
BDCM	28.5	2.9	0.0	0.0	0.0	1.7																																			
DBCM	17.4	0.8	0.0	0.0	0.0	1.9																																			
CHBr3	3.5	0.1	0.0	0.0	0.0	0.0																																			
THM4	100.0	12.5	1.5	0.0	2.0	5.3																																			
MCAA	0.0	0.0	0.0	0.0	0.0	0.0																																			
DCAA	17.6	1.7	0.0	0.0	0.0	0.0																																			
TCAA	3.3	0.3	0.0	0.0	0.0	0.0																																			
MBAA	0.0	0.0	0.0	0.0	0.0	0.0																																			
DBAA	4.2	0.3	0.0	0.0	0.0	0.0																																			
BCAA	8.7	0.2	0.0	0.0	0.0	0.0																																			
TBAA	NA	NA	NA	NA	NA	NA																																			
CDBAA	NA	NA	NA	NA	NA	NA																																			
DCBAA	NA	NA	NA	NA	NA	NA																																			
HAA5	25.1	1.1	0.0	0.0	0.0	0.0																																			
HAA6	33.7	1.4	0.0	0.0	0.0	0.0																																			
HAA9	NA	NA	NA	NA	NA	NA																																			
SDS Conditions																																									
WQP	Avg	SD	Count	Min - Max																																					
Res (mg/L) (0)	1.20	0.23	6	1.00 - 1.57																																					
Temp (°C)	13.0	0.0	6	13.0 - 13.0																																					
pH (unit)	9.5	0.0	6	9.5 - 9.5																																					
Time (hr)	42.0	0.0	6	42.0 - 42.0																																					
Comments:																																									

## Water Quality Parameter Graphs



## Water Quality Parameter Graphs (Continued)



**Productivity Graphs**


## ICR Information

**ID / ICR#:** KS200910 / 381  
**ICR Contact:** Mr. Thomas F. Schremp  
**Phone No.:** (913) 895-5820  
**Period:** 7/22/98 - 7/30/98 (8 days)

## Membrane Information

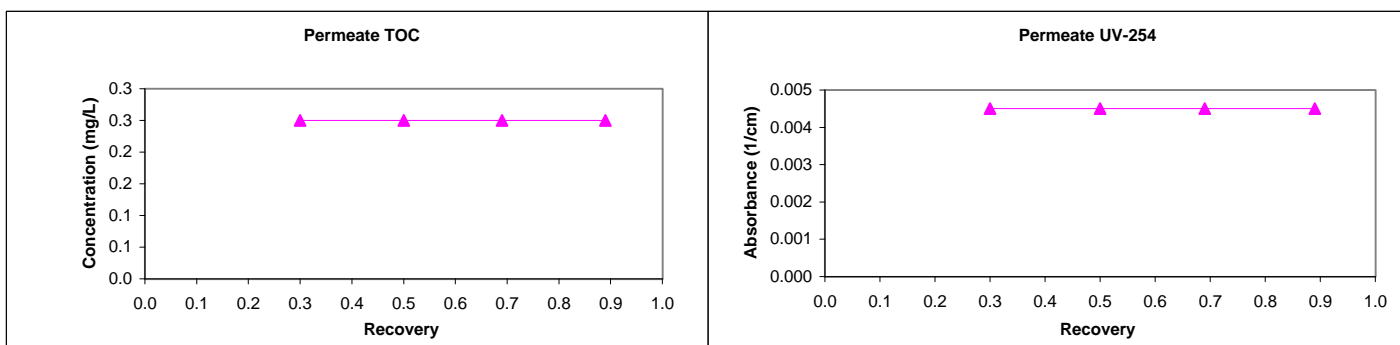
**Manufacturer:** Dow-Filmtec  
**Trade Name:** BW30-XLE  
**MWCO:** 100 Daltons  
**Mfr. Flux:** 30(15 av gfd)  
**Mfr. NDP:** 130.0 psi  
**Mfr. MTCw:** 0.231 gfd/psi

**Mfr. Temp:** 25.0 °C  
**840 Element Area:** 400.0 ft<sup>2</sup>  
**840 Purchase Price:** \$700  
**840 Maximum Flow:** 70.0 gpm  
**840 Minimum Flow:** 18.8 gpm  
**840 Total Width:** 70.6 ft  
**840 Feed Spacer Thickness:** 0.0026 ft

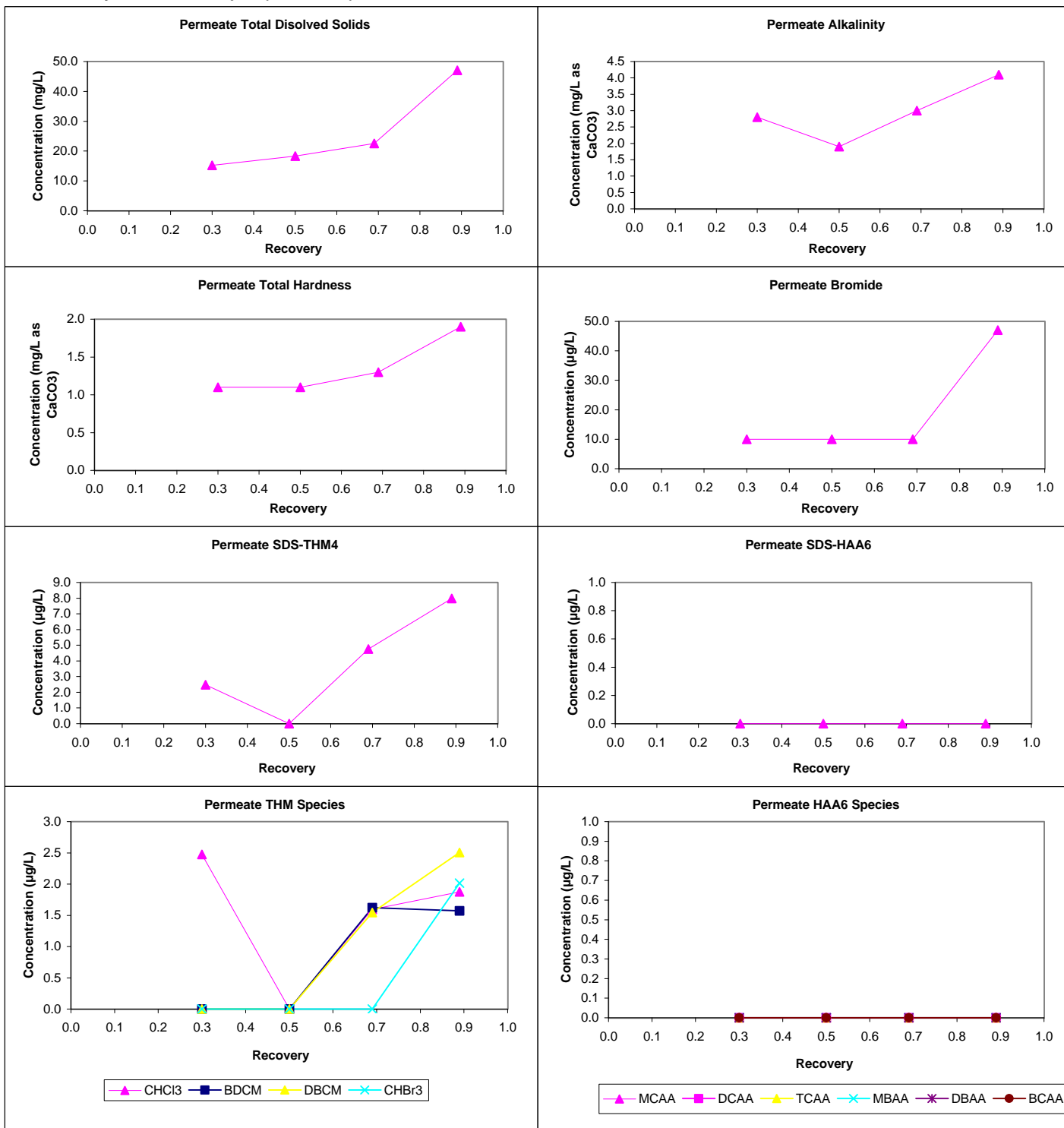
## Water Quality Summary

Water Quality Summary							Mass Balance Closure Err (%)													
Source ->	Feed		Permeate				Concentrate													
Recovery ->	Avg	Diff	0.30	0.50	0.69	0.89	0.30	0.50	0.69	0.89	WQP	Count	Avg	SD						
pH	9.1	0.2	8.2	7.6	7.5	7.1	8.9	8.2	8.6	8.3	TDS	7	1	19						
Temp	24.9	1.9	23.0	26.2	22.7	24.8	23.0	26.2	22.7	24.8										
Alk	49	9	3	2	3	4	65	105	130	229	Alk	4	-24	40						
TDS	220	22	15	18	23	47	339	475	661	1322	TDS	4	0	15						
TotHard	98	5	1	1	1	2	129	195	275	570	TotHard	4	-19	24						
CaHard	82	4	1	1	1	2	108	171	233	477	CaHard	4	-17	25						
Turb	0.13	0.01	0.09	0.12	0.13	0.12	0.15	0.16	0.16	0.20	Turb	4	7	11						
Amm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Amm	0	n/a	n/a						
TOC	2.6	0.0	0.3	0.3	0.3	0.3	3.6	4.9	6.6	10.0	TOC	0	n/a	n/a						
UV254	0.046	0.000	0.005	0.005	0.005	0.005	0.064	0.092	0.138	0.330	UV254	4	-8	13						
SUVA	1.77	0.00	1.80	1.80	1.80	1.80	1.78	1.88	2.10	3.30										
Bromide	110	10	10	10	10	47	Pretreatment Information													
TOX	180	0	13	13	13	13														
							Process		Description		Scale									
CHCl3	60.4	5.1	2.5	0.0	1.6	1.9	Presedimentation		3 Basins		Full-scale									
BDCM	26.1	1.4	0.0	0.0	1.6	1.6	Softening Lime, 180 mg/L as Ca(OH)2				Bench-scale									
DBCM	13.8	1.4	0.0	0.0	1.5	2.5	Coagulation lum: Al2(SO4)3.H2O, 15 mg/L				Bench-scale									
CHBr3	2.7	0.3	0.0	0.0	0.0	2.0	Sedimentation Gravity settling in test drums				Bench-scale									
THM4	103.0	2.1	2.5	0.0	4.8	8.0	Recarbonation CO2 gas added to pH 9.4				Bench-scale									
MCAA	1.7	1.7	0.0	0.0	0.0	0.0	Cartridge filtration 1 um size exclusion				Bench-scale									
DCAA	18.3	0.4	0.0	0.0	0.0	0.0	Antiscalant 4 mg/L Hypersperse 400UL				Bench-scale									
TCAA	3.5	0.5	0.0	0.0	0.0	0.0	Design Parameters													
MBAA	0.0	0.0	0.0	0.0	0.0	0.0														
DBAA	3.2	0.5	0.0	0.0	0.0	0.0														
BCAA	7.8	0.7	0.0	0.0	0.0	0.0														
TBAA	NA	NA	NA	NA	NA	NA														
CDBAA	NA	NA	NA	NA	NA	NA														
DCBAA	NA	NA	NA	NA	NA	NA	Active memb area:		0.167 ft²		ID#	Recov (dec.)	F <sub>W-des</sub> (gfd)							
HAA5	26.7	2.4	0.0	0.0	0.0	0.0	Active width:		0.333 ft		1	0.70	15.0							
HAA6	34.4	3.0	0.0	0.0	0.0	0.0	Norm Temp:		14.0 °C		2	0.90	15.0							
HAA9	NA	NA	NA	NA	NA	NA	Feed TDS:		322.0 mg/L		3	0.50	15.0							
SDS Conditions							Manuf rep TDS rej:		98%		4	0.30	15.0							
							Temp Norm MTC-w:		0.167 gfd/psi											
							Comments:													
WQP	Avg	SD	Count	Min - Max																
Res (mg/L) (0)	0.72	0.08	6	0.63 - 0.83																
Temp (°C)	26.2	0.1	6	26.0 - 26.2																
pH (unit)	9.4	0.0	6	9.4 - 9.5																
Time (hr)	24.0	0.0	6	24.0 - 24.0																

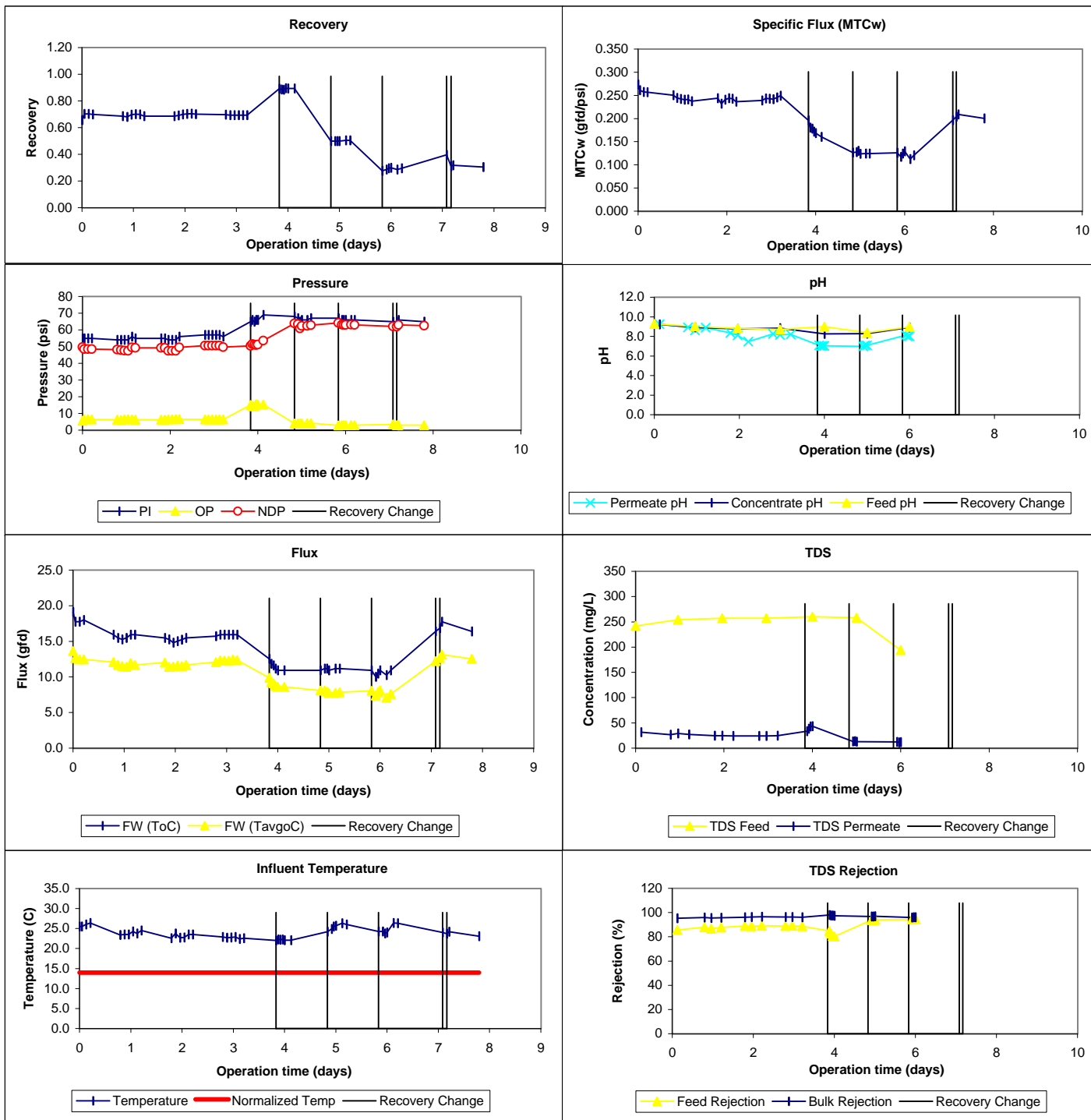
## Water Quality Parameter Graphs



Water Quality Parameter Graphs (Continued)



## Productivity Graphs





## ICR Information

**ID / ICR#:** KS200910 / 381  
**ICR Contact:** Mr. Thomas F. Schremp  
**Phone No.:** (913) 895-5820  
**Period:** 10/21/98 - 10/29 (8 days)

## Membrane Information

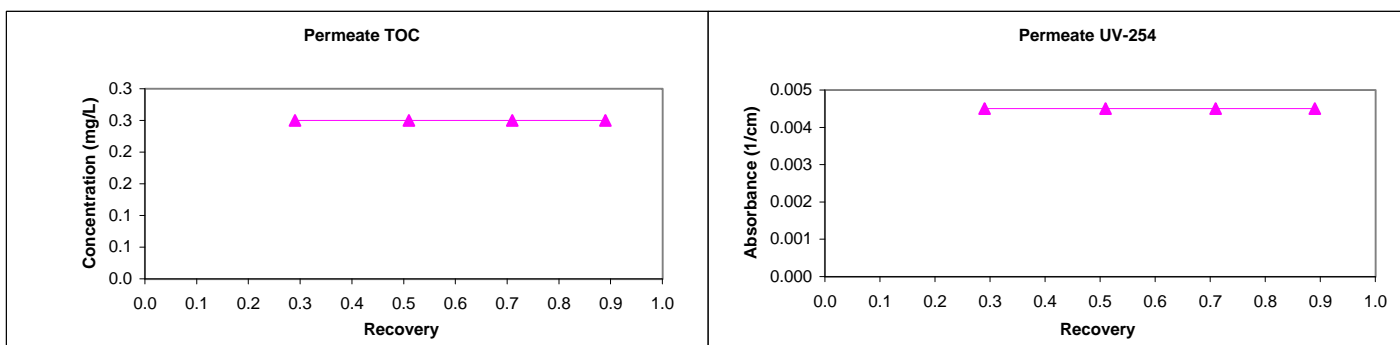
**Manufacturer:** Dow-Filmtec  
**Trade Name:** BW30-XLE  
**MWCO:** 100 Daltons  
**Mfr. Flux:** 30(15 av gfd)  
**Mfr. NDP:** 130.0 psi  
**Mfr. MTCw:** 0.231 gfd/psi

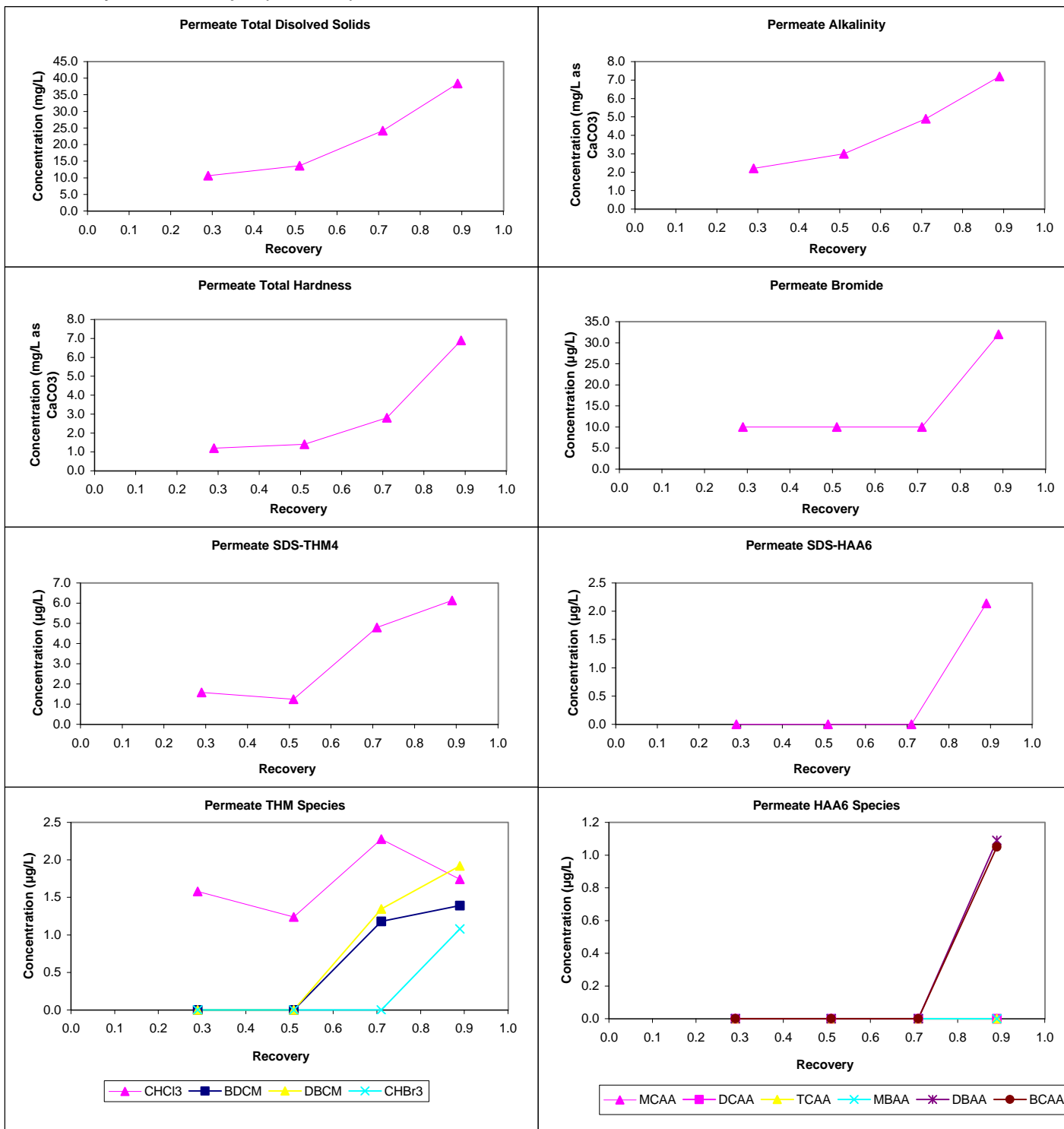
**Mfr. Temp:** 25.0 °C  
**840 Element Area:** 400.0 ft<sup>2</sup>  
**840 Purchase Price:** \$700  
**840 Maximum Flow:** 70.0 gpm  
**840 Minimum Flow:** 18.8 gpm  
**840 Total Width:** 70.6 ft  
**840 Feed Spacer Thickness:** 0.0026 ft

## Water Quality Summary

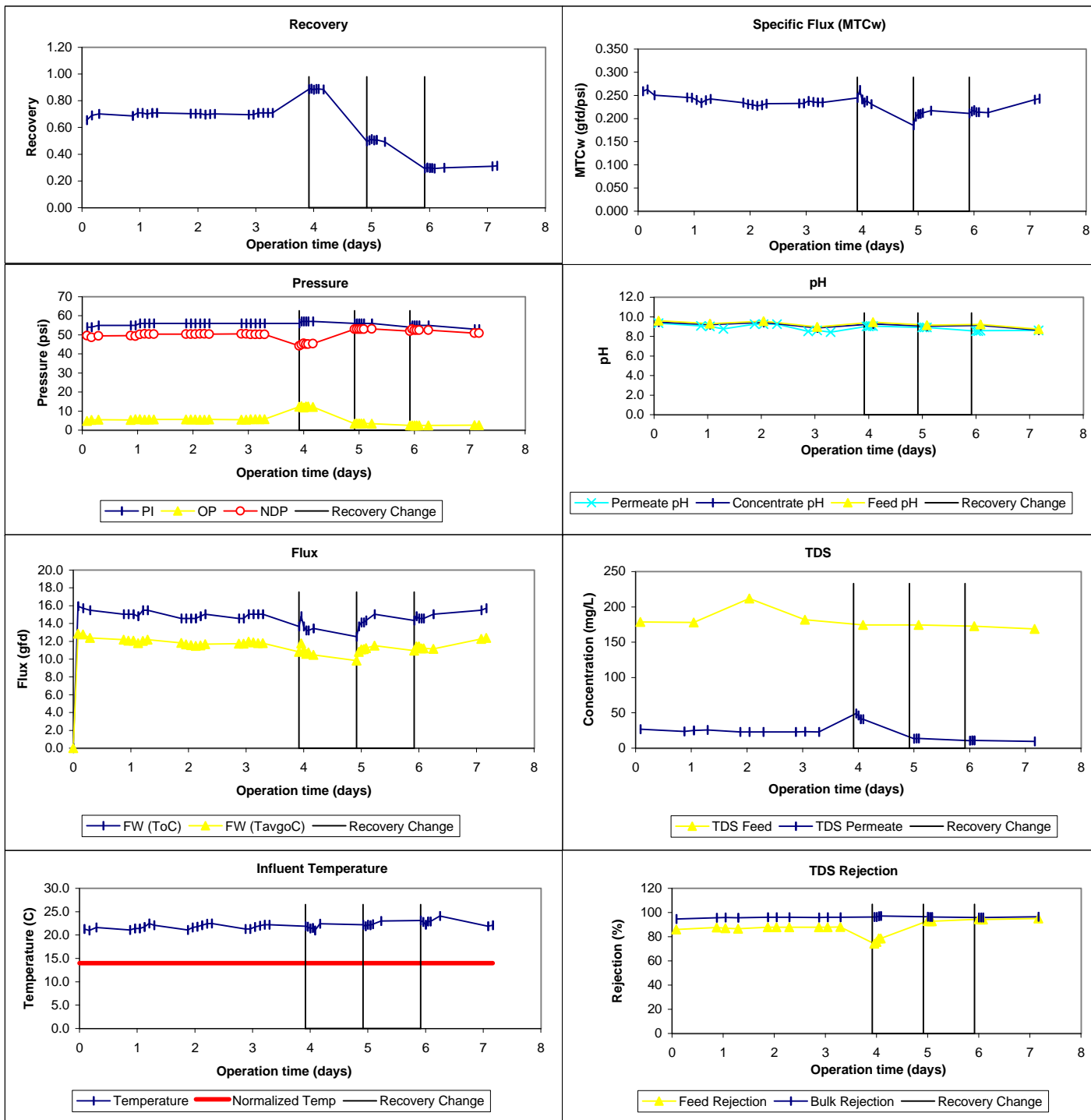
Water Quality Summary							Mass Balance Closure Err (%)														
Source ->	Feed		Permeate				Concentrate														
Recovery ->	Avg	Diff	0.29	0.51	0.71	0.89	0.29	0.51	0.71	0.89	WQP	Count	Avg	SD							
pH	8.8	0.8	7.7	7.0	8.0	8.4	8.9	8.5	8.6	8.9	TDS	8	-8	14							
Temp	23.6	1.9	25.5	23.7	22.7	22.5	25.5	23.7	22.7	22.5											
Alk	55	7	2	3	5	7	61	112	195	269	Alk	4	-19	33							
TDS	190	12	11	14	24	38	266	388	592	1001	TDS	4	-10	22							
TotHard	88	3	1	1	3	7	111	171	286	534	TotHard	4	-14	17							
CaHard	74	3	1	1	2	6	93	143	248	434	CaHard	4	-16	19							
Turb	0.10	0.02	0.07	0.06	0.08	0.06	0.11	0.16	0.15	0.25	Turb	4	-15	37							
Amm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Amm	0	n/a	n/a							
TOC	2.5	0.0	0.3	0.3	0.3	0.3	3.4	4.7	6.8	11.0	TOC	0	n/a	n/a							
UV254	0.041	0.003	0.005	0.005	0.005	0.005	0.057	0.087	0.134	0.306	UV254	4	-1	9							
SUVA	1.65	0.07	1.80	1.80	1.80	1.80	1.68	1.85	1.97	2.78											
Bromide	78	3	10	10	10	32	Pretreatment Information														
TOX	165	5	13	13	13	13									Process		Description		Scale		
CHCl3	46.4	0.9	1.6	1.2	2.3	1.7	Presedimentation		3 Basins		Full-scale										
BDCM	21.9	0.1	0.0	0.0	1.2	1.4	Softening Lime, 190 mg/L as Ca(OH)2				Bench-scale										
DBCM	10.7	0.2	0.0	0.0	1.3	1.9	Coagulation m: Al2(SO4)3.14 H2O, 15 mg/l				Bench-scale										
CHBr3	1.9	0.1	0.0	0.0	0.0	1.1	Sedimentation Gravity settling in test drums				Bench-scale										
THM4	80.9	0.7	1.6	1.2	4.8	6.1	Recarbonation CO2 gas added to pH 9.4				Bench-scale										
MCAA	0.0	0.0	0.0	0.0	0.0	0.0	Cartridge filtration 1 um size exclusion				Bench-scale										
DCAA	19.8	0.5	0.0	0.0	0.0	0.0	Antiscalant 4 mg/L Hypersperse 400UL				Bench-scale										
TCAA	3.3	0.1	0.0	0.0	0.0	0.0	Design Parameters														
MBAA	0.0	0.0	0.0	0.0	0.0	0.0									Active memb area:		0.167 ft <sup>2</sup>		ID#	Recov (dec.)	F <sub>W-des</sub> (gfd)
DBAA	3.5	0.1	0.0	0.0	0.0	1.1									Active width:		0.333 ft				
BCAA	9.7	0.7	0.0	0.0	0.0	1.1									Norm Temp:		14.0 °C		1	0.70	15.0
TBAA	NA	NA	NA	NA	NA	NA									Feed TDS:		322.0 mg/L		2	0.90	15.0
CDBAA	NA	NA	NA	NA	NA	NA	Manuf rep TDS rej:		98%		3	0.50	15.0								
DCBAA	NA	NA	NA	NA	NA	NA	Temp Norm MTC-w:		0.167 gfd/psi		4	0.30	15.0								
HAA5	26.6	0.6	0.0	0.0	0.0	1.1	Comments:														
HAA6	36.3	1.4	0.0	0.0	0.0	2.1															
HAA9	NA	NA	NA	NA	NA	NA															
SDS Conditions																					
WQP	Avg	SD	Count	Min - Max																	
Res (mg/L) (0)	0.81	0.15	6	0.67 - 1.02																	
Temp (°C)	19.8	0.1	6	19.8 - 20.0																	
pH (unit)	9.5	0.0	6	9.5 - 9.5																	
Time (hr)	31.0	0.0	6	31.0 - 31.0																	

## Water Quality Parameter Graphs



**Water Quality Parameter Graphs (Continued)**


## Productivity Graphs



## ICR Information

**ID / ICR#:** KS200910 / 381  
**ICR Contact:** Mr. Thomas F. Schremp  
**Phone No.:** (913) 895-5820  
**Period:** 1/28/99 - 2/4/99 (7 days)

## Membrane Information

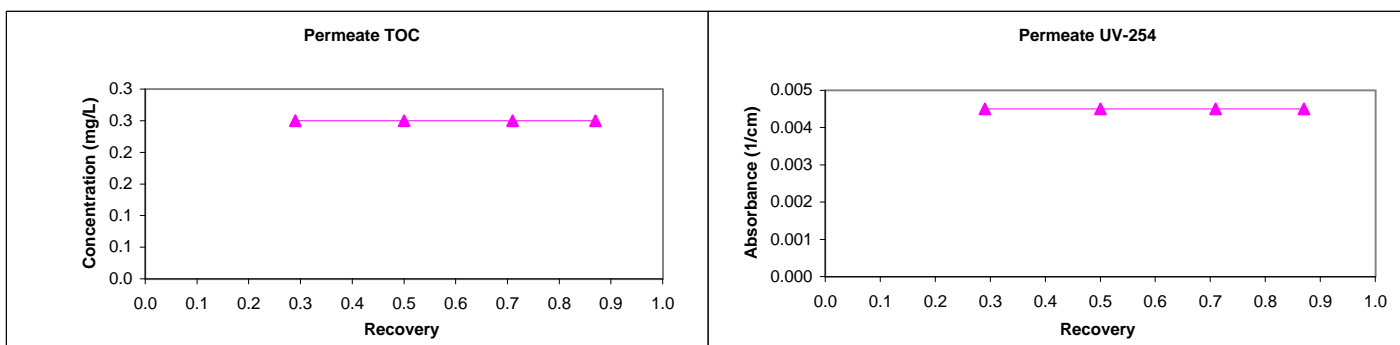
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**Mfr. NDP:** 130.0 psi  
**Mfr. MTCw:** 0.231 gfd/psi

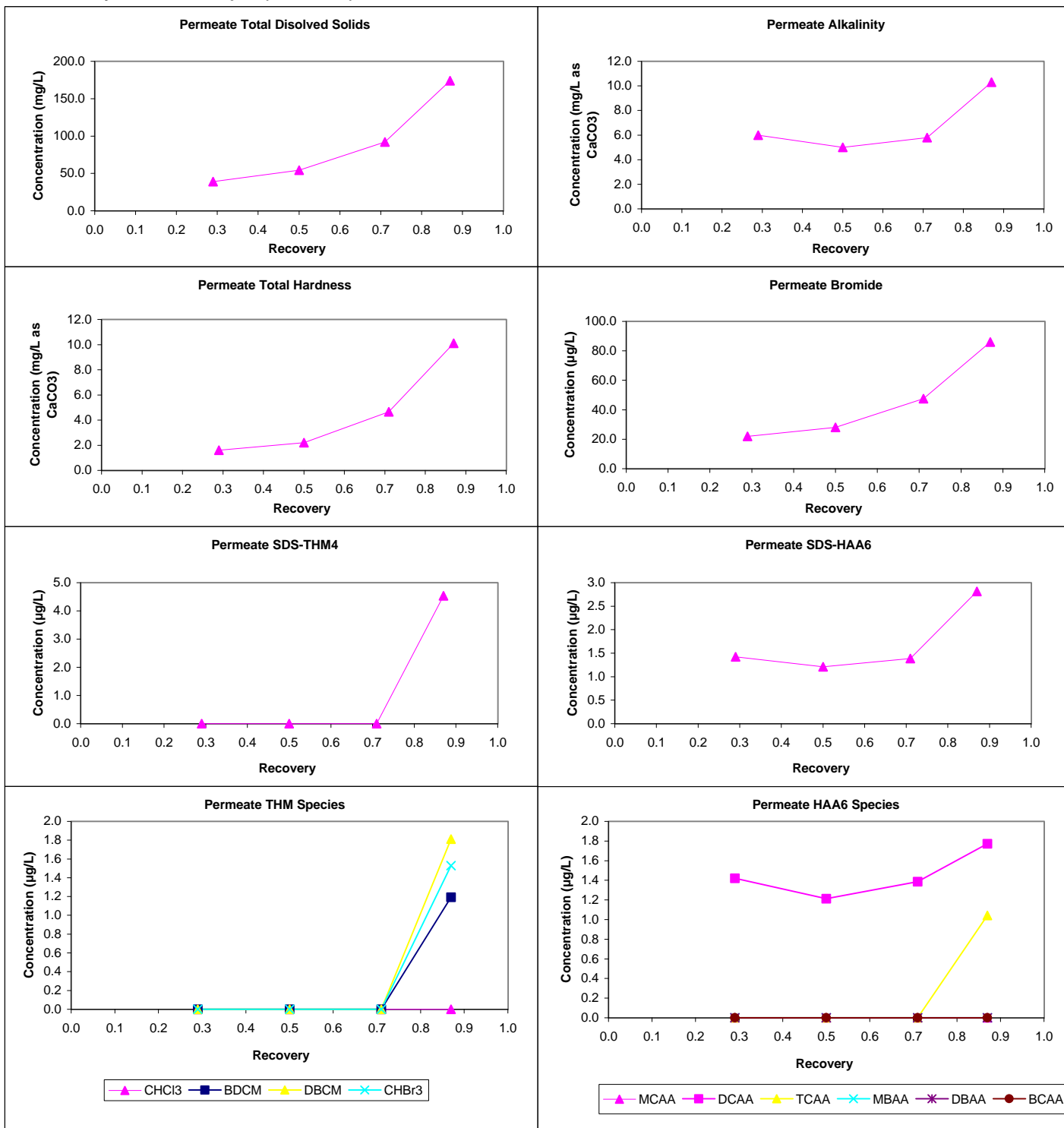
**Mfr. Temp:** 25.0 °C  
**840 Element Area:** 400.0 ft<sup>2</sup>  
**840 Purchase Price:** \$700  
**840 Maximum Flow:** 70.0 gpm  
**840 Minimum Flow:** 18.8 gpm  
**840 Total Width:** 70.6 ft  
**840 Feed Spacer Thickness:** 0.0026 ft

## Water Quality Summary

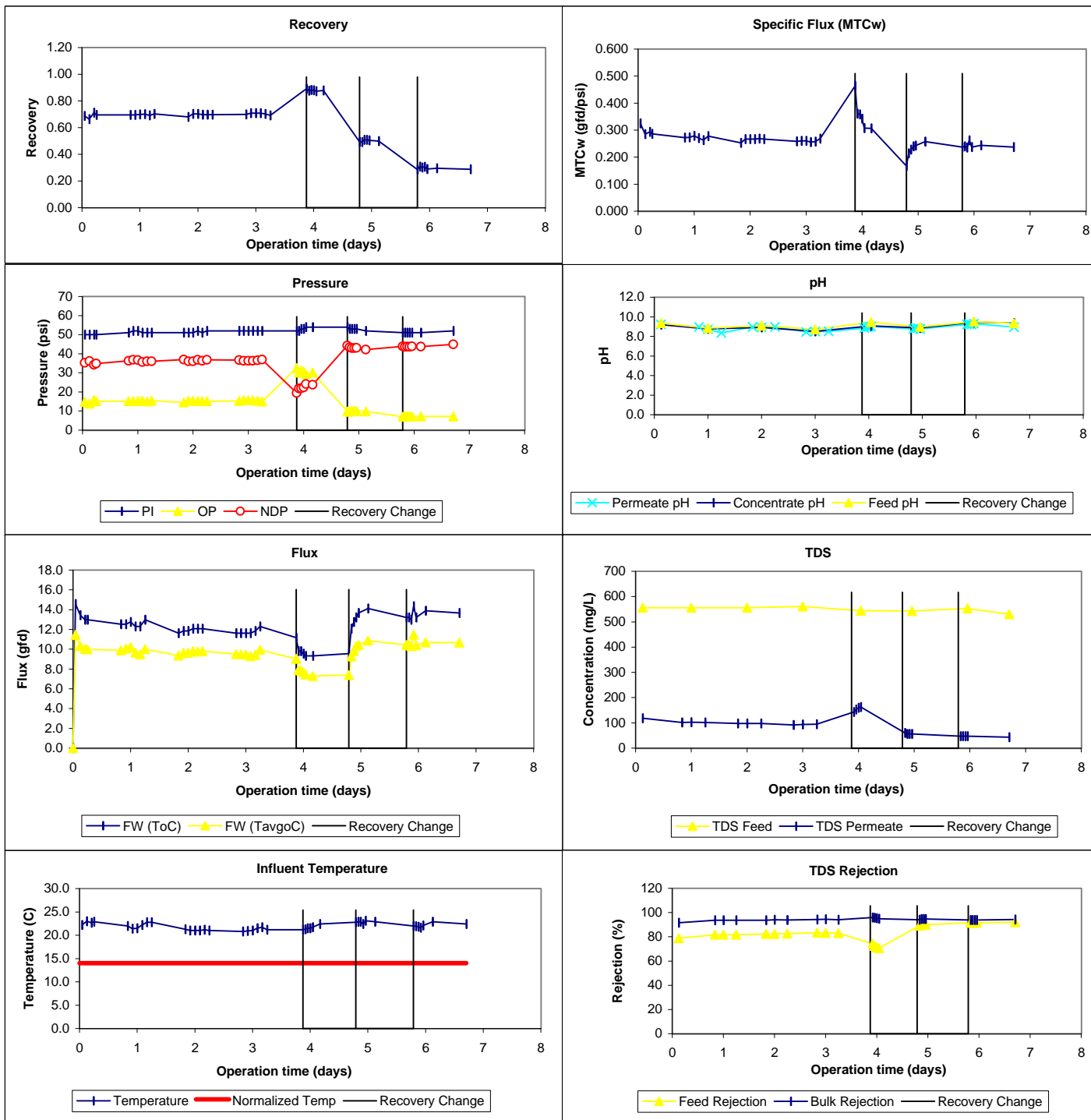
Water Quality Summary							Mass Balance Closure Err (%)							
Source ->	Feed		Permeate				Concentrate							
Recovery ->	Avg	Diff	0.29	0.50	0.71	0.87	0.29	0.50	0.71	0.87	WQP	Count	Avg	SD
pH	9.4	0.0	8.5	7.8	7.0	8.5	9.3	8.7	8.3	9.0	TDS	8	-17	20
Temp	22.9	0.1	22.4	22.9	23.0	23.1	22.3	22.0	23.2	22.7				
Alk	44	2	6	5	6	10	62	86	137	267	Alk	4	1	3
TDS	556	0	39	54	92	174	713	1008	1420	2488	TDS	4	-14	10
TotHard	157	6	2	2	5	10	234	314	500	1160	TotHard	4	1	5
CaHard	103	6	1	2	3	7	160	207	325	793	CaHard	4	2	7
Turb	0.09	0.01	0.08	0.13	0.11	0.11	0.10	0.12	0.14	0.15	Turb	4	66	51
Amm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Amm	0	n/a	n/a
TOC	2.3	0.1	0.3	0.3	0.3	0.3	2.9	4.3	6.2	12.0	TOC	0	n/a	n/a
UV254	0.030	0.000	0.005	0.005	0.005	0.005	0.046	0.061	0.103	0.214	UV254	4	7	2
SUVA	1.32	0.07	1.80	1.80	1.80	1.80	1.59	1.44	1.66	1.78				
Bromide	150	0	22	28	48	86								
TOX	95	0	13	13	13	13								
CHCl3	14.9	1.6	0.0	0.0	0.0	0.0								
BDCM	17.5	0.1	0.0	0.0	0.0	1.2								
DBCM	17.5	0.7	0.0	0.0	0.0	1.8								
CHBr3	10.0	0.6	0.0	0.0	0.0	1.5								
THM4	60.0	0.4	0.0	0.0	0.0	4.5								
MCAA	0.0	0.0	0.0	0.0	0.0	0.0								
DCAA	13.4	1.0	1.4	1.2	1.4	1.8								
TCAA	2.7	0.0	0.0	0.0	0.0	1.0								
MBAA	0.0	0.0	0.0	0.0	0.0	0.0								
DBAA	7.4	0.4	0.0	0.0	0.0	0.0								
BCAA	8.1	0.7	0.0	0.0	0.0	0.0								
TBAA	NA	NA	NA	NA	NA	NA								
CDBAA	NA	NA	NA	NA	NA	NA								
DCBAA	NA	NA	NA	NA	NA	NA								
HAA5	23.4	0.7	1.4	1.2	1.4	2.8								
HAA6	31.5	1.4	1.4	1.2	1.4	2.8								
HAA9	NA	NA	NA	NA	NA	NA								
SDS Conditions														
WQP	Avg	SD	Count	Min - Max										
Res (mg/L) (0)	1.07	0.35	6	0.70 - 1.61										
Temp (°C)	6.2	0.3	6	6.0 - 6.8										
pH (unit)	9.5	0.0	6	9.5 - 9.5										
Time (hr)	40.0	0.0	6	40.0 - 40.0										

## Water Quality Parameter Graphs



**Water Quality Parameter Graphs (Continued)**


## Productivity Graphs



## ICR Information

**ID / ICR#:** KS200910 / 381  
**ICR Contact:** Mr. Thomas F. Schrempf  
**Phone No.:** (913) 895-5820  
**Period:** 5/6/98 - 5/15/98 (9 days)

## Membrane Information

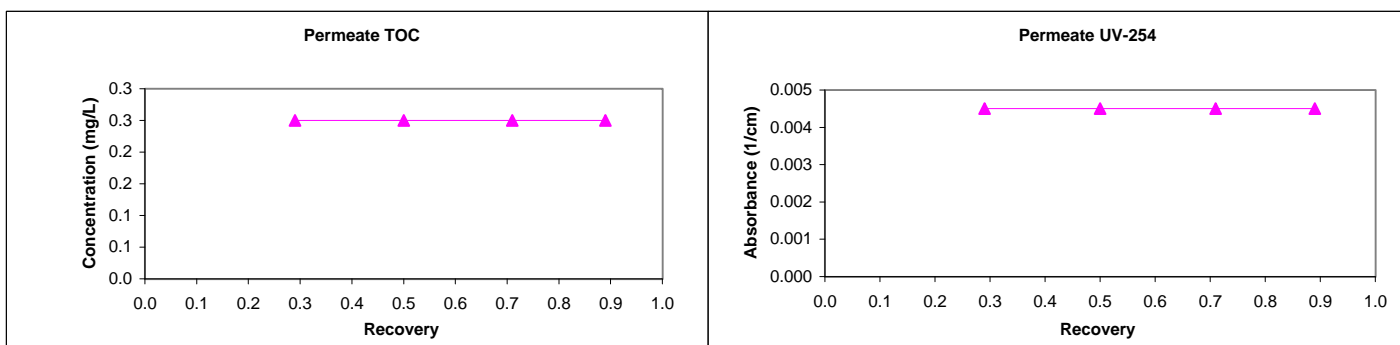
**Manufacturer:** FilmTec Corporation  
**Trade Name:** NF200B-4040  
**MWCO:** 400 Daltons  
**Mfr. Flux:** 16.5 gfd  
**Mfr. NDP:** 70.0 psi  
**Mfr. MTCw:** 0.235 gfd/psi

**Mfr. Temp:** 25.0 °C  
**840 Element Area:** 400.0 ft<sup>2</sup>  
**840 Purchase Price:** \$700  
**840 Maximum Flow:** 70.0 gpm  
**840 Minimum Flow:** 34.0 gpm  
**840 Total Width:** 70.7 ft  
**840 Feed Spacer Thickness:** 0.0023 ft

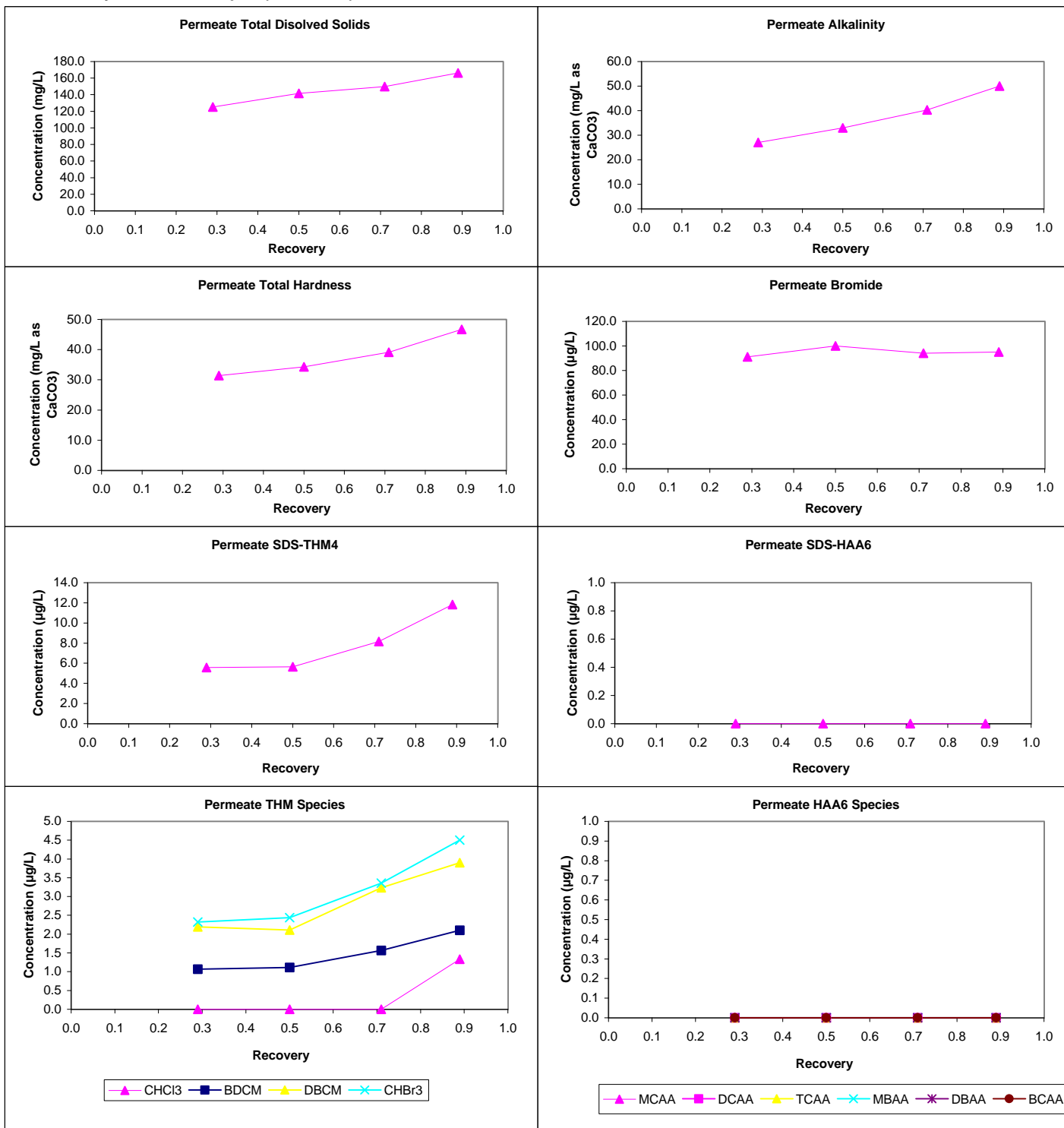
## Water Quality Summary

Water Quality Summary							Mass Balance Closure Err (%)											
Source ->	Feed		Permeate				Concentrate											
Recovery ->	Avg	Diff	0.29	0.50	0.71	0.89	0.29	0.50	0.71	0.89	WQP	Count	Avg	SD				
pH	8.6	0.0	7.7	8.3	8.3	8.2	8.3	7.9	8.5	8.3	TDS	9	-17	31				
Temp	22.3	0.8	21.0	22.0	19.0	21.0	21.0	22.0	19.0	21.0								
Alk	55	1	27	33	40	50	103	76	91	95	Alk	4	9	18				
TDS	322	0	125	142	150	166	400	472	654	1149	TDS	4	-15	16				
TotHard	117	1	31	34	39	47	162	215	327	726	TotHard	4	6	1				
CaHard	97	2	26	29	33	40	136	180	275	619	CaHard	4	8	1				
Turb	0.16	0.01	0.12	0.10	0.17	0.10	0.15	0.19	0.23	0.20	Turb	4	-55	114				
Amm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Amm	0	n/a	n/a				
TOC	3.2	0.0	0.3	0.3	0.3	0.3	4.4	5.9	9.9	25.0	TOC	0	n/a	n/a				
UV254	0.053	0.001	0.005	0.005	0.005	0.005	0.074	0.103	0.166	0.409	UV254	4	-2	6				
SUVA	1.67	0.04	1.80	1.80	1.80	1.80	1.68	1.75	1.68	1.64								
Bromide	114	17	91	100	94	95	Pretreatment Information											
TOX	180	30	13	13	13	13									Process	Description	Scale	
CHCl3	50.6	8.8	0.0	0.0	0.0	1.3	Presedimentation	3 Basins	Full-scale									
BDCM	28.5	2.9	1.1	1.1	1.6	2.1	Softening Lime	200 mg/L as Ca(OH)2	Bench-scale									
DBCM	17.4	0.8	2.2	2.1	3.2	3.9	Coagulation im:	Al2(SO4)3.14H2O, 15 mg/L	Bench-scale									
CHBr3	3.5	0.1	2.3	2.4	3.4	4.5	Sedimentation	Gravity settling in test drums	Bench-scale									
THM4	100.0	12.5	5.6	5.7	8.2	11.8	Recarbonation	CO2 gas added to pH 9.4	Bench-scale									
MCAA	0.0	0.0	0.0	0.0	0.0	0.0	Cartridge filtration	1 um size exclusion	Bench-scale									
DCAA	17.6	1.7	0.0	0.0	0.0	0.0	Antiscalant	4 mg/L Hypersperse 400UL	Bench-scale									
TCAA	3.3	0.3	0.0	0.0	0.0	0.0	Design Parameters											
MBAA	0.0	0.0	0.0	0.0	0.0	0.0								Active memb area:	0.167 ft <sup>2</sup>	ID#	Recov (dec.)	F <sub>W-des</sub> (gfd)
DBAA	4.2	0.3	0.0	0.0	0.0	0.0												
BCAA	8.7	0.2	0.0	0.0	0.0	0.0								Active width:	0.333 ft			
TBAA	NA	NA	NA	NA	NA	NA										Norm Temp:	14.0 °C	
CDBAA	NA	NA	NA	NA	NA	NA								Feed TDS:	322.0 mg/L			
DCBAA	NA	NA	NA	NA	NA	NA										Manuf rep TDS rej:	70%	
HAA5	25.1	1.1	0.0	0.0	0.0	0.0								Temp Norm MTC-w:	0.170 gfd/psi			
HAA6	33.7	1.4	0.0	0.0	0.0	0.0												
HAA9	NA	NA	NA	NA	NA	NA												
SDS Conditions							Comments:											
WQP	Avg	SD	Count	Min - Max														
Res (mg/L) (0)	1.07	0.18	6	0.82 - 1.36														
Temp (°C)	13.0	0.0	6	13.0 - 13.0														
pH (unit)	9.5	0.0	6	9.5 - 9.5														
Time (hr)	42.0	0.0	6	42.0 - 42.0														

## Water Quality Parameter Graphs

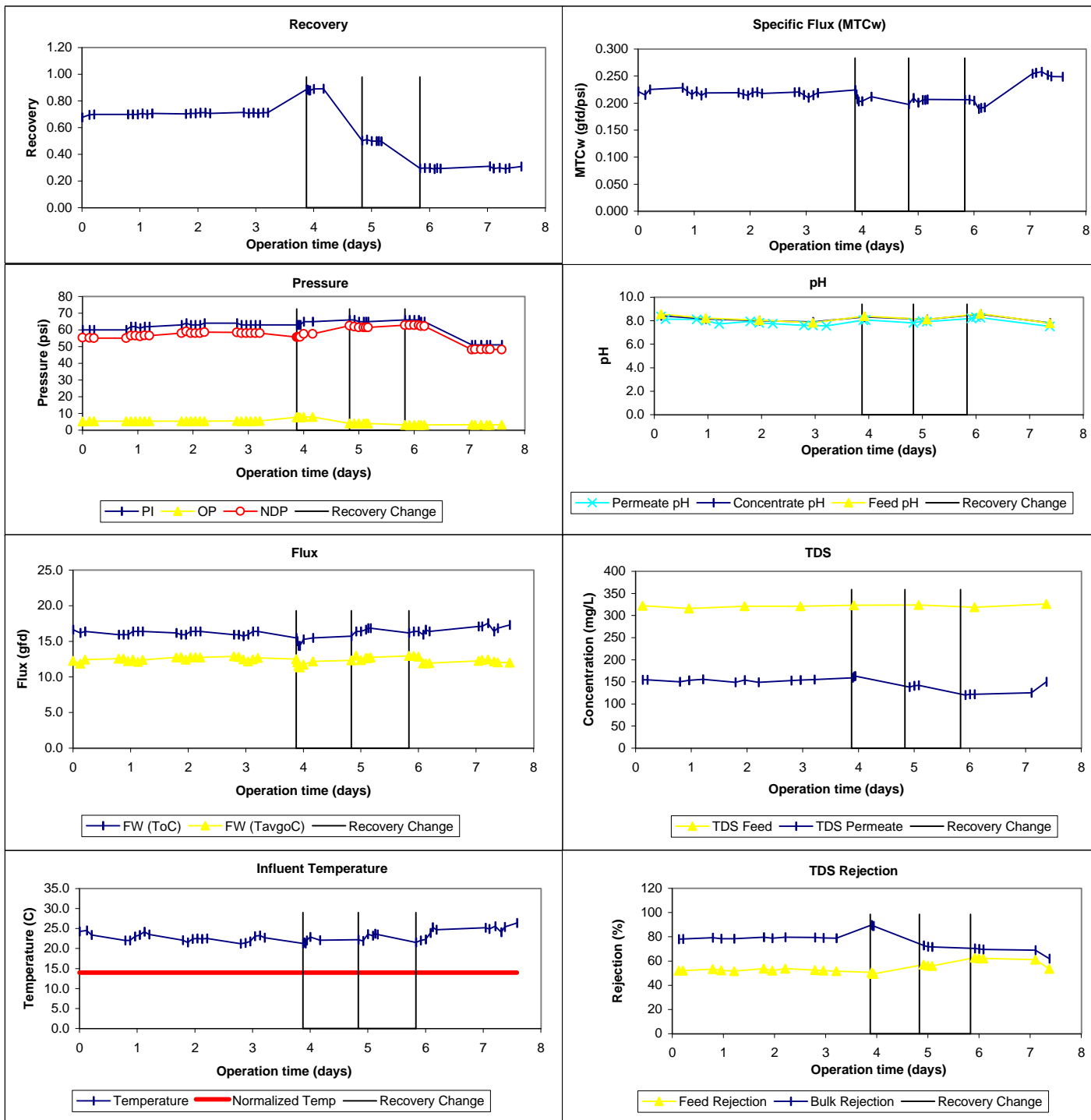


**Water Quality Parameter Graphs (Continued)**





# Productivity Graphs



## ICR Information

**ID / ICR#:** KS200910 / 381  
**ICR Contact:** Mr. Thomas F. Schrempf  
**Phone No.:** (913) 895-5820  
**Period:** 7/22/98 - 7/30/98 (8 days)

## Membrane Information

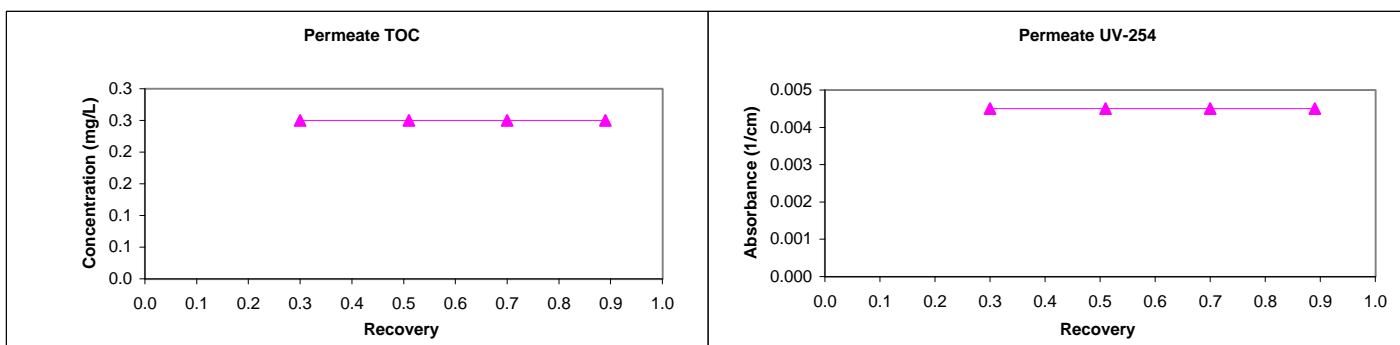
**Manufacturer:** FilmTec Corporation  
**Trade Name:** NF200B-4040  
**MWCO:** 400 Daltons  
**Mfr. Flux:** 16.5 gfd  
**Mfr. NDP:** 70.0 psi  
**Mfr. MTCw:** 0.235 gfd/psi

**Mfr. Temp:** 25.0 °C  
**840 Element Area:** 400.0 ft<sup>2</sup>  
**840 Purchase Price:** \$700  
**840 Maximum Flow:** 70.0 gpm  
**840 Minimum Flow:** 34.0 gpm  
**840 Total Width:** 70.7 ft  
**840 Feed Spacer Thickness:** 0.0023 ft

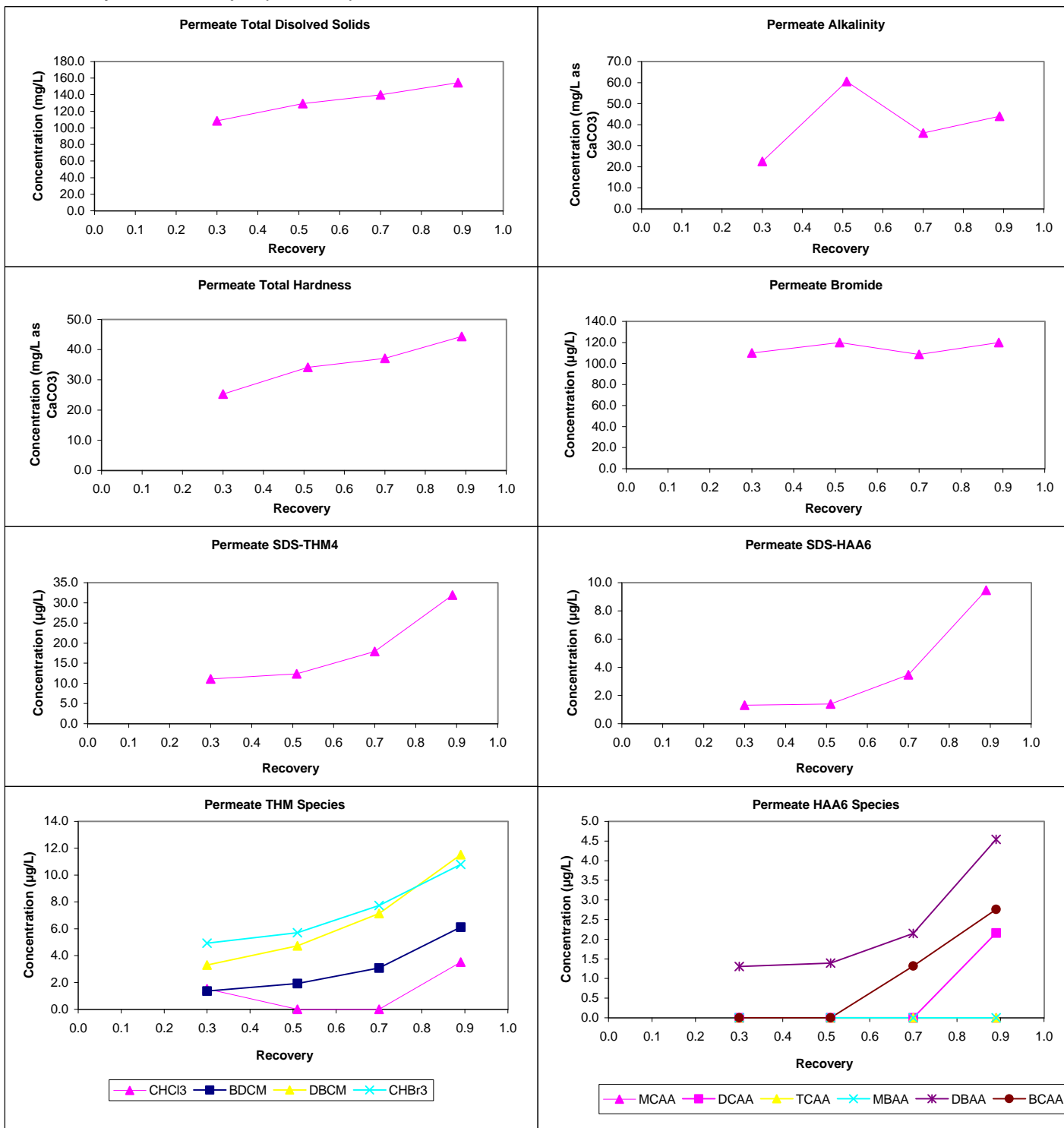
## Water Quality Summary

Water Quality Summary							Mass Balance Closure Err (%)							
Source ->	Feed		Permeate				Concentrate							
Recovery ->	Avg	Diff	0.30	0.51	0.70	0.89	0.30	0.51	0.70	0.89	WQP	Count	Avg	SD
pH	9.1	0.2	8.5	8.1	8.6	8.6	8.9	8.3	8.8	8.5	TDS	7	14	9
Temp	24.9	1.9	23.0	26.2	22.7	24.8	23.0	26.2	22.7	24.8				
Alk	49	9	23	61	36	44	54	75	86	88	Alk	4	10	27
TDS	220	22	108	129	140	154	299	383	492	773	TDS	4	12	7
TotHard	98	5	25	34	37	44	121	168	242	456	TotHard	4	-5	9
CaHard	82	4	21	29	32	38	103	145	209	394	CaHard	4	-1	8
Turb	0.13	0.01	0.09	0.11	0.13	0.16	0.12	0.16	0.22	0.24	Turb	4	41	74
Amm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Amm	0	n/a	n/a
TOC	2.6	0.0	0.3	0.3	0.3	0.3	3.6	5.0	7.9	18.0	TOC	0	n/a	n/a
UV254	0.045	0.001	0.005	0.005	0.005	0.005	0.062	0.091	0.141	0.311	UV254	4	-2	6
SUVA	1.73	0.04	1.80	1.80	1.80	1.80	1.72	1.82	1.78	1.73				
Bromide	110	10	110	120	109	120	Pretreatment Information							
TOX	178	3	13	13	36	32								
Process Description Scale														
CHCl3	60.4	5.1	1.5	0.0	0.0	3.5	Presedimentation	3 Basins	Full-scale					
BDCM	26.1	1.4	1.4	1.9	3.1	6.1	Softening Lime	180 mg/L as Ca(OH)2	Bench-scale					
DBCM	13.8	1.4	3.3	4.7	7.1	11.5	Coagulation im:	Al2(SO4)3.14H2O, 15 mg/L	Bench-scale					
CHBr3	2.6	0.3	4.9	5.7	7.7	10.8	Sedimentation	Gravity settling in test drums	Bench-scale					
THM4	103.0	2.1	11.1	12.4	17.9	31.9	Recarbonation	CO2 gas added to pH 9.4	Bench-scale					
MCAA	1.7	1.7	0.0	0.0	0.0	0.0	Cartridge filtration	1 um size exclusion	Bench-scale					
DCAA	18.3	0.4	0.0	0.0	0.0	2.2	Antiscalant	4 mg/L Hypersperse 400UL	Bench-scale					
TCAA	3.5	0.5	0.0	0.0	0.0	0.0	Design Parameters							
MBAA	0.0	0.0	0.0	0.0	0.0	0.0								
DBAA	3.2	0.5	1.3	1.4	2.1	4.5								
BCAA	7.8	0.7	0.0	0.0	1.3	2.8								
TBAA	NA	NA	NA	NA	NA	NA								
CDBAA	NA	NA	NA	NA	NA	NA								
DCBAA	NA	NA	NA	NA	NA	NA								
HAA5	26.7	2.4	1.3	1.4	2.1	6.7								
HAA6	34.4	3.0	1.3	1.4	3.5	9.5								
HAA9	NA	NA	NA	NA	NA	NA								
SDS Conditions							Active memb area: 0.167 ft² Active width: 0.333 ft Norm Temp: 14.0 °C Feed TDS: 322.0 mg/L Manuf rep TDS rej: 70% Temp Norm MTC-w: 0.170 gfd/psi							
WQP	Avg	SD	Count	Min - Max										
Res (mg/L) (0)	0.74	0.17	6	0.50 - 0.99										
Temp (°C)	26.2	0.1	6	26.0 - 26.2										
pH (unit)	9.4	0.0	6	9.4 - 9.5										
Time (hr)	24.0	0.0	6	24.0 - 24.0										
							ID# Recov (dec.) Fw-des (gfd)							
							1 0.70 15.0							
							2 0.90 15.0							
							3 0.50 15.0							
							4 0.30 15.0							
Comments:														

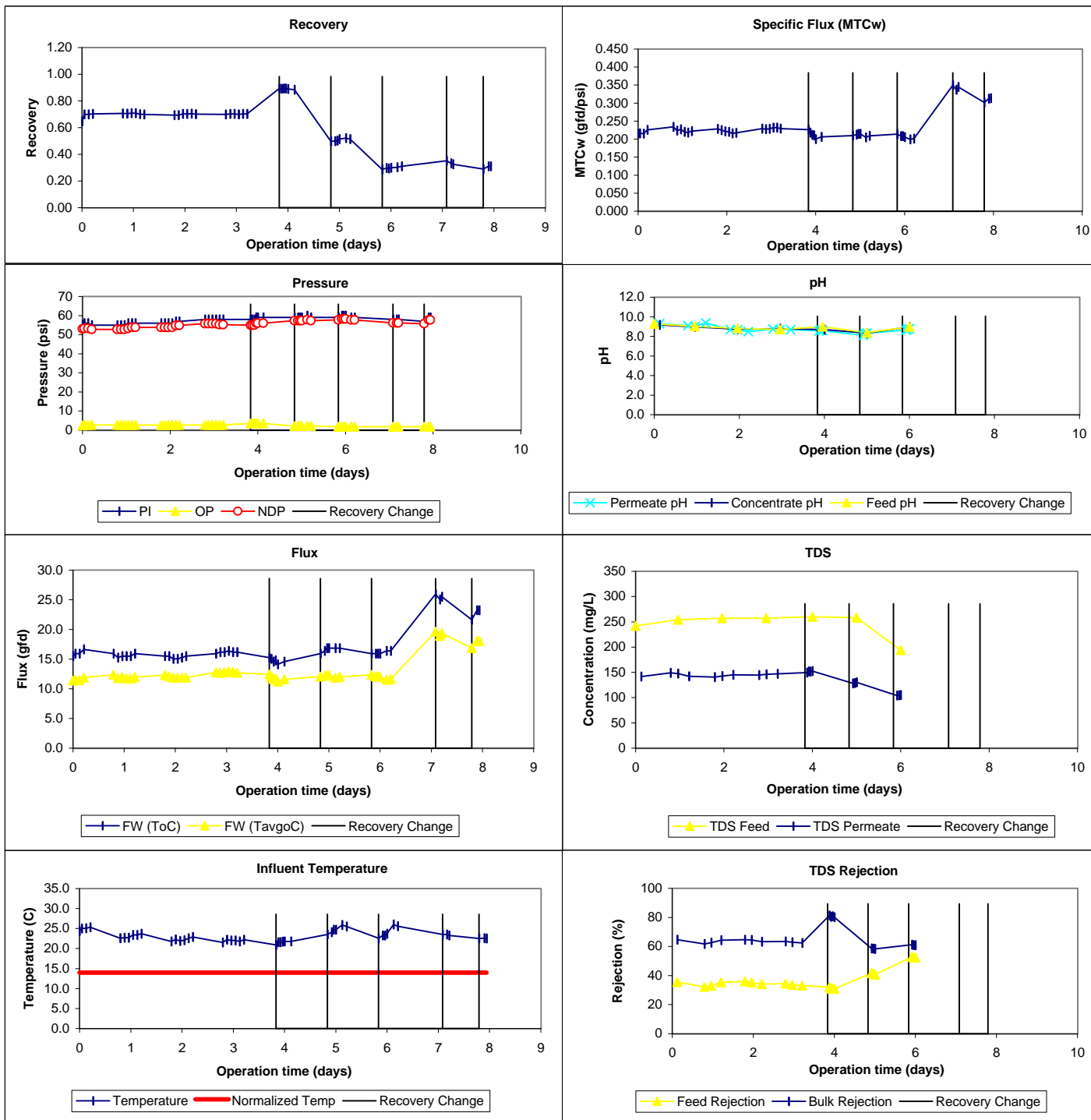
## Water Quality Parameter Graphs



Water Quality Parameter Graphs (Continued)



# Productivity Graphs



## ICR Information

**ID / ICR#:** KS200910 / 381  
**ICR Contact:** Mr. Thomas F. Schrempf  
**Phone No.:** (913) 895-5820  
**Period:** 10/21/98 - 10/29 (8 days)

## Membrane Information

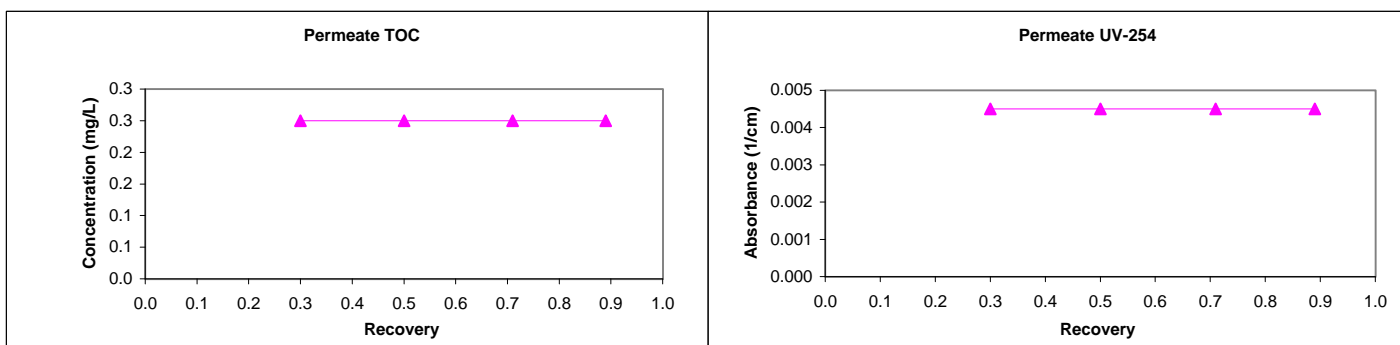
**Manufacturer:** FilmTec Corporation  
**Trade Name:** NF200B-4040  
**MWCO:** 400 Daltons  
**Mfr. Flux:** 16.5 gfd  
**Mfr. NDP:** 70.0 psi  
**Mfr. MTCw:** 0.235 gfd/psi

**Mfr. Temp:** 25.0 °C  
**840 Element Area:** 400.0 ft<sup>2</sup>  
**840 Purchase Price:** \$700  
**840 Maximum Flow:** 70.0 gpm  
**840 Minimum Flow:** 34.0 gpm  
**840 Total Width:** 70.7 ft  
**840 Feed Spacer Thickness:** 0.0023 ft

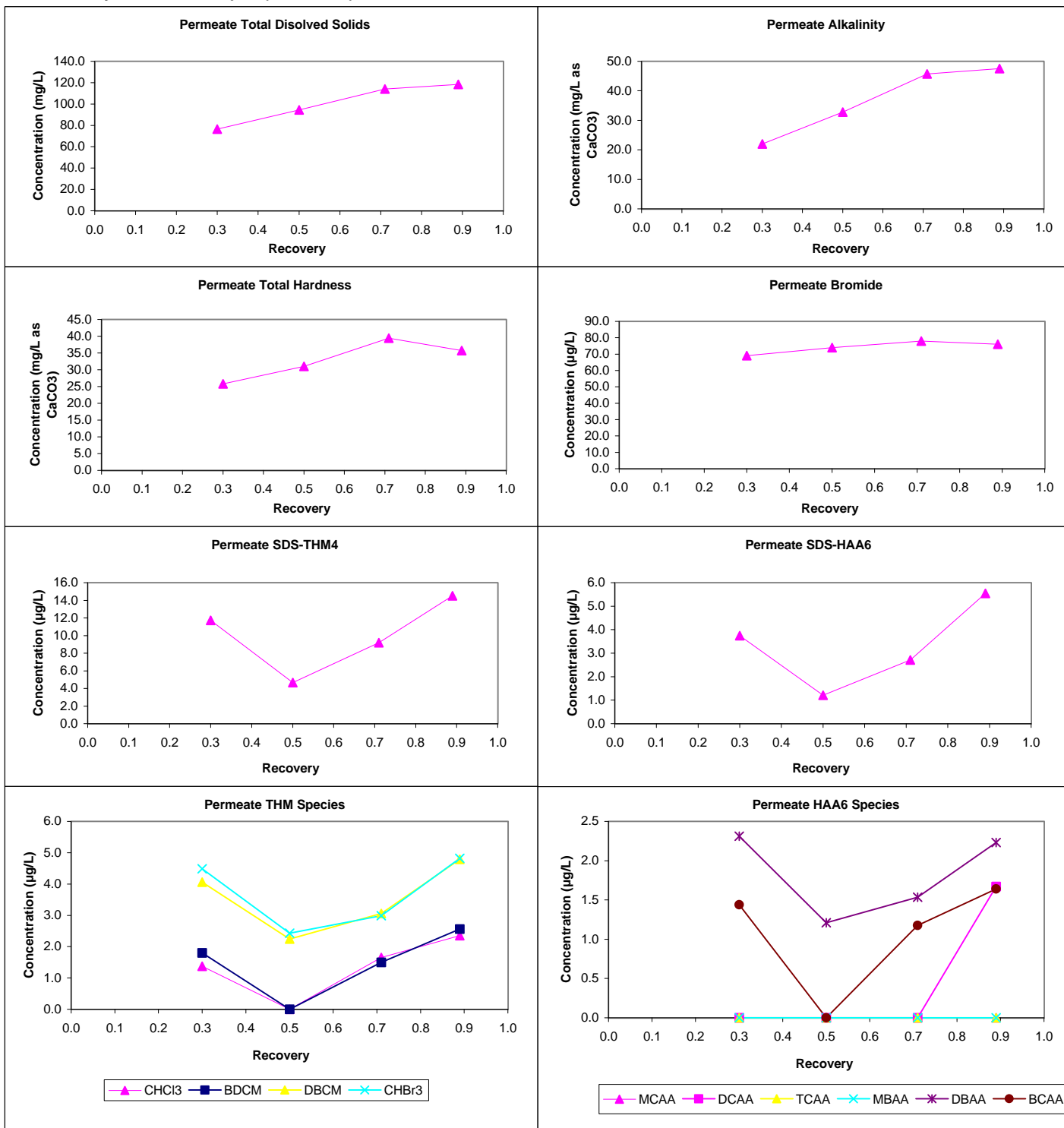
## Water Quality Summary

Water Quality Summary							Mass Balance Closure Error (%)							
Source ->	Feed		Permeate				Concentrate							
Recovery ->	Avg	Diff	0.30	0.50	0.71	0.89	0.30	0.50	0.71	0.89	WQP	Count	Avg	SD
pH	8.8	0.8	8.5	7.9	8.6	9.2	8.9	8.3	8.6	9.0	TDS	8	-1	12
Temp	23.6	1.9	25.5	23.7	22.7	22.5	25.5	23.7	22.7	22.5	Alk	4	-6	21
Alk	55	7	22	33	46	48	53	71	98	105	TDS	4	-4	15
<b>TDS</b>	<b>190</b>	<b>12</b>	<b>77</b>	<b>95</b>	<b>114</b>	<b>118</b>	<b>194</b>	<b>309</b>	<b>411</b>	<b>706</b>	TotHard	4	-8	9
TotHard	88	3	26	31	39	36	104	150	188	431	CaHard	4	-11	10
CaHard	74	3	21	26	33	29	87	125	157	361	Turb	4	-54	57
Turb	0.10	0.02	0.09	0.07	0.06	0.07	0.11	0.08	0.15	0.15	Amm	0	n/a	n/a
Amm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	TOC	0	n/a	n/a
<b>TOC</b>	<b>2.5</b>	<b>0.0</b>	<b>0.3</b>	<b>0.3</b>	<b>0.3</b>	<b>0.3</b>	<b>3.3</b>	<b>4.7</b>	<b>7.4</b>	<b>19.0</b>	UV254	4	0	2
UV254	0.041	0.003	0.005	0.005	0.005	0.005	0.055	0.080	0.128	0.322				
SUVA	1.65	0.07	1.80	1.80	1.80	1.80	1.67	1.70	1.73	1.69				
<b>Bromide</b>	<b>78</b>	<b>3</b>	<b>69</b>	<b>74</b>	<b>78</b>	<b>76</b>								
<b>TOX</b>	<b>165</b>	<b>5</b>	<b>13</b>	<b>13</b>	<b>13</b>	<b>13</b>								
CHCl3	46.4	0.9	1.4	0.0	1.7	2.4								
BDCM	21.9	0.1	1.8	0.0	1.5	2.6								
DBCM	10.7	0.2	4.1	2.2	3.1	4.8								
CHBr3	1.9	0.1	4.5	2.4	3.0	4.8								
<b>THM4</b>	<b>80.9</b>	<b>0.7</b>	<b>11.7</b>	<b>4.7</b>	<b>9.2</b>	<b>14.5</b>								
MCAA	0.0	0.0	0.0	0.0	0.0	0.0								
DCAA	19.8	0.5	0.0	0.0	0.0	1.7								
TCAA	3.3	0.1	0.0	0.0	0.0	0.0								
MBAA	0.0	0.0	0.0	0.0	0.0	0.0								
DBAA	3.5	0.1	2.3	1.2	1.5	2.2								
BCAA	9.7	0.7	1.4	0.0	1.2	1.6								
TBAA	NA	NA	NA	NA	NA	NA								
CDBAA	NA	NA	NA	NA	NA	NA								
DCBAA	NA	NA	NA	NA	NA	NA								
<b>HAA5</b>	<b>26.6</b>	<b>0.6</b>	<b>2.3</b>	<b>1.2</b>	<b>1.5</b>	<b>3.9</b>								
<b>HAA6</b>	<b>36.3</b>	<b>1.4</b>	<b>3.8</b>	<b>1.2</b>	<b>2.7</b>	<b>5.5</b>								
<b>HAA9</b>	<b>NA</b>	<b>NA</b>	<b>NA</b>	<b>NA</b>	<b>NA</b>	<b>NA</b>								
<b>SDS Conditions</b>														
<b>WQP</b>	<b>Avg</b>	<b>SD</b>	<b>Count</b>	<b>Min - Max</b>										
Res (mg/L) (0)	0.92	0.10	6	0.81 - 1.05										
Temp (°C)	19.8	0.1	6	19.8 - 20.0										
pH (unit)	9.5	0.0	6	9.5 - 9.5										
Time (hr)	31.0	0.0	6	31.0 - 31.0										

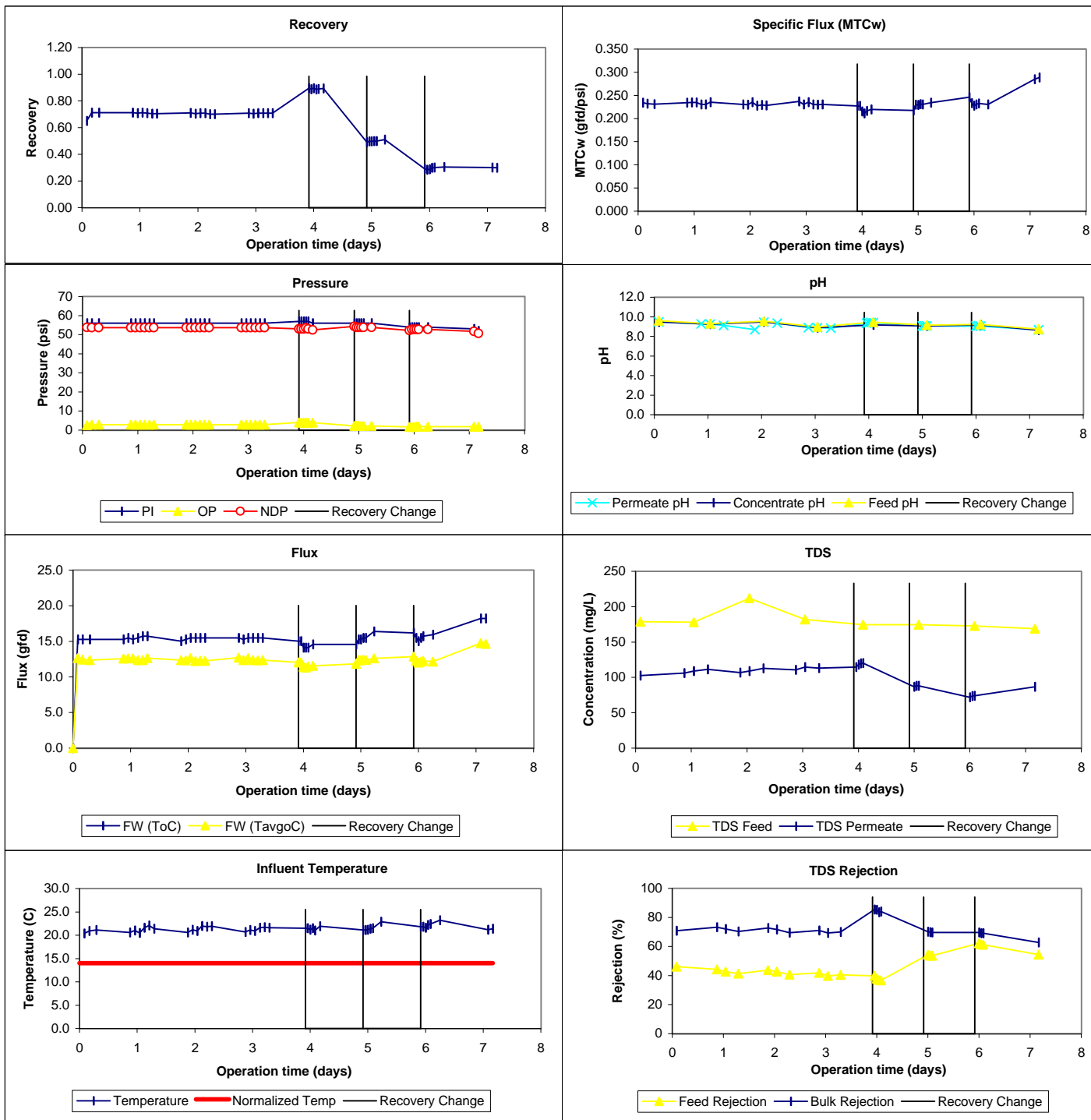
## Water Quality Parameter Graphs



**Water Quality Parameter Graphs (Continued)**



**Productivity Graphs**



## ICR Information

**ID / ICR#:** KS200910 / 381  
**ICR Contact:** Mr. Thomas F. Schrempf  
**Phone No.:** (913) 895-5820  
**Period:** 1/28/99 - 2/5/99 (8 days)

## Membrane Information

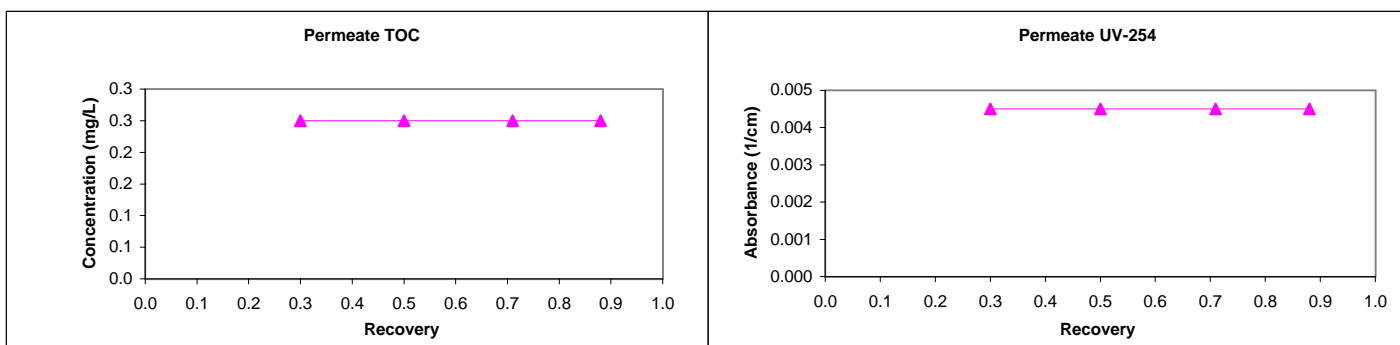
**Manufacturer:** FilmTec Corporation  
**Trade Name:** NF200B-4040  
**MWCO:** 400 Daltons  
**Mfr. Flux:** 16.5 gfd  
**Mfr. NDP:** 70.0 psi  
**Mfr. MTCw:** 0.235 gfd/psi

**Mfr. Temp:** 25.0 °C  
**840 Element Area:** 400.0 ft<sup>2</sup>  
**840 Purchase Price:** \$700  
**840 Maximum Flow:** 70.0 gpm  
**840 Minimum Flow:** 34.0 gpm  
**840 Total Width:** 70.7 ft  
**840 Feed Spacer Thickness:** 0.0023 ft

## Water Quality Summary

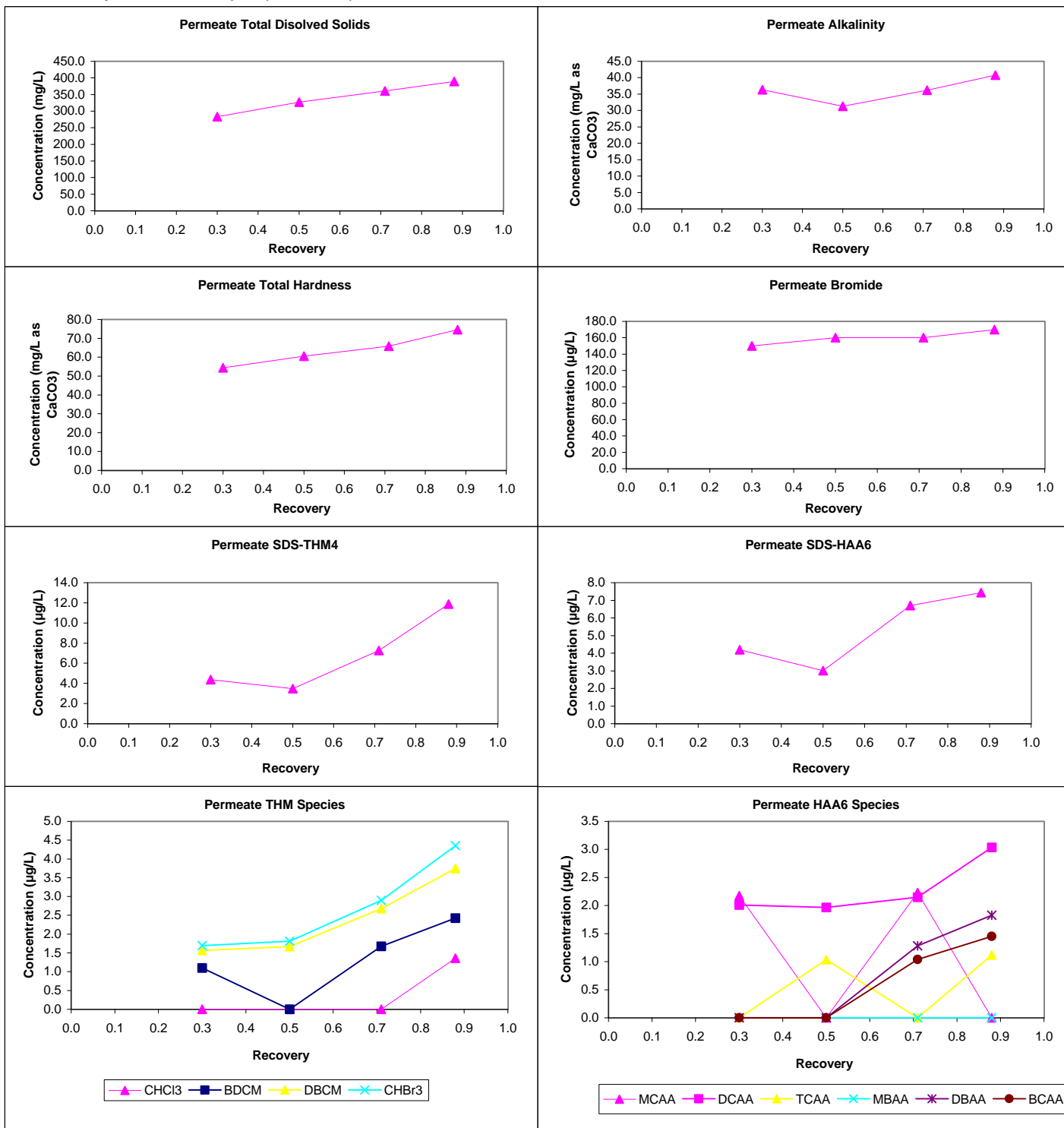
Water Quality Summary							Mass Balance Closure Err (%)							
Source ->	Feed		Permeate				Concentrate							
Recovery ->	Avg	Diff	0.30	0.50	0.71	0.88	0.30	0.50	0.71	0.88	WQP	Count	Avg	SD
pH	9.4	0.0	8.9	8.6	7.9	9.1	9.3	8.7	8.2	8.8	TDS	8	-10	8
Temp	22.9	0.1	22.1	22.1	23.1	23.0	22.3	21.9	22.8	23.0				
Alk	44	2	36	31	36	41	55	60	65	82	Alk	4	10	7
TDS	556	0	283	327	361	389	618	761	973	1419	TDS	4	-11	10
TotHard	157	6	54	61	66	75	206	259	360	784	TotHard	4	1	4
CaHard	103	6	38	40	42	47	140	177	234	536	CaHard	4	2	7
Turb	0.09	0.01	0.08	0.08	0.09	0.09	0.08	0.13	0.10	0.13	Turb	4	11	21
Amm	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	Amm	0	n/a	n/a
TOC	2.3	0.1	0.3	0.3	0.3	0.3	3.0	4.2	6.8	15.0	TOC	0	n/a	n/a
UV254	0.030	0.000	0.005	0.005	0.005	0.005	0.046	0.062	0.102	0.205	UV254	4	8	3
SUVA	1.32	0.07	1.80	1.80	1.80	1.80	1.56	1.49	1.51	1.37				
Bromide	150	0	150	160	160	170	Pretreatment Information							
TOX	95	0	13	26	13	13								
Process Description Scale														
CHCl3	14.9	1.6	0.0	0.0	0.0	1.4	Presedimentation	3 Basins	Full-scale					
BDCM	17.5	0.1	1.1	0.0	1.7	2.4	Softening Lime	270 mg/L as Ca(OH)2	Bench-scale					
DBCM	17.5	0.7	1.6	1.7	2.7	3.7	Coagulation im:	Al2(SO4)3.14H2O, 15 mg/L	Bench-scale					
CHBr3	10.0	0.6	1.7	1.8	2.9	4.4	Sedimentation	Gravity settling in test drums	Bench-scale					
THM4	60.0	0.4	4.4	3.5	7.3	11.9	Recarbonation	CO2 gas added to pH 9.4	Bench-scale					
MCAA	0.0	0.0	2.2	0.0	2.2	0.0	Cartridge filtration	1 um size exclusion	Bench-scale					
DCAA	13.4	1.0	2.0	2.0	2.1	3.0	Antiscalant	4 mg/L Hypersperse 400UL	Bench-scale					
TCAA	2.7	0.0	0.0	1.0	0.0	1.1	Design Parameters							
MBAA	0.0	0.0	0.0	0.0	0.0	0.0								
DBAA	7.4	0.4	0.0	0.0	1.3	1.8								
BCAA	8.1	0.7	0.0	0.0	1.0	1.4								
TBAA	NA	NA	NA	NA	NA	NA								
CDBAA	NA	NA	NA	NA	NA	NA								
DCBAA	NA	NA	NA	NA	NA	NA								
HAA5	23.4	0.7	4.2	3.0	5.7	6.0								
HAA6	31.5	1.4	4.2	3.0	6.7	7.4								
HAA9	NA	NA	NA	NA	NA	NA								
SDS Conditions							Active memb area: 0.167 ft² Active width: 0.333 ft Norm Temp: 14.0 °C Feed TDS: 553.0 mg/L Manuf rep TDS rej: 70% Temp Norm MTC-w: 0.170 gfd/psi							
WQP	Avg	SD	Count	Min - Max										
Res (mg/L) (0)	0.94	0.20	6	0.70 - 1.20										
Temp (°C)	6.1	0.1	6	6.0 - 6.3										
pH (unit)	9.5	0.0	6	9.5 - 9.5										
Time (hr)	40.0	0.0	6	40.0 - 40.0										
							Comments:							

## Water Quality Parameter Graphs





**Water Quality Parameter Graphs (Continued)**



# Productivity Graphs

