ICR Treatment Study Summary Report

Evaluation of Membrane Technology Using the Rapid Bench-Scale Test for Compliance with the Information Collection Rule

Conducted during the period of May 1998 through Feb 1999

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Water Plant # 1076

Attachments: 2 diskettes containing the *Data Collection Spreadsheets*
1 diskette containing the *Treatment Summary Report Spreadsheets*
1 diskette containing the *ICR Treatment Summary Report*

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I. Conclusions and Recommendations

Membrane technology is a proven, effective water treatment technology for treating ground water from the Biscayne Aquifer in South Florida, as evidenced by the fact that some local municipalities have incorporated the technology in their water treatment facilities. Results from this ICR Treatment Study indicate that permeate water from the nanofiltration membranes easily met EPA's proposed Stage 2 Disinfectant By-Products (DBP) limits.

The City of Lauderhill is currently in compliance with regulatory standards and does not believe that the addition of treatment units, including membranes, is warranted at this time. However, the City intends to comply with all regulatory standards, and will evaluate membrane technologies along with alternative treatment technologies if necessitated by a modification of regulatory standards (i.e. promulgation of proposed Stage 2 DBP Rule).

II. Background Information

A. Treatment Plant Description

Treatment Plant Schematic: See Figure 1.

Treatment Plant Design Information: Table 1a contains the full-scale plant unit process design information; Table 1 b contains the bench-scale unit process information.

Treatment challenges facing plant: The City of Lauderhill Water Treatment Plant is currently in compliance with all federal and state drinking water quality standards, and faces no significant treatment challenges.

B. Tabular summary of source and finished water quality: Tables 2a and 2b contain the summary of source and finished water quality provided by the water treatment plant.

III. Materials and Methods

A. Pretreatment Processes to the Advanced Treatment Process

Schematics of pretreatment processes: Figure 1 outlines the full-scale process used in the plant prior to the sampling point. Chlorinators were turned off prior to sampling.

Figure 2 describes water pretreatment prior to bench-scale nanofiltration.

B. Advanced Treatment Process Information

A schematic for the process equipment used for the RBSMT is shown in Figure 3. This schematic shows only one unit, but two identical units were used during the study. This allowed for the simultaneous evaluation of two membranes using the same influent water. The *ICR Manual for Bench and Pilot-scale Studies* was used as a guide in the set-up of the apparatus.

In general, the guidelines for evaluating the membranes in the RBSMT came directly from the *ICR Manual for Bench and Pilot-scale Studies*. The membranes were cleaned as described in the manual, using manufacturer recommended cleaning solutions. For both membranes, the following procedure was used:

1. Rinse with reagent water for 1-2 min at high cross- flow velocity (using recycle pump setting near “8”).
2. Clean with 0.5% phosphoric acid for 20 min at high cross-flow velocity.
3. Rinse with reagent water, 1-2 min.
4. Clean with 0.1% sodium hydroxide for 20 min at high cross-flow velocity.
5. Rinse with reagent water, 1-2 min.

After the final rinse, the membrane cell was re-attached to the system. The MTCw was then evaluated at 30% recovery using the test water. Note: At no time was the membrane cell opened during cleaning. After cleaning, the system was run until a stable MTCw was obtained, and permeate and concentrate samples were taken to compare feed rejection prior to cleaning. The system was then shut down for total cleaning.

C. Experimental Design

Table 3 describes the experimental design used in the study. Seasonal variability was examined as the primary variable using two nanofiltration membranes. Flux during each season was essentially held constant, and the four recoveries of 30, 50, 70, and 90 % were investigated. The two membranes chosen for the study were the NF200 and the BW30-XLE. The XLE is considered the “tighter” membrane since it rejects a higher percentage of inorganic ions than the NF-200. Each membrane meets the ICR MWCO criteria set forth in the *ICR Manual for Bench and Pilot-scale Studies*.

D. Analytical Methods

Table 4 lists the analytical methods and MRLs used for the study. There were no deviations from the QA/QC procedures outlined in the *DBP/ICR Analytical Methods Manual*.

All analytical services were performed at Environmental Health Laboratories.

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IV. Results and Discussion

A. Problems Encountered

At 90 % recovery, high mass balance closure errors (>20 %) were observed for some of the runs. This was likely due to inaccurate flow measurements and/or analytical errors. To improve the situation, longer stabilization and increased volumetric flow measurement times were used.

During some runs, the pH of the influent was difficult to control. Aliquots were taken out of the cooler, warmed, and used for only 48 hours in an attempt to minimize this effect.

The test water had a greenish tint and algae would begin growing on the teflon feed and return lines. Tubes were cleaned between runs. The test water did not seem to foul the membranes significantly.

Some of the TOX results had high relative percent differences (RPDs). The method used and the results meet the QA/QC criteria in the *DBP/ICR Analytical Methods Manual.*

B. Water Quality Data

1. The water quality of the pretreated influent is summarized in Table 5. Table 5 includes a summary of the DBP data obtained at these SDS conditions in the influent water.
2. Table 6 contains the SDS conditions used in the study.

C. Impact of Seasonal Variability and

D. Impact of Specific Variables on Performance

Included in this final report are several tables and graphs that illustrate the performance of the membranes throughout the course of the study. They are as follows:

1. Flux and water mass transfer coefficient relationships- NF200 Membrane
   Figures 4-7: Flux as a function of operation time
   Figures 8-12: MTCw as a function of operation time
   Figures 13-16: Rate of MTCw Decline Linear Regression Plots
   Table 7: Summary of Membrane Productivity for each season

2. Pressure, temperature, pH, and TDS grab samples-NF200 Membrane
   Figures 17-20: Influent, osmotic, and NDP as a function of operation time
   Figures 21-24: Influent and ave feed temperature as a function of operation time
   Figures 25-28: pH of permeate, concentrate, and feed as a function of operation time
   Figures 29-32: TDS of feed and permeate as a function of operation time

3. Analyte concentration and DBP formation as a function of recovery- NF200 Membrane

Figure 33: Recovery plot for all 4 quarters as a function of operation time
Figures 34-39: Permeate water quality parameters as a function of recovery
Figures 40-44: Permeate SDS THMs as a function of recovery
Figures 45-49: Permeate SDS HAA6 as a function of recovery

4. Feed and bulk rejection plots- NF200 Membrane
   Tables 8a-d: Effect of recovery on feed rejection on the composite samples for the RBSMT
   Figures 50-57: TDS and UV254 rejection as a function of operation time

5. Flux and water mass transfer coefficient relationships- XLE Membrane
   Figures 58-61: Flux as a function of operation time
   Figures 62-66: MTCw as a function of operation time
   Figures 67-70: Rate of MTCw Decline Linear Regression Plots
   Table 13: Summary of Membrane Productivity for each season

6. Pressure, temperature, pH, and TDS grab samples-XLE Membrane
   Figures 71-74: Influent, osmotic, and NDP as a function of operation time
   Figures 75-78: Influent and ave feed temperature as a function of operation time
   Figures 79-82: pH of permeate, concentrate, and feed as a function of operation time
   Figures 83-86: TDS of feed and permeate as a function of operation time

7. Analyte concentration and DBP formation as a function of recovery- XLE Membrane
   Figure 87: Recovery plot for all 4 quarters as a function of operation time
   Figures 88-93: Permeate water quality parameters as a function of recovery
   Figures 94-98: Permeate SDS THMs as a function of recovery
   Figures 99-103: Permeate SDS HAA6 as a function of recovery

8. Feed and bulk rejection plots- XLE Membrane
   Table 14a-d: Effect of recovery on feed rejection on the composite samples for the RBSMT
   Figures 104-111: TDS and UV254 rejection as a function of operation time

E. Cost Information and Analysis (CG&A)

F. Summary of Significant Results

In addition to the tables and graphs listed above in Sections C and D, the following tables illustrate the blend ratios to achieve various finished water qualities for each membrane:

Tables 9-12: Blend Ratio Tables -NF200 Membrane
Tables 15-18: Blend Ratio Tables- XLE Membrane

In general, both membranes rejected significant amounts of precursor material at all recoveries (UV 254 and TOC at > 95%). The permeate water easily met the proposed Stage 2 DBP limits under the SDS conditions used in the study. Membrane fouling was minor.

V. QA/QC Summary

All QA/QC procedures and requirements were followed as described in the *DBP/ICR Analytical Methods Manual*. Note that Table 4 lists the MRLs, some of which are lower than those listed in the manual.

All results for lab duplicates and lab fortified matrices are summarized in the *ICR Treatment Study Summary Report Spreadsheets*, along with some miscellaneous data about the public water supply.

PE results: Environmental Health Laboratories is a certified ICR lab that participated in all ICR PE studies. The results for these studies during the ICR Treatment Studies are listed in Tables 19-22.

Calibration Procedures: The calibration procedures used during the study are consistent with the *DBP/ICR Analytical Methods Manual*. Tables 9.1 to 9.4 in this manual were used as guidelines for the frequency and percent recovery requirements.

Noted QC failures: The following samples failed QC criteria and were reported as “NR” in the spreadsheets:

Quarter 4: Twice the amount of surrogate standard was added to the permeate water sample at 90% recovery for the XLE membrane. This did not effect the results of the target analytes. This sample is presented in the graphs.

Outlier Data Points: The following data points were considered “outliers” and were reported as “NR” in the *Data Collection Spreadsheets*:

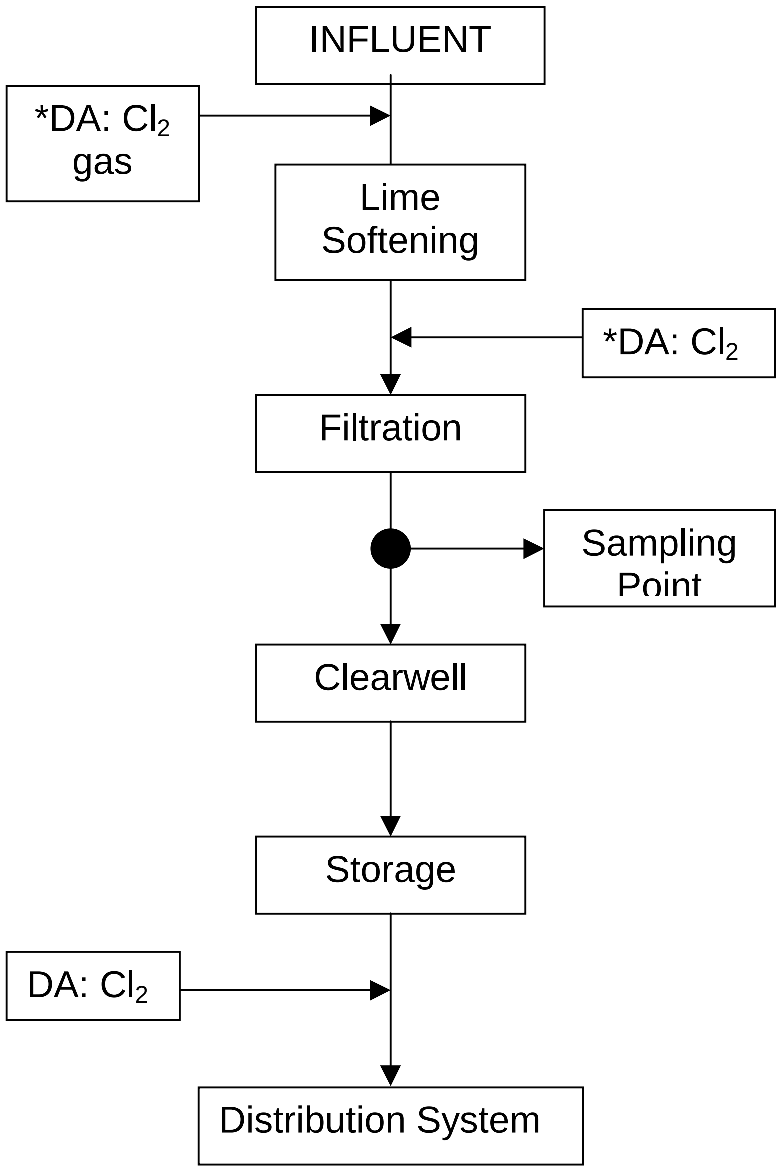
Quarter 2, NF200 membrane: The permeate alkalinity at 30 % recovery was very high biased, indicating that the sample may have become contaminated.

There were some other data points in the SDS permeate THM, HAA and inorganic data for both membranes that did not follow the predicted trend of increasing analyte concentration with increasing recovery. Many of these observations were at concentration levels near the MRLs. This data was reported in the *Data Collection Spreadsheets* since no good reason for exclusion could be determined.

<u>SDS Testing: Incubation temperature and time measurements</u>- During the bench-scale runs, a high-precision incubator was used. All of the samples in a given batch were taken out of the incubator at the same time and measurements for residual chlorine were taken immediately and quenched using the proper dechlorinating agent. The temperature of the incubator was recorded for the batch. Therefore the same temperature reading was recorded in the *Data Collection Spreadsheets* for the entire group of samples. This is why some of the observed standard deviations (SDs) are 0.0. Also, the time recorded for all SDS samples in a given batch was the same, as this was monitored very closely during the study. This will also result in times having SDs of 0.0.

Figure 1: City of Lauderhill, Florida

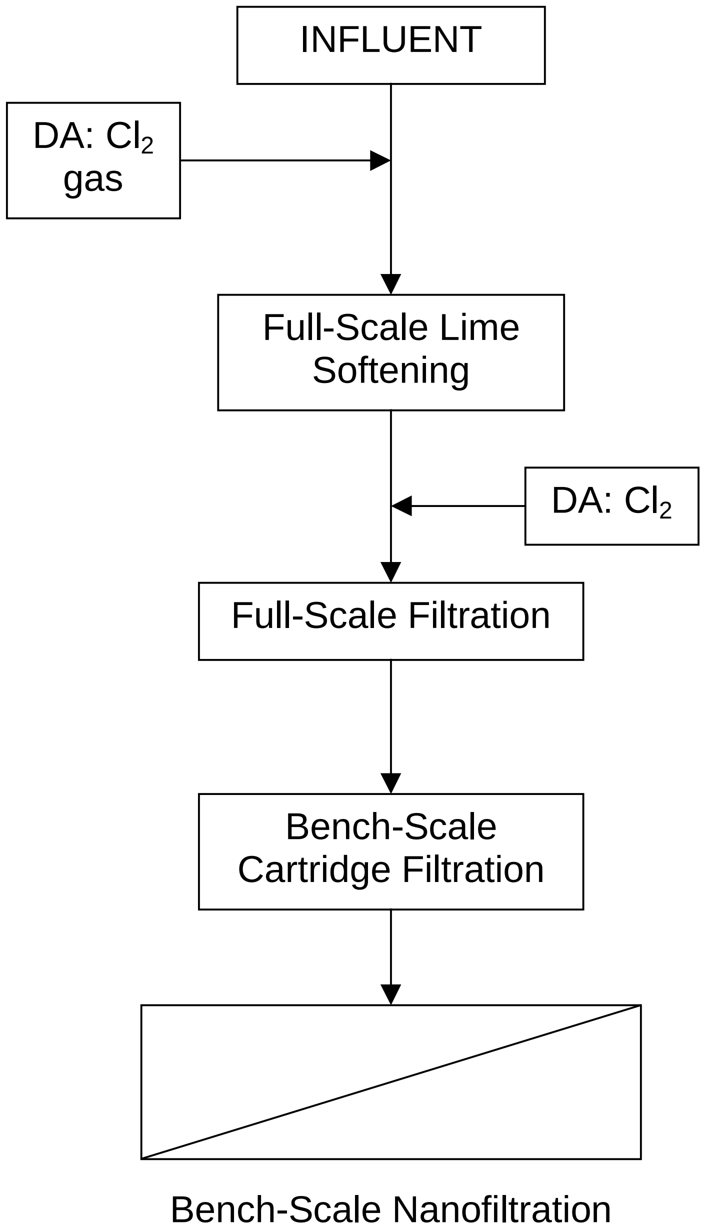
Treatment Plant Schematic



*Note: Sample was taken after chlorinators had been turned off, therefore no chlorine residual was present at the time of collection.

Figure 2

Pretreatment System Prior to Bench-Scale Nanofiltration



*Note: Sample was taken after chlorinators had been turned off, therefore no chlorine residual was present at the time of collection.

Figure 3

RBSMT Test Apparatus Diagram

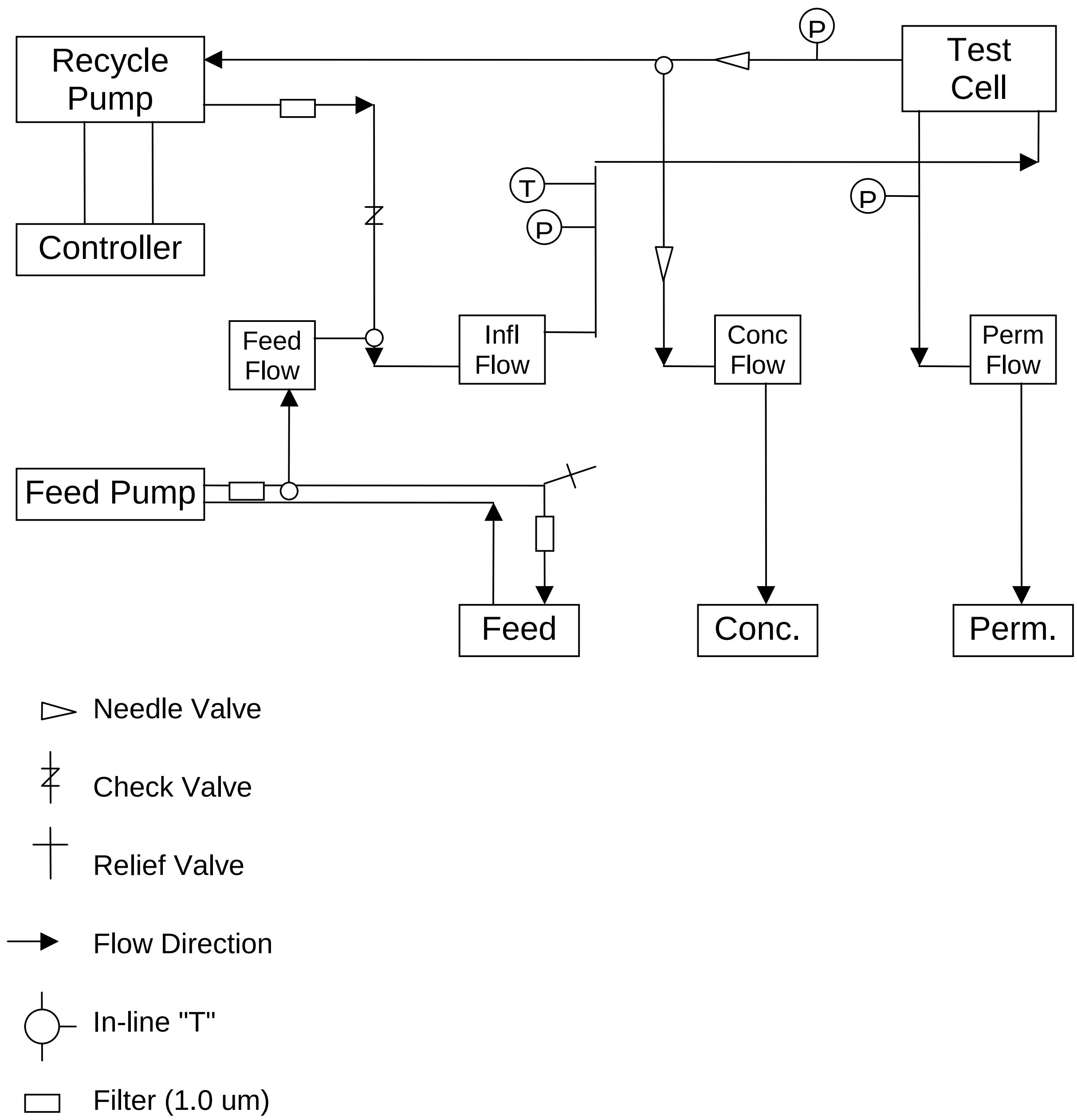


Table 1a: Full-Scale Plant Unit Process Design Information

Unit Process	Process Description
Lime Softening (2 units)	Manufacturer: Infilco Degremont Inc. Model: Accelator NS (no scraper) Capacity Per Unit (mgd): 6.5 – 8.0 Maximum Hydraulic Capacity Per Unit (mgd): 9.0 Volume Per Unit (gallons): 300,000 Design Rise Rate (gpm/sq.ft.): 1.7 – 2.0
Disinfection	Chemical Type: Chlorine Gas Measured as: Cl_2 Dose Rate (mg/L): 10
Gravity Filtration (2 units)	Manufacturer: Infilco Degremont Inc. Model: Greenleaf Self-Backwashing No. Cells Per Unit: 4 Surface Area Per Cell (sq.ft.): 296 Capacity Per Unit (mgd): 8.0 Filtration Rate (gpm/sq.ft.): 4.7

mgd = million gallons per day
gpm = gallons per minute
sq.ft. = square feet
mg/L = milligrams per liter

Table 1b: Bench-Scale Pretreatment Data

Unit Process	Process Description
Scale Control (Bench-Scale)	Chemical Type: Hypersperse AF 200 ul
	Adjusted pH: NA
	Dose Rate (mg/L): 4.0 mg/L
Cartridge Filtration (Bench-Scale)	Surface Area (ft2): 4.5
	Nominal Pore Size (μm): 1.0
	Filter Material: Polypropylene
	Filter Life (gallons of processed water): NA

Table 2a: Tabular Summary of Source Water Quality

Water Quality Parameter	Average Yearly Concentration	Standard Deviation	Maximum Yearly Value	Minimum Yearly Value
Temperature (oC)	25.6	6.3	NA	NA
pH	7.2	0.0	7.3	7.2
Turbidity (ntu)	NA	NA	NA	NA
Alkalinity (mg/L as CaCO3)	229	4	236	222
Calcium Hardness (mg/L as CaCO3)	236	5	243	229
TOC (mg/L)	NA	NA	NA	NA
UV254 (cm-1)	NA	NA	NA	NA
Bromide (μg/L)	NA	NA	NA	NA

Table 2b: Tabular Summary of Finished Water Quality

Water Quality Parameter	Average Yearly Concentration	Standard Deviation	Maximum Yearly Value	Minimum Yearly Value
Temperature (°C)	25.3	1.16	28.0	24.0
pH	8.75	0.80	8.90	8.60
Turbidity (ntu)	0.13	0.01	0.15	0.12
TOC (mg/L)	7.61	0.04	8.25	6.96
Distribution System THM4 (μg/L)	46.0	11.2	70.8	29.4

Table 3: Experimental Design Summary for a RBSMT Study

Season	Membrane	Pretreatment	Water Flux, gfd	Recovery, %
Spring	Membrane A	Conventional filtration & antiscalant addition	16.5	31, 51, 72, & 90
Spring	Membrane B	Conventional filtration & antiscalant addition	15.0	31, 50, 69, & 89
Summer	Membrane A	Conventional filtration & antiscalant addition	16.5	30, 50, 71, & 89
Summer	Membrane B	Conventional filtration & antiscalant addition	15.0	30, 50, 70, & 90
Fall	Membrane A	Conventional filtration & antiscalant addition	16.5	31, 50, 69, & 90
Fall	Membrane B	Conventional filtration & antiscalant addition	15.0	31, 50, 70, & 90
Winter	Membrane A	Conventional filtration & antiscalant addition	16.5	31, 50, 71, & 91
Winter	Membrane B	Conventional filtration & antiscalant addition	15.0	30, 50, 69, & 89

Notes:
Membrane A: NF200
Membrane B: XLE

Table 4: Summary of Analytical Methods and MRLs Used During a Study

Analyte	Method	Minimum Reporting Level
Alkalinity	SM 2320 B	1 mg/L $CaCO_3$
Ammonia	SM 4500-NH_3 D	0.30 mg/L NH_3-N
Bromide	EPA 300.0	20 µg/L
Calcium Hardness	SM 2340 B	0.25 mg/L $CaCO_3$
Chlorine Residual	SM 4500-Cl G	0.1 mg/L
BCAA, DBAA, DCAA, MBAA, MCAA, TCAA,	EPA 552.2	2.0 µg/L for MCAA 1.0 µg/L for all others
pH	SM 4500-H^+	Not Applicable
TDS	SM 2510 B (TDS meter)	5.0 mg/L
Temperature	SM 2550 B	Not Applicable
CHCl3, BDCM, DBCM, CHBr3	EPA 524.2	1.0 µg/L for each analyte
Total Hardness	SM 2340 B	0.33 mg/L $CaCO_3$
TOC	SM 5310 C	0.50 mg/L
TOX	SM 5320 B	25.0 µg/L
Turbidity	EPA 180.1	0.05 ntu
UV_{254}	SM 5910	0.001 cm^{-1}

Table 5: Average Pretreated Feed Water Quality During 4 Seasons of a RBSMT Study

Water Quality Parameter	Units	Spring Average	Spring S.D.	Summer Average	Summer S.D.	Fall Average	Fall S.D.	Winter Average	Winter S.D.
pH	---	8.67	0.00	8.67	0.13	8.77	0.11	8.76	0.24
Temperature	^{o}C	23.0	0.00	23.9	0.71	21.2	0.85	22.9	0.57
Alkalinity	mg/L as $CaCO_3$	43.1	1.63	54.4	12.87	40.3	1.77	51.3	7.42
Total dissolved solids	mg/L	151.1	0.00	152.2	1.63	146.0	2.05	151.0	0.00
Total hardness	mg/L as $CaCO_3$	66.7	1.20	64.9	2.69	56.6	5.73	64.2	4.88
Calcium hardness	mg/L as $CaCO_3$	56.2	0.71	55.2	1.41	46.8	5.73	53.6	4.03
Turbidity	ntu	0.59	0.05	0.26	0.01	0.33	0.11	0.34	0.01
Ammonia	mg NH_3-N / L	0.70	0.00	0.80	0.07	0.60	0.00	0.70	NA
Total organic carbon	mg/L	8.15	0.07	8.15	0.21	7.60	0.14	7.35	0.14
UV_{254}	cm^{-1}	0.231	0.00	0.220	0.00	0.233	0.00	0.224	0.00
SUVA	L/(mg*m)	2.83	0.02	2.70	0.13	3.06	0.04	3.05	0.06
Bromide	µg/L	105.0	7.07	100.0	14.14	110.0	0.00	86.5	9.90
SDS-Cl_2 dose	mg/L	12.70	0.00	11.48	0.60	11.80	0.57	11.95	0.78
SDS-Free Cl_2 residual	mg/L	0.90	0.14	0.60	0.04	0.79	0.26	0.82	0.01
SDS-Cl_2 demand	mg/L	11.80	0.14	10.88	0.57	11.01	0.30	11.13	0.77
SDS-Chlorination temp.	^{o}C	25.5	0.28	25.6	0.21	25.2	0.07	25.6	0.35
SDS-Chlorination pH	---	8.04	0.00	8.02	0.01	8.00	0.01	8.06	0.01
SDS-Incubation time	hours	3.5	0.00	3.5	0.00	3.5	0.00	3.5	0.00
SDS-TOX	µg Cl^-/L	467.50	31.82	345.00	98.99	455.00	14.14	487.50	144.96
SDS-CHCl3	µg/L	81.49	2.27	73.18	0.39	78.33	2.66	66.11	5.61
SDS-BDCM	µg/L	21.43	0.60	20.88	0.25	23.13	0.33	19.81	1.72
SDS-DBCM	µg/L	4.15	0.12	3.83	0.03	4.83	0.18	4.59	0.30
SDS-CHBr3	µg/L	BMRL	BMRL	BMRL	BMRL	BMRL	BMRL	BMRL	BMRL
SDS-THM4	µg/L	107.06	2.99	97.89	0.16	106.29	2.81	90.51	7.04
SDS-MCAA*	µg/L	3.51	0.05	BMRL	BMRL	3.57	0.93	4.98	NA
SDS-DCAA*	µg/L	40.61	1.32	35.10	9.31	41.16	1.61	36.99	0.04
SDS-TCAA*	µg/L	45.86	3.28	38.73	10.65	41.55	8.94	36.42	5.18
SDS-MBAA*	µg/L	BMRL	BMRL	BMRL	BMRL	BMRL	BMRL	BMRL	BMRL
SDS-DBAA*	µg/L	1.23	0.04	1.18	0.23	1.98	0.10	1.53	0.04
SDS-BCAA*	µg/L	8.04	0.16	7.04	1.67	9.53	0.28	8.14	0.95
SDS-TBAA	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
SDS-CDBAA	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
SDS-DCBAA	µg/L	NA	NA	NA	NA	NA	NA	NA	NA
SDS-HAA5	µg/L	91.20	4.61	75.01	20.19	88.25	6.31	77.42	1.66
SDS-HAA6	µg/L	99.24	4.77	82.05	21.86	97.78	6.03	85.56	2.62

Table 6: SDS (Simulated Distribution System) Conditions

Parameters	Units	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
pH	-	8.0	8.0	8.0	8.0
Temperature	°C	25.3	25.3	25.3	25.3
Target residual	mg/L	0.5 - 1.0	0.5 - 1.0	0.5 - 1.0	0.5 - 1.0
Retention Time	hours	3.50	3.50	3.50	3.50

Table 7: Average NF200 Membrane Productivity Observed Under Different Operating Conditions During a Membrane Treatment Study

Operating Conditions	Average Rate of MTCw Decline (gfd/psi/day)	Initial MTCw (at setting) (gfd/psi)	Initial MTCw (at start of water test) (gfd/psi)	Final MTCw (gfd/psi)	MTCw After Cleaning (gfd/psi)
Spring	0.00008	0.354	0.299	0.321	0.353
Summer	0.00319	0.244	0.213	0.234	0.223
Fall	0.00183	0.356	0.290	0.317	0.366
Winter	-0.00150	0.305	0.255	0.261	0.284

Effect of Recovery on Feed Rejection for a RBSMT Study on Composite Samples Using the NF200 Membrane

Table 8a: Quarter 1

Water Quality Parameter	Feed Rejection at Listed Recovery (%)			
	Recovery=31%	Recovery=51%	Recovery=72%	Recovery=90%
TDS	39.38	34.28	26.20	15.40
Ca Hardness	56.41	46.62	43.30	31.50
Total Hardness	57.39	47.64	43.40	31.90
Bromide	10.48	9.52	4.80	4.80
TOC	100.00	100.00	100.00	100.00
UV254	100.00	97.84	98.50	95.70
SDS-THM4	100.00	100.00	98.90	92.60
SDS-HAA5	100.00	100.00	100.00	97.10
SDS-HAA6	100.00	100.00	100.00	96.30
SDS-TOX	100.00	100.00	100.00	91.40

Table 8b: Quarter 2

Water Quality Parameter	Feed Rejection at Listed Recovery (%)			
	Recovery=30%	Recovery=50%	Recovery=71%	Recovery=89%
TDS	40.78	31.05	21.90	12.70
Ca Hardness	57.61	47.83	33.00	27.90
Total Hardness	57.32	47.92	34.40	29.10
Bromide	25.00	18.00	9.00	9.00
TOC	100.00	100.00	100.00	100.00
UV254	99.09	99.55	98.60	95.90
SDS-THM4	98.46	100.00	96.10	90.50
SDS-HAA5	100.00	100.00	100.00	95.30
SDS-HAA6	100.00	100.00	100.00	95.70
SDS-TOX	100.00	100.00	100.00	100.00

Table 8c: Quarter 3

Water Quality Parameter	Feed Rejection at Listed Recovery (%)			
	Recovery=31%	Recovery=50%	Recovery=69%	Recovery=90%
TDS	37.58	27.78	23.70	12.40
Ca Hardness	59.36	36.90	41.30	33.30
Total Hardness	58.44	38.99	41.60	33.20
Bromide	13.64	9.09	9.50	0.00
TOC	100.00	100.00	100.00	100.00
UV254	97.85	97.85	96.30	94.80
SDS-THM4	97.43	97.21	94.00	88.80
SDS-HAA5	98.53	95.39	94.60	93.10
SDS-HAA6	98.67	94.56	93.90	92.00
SDS-TOX	100.00	100.00	93.80	84.20

Table 8d: Quarter 4

Water Quality Parameter	Feed Rejection at Listed Recovery (%)			
	Recovery=31%	Recovery=50%	Recovery=71%	Recovery=91%
TDS	45.70	36.36	24.20	13.50
Ca Hardness	54.81	52.01	45.20	35.20
Total Hardness	54.01	51.21	43.40	33.10
Bromide	9.83	4.05	0.00	0.00
TOC	100.00	100.00	100.00	90.50
UV254	98.21	97.32	95.50	89.70
SDS-THM4	95.28	94.00	89.70	80.30
SDS-HAA5	98.14	96.36	93.40	92.70
SDS-HAA6	98.32	96.71	92.60	91.10
SDS-TOX	100.00	93.73	93.50	100.00

Table 9: Quarter 1 - Blend Ratios to Achieve Various Finished Water Qualities for a NF200 Nanofiltration Membrane

Stage	Controlling Treatment Objective	Value of Listed Parameter at Blend Ratio to Achieve Controlling Treatment Objective				
		Permeate:Total Flow Blend Ratio	***TOC (mg/L)***	***SDS-THM4 (μg/L)***	***SDS-HAA5 (μg/L)***	***SDS-HAA6 (μg/L)***
1	SDS-THM4 = 72 (μg/L) (Recovery = 31%)	0.327	NA	72.00	61.34	66.79
2	SDS-THM4 = 36 (μg/L) (Recovery = 31%)	0.664	NA	36.00	30.67	33.34
1	SDS-THM4 = 72 (μg/L) (Recovery = 51%)	0.327	NA	72.00	61.34	66.79
2	SDS-THM4 = 36 (μg/L) (Recovery = 51%)	0.664	NA	36.00	30.67	33.34
1	SDS-THM4 = 72 (μg/L) (Recovery = 72%)	0.331	NA	72.00	61.00	66.39
2	SDS-THM4 = 36 (μg/L) (Recovery = 72%)	0.671	NA	36.00	29.99	32.65
1	SDS-THM4 = 72 (μg/L) (Recovery = 90%)	0.353	NA	72.00	59.89	65.49
2	SDS-THM4 = 36 (μg/L) (Recovery = 90%)	0.716	NA	36.00	27.74	30.79

Stage	Controlling Treatment Objective	Value of Listed Parameter at Blend Ratio to Achieve Controlling Treatment Objective				
		Permeate:Total Flow Blend Ratio	***TOC (mg/L)***	***SDS-THM4 (μg/L)***	***SDS-HAA5 (μg/L)***	***SDS-HAA6 (μg/L)***
1	SDS-HAA5 = 54 (μg/L) (Recovery = 31%)	0.408	NA	63.39	54.00	58.75
2	SDS-HAA5 = 27 (μg/L) (Recovery = 31%)	0.704	NA	31.69	27.00	29.38
1	SDS-HAA5 = 54 (μg/L) (Recovery = 51%)	0.408	NA	63.39	54.00	58.75
2	SDS-HAA5 = 27 (μg/L) (Recovery = 51%)	0.704	NA	31.69	27.00	29.38
1	SDS-HAA5 = 54 (μg/L) (Recovery = 72%)	0.408	NA	63.87	54.00	58.75
2	SDS-HAA5 = 27 (μg/L) (Recovery = 72%)	0.704	NA	32.53	27.00	29.38
1	SDS-HAA5 = 54 (μg/L) (Recovery = 90%)	0.420	NA	65.41	54.00	59.09
2	SDS-HAA5 = 27 (μg/L) (Recovery = 90%)	0.725	NA	35.18	27.00	29.93

Note:
Stage 1: SDS-THM4 = 72 μg/L, SDS-HAA5 = 54 μg/L
Stage 2: SDS-THM4 = 36 μg/L, SDS-HAA5 = 27 μg/L
The value of SDS-HAA6 at the appropriate blend ratio (Q_P/Q_T) was calculated using the following formula:

$$(Q_P/Q_T)/100 * (SDS\text{-}HAA6_P - SDS\text{-}HAA6_F) + SDS\text{-}HAA6_F$$

Table 10: Quarter 2 - Blend Ratios to Achieve Various Finished Water Qualities for a NF200 Nanofiltration Membrane

Stage	Controlling Treatment Objective	Value of Listed Parameter at Blend Ratio to Achieve Controlling Treatment Objective				
		Permeate:Total Flow Blend Ratio	*TOC (mg/L)*	*SDS-THM4 (µg/L)*	*SDS-HAA5 (µg/L)*	*SDS-HAA6 (µg/L)*
1	SDS-THM4 = 72 (µg/L) (Recovery = 30%)	0.269	NA	72.00	54.88	59.98
2	SDS-THM4 = 36 (µg/L) (Recovery = 30%)	0.642	NA	36.00	26.84	29.37
1	SDS-THM4 = 72 (µg/L) (Recovery = 50%)	0.264	NA	72.00	55.17	60.39
2	SDS-THM4 = 36 (µg/L) (Recovery = 50%)	0.632	NA	36.00	27.59	30.19
1	SDS-THM4 = 72 (µg/L) (Recovery = 71%)	0.275	NA	72.00	54.37	59.49
2	SDS-THM4 = 36 (µg/L) (Recovery = 71%)	0.658	NA	36.00	25.68	28.06
1	SDS-THM4 = 72 (µg/L) (Recovery = 89%)	0.292	NA	72.00	54.10	59.11
2	SDS-THM4 = 36 (µg/L) (Recovery = 89%)	0.699	NA	36.00	25.02	27.14

Stage	Controlling Treatment Objective	Value of Listed Parameter at Blend Ratio to Achieve Controlling Treatment Objective				
		Permeate:Total Flow Blend Ratio	*TOC (mg/L)*	*SDS-THM4 (µg/L)*	*SDS-HAA5 (µg/L)*	*SDS-HAA6 (µg/L)*
1	SDS-HAA5 = 54 (µg/L) (Recovery = 30%)	0.280	NA	70.90	54.00	59.08
2	SDS-HAA5 = 27 (µg/L) (Recovery = 30%)	0.640	NA	36.20	27.00	29.54
1	SDS-HAA5 = 54 (µg/L) (Recovery = 50%)	0.280	NA	70.47	54.00	59.08
2	SDS-HAA5 = 27 (µg/L) (Recovery = 50%)	0.640	NA	35.24	27.00	29.54
1	SDS-HAA5 = 54 (µg/L) (Recovery = 71%)	0.280	NA	71.53	54.00	59.08
2	SDS-HAA5 = 27 (µg/L) (Recovery = 71%)	0.640	NA	37.66	27.00	29.54
1	SDS-HAA5 = 54 (µg/L) (Recovery = 89%)	0.294	NA	71.88	54.00	58.95
2	SDS-HAA5 = 27 (µg/L) (Recovery = 89%)	0.671	NA	38.45	27.00	29.34

Note:
Stage 1: SDS-THM4 = 72 µg/L, SDS-HAA5 = 54 µg/L
Stage 2: SDS-THM4 = 36 µg/L, SDS-HAA5 = 27 µg/L
The value of SDS-HAA6 at the appropriate blend ratio (Q_P/Q_T) was calculated using the following formula:

$$(Q_P/Q_T)/100 * (SDS\text{-}HAA6_P - SDS\text{-}HAA6_F) + SDS\text{-}HAA6_F$$

Table 11: Quarter 3 - Blend Ratios to Achieve Various Finished Water Qualities for a NF200 Nanofiltration Membrane

Stage	Controlling Treatment Objective	Value of Listed Parameter at Blend Ratio to Achieve Controlling Treatment Objective				
		Permeate:Total Flow Blend Ratio	***TOC (mg/L)***	***SDS-THM4 (µg/L)***	***SDS-HAA5 (µg/L)***	***SDS-HAA6 (µg/L)***
1	SDS-THM4 = 72 (µg/L) (Recovery = 31%)	0.331	NA	72.00	59.46	65.85
2	SDS-THM4 = 36 (µg/L) (Recovery = 31%)	0.679	NA	36.00	29.23	32.27
1	SDS-THM4 = 72 (µg/L) (Recovery = 50%)	0.332	NA	72.00	60.31	67.08
2	SDS-THM4 = 36 (µg/L) (Recovery = 50%)	0.680	NA	36.00	30.98	34.91
1	SDS-THM4 = 72 (µg/L) (Recovery = 69%)	0.343	NA	72.00	59.59	66.30
2	SDS-THM4 = 36 (µg/L) (Recovery = 69%)	0.703	NA	36.00	29.51	33.26
1	SDS-THM4 = 72 (µg/L) (Recovery = 90%)	0.363	NA	72.00	58.41	65.12
2	SDS-THM4 = 36 (µg/L) (Recovery = 90%)	0.745	NA	36.00	27.08	30.74

Stage	Controlling Treatment Objective	Value of Listed Parameter at Blend Ratio to Achieve Controlling Treatment Objective				
		Permeate:Total Flow Blend Ratio	***TOC (mg/L)***	***SDS-THM4 (µg/L)***	***SDS-HAA5 (µg/L)***	***SDS-HAA6 (µg/L)***
1	SDS-HAA5 = 54 (µg/L) (Recovery = 31%)	0.394	NA	65.50	54.00	59.77
2	SDS-HAA5 = 27 (µg/L) (Recovery = 31%)	0.704	NA	33.34	27.00	29.86
1	SDS-HAA5 = 54 (µg/L) (Recovery = 50%)	0.407	NA	64.25	54.00	60.15
2	SDS-HAA5 = 27 (µg/L) (Recovery = 50%)	0.728	NA	31.11	27.00	30.47
1	SDS-HAA5 = 54 (µg/L) (Recovery = 69%)	0.410	NA	65.31	54.00	60.15
2	SDS-HAA5 = 27 (µg/L) (Recovery = 69%)	0.734	NA	33.00	27.00	30.41
1	SDS-HAA5 = 54 (µg/L) (Recovery = 90%)	0.417	NA	66.94	54.00	60.26
2	SDS-HAA5 = 27 (µg/L) (Recovery = 90%)	0.746	NA	35.91	27.00	30.65

Note:
Stage 1: SDS-THM4 = 72 µg/L, SDS-HAA5 = 54 µg/L
Stage 2: SDS-THM4 = 36 µg/L, SDS-HAA5 = 27 µg/L
The value of SDS-HAA6 at the appropriate blend ratio (Q_P/Q_T) was calculated using the following formula:

$(Q_P/Q_T)/100 * (\text{SDS-HAA6}_P - \text{SDS-HAA6}_F) + \text{SDS-HAA6}_F$

Table 12: Quarter 4 - Blend Ratios to Achieve Various Finished Water Qualities for a NF200 Nanofiltration Membrane

Stage	Controlling Treatment Objective	Value of Listed Parameter at Blend Ratio to Achieve Controlling Treatment Objective				
		Permeate:Total Flow Blend Ratio	***TOC (mg/L)***	***SDS-THM4 (µg/L)***	***SDS-HAA5 (µg/L)***	***SDS-HAA6 (µg/L)***
1	SDS-THM4 = 72 (µg/L) (Recovery = 31%)	0.215	NA	72.00	61.11	67.47
2	SDS-THM4 = 36 (µg/L) (Recovery = 31%)	0.632	NA	36.00	29.40	32.40
1	SDS-THM4 = 72 (µg/L) (Recovery = 50%)	0.218	NA	72.00	61.19	67.52
2	SDS-THM4 = 36 (µg/L) (Recovery = 50%)	0.641	NA	36.00	29.62	32.52
1	SDS-THM4 = 72 (µg/L) (Recovery = 71%)	0.228	NA	72.00	60.94	67.50
2	SDS-THM4 = 36 (µg/L) (Recovery = 71%)	0.671	NA	36.00	28.89	32.40
1	SDS-THM4 = 72 (µg/L) (Recovery = 91%)	0.255	NA	72.00	59.14	65.67
2	SDS-THM4 = 36 (µg/L) (Recovery = 91%)	0.750	NA	36.00	23.58	27.07

Stage	Controlling Treatment Objective	Value of Listed Parameter at Blend Ratio to Achieve Controlling Treatment Objective				
		Permeate:Total Flow Blend Ratio	***TOC (mg/L)***	***SDS-THM4 (µg/L)***	***SDS-HAA5 (µg/L)***	***SDS-HAA6 (µg/L)***
1	SDS-HAA5 = 54 (µg/L) (Recovery = 31%)	0.308	NA	63.93	54.00	59.65
2	SDS-HAA5 = 27 (µg/L) (Recovery = 31%)	0.664	NA	33.28	27.00	29.70
1	SDS-HAA5 = 54 (µg/L) (Recovery = 50%)	0.314	NA	63.80	54.00	59.58
2	SDS-HAA5 = 27 (µg/L) (Recovery = 50%)	0.676	NA	33.01	27.00	29.63
1	SDS-HAA5 = 54 (µg/L) (Recovery = 71%)	0.324	NA	64.20	54.00	59.89
2	SDS-HAA5 = 27 (µg/L) (Recovery = 71%)	0.698	NA	33.87	27.00	30.26
1	SDS-HAA5 = 54 (µg/L) (Recovery = 91%)	0.326	NA	66.79	54.00	60.14
2	SDS-HAA5 = 27 (µg/L) (Recovery = 91%)	0.703	NA	39.46	27.00	30.73

Note:
Stage 1: SDS-THM4 = 72 µg/L, SDS-HAA5 = 54 µg/L
Stage 2: SDS-THM4 = 36 µg/L, SDS-HAA5 = 27 µg/L
The value of SDS-HAA6 at the appropriate blend ratio (Q_P/Q_T) was calculated using the following formula:

$$(Q_P/Q_T)/100 * (SDS\text{-}HAA6_P - SDS\text{-}HAA6_F) + SDS\text{-}HAA6_F$$

Table 13: Average XLE Membrane Productivity Observed Under Different Operating Conditions During a Membrane Treatment Study

Operating Conditions	Average Rate of MTCw Decline (gfd/psi/day)	Initial MTCw (at setting) (gfd/psi)	Initial MTCw (at start of water test) (gfd/psi)	Final MTCw (gfd/psi)	MTCw After Cleaning (gfd/psi)
Spring	-0.00958	0.405	0.395	0.308	0.337
Summer	-0.00921	0.354	0.337	0.282	0.272
Fall	-0.00857	0.442	0.416	0.347	0.353
Winter	-0.01394	0.467	0.400	0.321	0.338

Effect of Recovery on Feed Rejection for a RBSMT Study on Composite Samples Using the XLE Membrane

Table 14a: Quarter 1

Water Quality Parameter	Feed Rejection at Listed Recovery (%)			
	Recovery=31%	Recovery=50%	Recovery=69%	Recovery=89%
TDS	93.78	90.60	88.00	76.80
Ca Hardness	100.00	99.64	99.40	98.40
Total Hardness	100.00	92.35	99.30	98.30
Bromide	100.00	100.00	100.00	61.00
TOC	100.00	100.00	100.00	100.00
UV254	100.00	99.13	99.40	98.30
SDS-THM4	100.00	100.00	100.00	100.00
SDS-HAA5	100.00	100.00	100.00	100.00
SDS-HAA6	100.00	100.00	100.00	100.00
SDS-TOX	100.00	100.00	100.00	NR

Table 14b: Quarter 2

Water Quality Parameter	Feed Rejection at Listed Recovery (%)			
	Recovery=30%	Recovery=50%	Recovery=70%	Recovery=90%
TDS	91.72	91.78	87.90	75.50
Ca Hardness	100.00	100.00	99.10	97.60
Total Hardness	100.00	100.00	99.20	97.80
Bromide	100.00	100.00	100.00	65.00
TOC	100.00	100.00	100.00	100.00
UV254	99.55	100.00	99.50	98.60
SDS-THM4	98.90	100.00	100.00	98.70
SDS-HAA5	100.00	100.00	100.00	100.00
SDS-HAA6	100.00	100.00	100.00	100.00
SDS-TOX	100.00	100.00	100.00	100.00

Table 14c: Quarter 3

Water Quality Parameter	Feed Rejection at Listed Recovery (%)			
	Recovery=31%	Recovery=50%	Recovery=70%	Recovery=90%
TDS	93.90	91.16	85.60	71.80
Ca Hardness	100.00	98.93	98.50	96.40
Total Hardness	99.82	99.12	98.60	96.50
Bromide	100.00	100.00	80.90	58.20
TOC	100.00	100.00	100.00	100.00
UV254	99.57	100.00	99.40	99.60
SDS-THM4	100.00	100.00	100.00	100.00
SDS-HAA5	100.00	100.00	99.40	97.60
SDS-HAA6	100.00	100.00	99.50	97.80
SDS-TOX	100.00	100.00	100.00	100.00

Table 14d: Quarter 4

Water Quality Parameter	Feed Rejection at Listed Recovery (%)			
	Recovery=30%	Recovery=50%	Recovery=69%	Recovery=89%
TDS	92.85	92.72	87.40	72.20
Ca Hardness	100.00	100.00	98.70	93.30
Total Hardness	100.00	100.00	98.40	93.30
Bromide	100.00	100.00	75.80	52.70
TOC	100.00	100.00	100.00	100.00
UV254	99.55	99.11	98.90	96.40
SDS-THM4	98.81	98.81	100.00	98.40
SDS-HAA5	100.00	100.00	100.00	96.60
SDS-HAA6	100.00	100.00	100.00	96.90
SDS-TOX	100.00	100.00	100.00	100.00

Table 15: Quarter 1 - Blend Ratios to Achieve Various Finished Water Qualities for a XLE Nanofiltration Membrane

Stage	Controlling Treatment Objective	Value of Listed Parameter at Blend Ratio to Achieve Controlling Treatment Objective				
		Permeate:Total Flow Blend Ratio	*TOC (mg/L)*	*SDS-THM4 (μg/L)*	*SDS-HAA5 (μg/L)*	*SDS-HAA6 (μg/L)*
1	SDS-THM4 = 72 (μg/L) (Recovery = 31%)	0.327	NA	72.00	61.34	66.79
2	SDS-THM4 = 36 (μg/L) (Recovery = 31%)	0.664	NA	36.00	30.67	33.34
1	SDS-THM4 = 72 (μg/L) (Recovery = 50%)	0.327	NA	72.00	61.34	66.79
2	SDS-THM4 = 36 (μg/L) (Recovery = 50%)	0.664	NA	36.00	30.67	33.34
1	SDS-THM4 = 72 (μg/L) (Recovery = 69%)	0.327	NA	72.00	61.34	66.79
2	SDS-THM4 = 36 (μg/L) (Recovery = 69%)	0.664	NA	36.00	30.67	33.34
1	SDS-THM4 = 72 (μg/L) (Recovery = 89%)	0.327	NA	72.00	61.34	66.79
2	SDS-THM4 = 36 (μg/L) (Recovery = 89%)	0.664	NA	36.00	30.67	33.34

Stage	Controlling Treatment Objective	Value of Listed Parameter at Blend Ratio to Achieve Controlling Treatment Objective				
		Permeate:Total Flow Blend Ratio	*TOC (mg/L)*	*SDS-THM4 (μg/L)*	*SDS-HAA5 (μg/L)*	*SDS-HAA6 (μg/L)*
1	SDS-HAA5 = 54 (μg/L) (Recovery = 31%)	0.408	NA	63.39	54.00	58.75
2	SDS-HAA5 = 27 (μg/L) (Recovery = 31%)	0.704	NA	31.69	27.00	29.38
1	SDS-HAA5 = 54 (μg/L) (Recovery = 50%)	0.408	NA	63.39	54.00	58.75
2	SDS-HAA5 = 27 (μg/L) (Recovery = 50%)	0.704	NA	31.69	27.00	29.38
1	SDS-HAA5 = 54 (μg/L) (Recovery = 69%)	0.408	NA	63.39	54.00	58.75
2	SDS-HAA5 = 27 (μg/L) (Recovery = 69%)	0.704	NA	31.69	27.00	29.38
1	SDS-HAA5 = 54 (μg/L) (Recovery = 89%)	0.408	NA	63.39	54.00	58.75
2	SDS-HAA5 = 27 (μg/L) (Recovery = 89%)	0.704	NA	31.69	27.00	29.38

Note:
Stage 1: SDS-THM4 = 72 μg/L, SDS-HAA5 = 54 μg/L
Stage 2: SDS-THM4 = 36 μg/L, SDS-HAA5 = 27 μg/L
The value of SDS-HAA6 at the appropriate blend ratio (Q_P/Q_T) was calculated using the following formula:

$$(Q_P/Q_T)/100 * (\text{SDS-HAA6}_P - \text{SDS-HAA6}_F) + \text{SDS-HAA6}_F$$

Table 16: Quarter 2 - Blend Ratios to Achieve Various Finished Water Qualities for a XLE Nanofiltration Membrane

Stage	Controlling Treatment Objective	Value of Listed Parameter at Blend Ratio to Achieve Controlling Treatment Objective				
		Permeate:Total Flow Blend Ratio	***TOC (mg/L)***	***SDS-THM4 (µg/L)***	***SDS-HAA5 (µg/L)***	***SDS-HAA6 (µg/L)***
1	SDS-THM4 = 72 (µg/L) (Recovery = 30%)	0.267	NA	72.00	54.95	60.14
2	SDS-THM4 = 36 (µg/L) (Recovery = 30%)	0.639	NA	36.00	27.06	29.62
1	SDS-THM4 = 72 (µg/L) (Recovery = 50%)	0.264	NA	72.00	55.17	60.39
2	SDS-THM4 = 36 (µg/L) (Recovery = 50%)	0.632	NA	36.00	27.59	30.19
1	SDS-THM4 = 72 (µg/L) (Recovery = 70%)	0.264	NA	72.00	55.17	60.39
2	SDS-THM4 = 36 (µg/L) (Recovery = 70%)	0.632	NA	36.00	27.59	30.19
1	SDS-THM4 = 72 (µg/L) (Recovery = 90%)	0.268	NA	72.00	54.90	60.06
2	SDS-THM4 = 36 (µg/L) (Recovery = 90%)	0.641	NA	36.00	26.94	29.46

Stage	Controlling Treatment Objective	Value of Listed Parameter at Blend Ratio to Achieve Controlling Treatment Objective				
		Permeate:Total Flow Blend Ratio	***TOC (mg/L)***	***SDS-THM4 (µg/L)***	***SDS-HAA5 (µg/L)***	***SDS-HAA6 (µg/L)***
1	SDS-HAA5 = 54 (µg/L) (Recovery = 30%)	0.280	NA	70.77	54.00	59.08
2	SDS-HAA5 = 27 (µg/L) (Recovery = 30%)	0.640	NA	35.93	27.00	29.54
1	SDS-HAA5 = 54 (µg/L) (Recovery = 50%)	0.280	NA	70.47	54.00	59.08
2	SDS-HAA5 = 27 (µg/L) (Recovery = 50%)	0.640	NA	35.24	27.00	29.54
1	SDS-HAA5 = 54 (µg/L) (Recovery = 70%)	0.280	NA	70.47	54.00	59.08
2	SDS-HAA5 = 27 (µg/L) (Recovery = 70%)	0.640	NA	35.24	27.00	29.54
1	SDS-HAA5 = 54 (µg/L) (Recovery = 90%)	0.280	NA	70.84	54.00	59.08
2	SDS-HAA5 = 27 (µg/L) (Recovery = 90%)	0.640	NA	36.08	27.00	29.54

Note:
Stage 1: SDS-THM4 = 72 µg/L, SDS-HAA5 = 54 µg/L
Stage 2: SDS-THM4 = 36 µg/L, SDS-HAA5 = 27 µg/L
The value of SDS-HAA6 at the appropriate blend ratio (Q_P/Q_T) was calculated using the following formula:

$$(Q_P/Q_T)/100 * (SDS\text{-}HAA6_P - SDS\text{-}HAA6_F) + SDS\text{-}HAA6_F$$

Table 17: Quarter 3 - Blend Ratios to Achieve Various Finished Water Qualities for a XLE Nanofiltration Membrane

Stage	Controlling Treatment Objective	Value of Listed Parameter at Blend Ratio to Achieve Controlling Treatment Objective				
		Permeate:Total Flow Blend Ratio	*TOC (mg/L)*	*SDS-THM4 (μg/L)*	*SDS-HAA5 (μg/L)*	*SDS-HAA6 (μg/L)*
1	SDS-THM4 = 72 (μg/L) (Recovery = 31%)	0.323	NA	72.00	59.78	66.20
2	SDS-THM4 = 36 (μg/L) (Recovery = 31%)	0.661	NA	36.00	29.89	33.15
1	SDS-THM4 = 72 (μg/L) (Recovery = 50%)	0.323	NA	72.00	59.78	66.20
2	SDS-THM4 = 36 (μg/L) (Recovery = 50%)	0.661	NA	36.00	29.89	33.15
1	SDS-THM4 = 72 (μg/L) (Recovery = 70%)	0.323	NA	72.00	59.94	66.36
2	SDS-THM4 = 36 (μg/L) (Recovery = 70%)	0.661	NA	36.00	30.22	33.48
1	SDS-THM4 = 72 (μg/L) (Recovery = 90%)	0.323	NA	72.00	60.47	66.89
2	SDS-THM4 = 36 (μg/L) (Recovery = 90%)	0.661	NA	36.00	31.30	34.56

Stage	Controlling Treatment Objective	Value of Listed Parameter at Blend Ratio to Achieve Controlling Treatment Objective				
		Permeate:Total Flow Blend Ratio	*TOC (mg/L)*	*SDS-THM4 (μg/L)*	*SDS-HAA5 (μg/L)*	*SDS-HAA6 (μg/L)*
1	SDS-HAA5 = 54 (μg/L) (Recovery = 31%)	0.388	NA	65.04	54.00	59.84
2	SDS-HAA5 = 27 (μg/L) (Recovery = 31%)	0.694	NA	32.52	27.00	29.92
1	SDS-HAA5 = 54 (μg/L) (Recovery = 50%)	0.388	NA	65.04	54.00	59.84
2	SDS-HAA5 = 27 (μg/L) (Recovery = 50%)	0.694	NA	32.52	27.00	29.92
1	SDS-HAA5 = 54 (μg/L) (Recovery = 70%)	0.390	NA	64.80	54.00	59.84
2	SDS-HAA5 = 27 (μg/L) (Recovery = 70%)	0.698	NA	32.10	27.00	29.89
1	SDS-HAA5 = 54 (μg/L) (Recovery = 90%)	0.398	NA	64.02	54.00	59.72
2	SDS-HAA5 = 27 (μg/L) (Recovery = 90%)	0.711	NA	30.69	27.00	29.78

Note:
Stage 1: SDS-THM4 = 72 μg/L, SDS-HAA5 = 54 μg/L
Stage 2: SDS-THM4 = 36 μg/L, SDS-HAA5 = 27 μg/L
The value of SDS-HAA6 at the appropriate blend ratio (Q_P/Q_T) was calculated using the following formula:

$$(Q_P/Q_T)/100 * (SDS\text{-}HAA6_P - SDS\text{-}HAA6_F) + SDS\text{-}HAA6_F$$

Table 18: Quarter 4 - Blend Ratios to Achieve Various Finished Water Qualities for a XLE Nanofiltration Membrane

Stage	Controlling Treatment Objective	Value of Listed Parameter at Blend Ratio to Achieve Controlling Treatment Objective				
		Permeate:Total Flow Blend Ratio	***TOC (mg/L)***	***SDS-THM4 (µg/L)***	***SDS-HAA5 (µg/L)***	***SDS-HAA6 (µg/L)***
1	SDS-THM4 = 72 (µg/L) (Recovery = 30%)	0.207	NA	72.00	61.40	67.85
2	SDS-THM4 = 36 (µg/L) (Recovery = 30%)	0.610	NA	36.00	30.23	33.37
1	SDS-THM4 = 72 (µg/L) (Recovery = 50%)	0.207	NA	72.00	61.40	67.85
2	SDS-THM4 = 36 (µg/L) (Recovery = 50%)	0.610	NA	36.00	30.23	33.37
1	SDS-THM4 = 72 (µg/L) (Recovery = 69%)	0.205	NA	72.00	61.59	68.02
2	SDS-THM4 = 36 (µg/L) (Recovery = 69%)	0.602	NA	36.00	30.80	34.05
1	SDS-THM4 = 72 (µg/L) (Recovery = 89%)	0.208	NA	72.00	61.88	68.31
2	SDS-THM4 = 36 (µg/L) (Recovery = 89%)	0.612	NA	36.00	31.63	34.79

Stage	Controlling Treatment Objective	Value of Listed Parameter at Blend Ratio to Achieve Controlling Treatment Objective				
		Permeate:Total Flow Blend Ratio	***TOC (mg/L)***	***SDS-THM4 (µg/L)***	***SDS-HAA5 (µg/L)***	***SDS-HAA6 (µg/L)***
1	SDS-HAA5 = 54 (µg/L) (Recovery = 30%)	0.303	NA	63.45	54.00	59.64
2	SDS-HAA5 = 27 (µg/L) (Recovery = 30%)	0.651	NA	32.26	27.00	29.86
1	SDS-HAA5 = 54 (µg/L) (Recovery = 50%)	0.303	NA	63.45	54.00	59.64
2	SDS-HAA5 = 27 (µg/L) (Recovery = 50%)	0.651	NA	32.27	27.00	29.86
1	SDS-HAA5 = 54 (µg/L) (Recovery = 69%)	0.303	NA	63.13	54.00	59.64
2	SDS-HAA5 = 27 (µg/L) (Recovery = 69%)	0.651	NA	31.56	27.00	29.86
1	SDS-HAA5 = 54 (µg/L) (Recovery = 89%)	0.313	NA	62.63	54.00	59.60
2	SDS-HAA5 = 27 (µg/L) (Recovery = 89%)	0.674	NA	30.48	27.00	29.65

Note:
Stage 1: SDS-THM4 = 72 µg/L, SDS-HAA5 = 54 µg/L
Stage 2: SDS-THM4 = 36 µg/L, SDS-HAA5 = 27 µg/L
The value of SDS-HAA6 at the appropriate blend ratio (Q_P/Q_T) was calculated using the following formula:

$$(Q_P/Q_T)/100 * (\text{SDS-HAA6}_P - \text{SDS-HAA6}_F) + \text{SDS-HAA6}_F$$

Table 19: PE Study for 1st Quarter (PE Study #6)

Parameter	Units	True Value	Measured Value	RPD
UV_{254}	cm^{-1}	0.101	0.090	10.89
TOC	mg/L	2.69	3.01	11.90
TOX	µg Cl^- /L	135	102.0	24.44
Bromide	mg/L	0.059	0.056	5.08
Inorganic DBPs:				
ClO_2^-	µg/L	73.6	63.0	14.40
BrO_3^-	µg/L	16.2	17.10	5.56
ClO_3^-	µg/L	141	140.0	0.71
HAAs:				
MCAA	µg/L	9.04	7.86	13.05
MBAA	µg/L	8.10	6.84	15.56
DCAA	µg/L	18.1	16.60	8.29
TCAA	µg/L	26.2	26.80	2.29
BCAA	µg/L	11.1	8.50	23.42
DBAA	µg/L	4.97	4.36	12.27
THMs:				
$CHCl_3$	µg/L	16.2	15.10	6.79
BDCM	µg/L	22.8	23.20	1.75
DBCM	µg/L	28.6	29.70	3.85
$CHBr_3$	µg/L	20.2	20.20	0.00
HANs:				
TCAN	µg/L	-	5.97	-
DCAN	µg/L	10.9	9.02	17.25
DCP	µg/L	9.00	8.30	7.78
BCAN	µg/L	13.0	12.00	7.69
TCP	µg/L	8.01	6.90	13.86
DBAN	µg/L	15.9	15.20	4.40
CH	µg/L	12.2	13.80	13.11

Table 20a: PE Study for 2nd Quarter (PE Study #7)

Parameter	Units	True Value	Measured Value	RPD
UV_{254}	cm^{-1}	0.361	0.339	6.09
TOC	mg/L	1.22	1.29	5.74
TOX	µg Cl^-/L	188	149.0	20.74
Inorganic DBPs:				
ClO_2^-	µg/L	483	449.0	7.04
BrO_3^-	µg/L	26.1	24.50	6.13
ClO_3^-	µg/L	375	352.0	6.13
HAAs:				
MCAA	µg/L	5.94	5.07	14.65
MBAA	µg/L	11.1	7.50	32.43
DCAA	µg/L	24.0	17.10	28.75
TCAA	µg/L	15.0	12.90	14.00
BCAA	µg/L	12.1	7.37	39.09
DBAA	µg/L	14.0	9.03	35.50
THMs:				
$CHCl_3$	µg/L	17.0	16.00	5.88
BDCM	µg/L	11.0	11.30	2.73
DBCM	µg/L	28.1	28.00	0.36
$CHBr_3$	µg/L	18.2	18.20	0.00
HANs:				
TCAN	µg/L	12.1	12.00	0.83
DCAN	µg/L	19.0	18.60	2.11
DCP	µg/L	5.06	5.22	3.16
BCAN	µg/L	9.10	8.69	4.51
TCP	µg/L	11.1	11.80	6.31
DBAN	µg/L	14.0	14.30	2.14
CH	µg/L	22.1	20.10	9.05

Table 20b: Makeup PE Study for 2nd Quarter

Parameter	Units	True Value	Measured Value	RPD
Bromide	mg/L	0.091	0.090	1.10

Table 21a: PE Study for 3rd Quarter (PE Study #8)

Parameter	Units	True Value	Measured Value	RPD
UV_{254}	cm^{-1}	0.072	0.066	8.33
TOC	mg/L	2.62	3.14	19.85
TOX	µg Cl^-/L	80.3	62.8	21.79
Bromide	mg/L	0.325	0.296	8.92
Inorganic DBPs:				
ClO_2^-	µg/L	687	635.0	7.57
BrO_3^-	µg/L	13.1	12.30	6.11
ClO_3^-	µg/L	768	700.0	8.85
HAAs:				
MCAA	µg/L	13.0	12.60	3.08
MBAA	µg/L	16.0	14.30	10.63
DCAA	µg/L	14.2	12.60	11.27
TCAA	µg/L	8.03	6.76	15.82
BCAA	µg/L	5.07	4.77	5.92
DBAA	µg/L	18.0	17.90	0.56
HANs:				
TCAN	µg/L	6.92	5.52	20.23
DCAN	µg/L	6.16	4.51	26.79
DCP	µg/L	4.09	4.38	7.09
BCAN	µg/L	10.0	7.44	25.60
TCP	µg/L	2.99	3.61	20.74
DBAN	µg/L	5.07	4.52	10.85
CH	µg/L	9.08	10.60	16.74

Table 21b: Makeup PE Study for 3rd Quarter

Parameter	Units	True Value	Measured Value	RPD
THMs:				
$CHCl_3$	µg/L	17.1	17.10	0.00
BDCM	µg/L	11.0	11.00	0.00
DBCM	µg/L	28.1	26.70	4.98
$CHBr_3$	µg/L	18.2	18.10	0.55

Table 22: PE Study for 4th Quarter (PE Study #9)

Parameter	Units	True Value	Measured Value	RPD
UV_{254}	cm^{-1}	0.223	0.206	7.62
TOC	mg/L	4.19	4.25	1.43
TOX	µg Cl^-/L	92.9	62.5	32.72
Bromide	mg/L	0.091	0.092	1.10
Inorganic DBPs:				
ClO_2^-	µg/L	167	170.0	1.80
BrO_3^-	µg/L	9.17	9.68	5.56
ClO_3^-	µg/L	211	209.0	0.95
HAAs:				
MCAA	µg/L	11.1	12.10	9.01
MBAA	µg/L	9.11	8.54	6.26
DCAA	µg/L	8.01	7.39	7.74
TCAA	µg/L	12.0	9.47	21.08
BCAA	µg/L	7.05	5.60	20.57
DBAA	µg/L	5.00	3.85	23.00
THMs:				
$CHCl_3$	µg/L	32.2	32.10	0.31
BDCM	µg/L	15.0	14.90	0.67
DBCM	µg/L	9.10	8.73	4.07
$CHBr_3$	µg/L	2.98	2.91	2.35
HANs:				
TCAN	µg/L	17.0	18.30	7.65
DCAN	µg/L	16.2	16.20	0.00
DCP	µg/L	8.13	9.73	19.68
BCAN	µg/L	14.1	11.50	18.44
TCP	µg/L	14.1	14.50	2.84
DBAN	µg/L	12.1	9.64	20.33
CH	µg/L	19.1	15.30	19.90

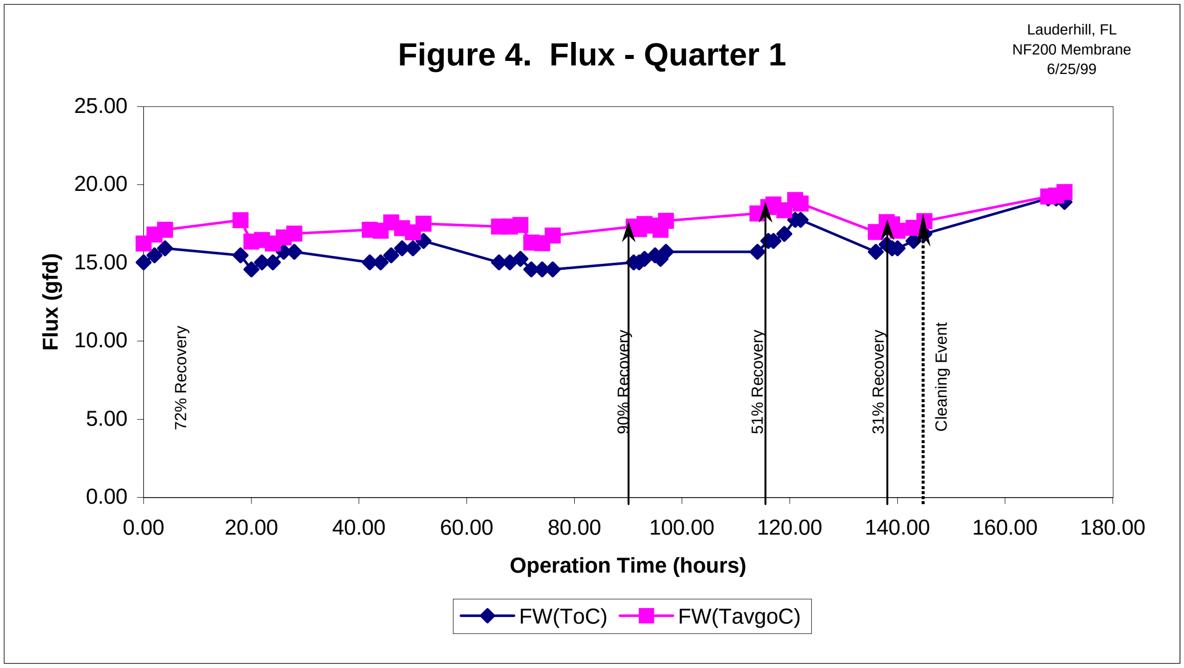


Figure 4. Flux - Quarter 1
Lauderhill, FL
NF200 Membrane
6/25/99
Flux (gfd)
25.00
20.00
15.00
10.00
5.00
0.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
Operation Time (hours)
72% Recovery
90% Recovery
51% Recovery
31% Recovery
Cleaning Event
FW(ToC)
FW(TavgoC)

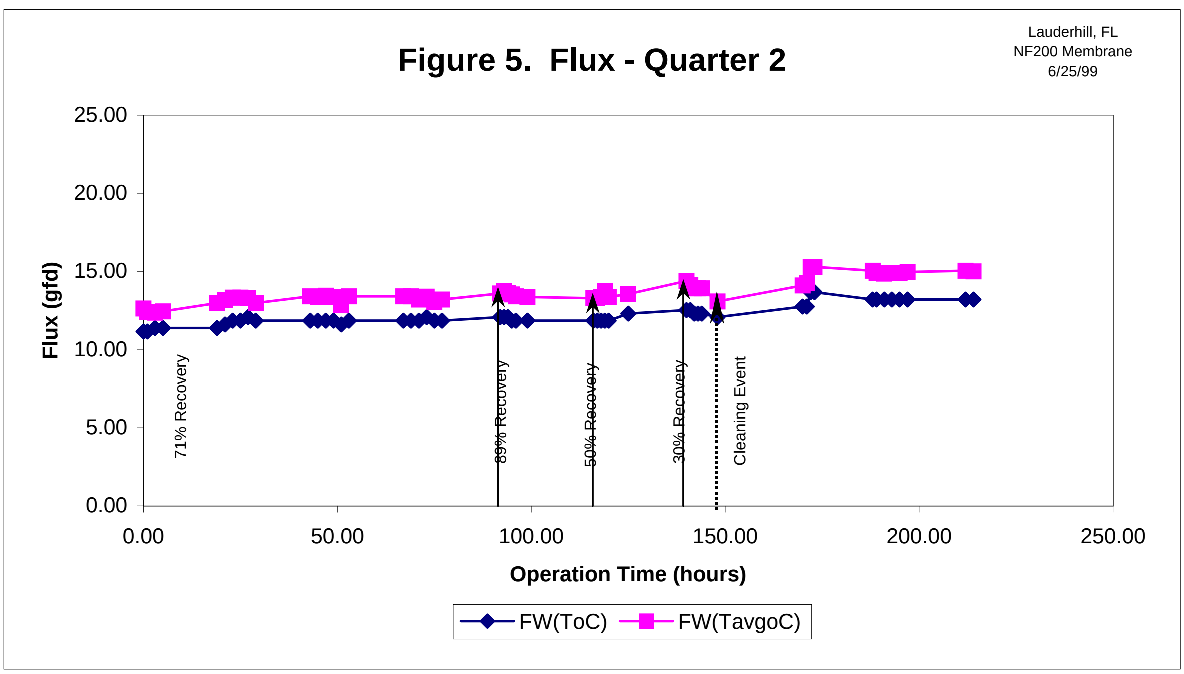


Figure 5. Flux - Quarter 2
Lauderhill, FL
NF200 Membrane
6/25/99
Flux (gfd)
25.00
20.00
15.00
10.00
5.00
0.00
0.00
50.00
100.00
150.00
200.00
250.00
Operation Time (hours)
71% Recovery
89% Recovery
50% Recovery
30% Recovery
Cleaning Event
FW(ToC)
FW(TavgoC)

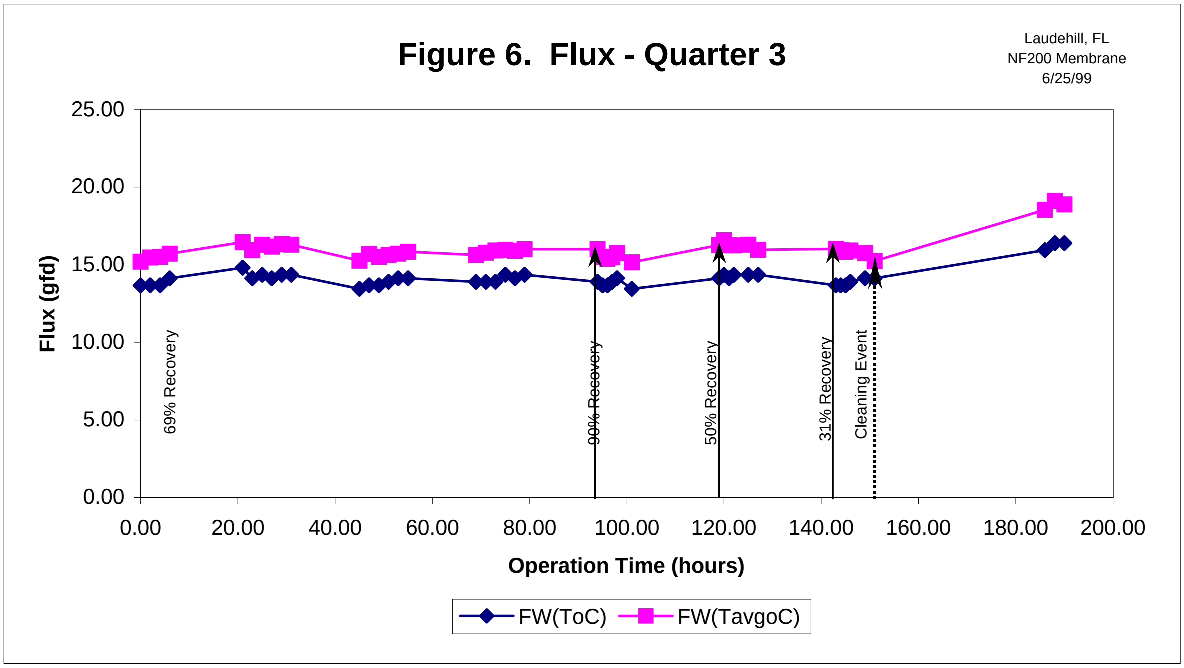


Figure 6. Flux - Quarter 3
Laudehill, FL
NF200 Membrane
6/25/99
Flux (gfd)
25.00
20.00
15.00
10.00
5.00
0.00
69% Recovery
90% Recovery
50% Recovery
31% Recovery
Cleaning Event
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
Operation Time (hours)
FW(ToC)
FW(TavgoC)

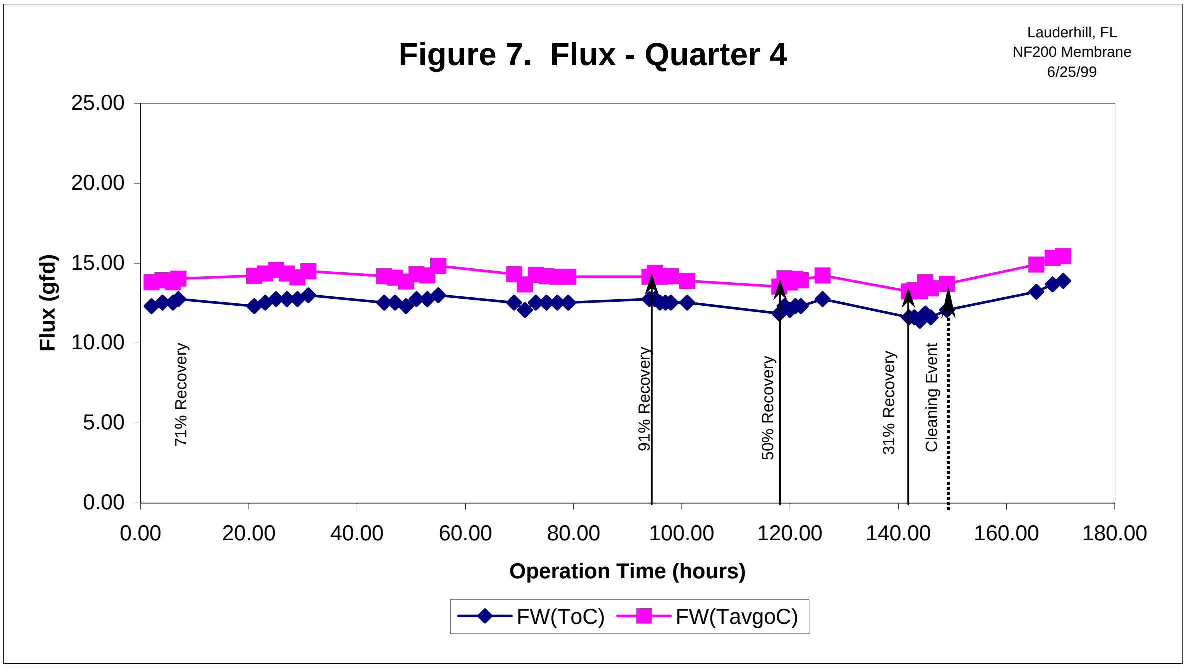


Figure 7. Flux - Quarter 4
Lauderhill, FL
NF200 Membrane
6/25/99
Flux (gfd)
25.00
20.00
15.00
10.00
5.00
0.00
71% Recovery
91% Recovery
50% Recovery
31% Recovery
Cleaning Event
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
Operation Time (hours)
FW(ToC)
FW(TavgoC)

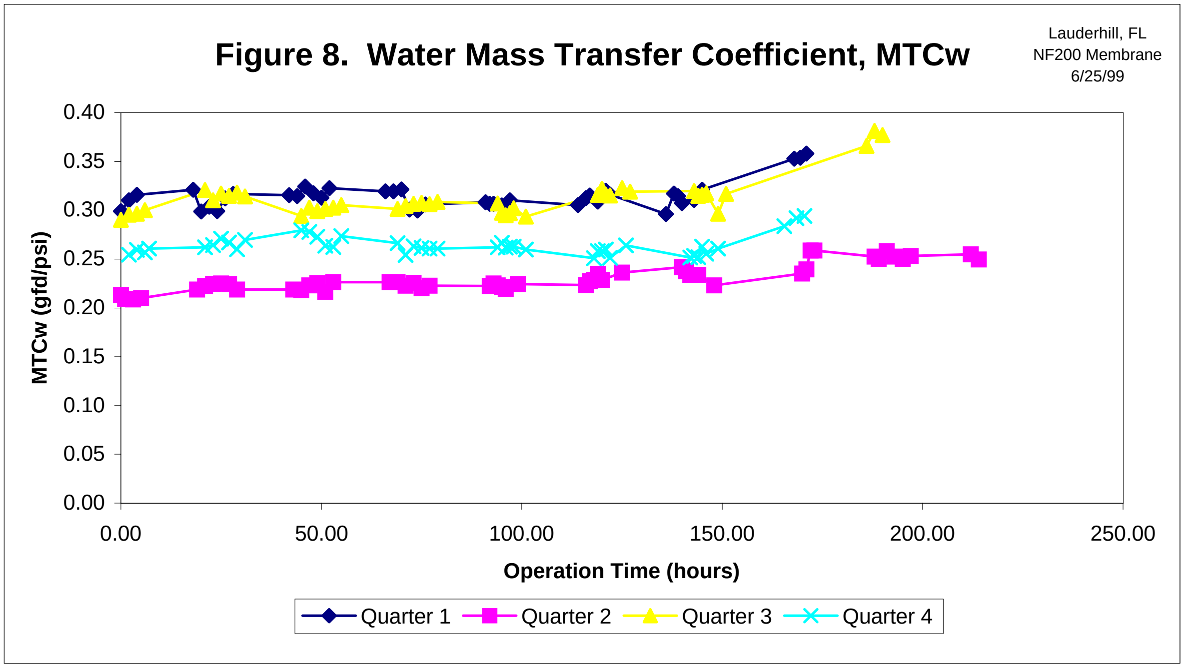


Figure 8. Water Mass Transfer Coefficient, MTCw
Lauderhill, FL
NF200 Membrane
6/25/99
MTCw (gfd/psi)
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.00
50.00
100.00
150.00
200.00
250.00
Operation Time (hours)
Quarter 1
Quarter 2
Quarter 3
Quarter 4

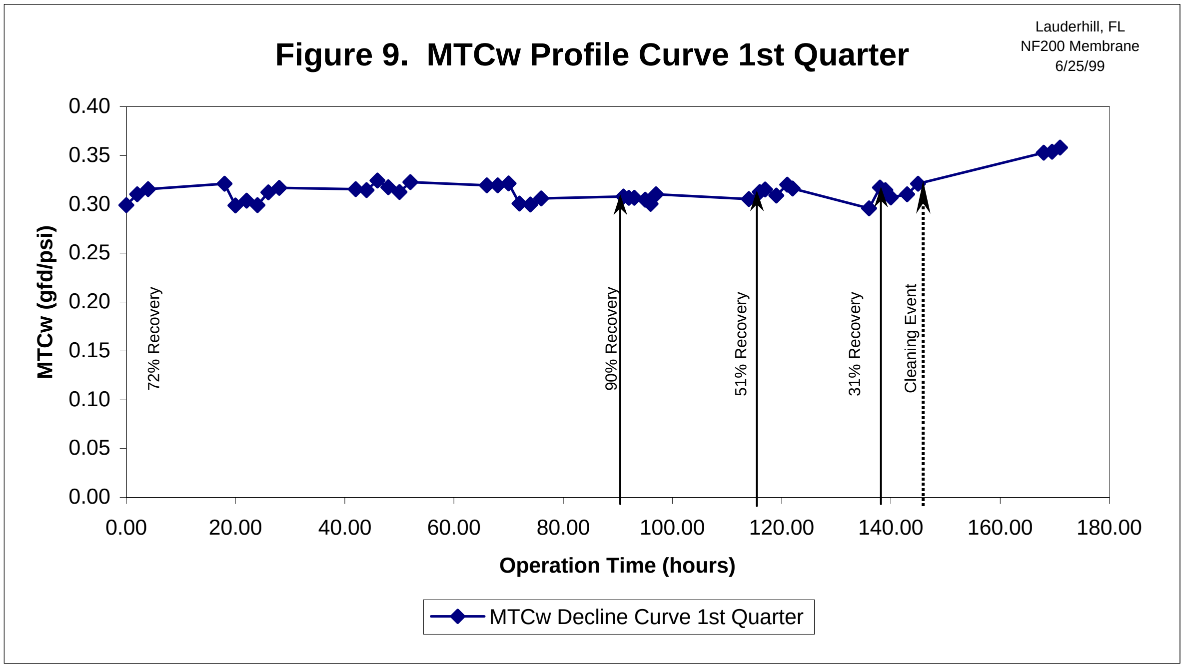


Figure 9. MTCw Profile Curve 1st Quarter
Lauderhill, FL
NF200 Membrane
6/25/99
MTCw (gfd/psi)
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
Operation Time (hours)
72% Recovery
90% Recovery
51% Recovery
31% Recovery
Cleaning Event
MTCw Decline Curve 1st Quarter

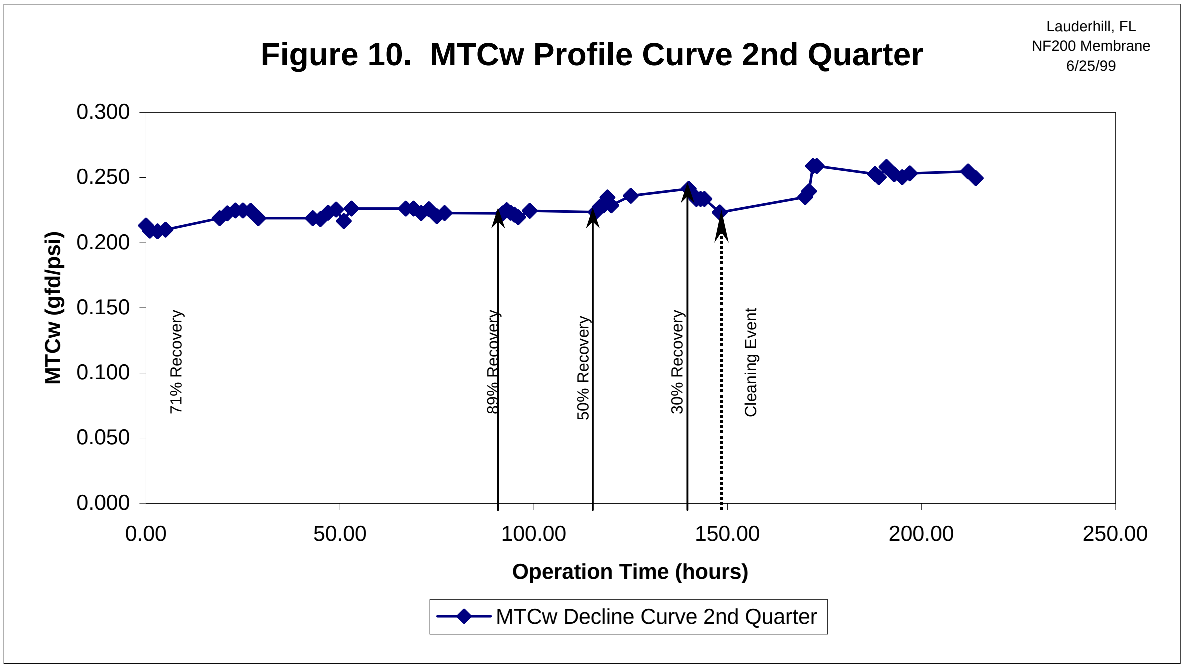


Figure 10. MTCw Profile Curve 2nd Quarter
Lauderhill, FL
NF200 Membrane
6/25/99
MTCw (gfd/psi)
0.300
0.250
0.200
0.150
0.100
0.050
0.000
0.00
50.00
100.00
150.00
200.00
250.00
Operation Time (hours)
71% Recovery
89% Recovery
50% Recovery
30% Recovery
Cleaning Event
MTCw Decline Curve 2nd Quarter

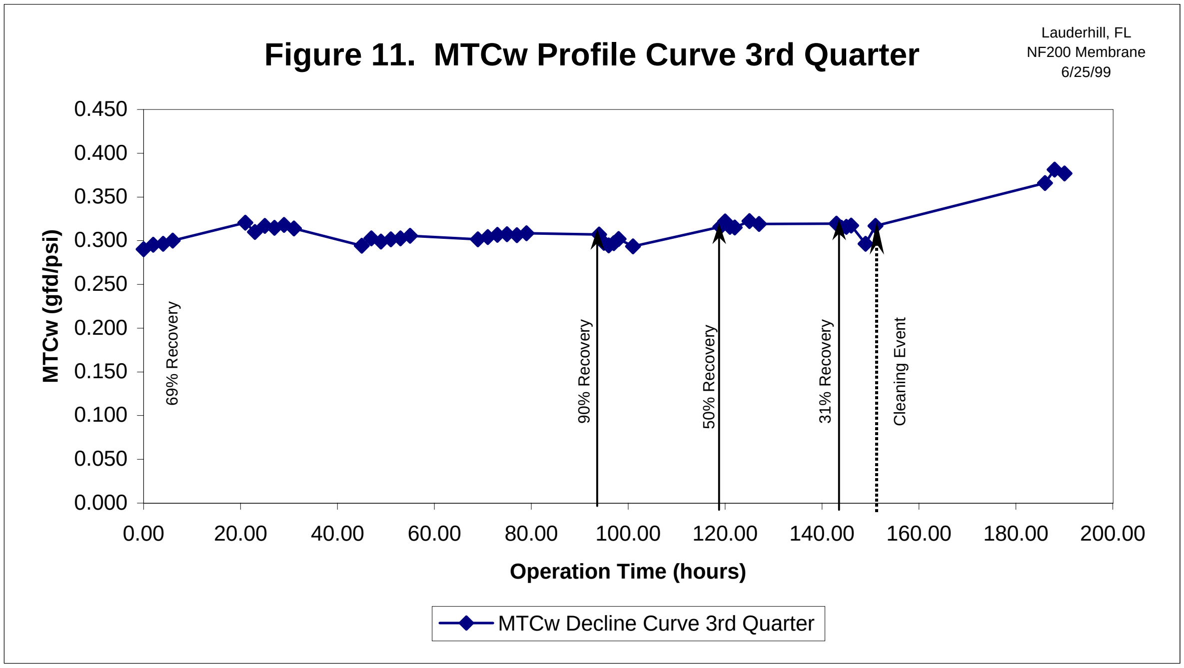


Figure 11. MTCw Profile Curve 3rd Quarter
Lauderhill, FL
NF200 Membrane
6/25/99
MTCw (gfd/psi)
0.450
0.400
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
69% Recovery
90% Recovery
50% Recovery
31% Recovery
Cleaning Event
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
Operation Time (hours)
MTCw Decline Curve 3rd Quarter

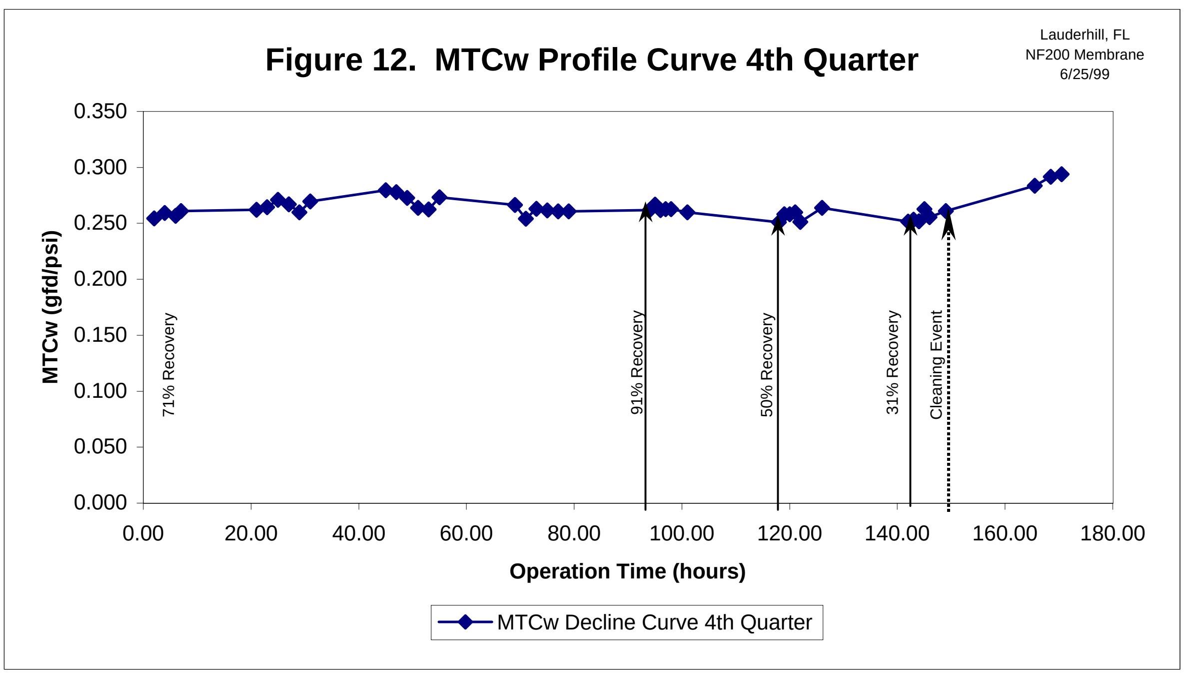


Figure 12. MTCw Profile Curve 4th Quarter
Lauderhill, FL
NF200 Membrane
6/25/99
MTCw (gfd/psi)
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
71% Recovery
91% Recovery
50% Recovery
31% Recovery
Cleaning Event
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
Operation Time (hours)
MTCw Decline Curve 4th Quarter

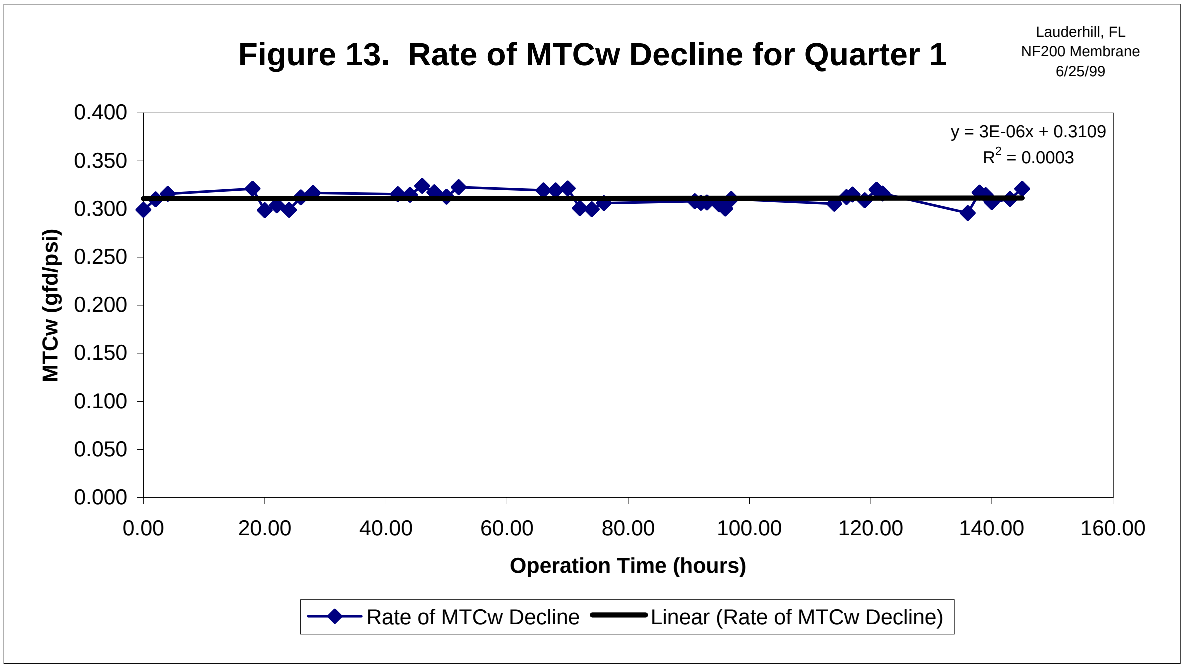


Figure 13. Rate of MTCw Decline for Quarter 1
Lauderhill, FL
NF200 Membrane
6/25/99
y = 3E-06x + 0.3109
R^2 = 0.0003
MTCw (gfd/psi)
0.400
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
Operation Time (hours)
Rate of MTCw Decline
Linear (Rate of MTCw Decline)

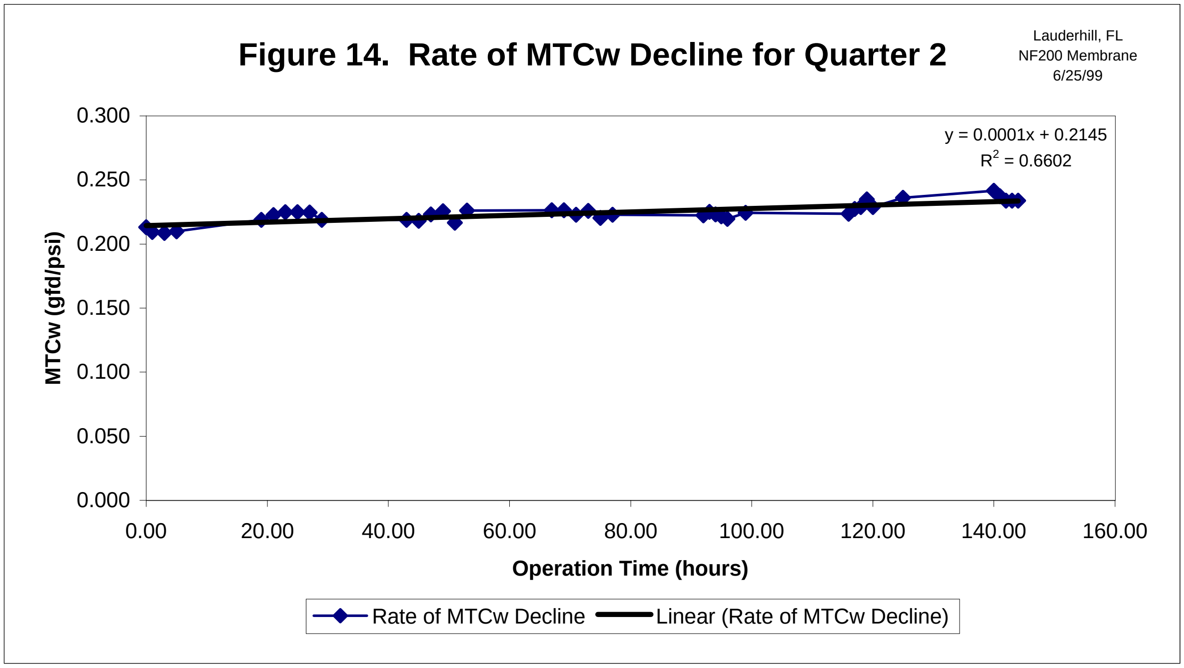
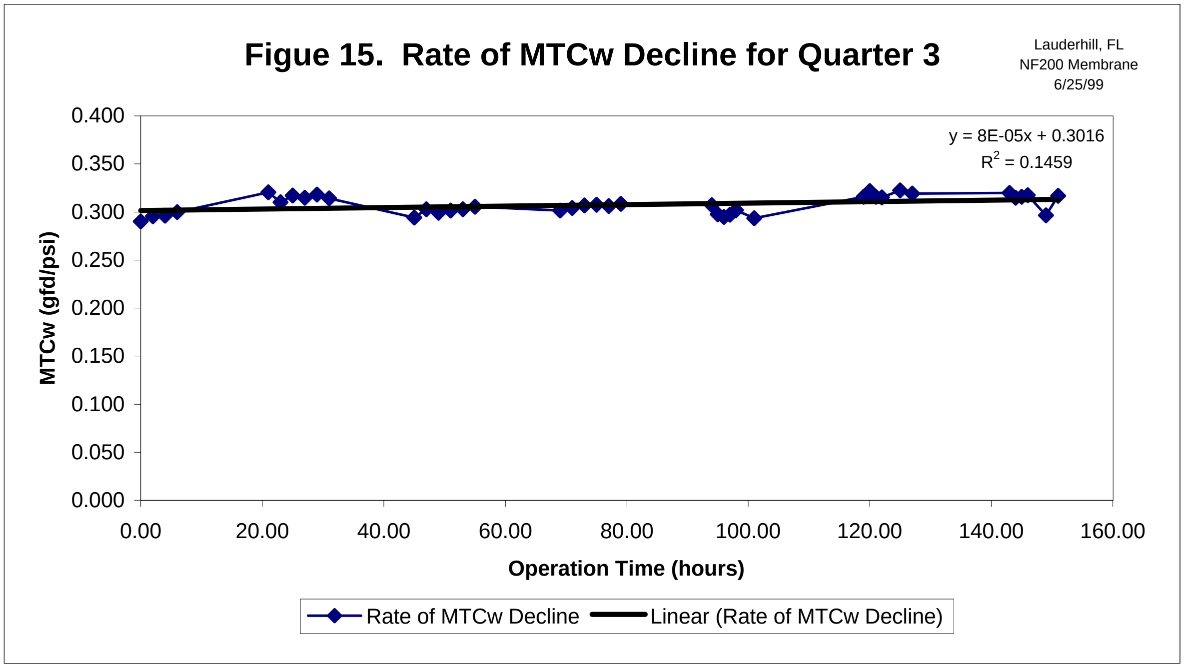


Figure 14. Rate of MTCw Decline for Quarter 2
Lauderhill, FL
NF200 Membrane
6/25/99
y = 0.0001x + 0.2145
R^2 = 0.6602
MTCw (gfd/psi)
0.300
0.250
0.200
0.150
0.100
0.050
0.000
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
Operation Time (hours)
Rate of MTCw Decline
Linear (Rate of MTCw Decline)



Figue 15. Rate of MTCw Decline for Quarter 3
Lauderhill, FL
NF200 Membrane
6/25/99
y = 8E-05x + 0.3016
R^2 = 0.1459
MTCw (gfd/psi)
0.400
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
Operation Time (hours)
Rate of MTCw Decline
Linear (Rate of MTCw Decline)

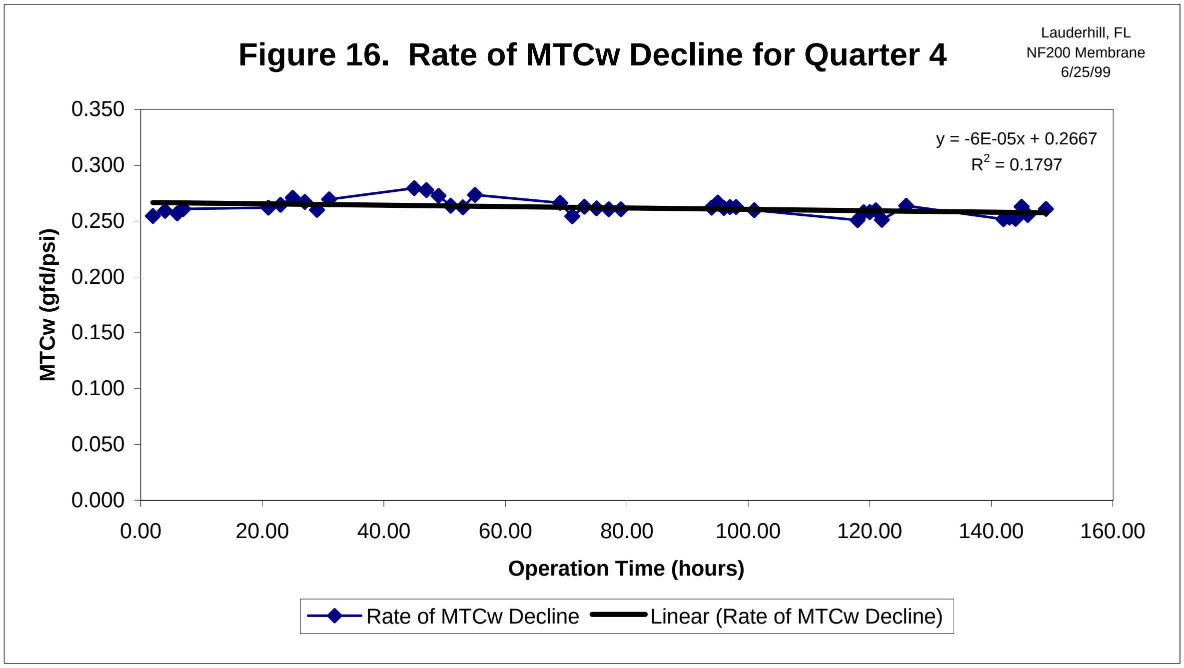


Figure 16. Rate of MTCw Decline for Quarter 4
Lauderhill, FL
NF200 Membrane
6/25/99
y = -6E-05x + 0.2667
R^2 = 0.1797
MTCw (gfd/psi)
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
Operation Time (hours)
Rate of MTCw Decline
Linear (Rate of MTCw Decline)

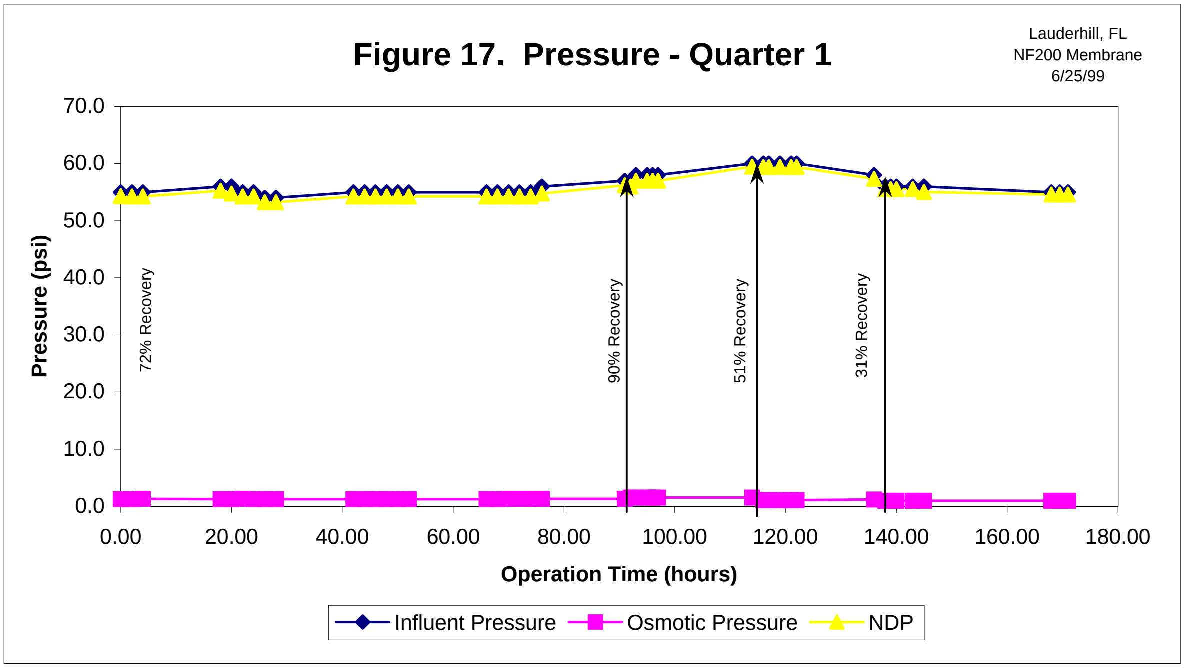


Figure 17. Pressure - Quarter 1
Lauderhill, FL
NF200 Membrane
6/25/99
Pressure (psi)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
72% Recovery
90% Recovery
51% Recovery
31% Recovery
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
Operation Time (hours)
Influent Pressure
Osmotic Pressure
NDP

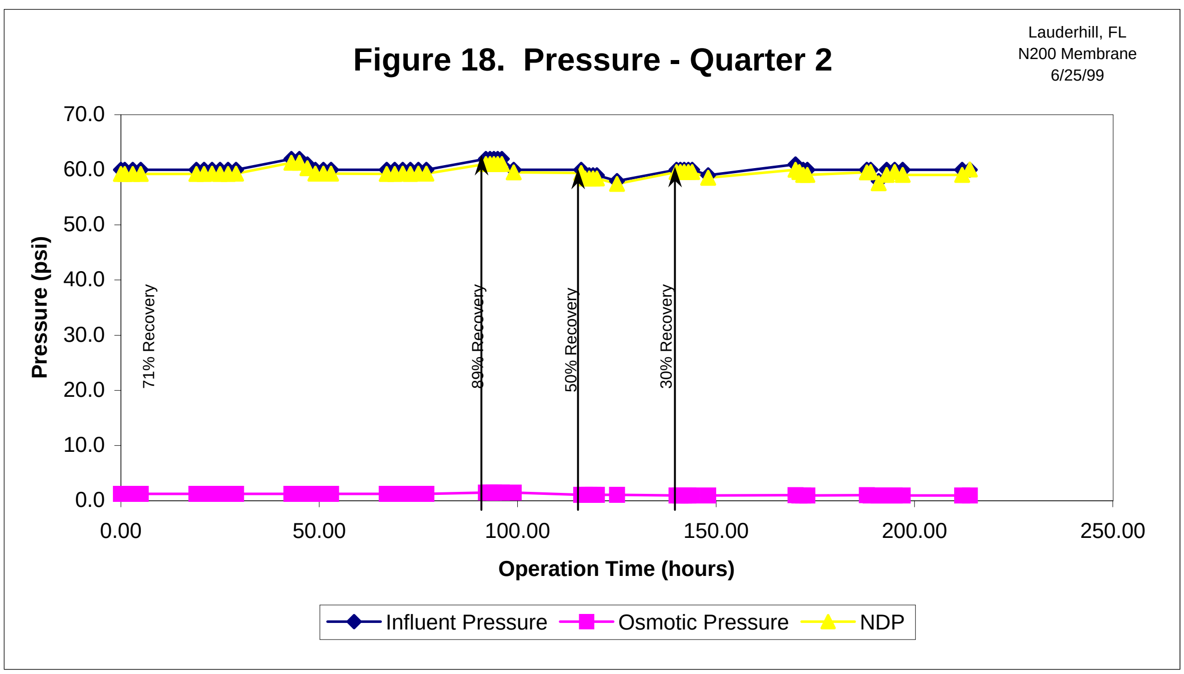


Figure 18. Pressure - Quarter 2
Lauderhill, FL
N200 Membrane
6/25/99
Pressure (psi)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
71% Recovery
89% Recovery
50% Recovery
30% Recovery
0.00
50.00
100.00
150.00
200.00
250.00
Operation Time (hours)
Influent Pressure
Osmotic Pressure
NDP

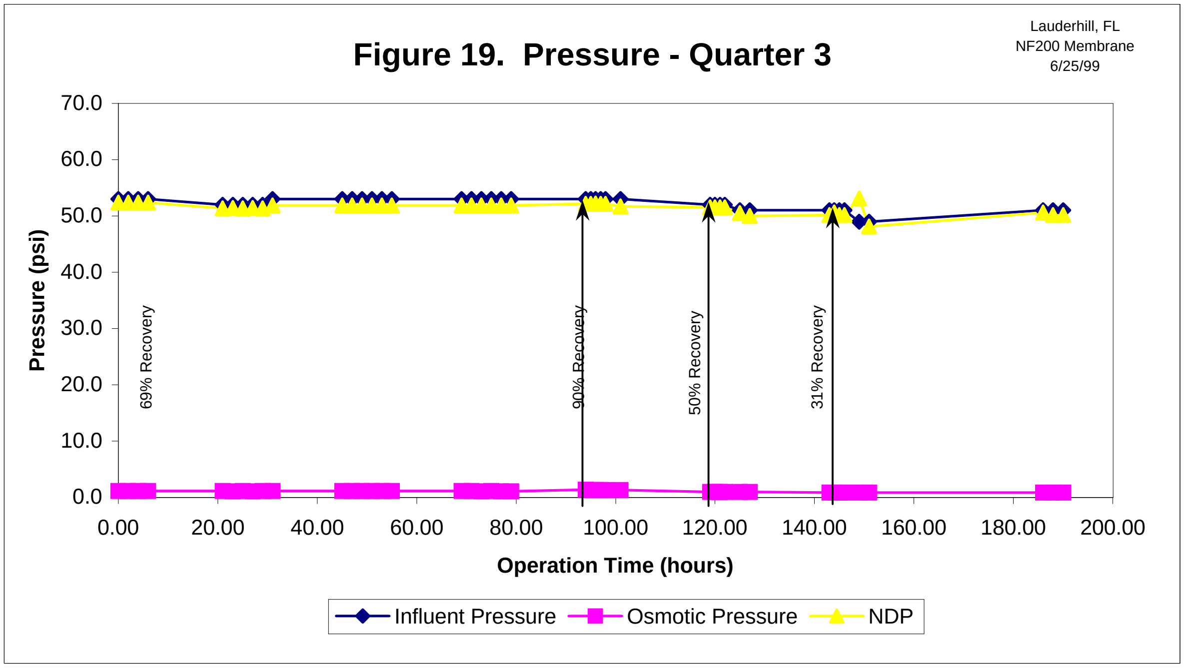


Figure 19. Pressure - Quarter 3
Lauderhill, FL
NF200 Membrane
6/25/99
Pressure (psi)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
69% Recovery
90% Recovery
50% Recovery
31% Recovery
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
Operation Time (hours)
Influent Pressure
Osmotic Pressure
NDP

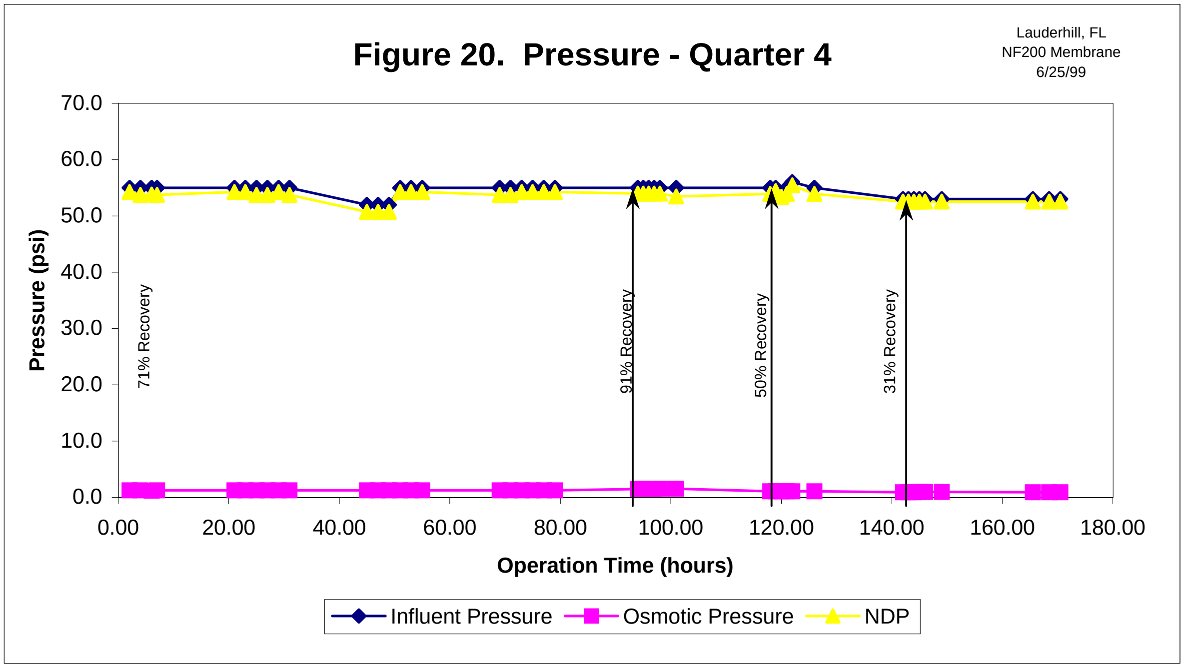


Figure 20. Pressure - Quarter 4
Lauderhill, FL
NF200 Membrane
6/25/99
Pressure (psi)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
71% Recovery
91% Recovery
50% Recovery
31% Recovery
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
Operation Time (hours)
Influent Pressure
Osmotic Pressure
NDP

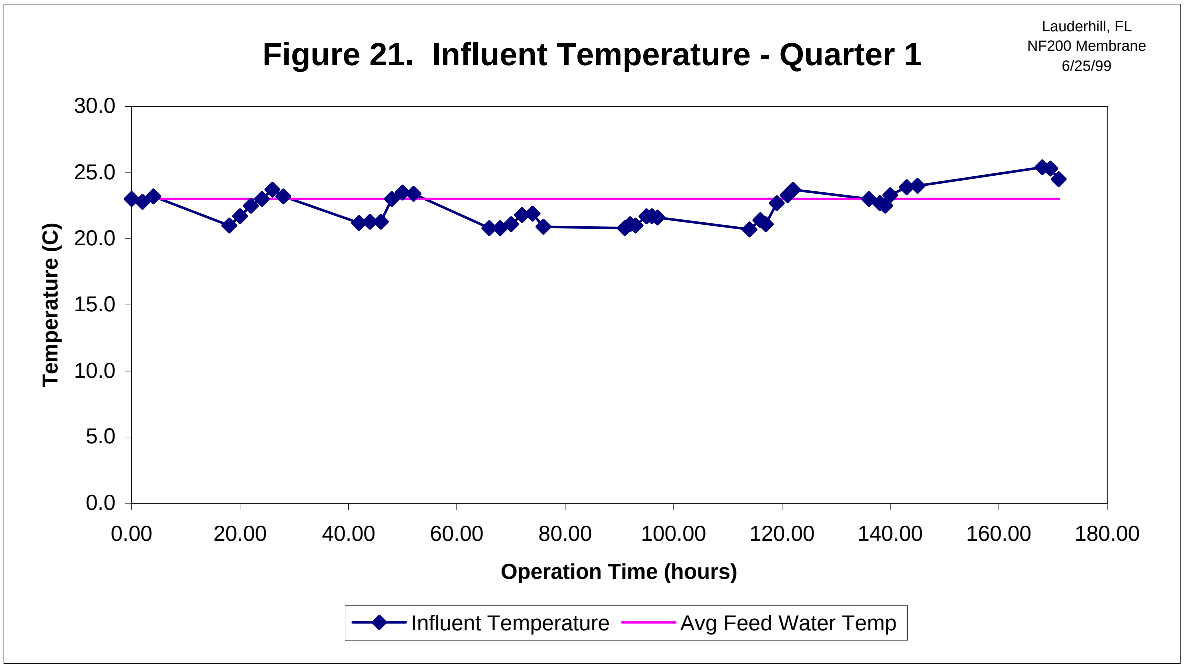


Figure 21. Influent Temperature - Quarter 1
Lauderhill, FL
NF200 Membrane
6/25/99
Temperature (C)
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
Operation Time (hours)
Influent Temperature
Avg Feed Water Temp

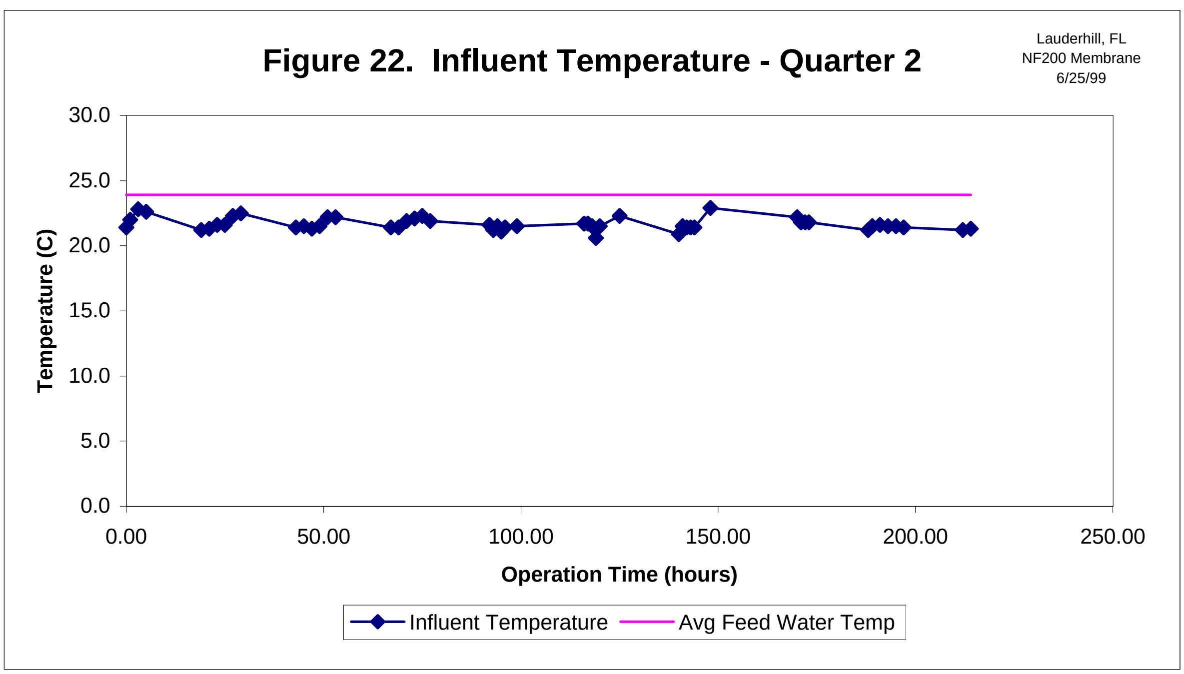
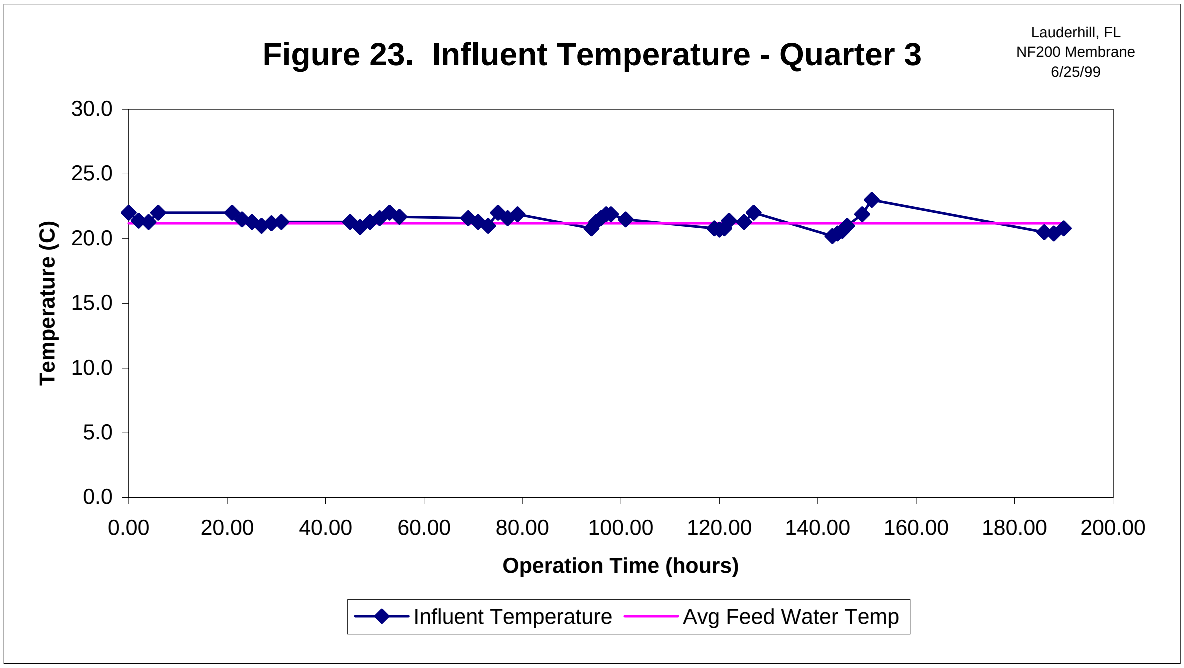
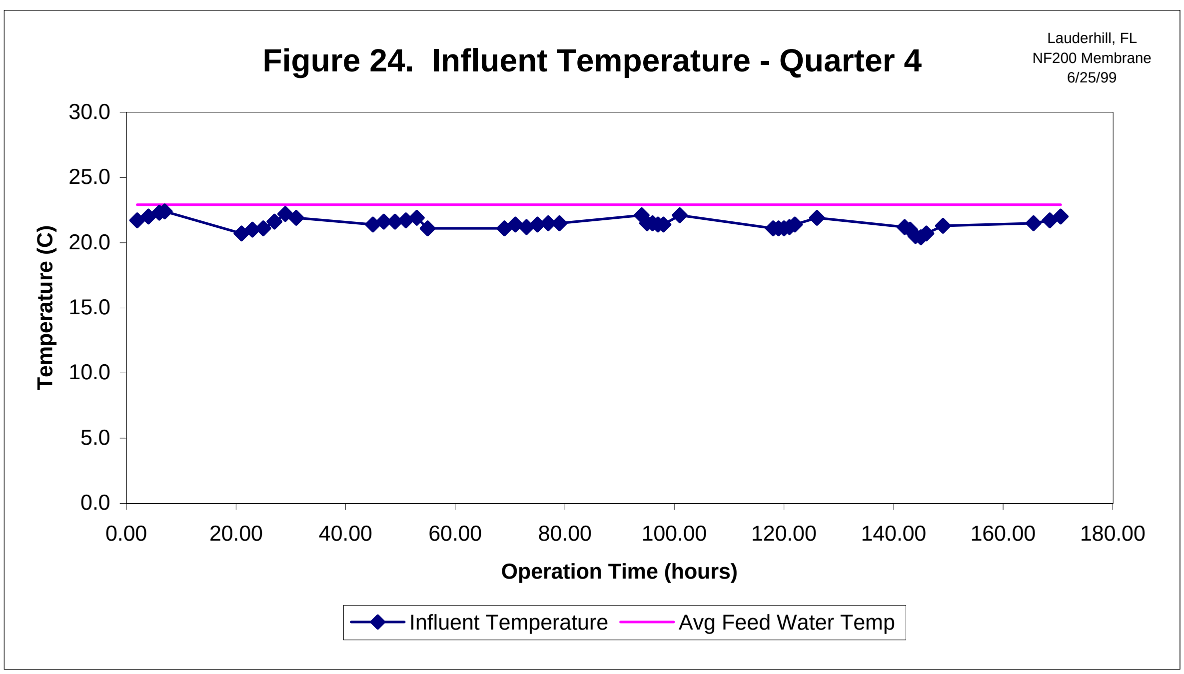


Figure 22. Influent Temperature - Quarter 2
Lauderhill, FL
NF200 Membrane
6/25/99
Temperature (C)
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0.00
50.00
100.00
150.00
200.00
250.00
Operation Time (hours)
Influent Temperature
Avg Feed Water Temp


Lauderhill, FL
NF200 Membrane
6/25/99
Figure 23. Influent Temperature - Quarter 3
Temperature (C)
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
Operation Time (hours)
Influent Temperature
Avg Feed Water Temp


Lauderhill, FL
NF200 Membrane
6/25/99
Figure 24. Influent Temperature - Quarter 4
Temperature (C)
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
Operation Time (hours)
Influent Temperature
Avg Feed Water Temp

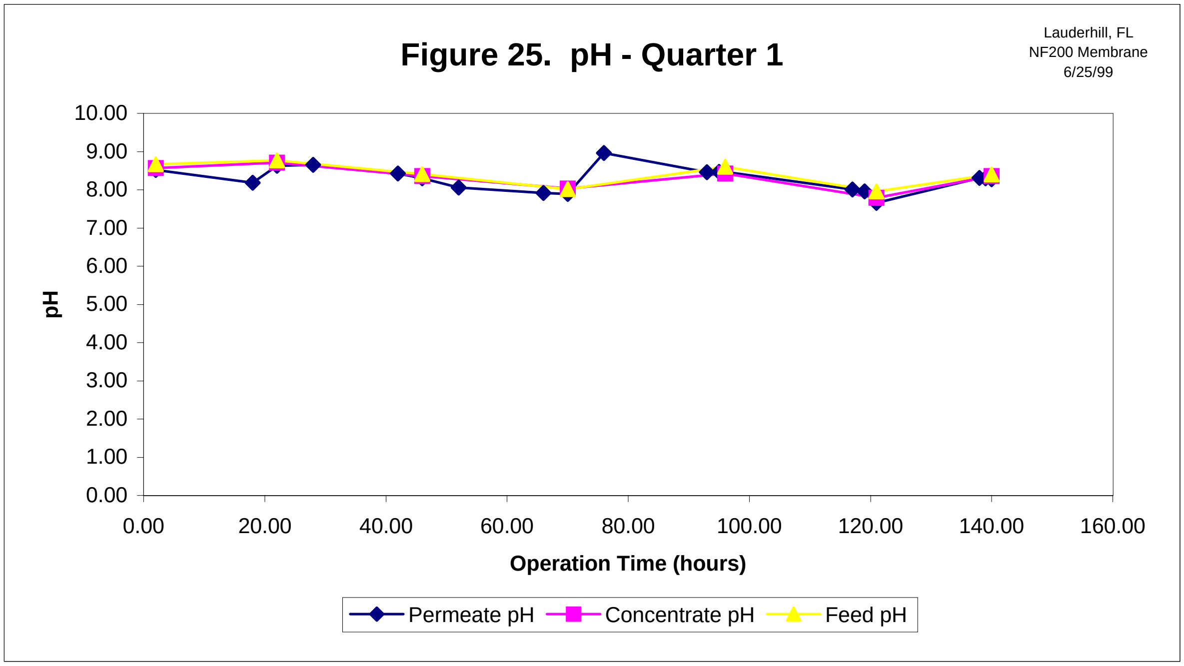


Figure 25. pH - Quarter 1
Lauderhill, FL
NF200 Membrane
6/25/99
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
pH
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
Operation Time (hours)
Permeate pH
Concentrate pH
Feed pH

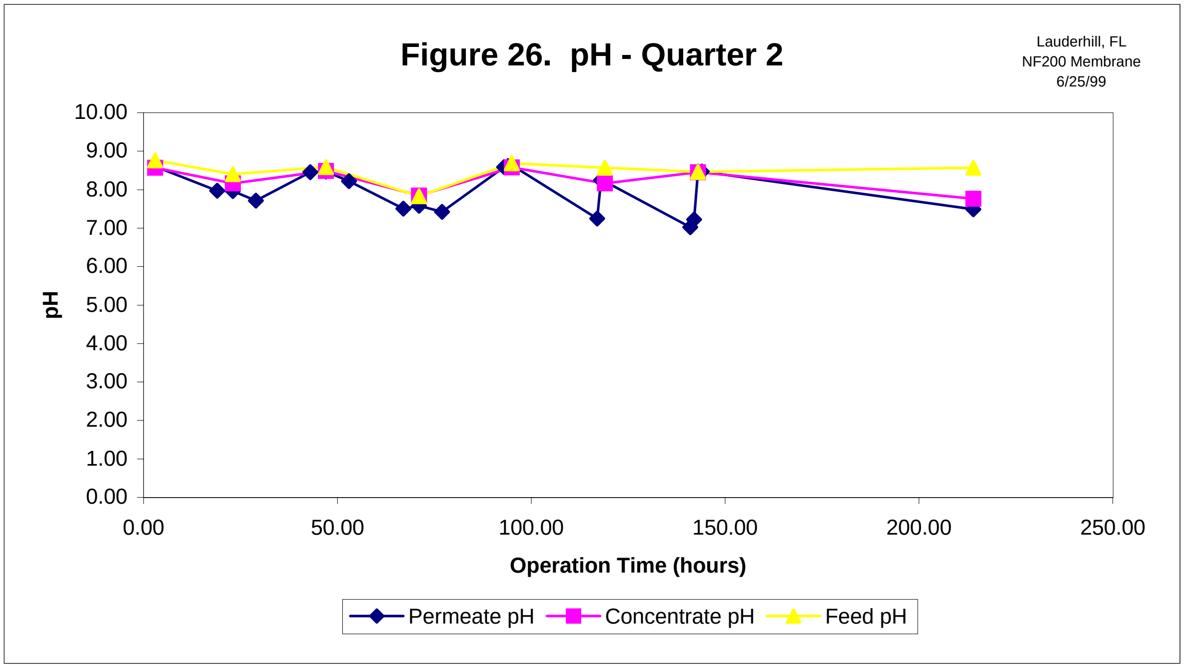


Figure 26. pH - Quarter 2
Lauderhill, FL
NF200 Membrane
6/25/99
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
pH
0.00
50.00
100.00
150.00
200.00
250.00
Operation Time (hours)
Permeate pH
Concentrate pH
Feed pH

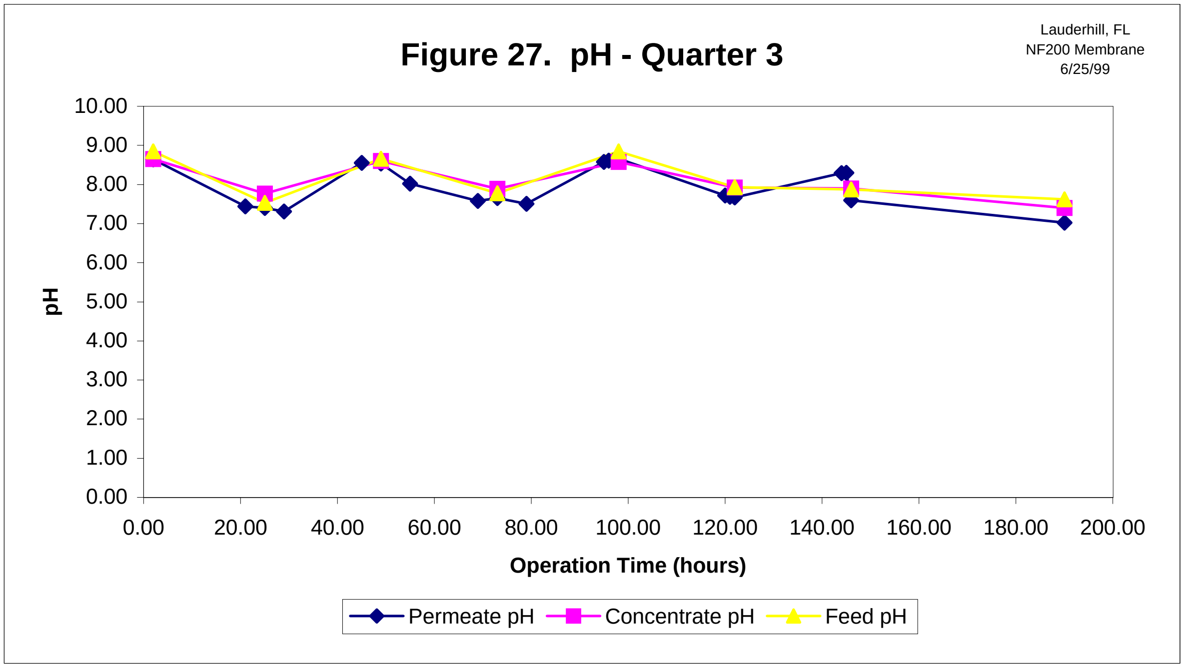


Figure 27. pH - Quarter 3
Lauderhill, FL
NF200 Membrane
6/25/99
pH
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
Operation Time (hours)
Permeate pH
Concentrate pH
Feed pH

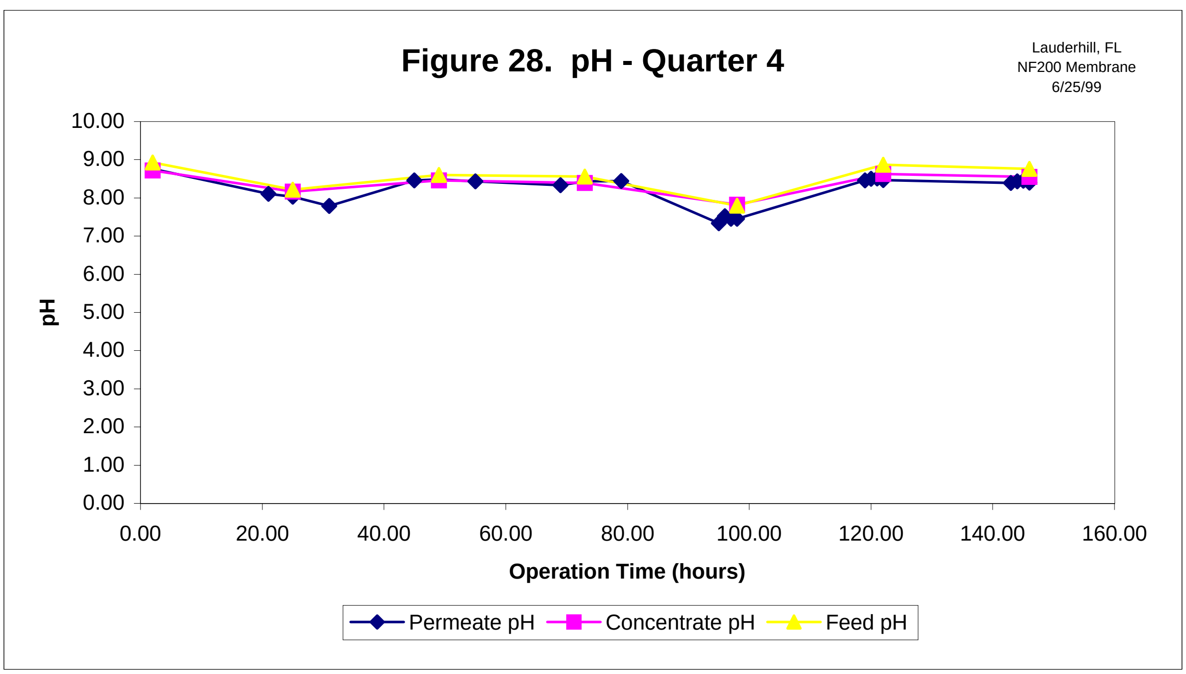


Figure 28. pH - Quarter 4
Lauderhill, FL
NF200 Membrane
6/25/99
pH
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
Operation Time (hours)
Permeate pH
Concentrate pH
Feed pH

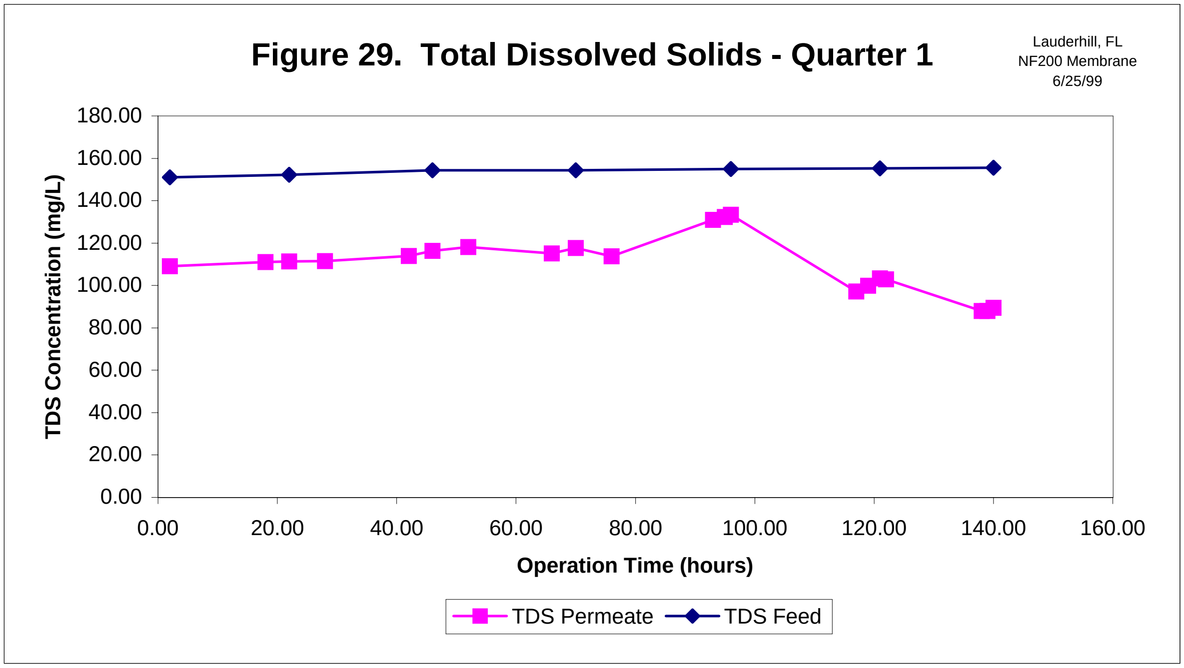


Figure 29. Total Dissolved Solids - Quarter 1
Lauderhill, FL
NF200 Membrane
6/25/99
TDS Concentration (mg/L)
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
Operation Time (hours)
TDS Permeate
TDS Feed

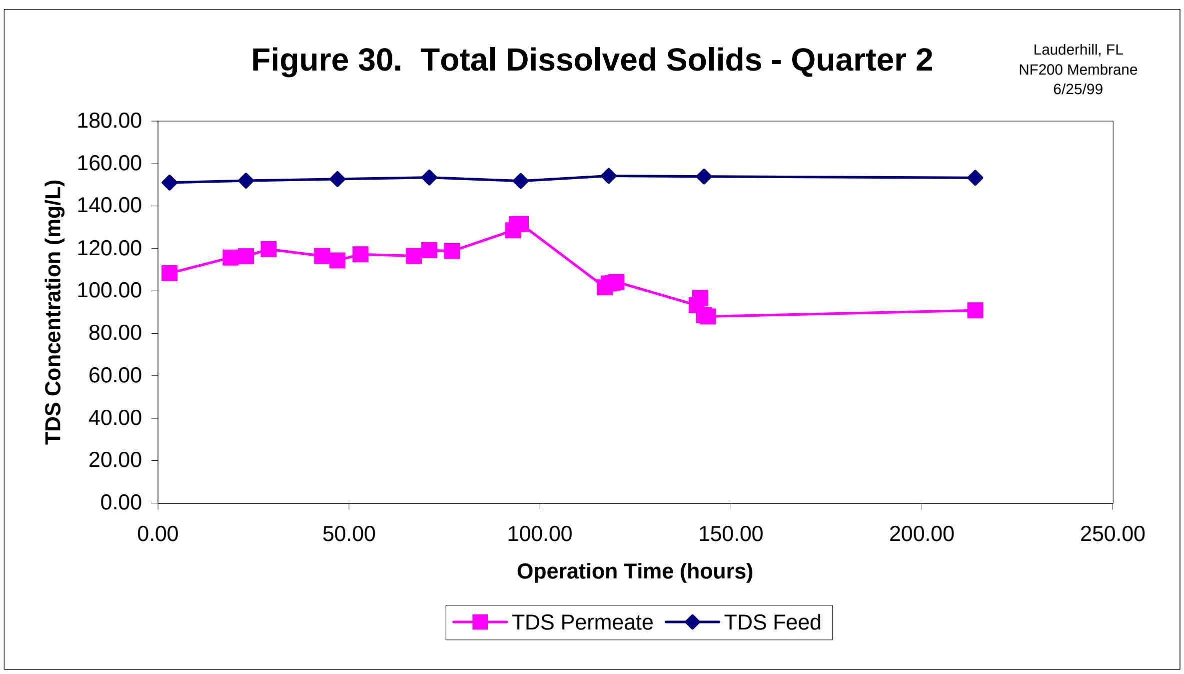


Figure 30. Total Dissolved Solids - Quarter 2
Lauderhill, FL
NF200 Membrane
6/25/99
TDS Concentration (mg/L)
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
0.00
50.00
100.00
150.00
200.00
250.00
Operation Time (hours)
TDS Permeate
TDS Feed

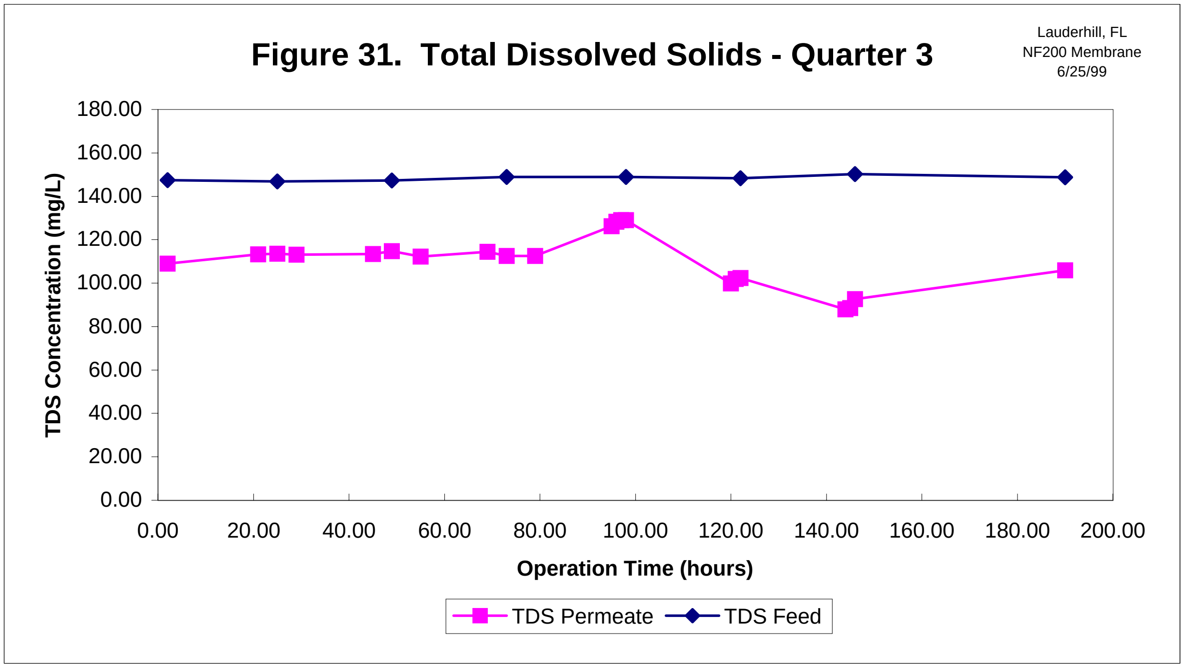


Figure 31. Total Dissolved Solids - Quarter 3
Lauderhill, FL
NF200 Membrane
6/25/99
TDS Concentration (mg/L)
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
Operation Time (hours)
TDS Permeate
TDS Feed

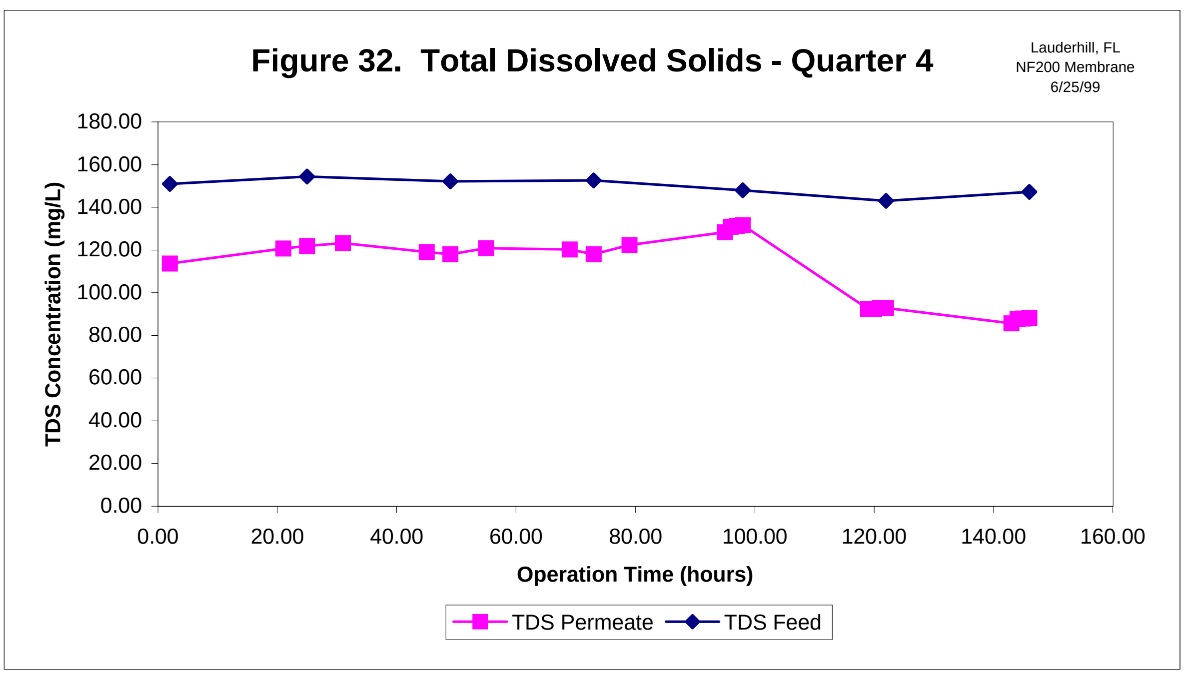


Figure 32. Total Dissolved Solids - Quarter 4
Lauderhill, FL
NF200 Membrane
6/25/99
TDS Concentration (mg/L)
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
Operation Time (hours)
TDS Permeate
TDS Feed

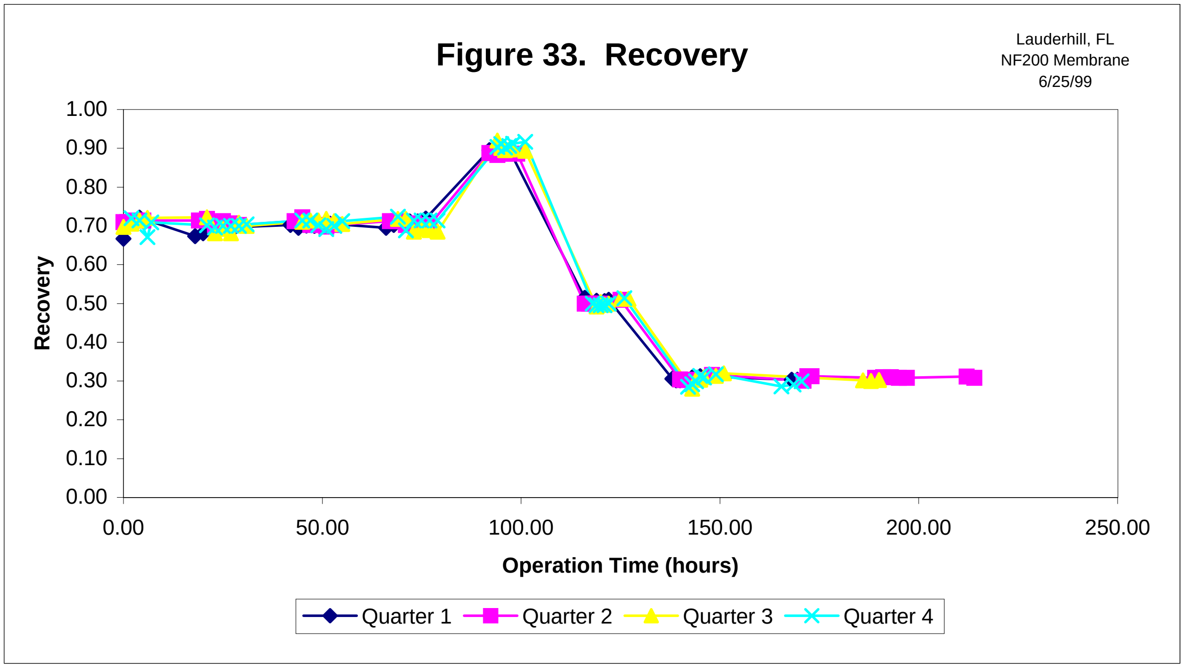


Figure 33. Recovery
Lauderhill, FL
NF200 Membrane
6/25/99
Recovery
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.00
50.00
100.00
150.00
200.00
250.00
Operation Time (hours)
Quarter 1
Quarter 2
Quarter 3
Quarter 4

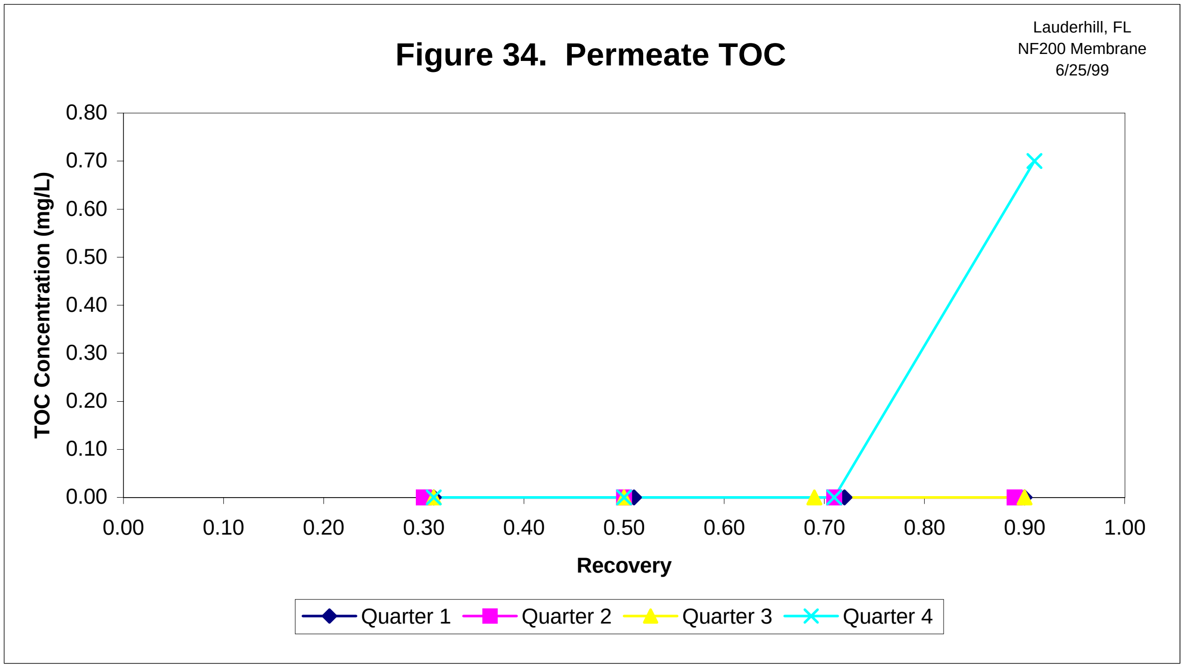


Figure 34. Permeate TOC
Lauderhill, FL
NF200 Membrane
6/25/99
TOC Concentration (mg/L)
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Recovery
Quarter 1
Quarter 2
Quarter 3
Quarter 4

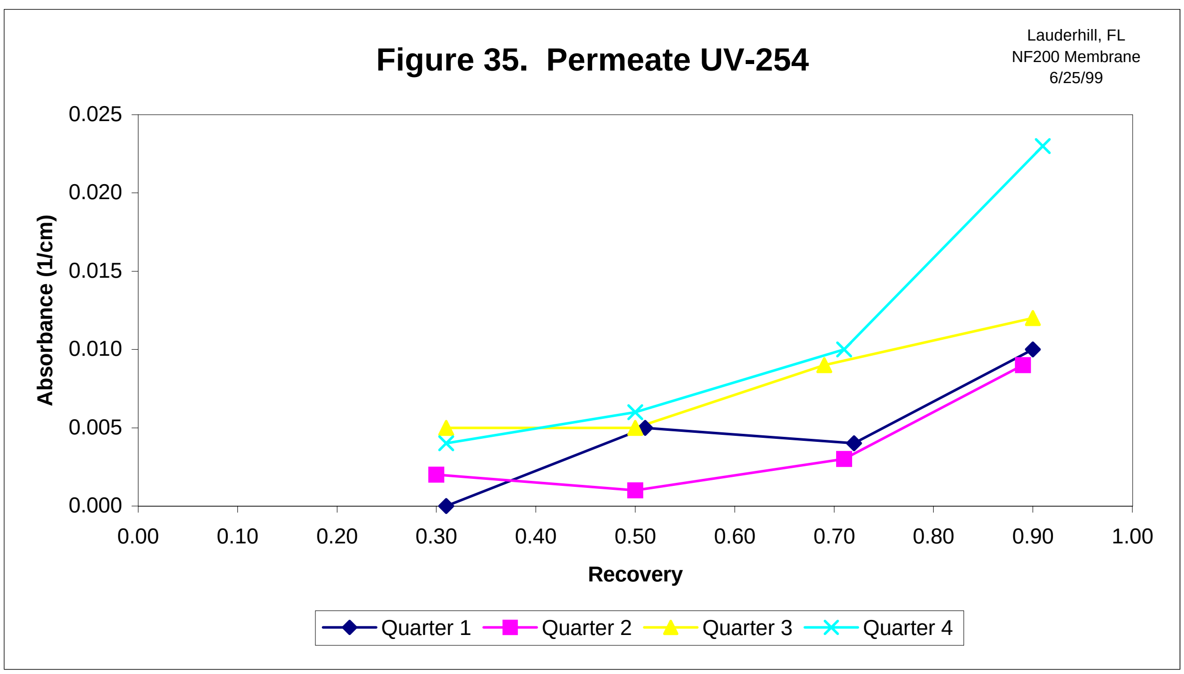


Figure 35. Permeate UV-254
Lauderhill, FL
NF200 Membrane
6/25/99
Absorbance (1/cm)
0.025
0.020
0.015
0.010
0.005
0.000
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Recovery
Quarter 1
Quarter 2
Quarter 3
Quarter 4

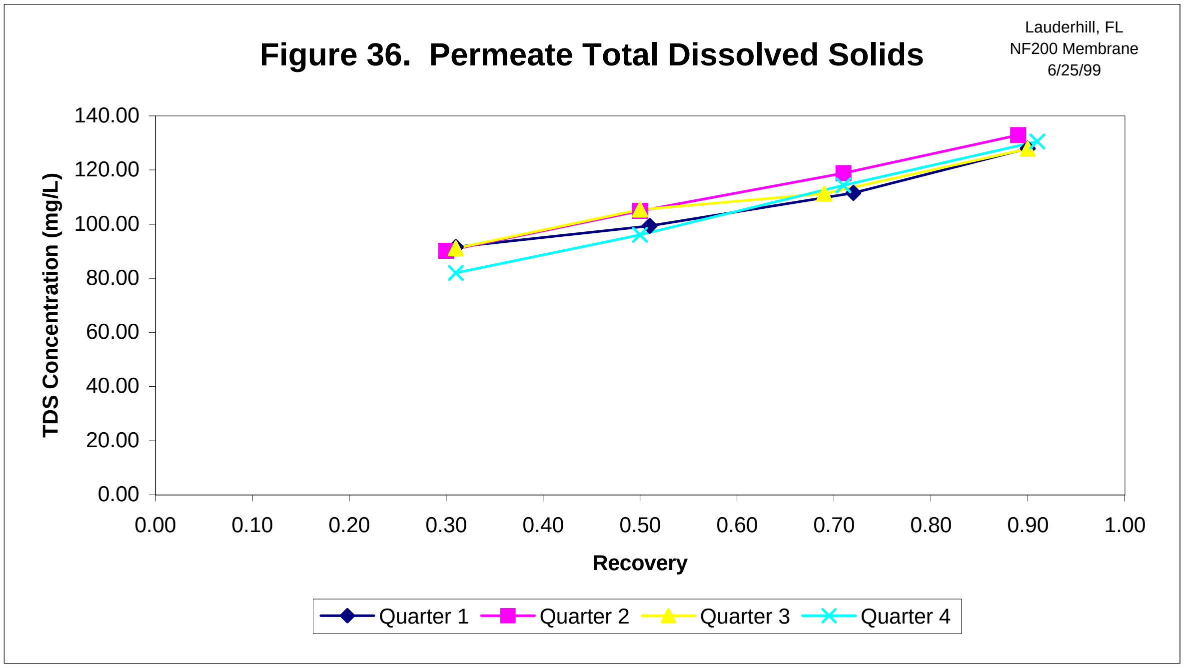


Figure 36. Permeate Total Dissolved Solids
Lauderhill, FL
NF200 Membrane
6/25/99
TDS Concentration (mg/L)
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Recovery
Quarter 1
Quarter 2
Quarter 3
Quarter 4

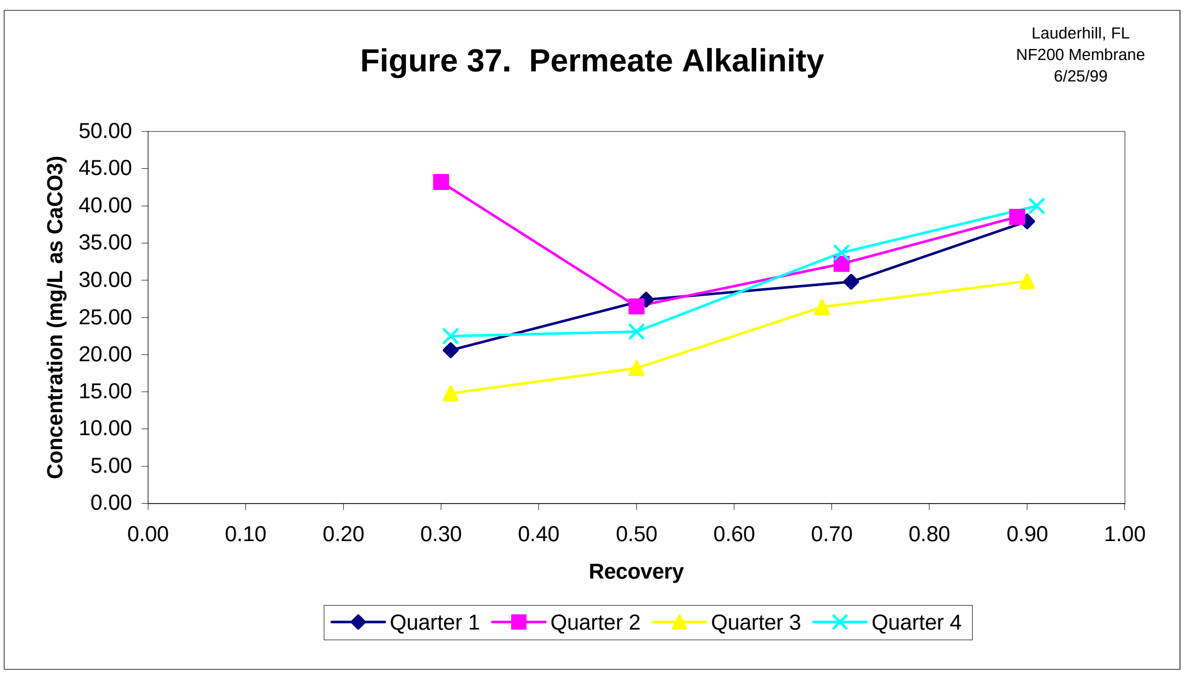


Figure 37. Permeate Alkalinity
Lauderhill, FL
NF200 Membrane
6/25/99
Concentration (mg/L as CaCO3)
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Recovery
Quarter 1
Quarter 2
Quarter 3
Quarter 4

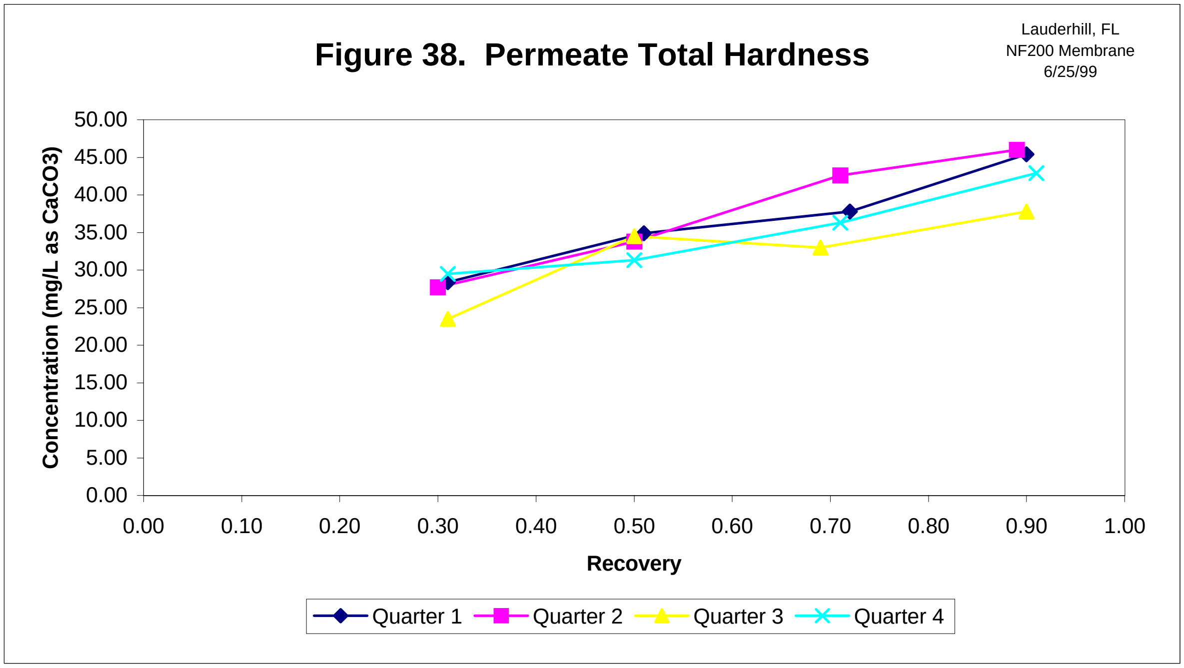


Figure 38. Permeate Total Hardness
Lauderhill, FL
NF200 Membrane
6/25/99
Concentration (mg/L as CaCO3)
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Recovery
Quarter 1
Quarter 2
Quarter 3
Quarter 4

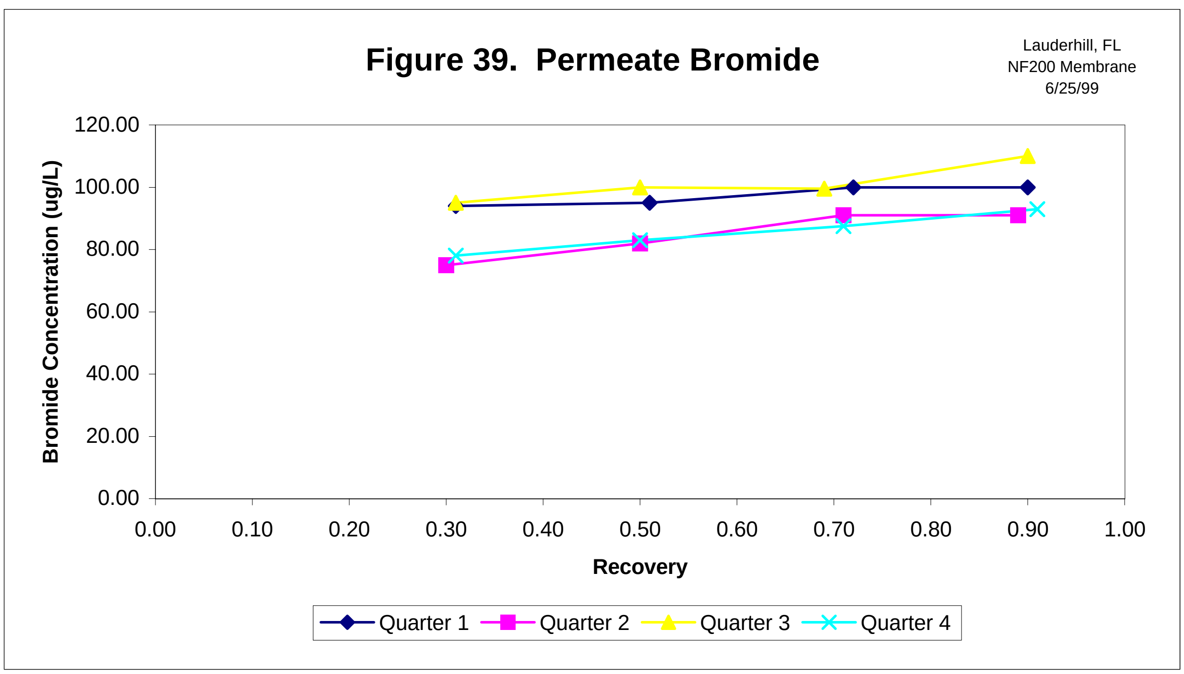


Figure 39. Permeate Bromide
Lauderhill, FL
NF200 Membrane
6/25/99
Bromide Concentration (ug/L)
120.00
100.00
80.00
60.00
40.00
20.00
0.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Recovery
Quarter 1
Quarter 2
Quarter 3
Quarter 4

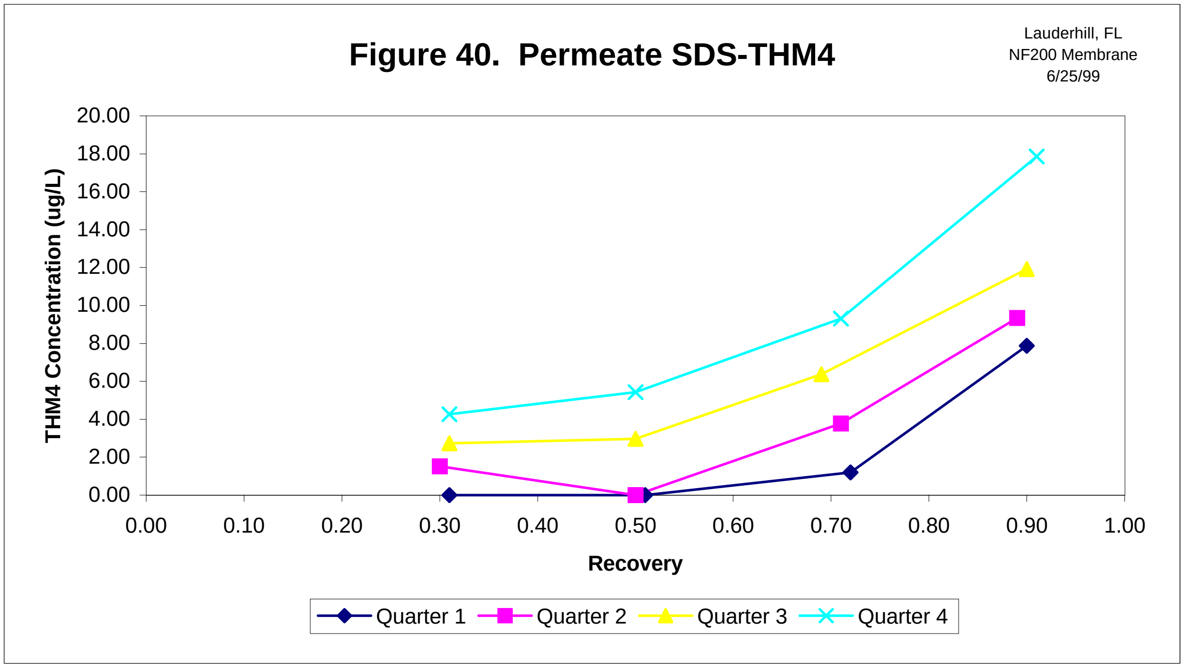


Figure 40. Permeate SDS-THM4
Lauderhill, FL
NF200 Membrane
6/25/99
THM4 Concentration (ug/L)
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Recovery
Quarter 1
Quarter 2
Quarter 3
Quarter 4

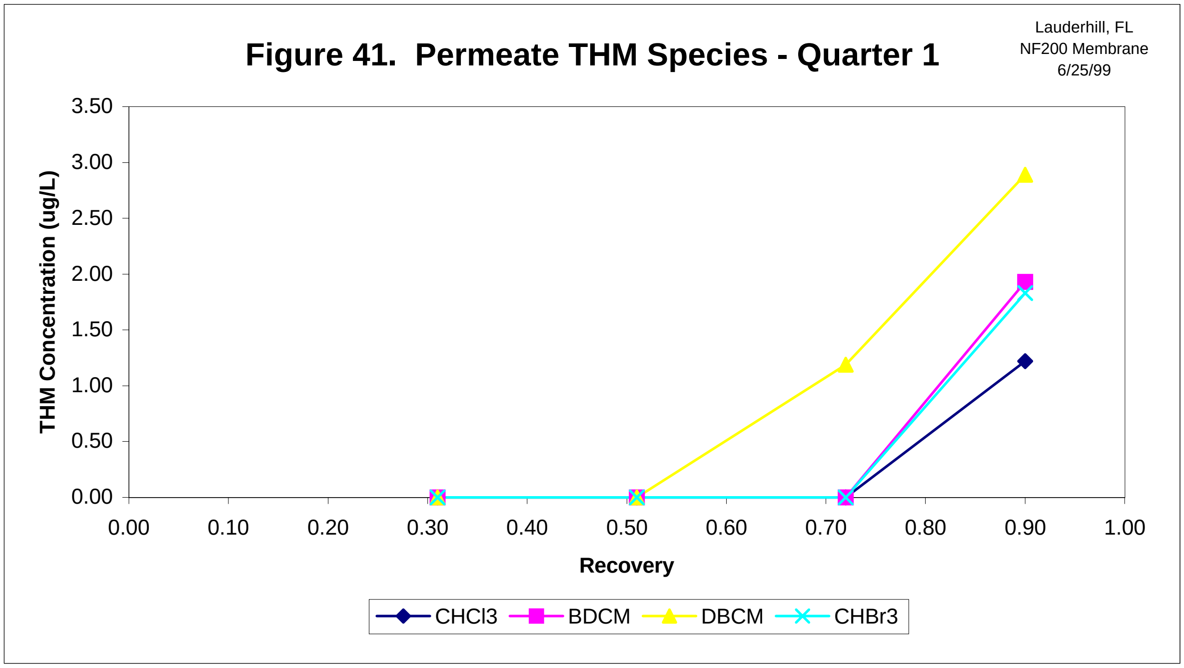


Figure 41. Permeate THM Species - Quarter 1
Lauderhill, FL
NF200 Membrane
6/25/99
THM Concentration (ug/L)
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Recovery
CHCl3
BDCM
DBCM
CHBr3

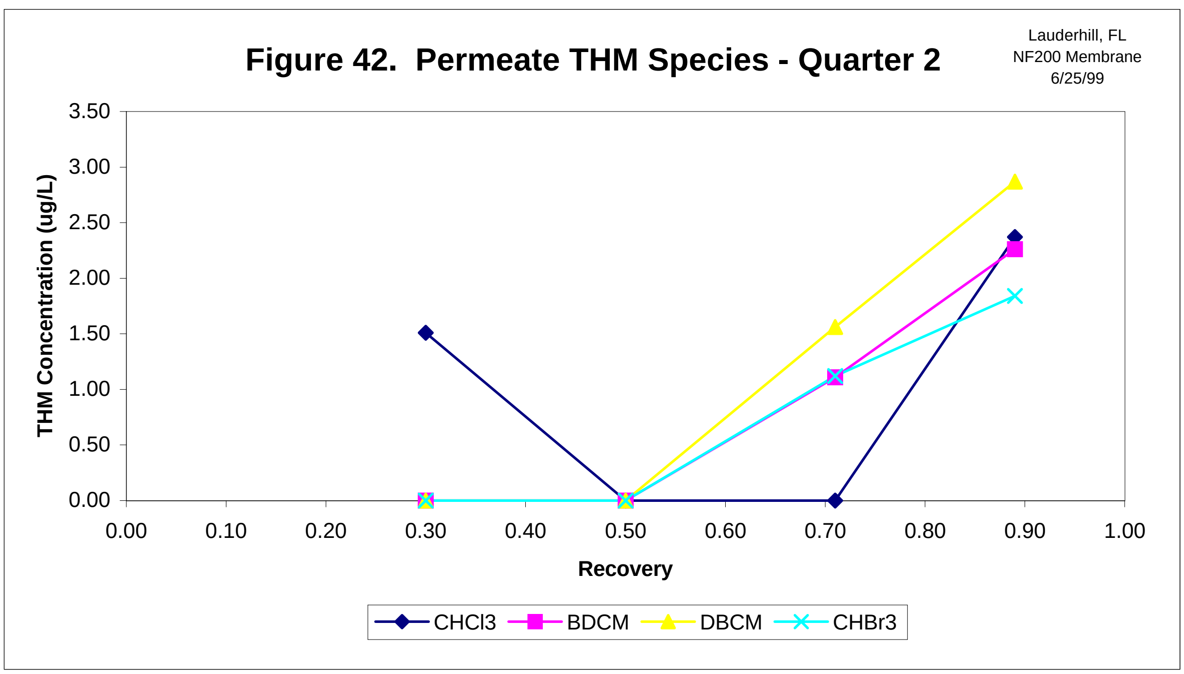


Figure 42. Permeate THM Species - Quarter 2
Lauderhill, FL
NF200 Membrane
6/25/99
THM Concentration (ug/L)
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Recovery
CHCl3
BDCM
DBCM
CHBr3

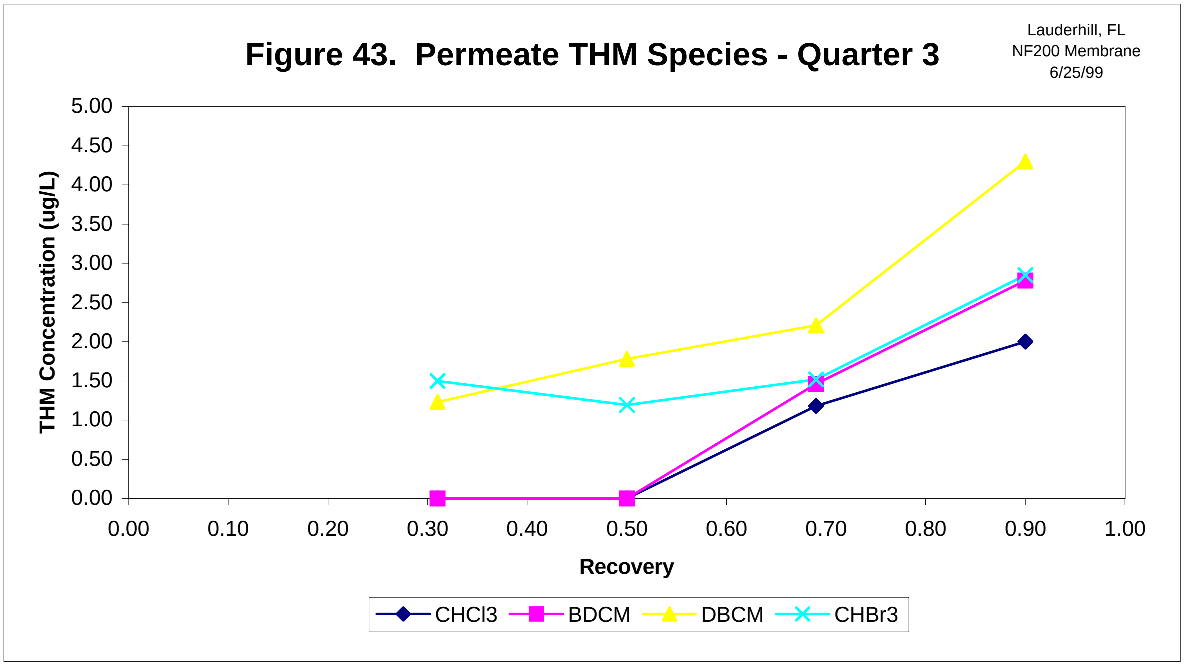


Figure 43. Permeate THM Species - Quarter 3
Lauderhill, FL
NF200 Membrane
6/25/99
THM Concentration (ug/L)
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Recovery
CHCl3
BDCM
DBCM
CHBr3

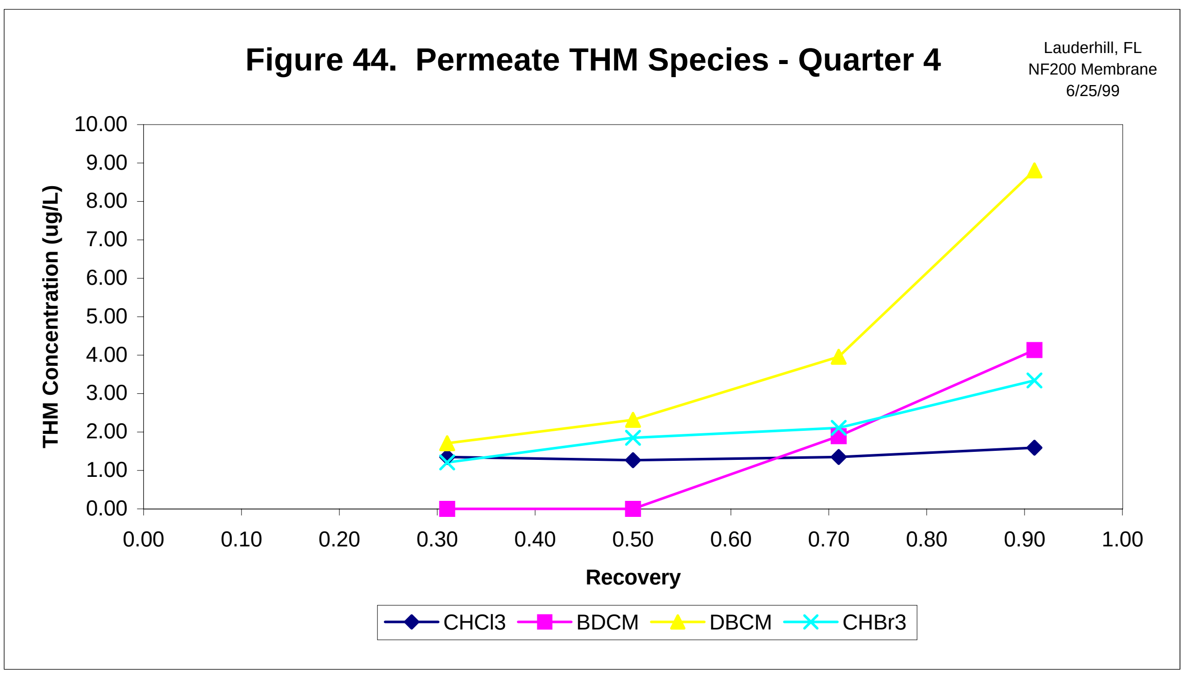


Figure 44. Permeate THM Species - Quarter 4
Lauderhill, FL
NF200 Membrane
6/25/99
THM Concentration (ug/L)
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Recovery
CHCl3
BDCM
DBCM
CHBr3

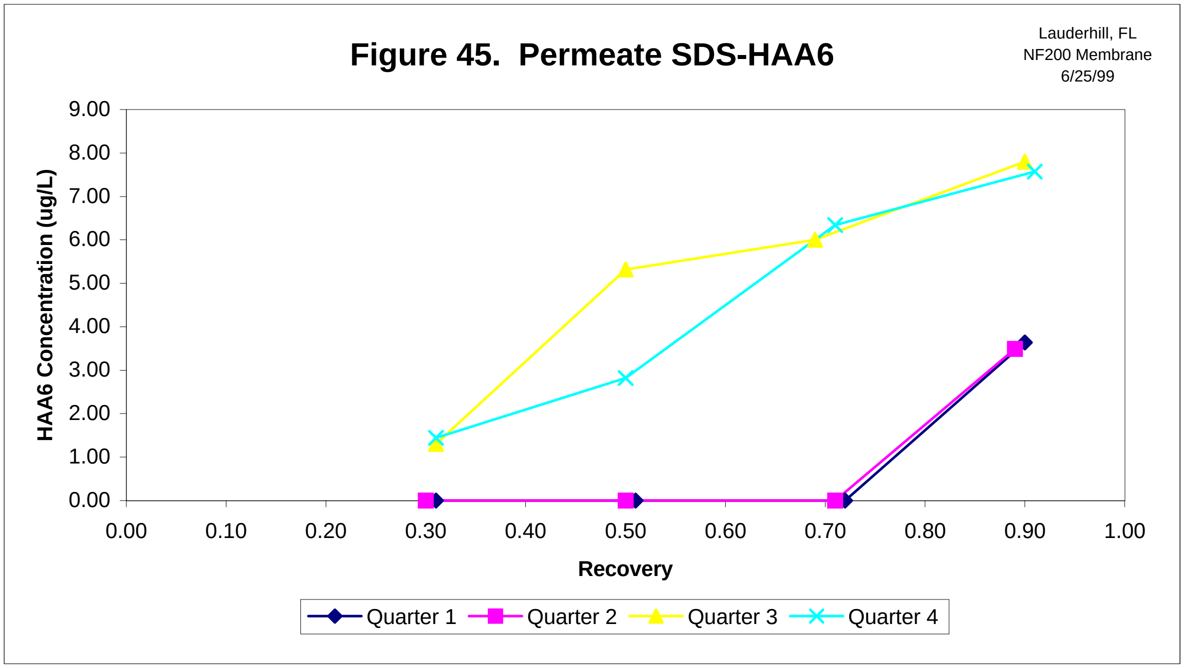
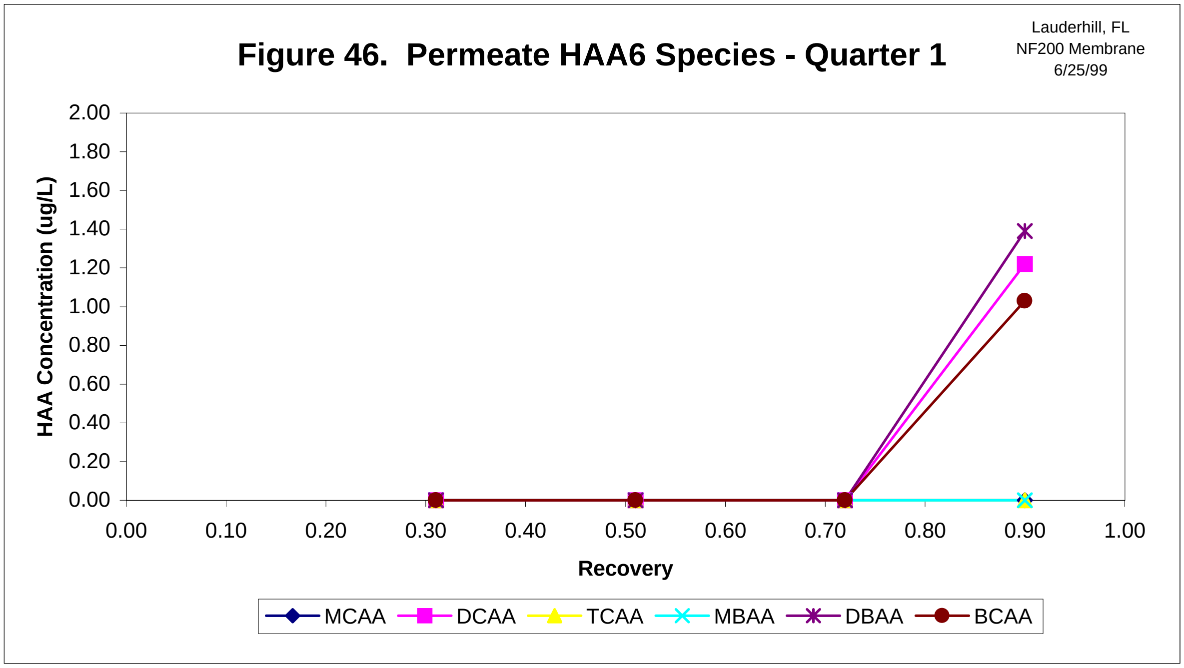
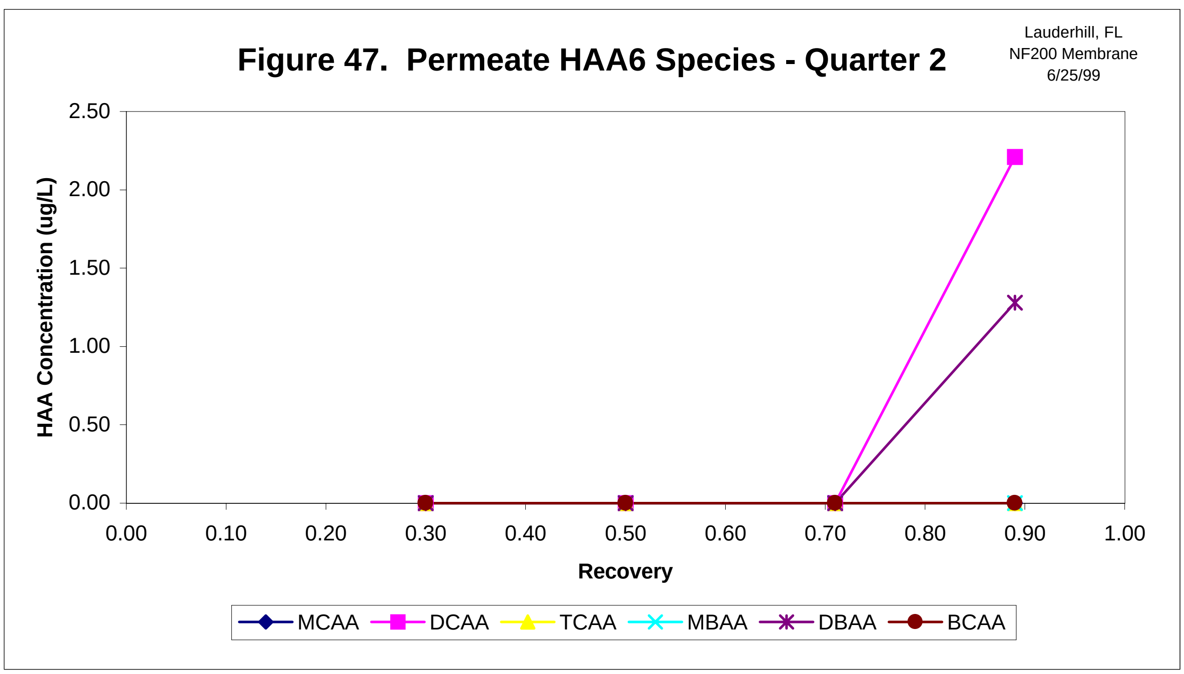


Figure 45. Permeate SDS-HAA6
Lauderhill, FL
NF200 Membrane
6/25/99
HAA6 Concentration (ug/L)
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Recovery
Quarter 1
Quarter 2
Quarter 3
Quarter 4


Lauderhill, FL
NF200 Membrane
6/25/99
Figure 46. Permeate HAA6 Species - Quarter 1
HAA Concentration (ug/L)
2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Recovery
MCAA
DCAA
TCAA
MBAA
DBAA
BCAA


Lauderhill, FL
NF200 Membrane
6/25/99
Figure 47. Permeate HAA6 Species - Quarter 2
HAA Concentration (ug/L)
2.50
2.00
1.50
1.00
0.50
0.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Recovery
MCAA
DCAA
TCAA
MBAA
DBAA
BCAA

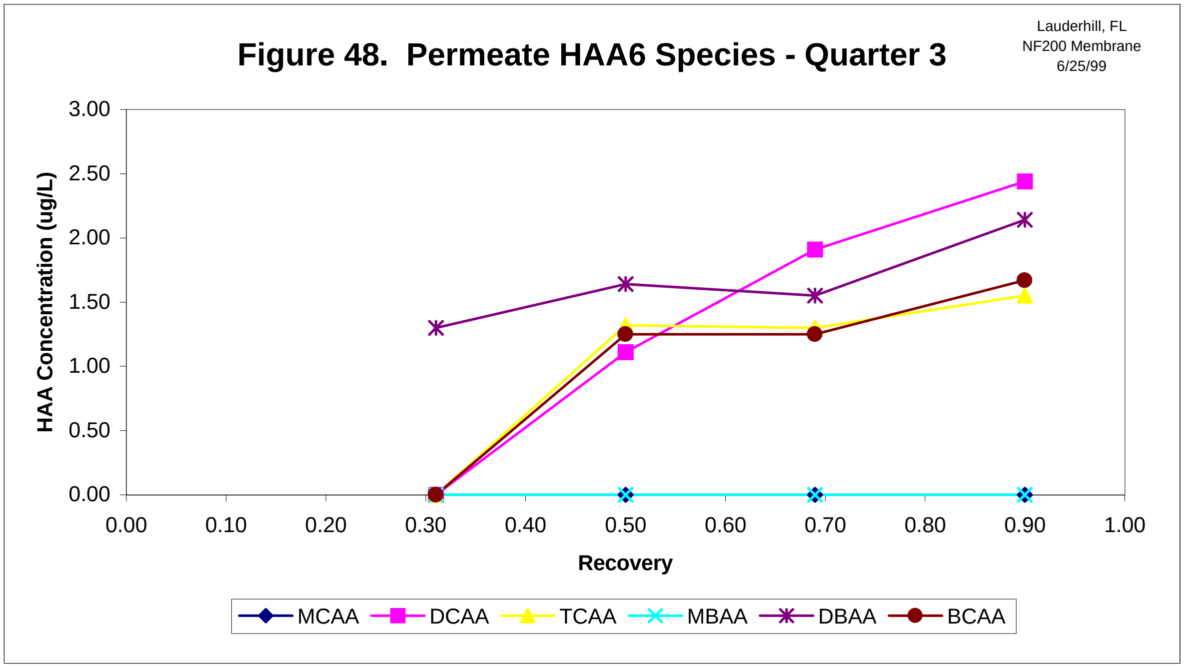


Figure 48. Permeate HAA6 Species - Quarter 3
Lauderhill, FL
NF200 Membrane
6/25/99
HAA Concentration (ug/L)
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Recovery
MCAA
DCAA
TCAA
MBAA
DBAA
BCAA

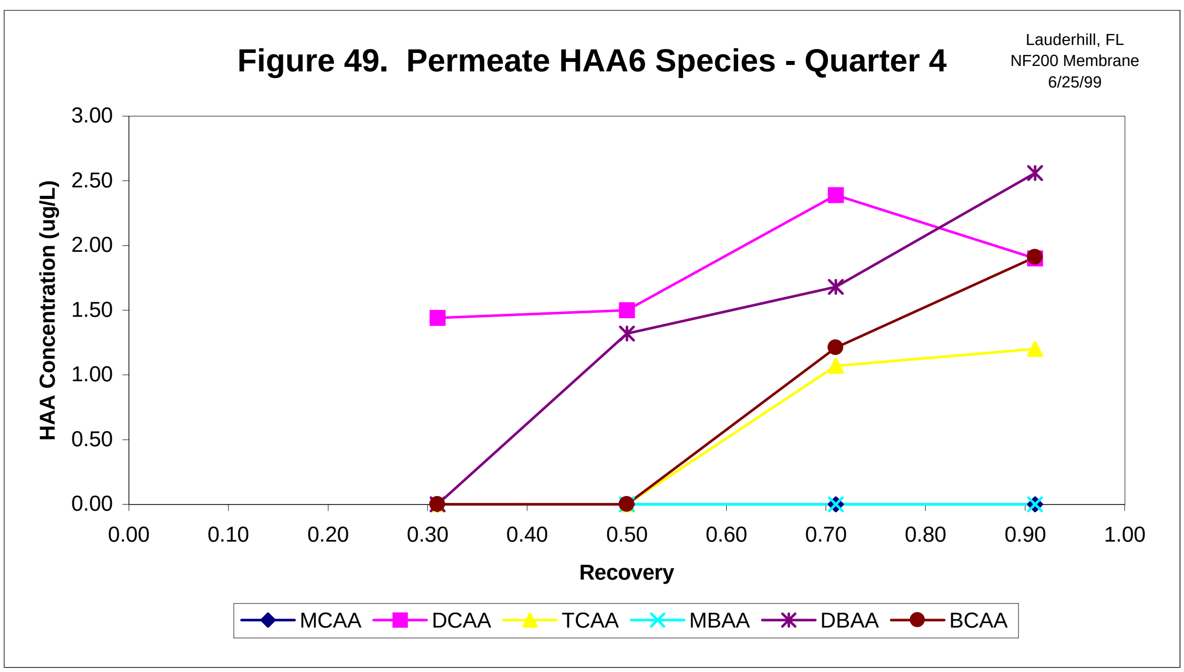


Figure 49. Permeate HAA6 Species - Quarter 4
Lauderhill, FL
NF200 Membrane
6/25/99
HAA Concentration (ug/L)
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Recovery
MCAA
DCAA
TCAA
MBAA
DBAA
BCAA

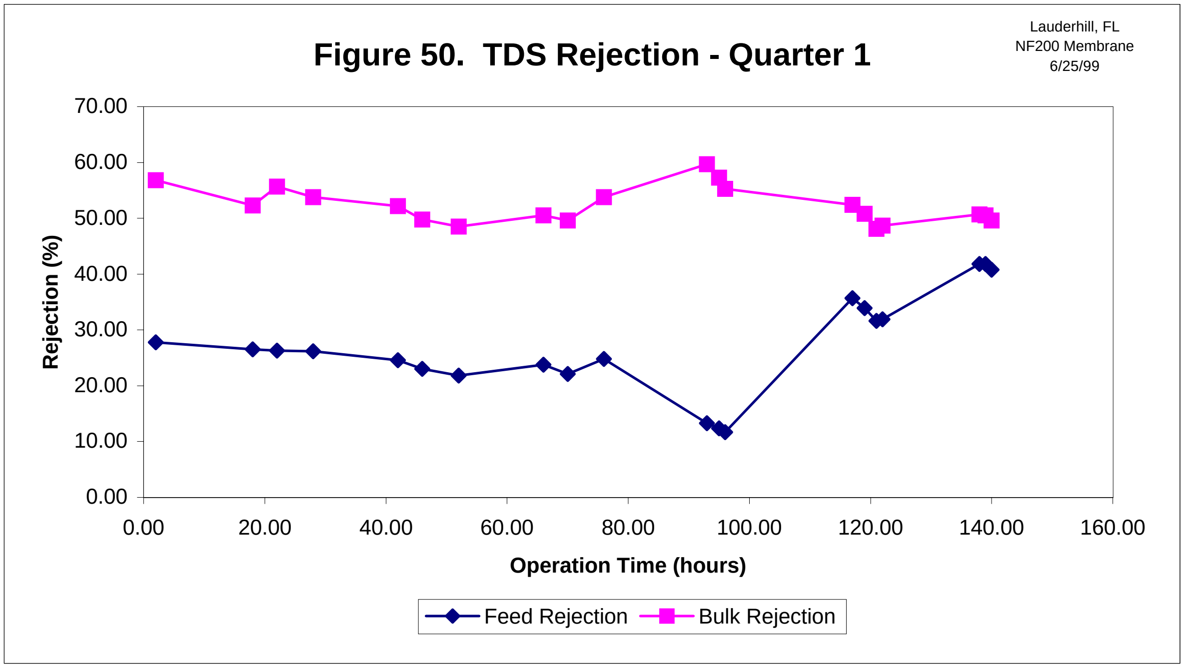


Figure 50. TDS Rejection - Quarter 1
Lauderhill, FL
NF200 Membrane
6/25/99
Rejection (%)
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
Operation Time (hours)
Feed Rejection
Bulk Rejection

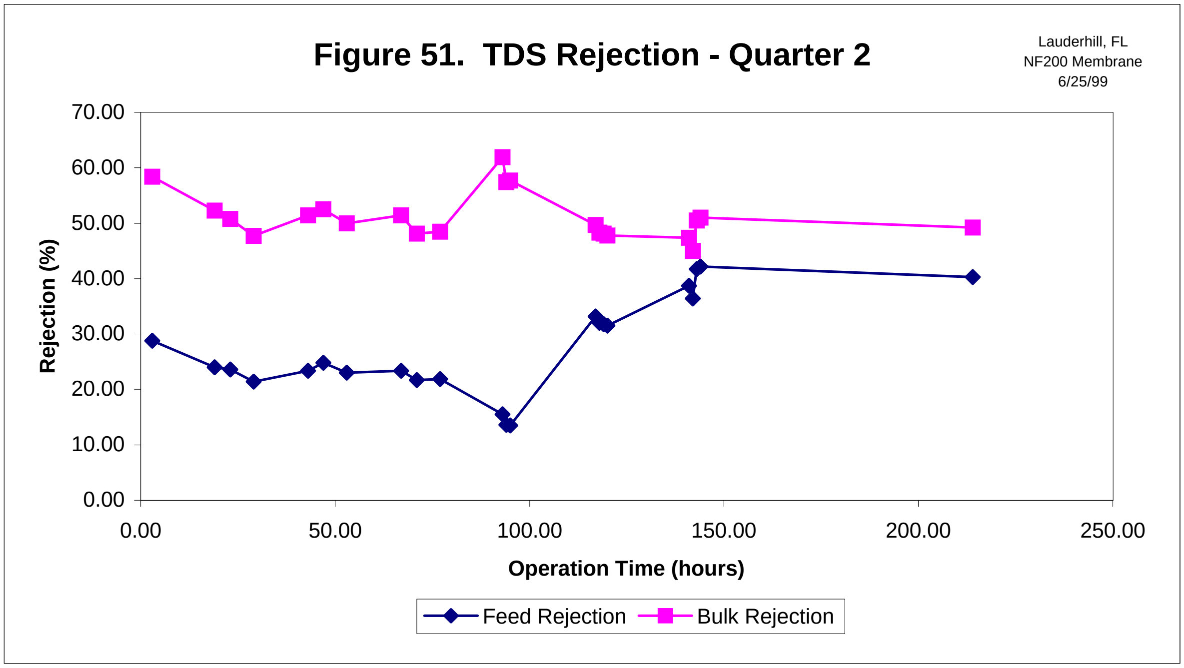


Figure 51. TDS Rejection - Quarter 2
Lauderhill, FL
NF200 Membrane
6/25/99
Rejection (%)
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
0.00
50.00
100.00
150.00
200.00
250.00
Operation Time (hours)
Feed Rejection
Bulk Rejection

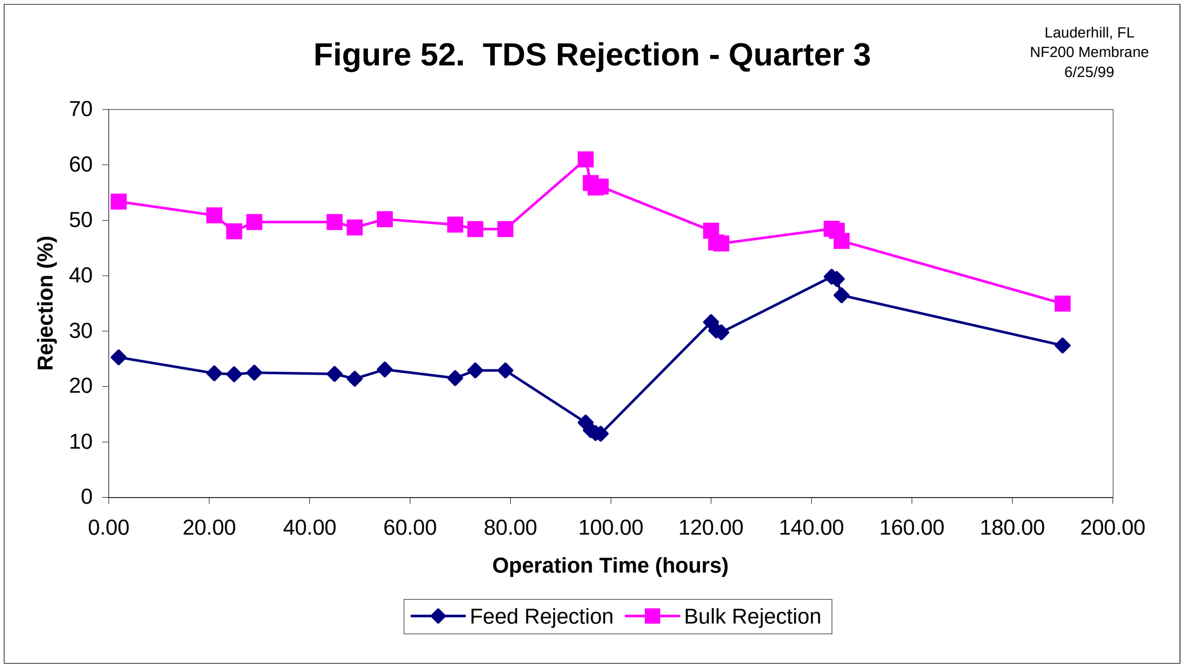


Figure 52. TDS Rejection - Quarter 3
Lauderhill, FL
NF200 Membrane
6/25/99
Rejection (%)
0
10
20
30
40
50
60
70
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
Operation Time (hours)
Feed Rejection
Bulk Rejection

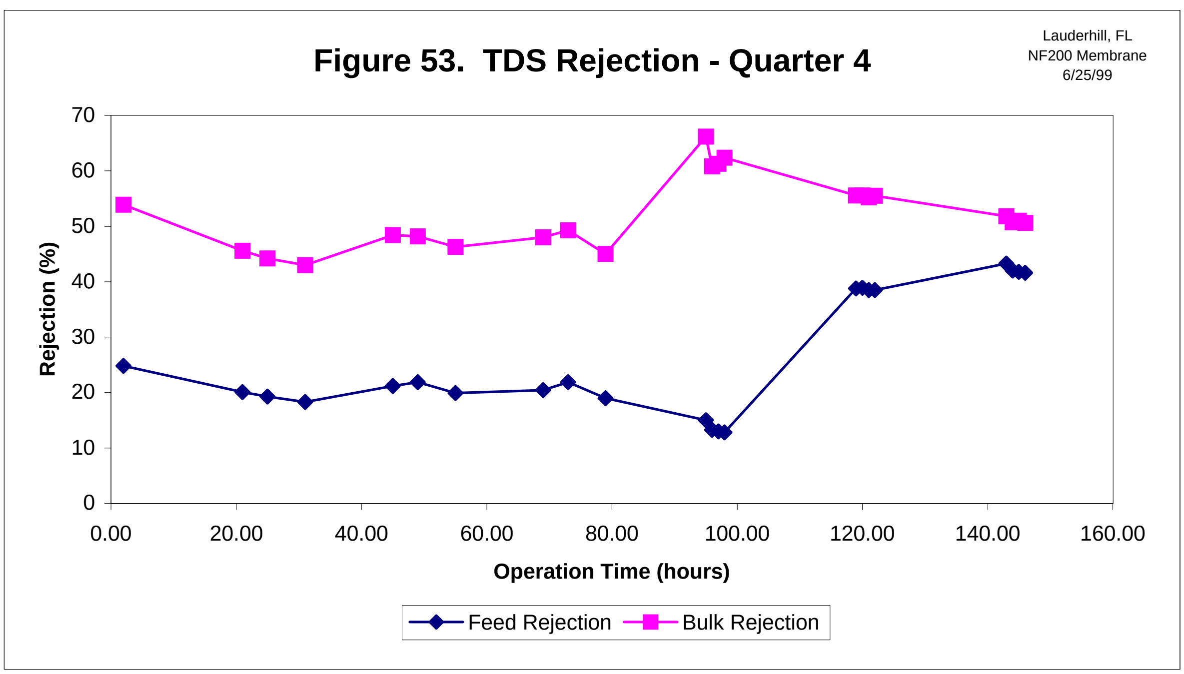


Figure 53. TDS Rejection - Quarter 4
Lauderhill, FL
NF200 Membrane
6/25/99
Rejection (%)
0
10
20
30
40
50
60
70
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
Operation Time (hours)
Feed Rejection
Bulk Rejection

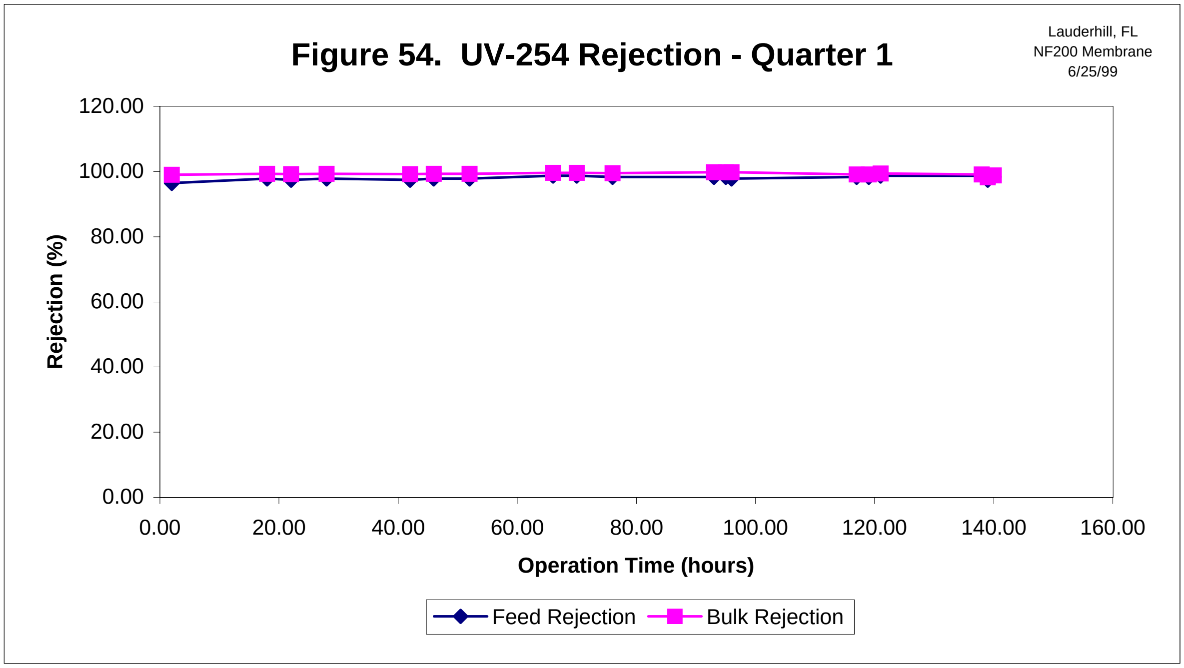


Figure 54. UV-254 Rejection - Quarter 1
Lauderhill, FL
NF200 Membrane
6/25/99
Rejection (%)
120.00
100.00
80.00
60.00
40.00
20.00
0.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
Operation Time (hours)
Feed Rejection
Bulk Rejection

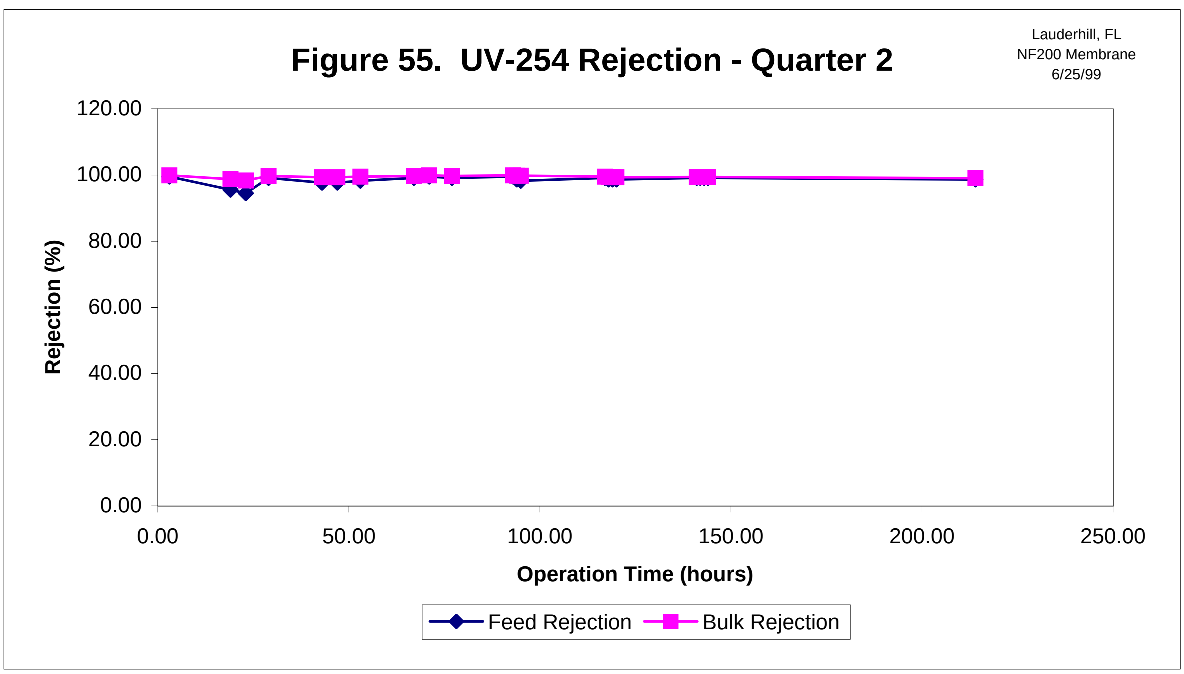


Figure 55. UV-254 Rejection - Quarter 2
Lauderhill, FL
NF200 Membrane
6/25/99
Rejection (%)
120.00
100.00
80.00
60.00
40.00
20.00
0.00
0.00
50.00
100.00
150.00
200.00
250.00
Operation Time (hours)
Feed Rejection
Bulk Rejection

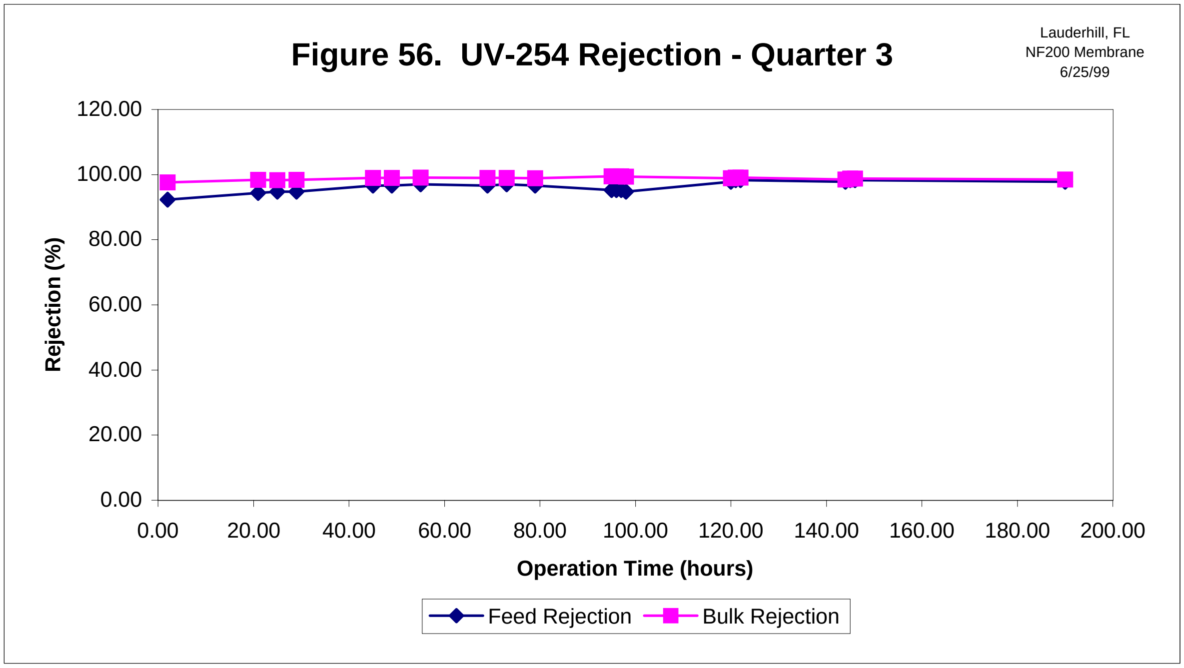


Figure 56. UV-254 Rejection - Quarter 3
Lauderhill, FL
NF200 Membrane
6/25/99
120.00
100.00
80.00
60.00
40.00
20.00
0.00
Rejection (%)
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
Operation Time (hours)
Feed Rejection
Bulk Rejection

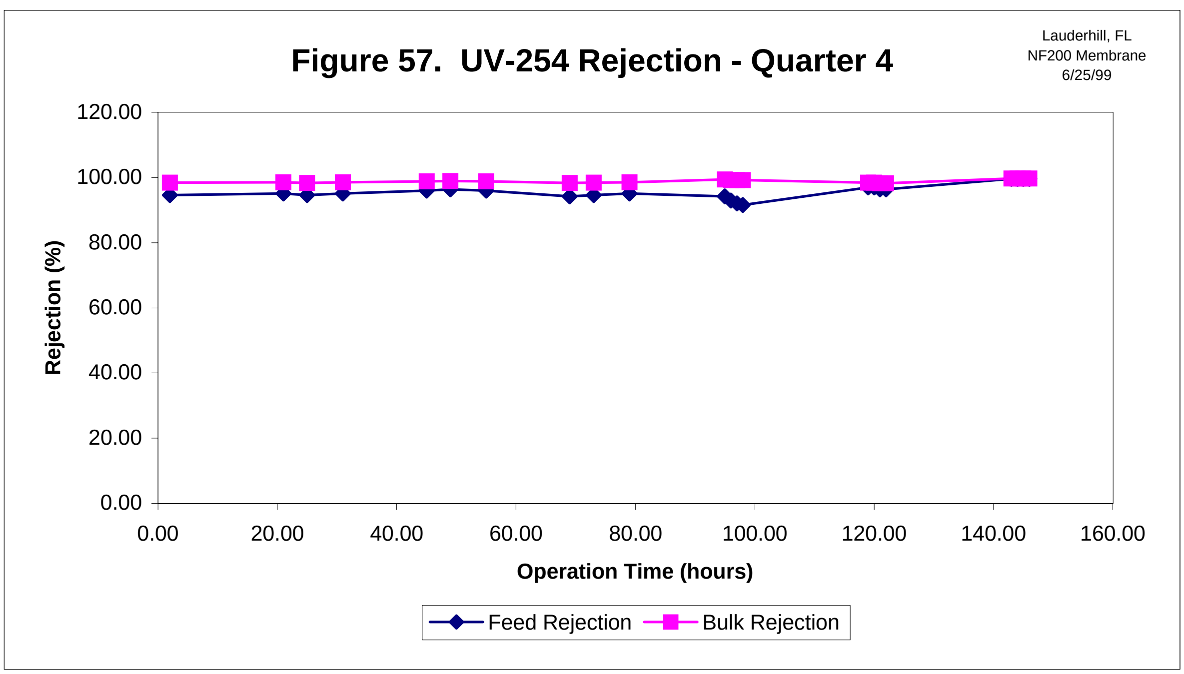


Figure 57. UV-254 Rejection - Quarter 4
Lauderhill, FL
NF200 Membrane
6/25/99
120.00
100.00
80.00
60.00
40.00
20.00
0.00
Rejection (%)
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
Operation Time (hours)
Feed Rejection
Bulk Rejection

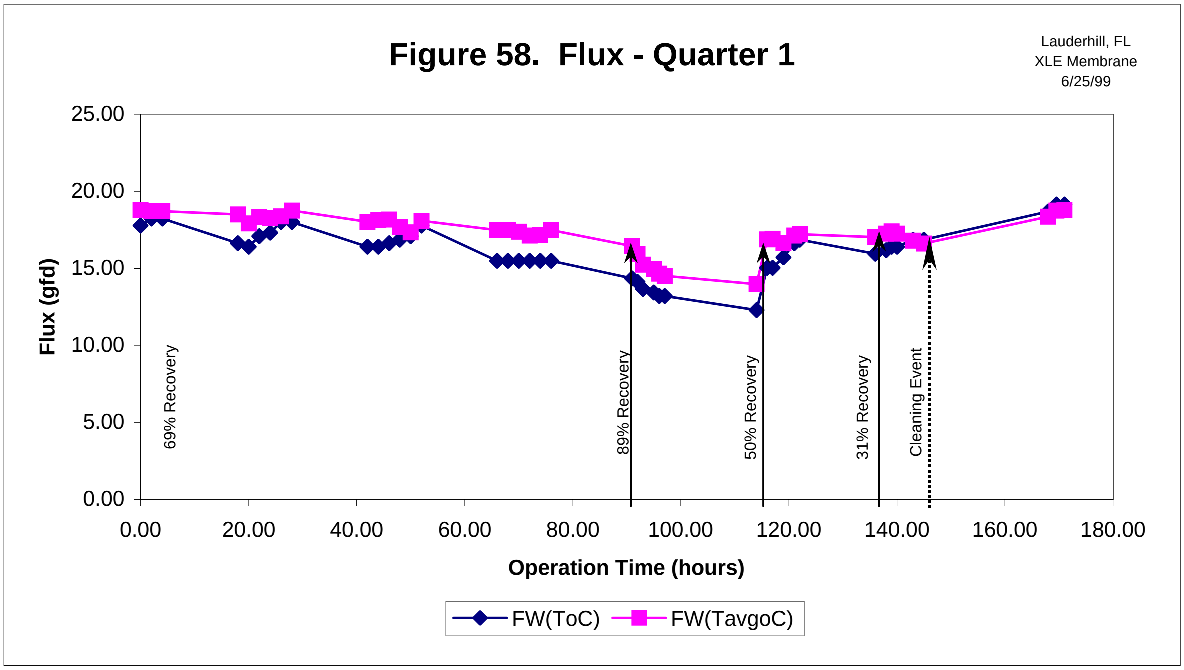


Figure 58. Flux - Quarter 1
Lauderhill, FL
XLE Membrane
6/25/99
Flux (gfd)
25.00
20.00
15.00
10.00
5.00
0.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
Operation Time (hours)
69% Recovery
89% Recovery
50% Recovery
31% Recovery
Cleaning Event
FW(ToC)
FW(TavgoC)

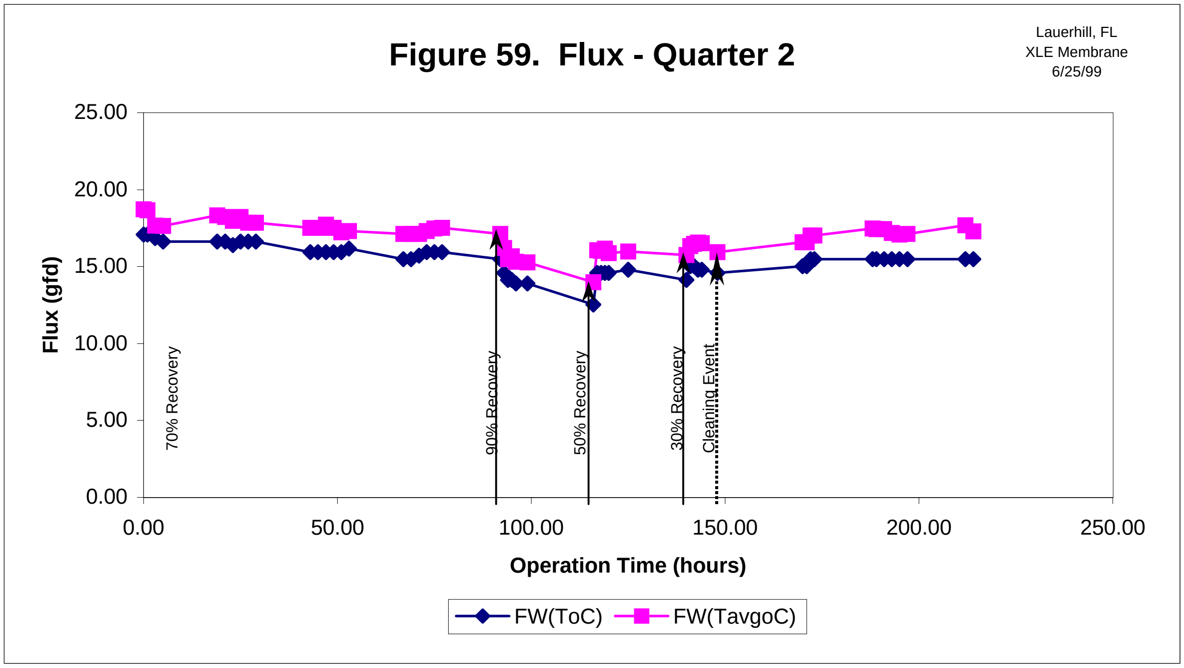


Figure 59. Flux - Quarter 2
Lauerhill, FL
XLE Membrane
6/25/99
Flux (gfd)
25.00
20.00
15.00
10.00
5.00
0.00
0.00
50.00
100.00
150.00
200.00
250.00
Operation Time (hours)
70% Recovery
90% Recovery
50% Recovery
30% Recovery
Cleaning Event
FW(ToC)
FW(TavgoC)

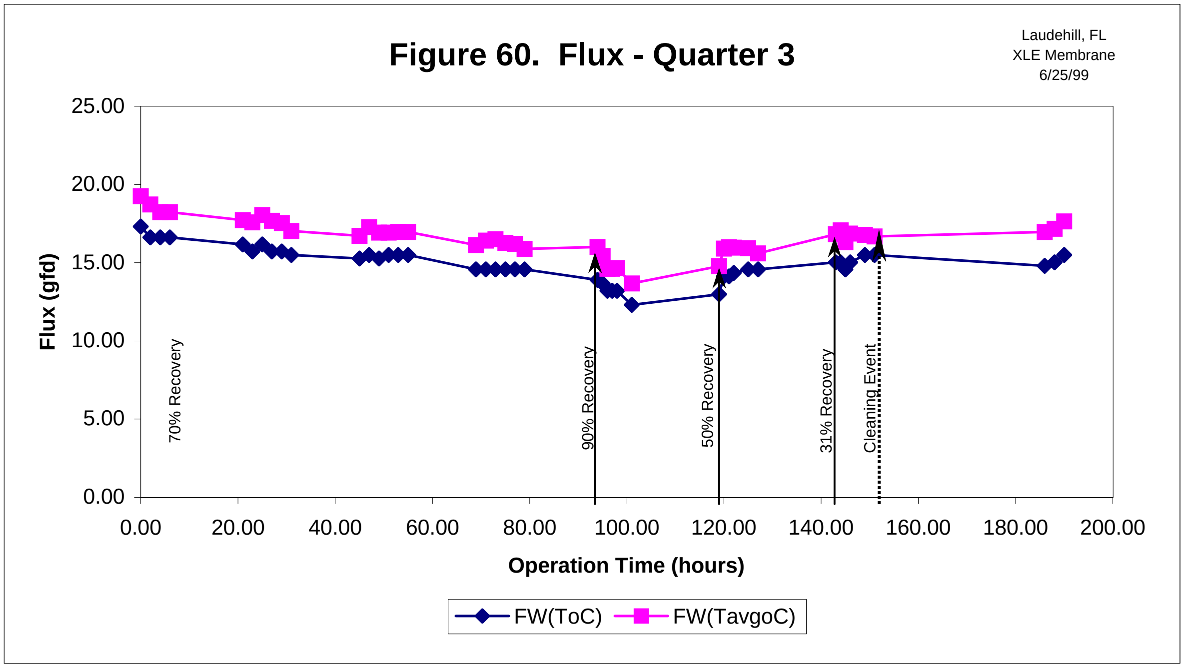


Figure 60. Flux - Quarter 3
Laudehill, FL
XLE Membrane
6/25/99
25.00
20.00
15.00
10.00
5.00
0.00
Flux (gfd)
70% Recovery
90% Recovery
50% Recovery
31% Recovery
Cleaning Event
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
Operation Time (hours)
FW(ToC)
FW(TavgoC)

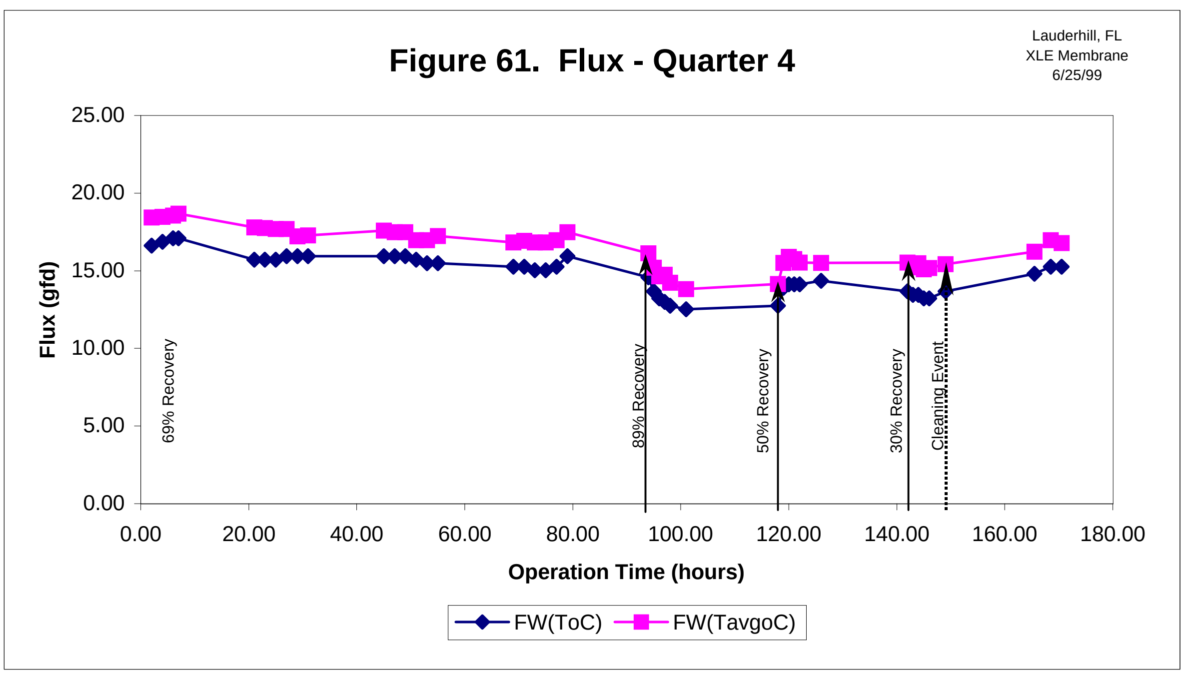


Figure 61. Flux - Quarter 4
Lauderhill, FL
XLE Membrane
6/25/99
25.00
20.00
15.00
10.00
5.00
0.00
Flux (gfd)
69% Recovery
89% Recovery
50% Recovery
30% Recovery
Cleaning Event
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
Operation Time (hours)
FW(ToC)
FW(TavgoC)

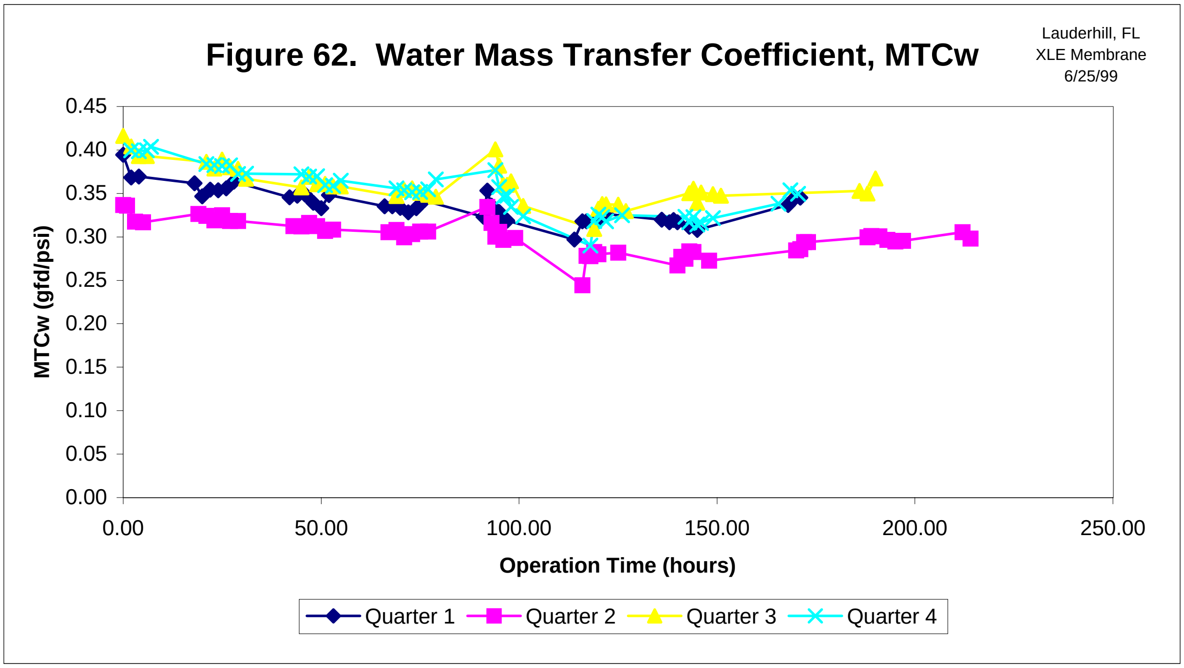


Figure 62. Water Mass Transfer Coefficient, MTCw
Lauderhill, FL
XLE Membrane
6/25/99
MTCw (gfd/psi)
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.00
50.00
100.00
150.00
200.00
250.00
Operation Time (hours)
Quarter 1
Quarter 2
Quarter 3
Quarter 4

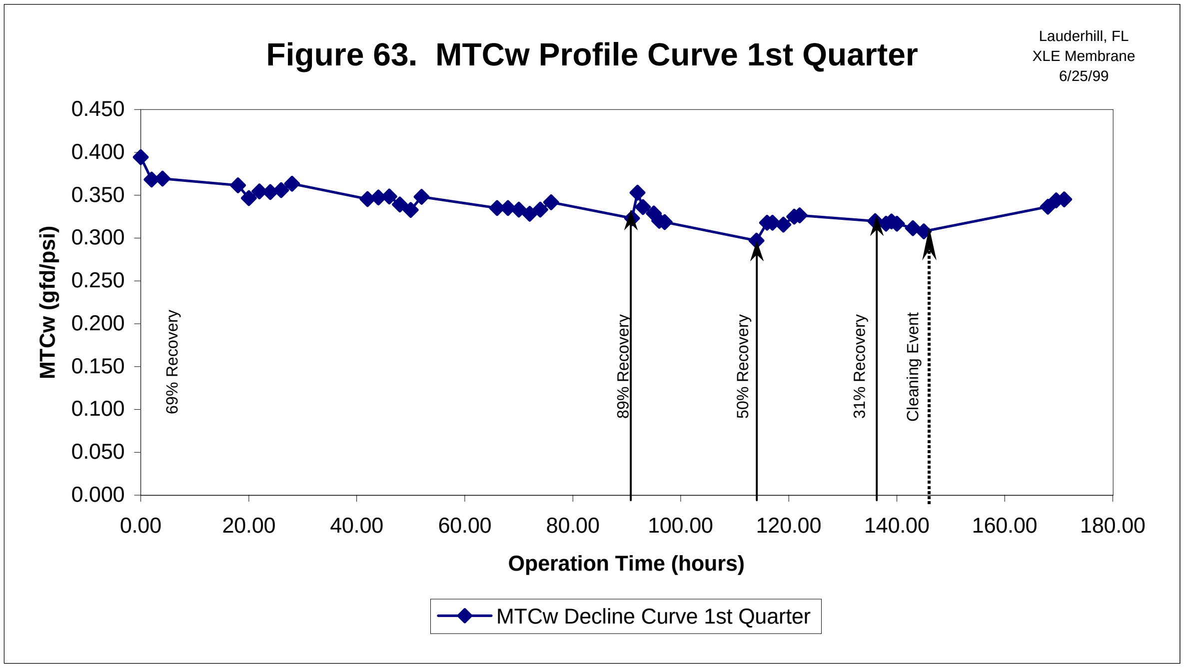


Figure 63. MTCw Profile Curve 1st Quarter
Lauderhill, FL
XLE Membrane
6/25/99
MTCw (gfd/psi)
0.450
0.400
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
69% Recovery
89% Recovery
50% Recovery
31% Recovery
Cleaning Event
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
Operation Time (hours)
MTCw Decline Curve 1st Quarter

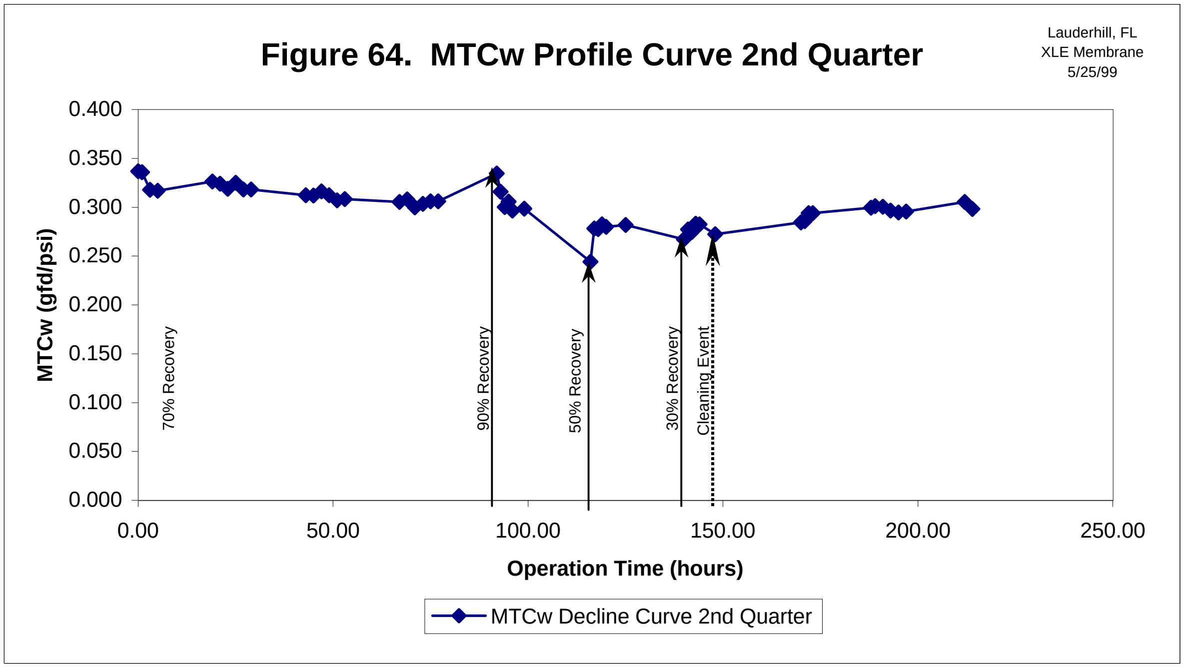


Figure 64. MTCw Profile Curve 2nd Quarter
Lauderhill, FL
XLE Membrane
5/25/99
MTCw (gfd/psi)
0.400
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
70% Recovery
90% Recovery
50% Recovery
30% Recovery
Cleaning Event
0.00
50.00
100.00
150.00
200.00
250.00
Operation Time (hours)
MTCw Decline Curve 2nd Quarter

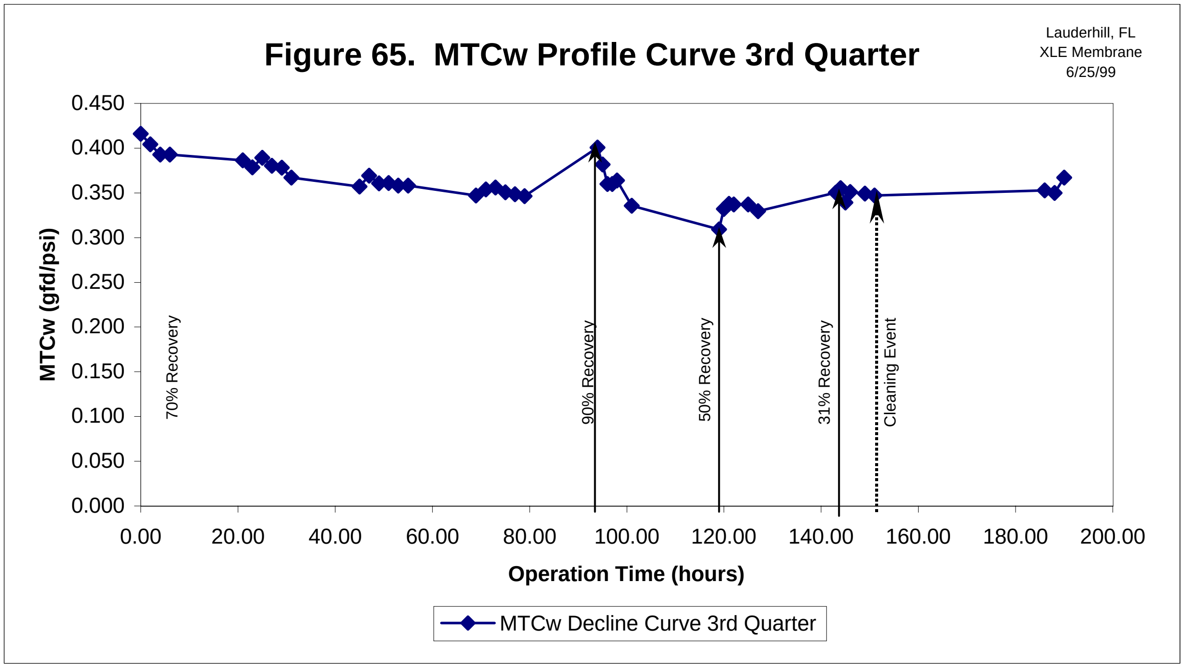


Figure 65. MTCw Profile Curve 3rd Quarter
Lauderhill, FL
XLE Membrane
6/25/99
MTCw (gfd/psi)
0.450
0.400
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
Operation Time (hours)
70% Recovery
90% Recovery
50% Recovery
31% Recovery
Cleaning Event
MTCw Decline Curve 3rd Quarter

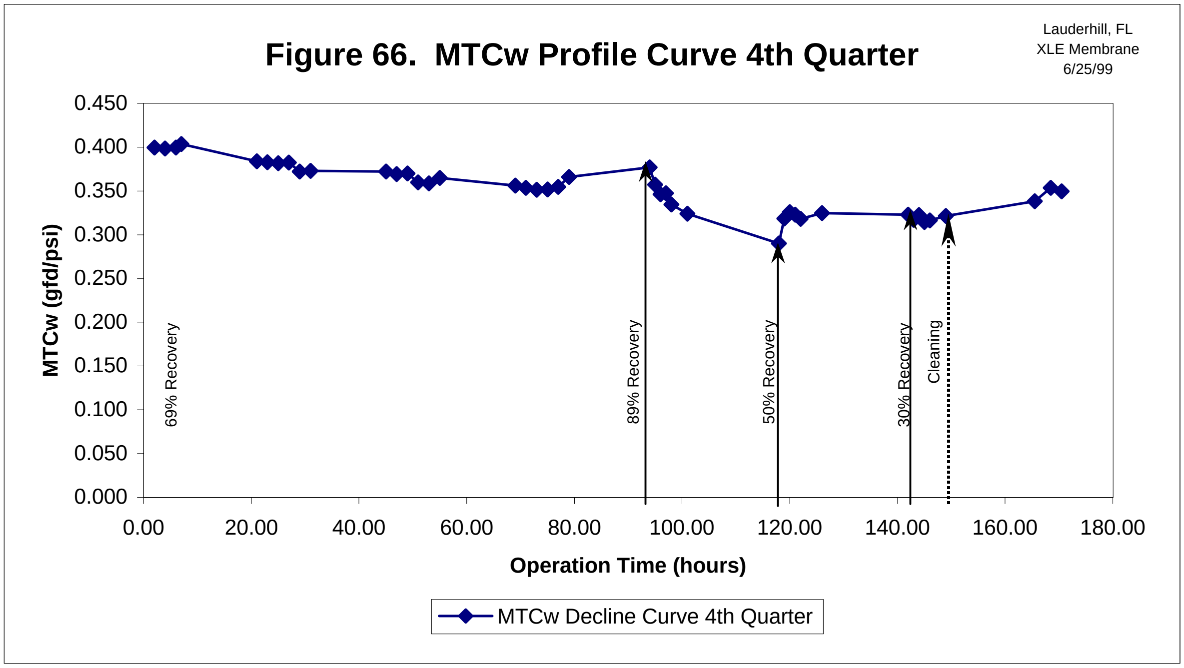


Figure 66. MTCw Profile Curve 4th Quarter
Lauderhill, FL
XLE Membrane
6/25/99
MTCw (gfd/psi)
0.450
0.400
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
Operation Time (hours)
69% Recovery
89% Recovery
50% Recovery
30% Recovery
Cleaning
MTCw Decline Curve 4th Quarter

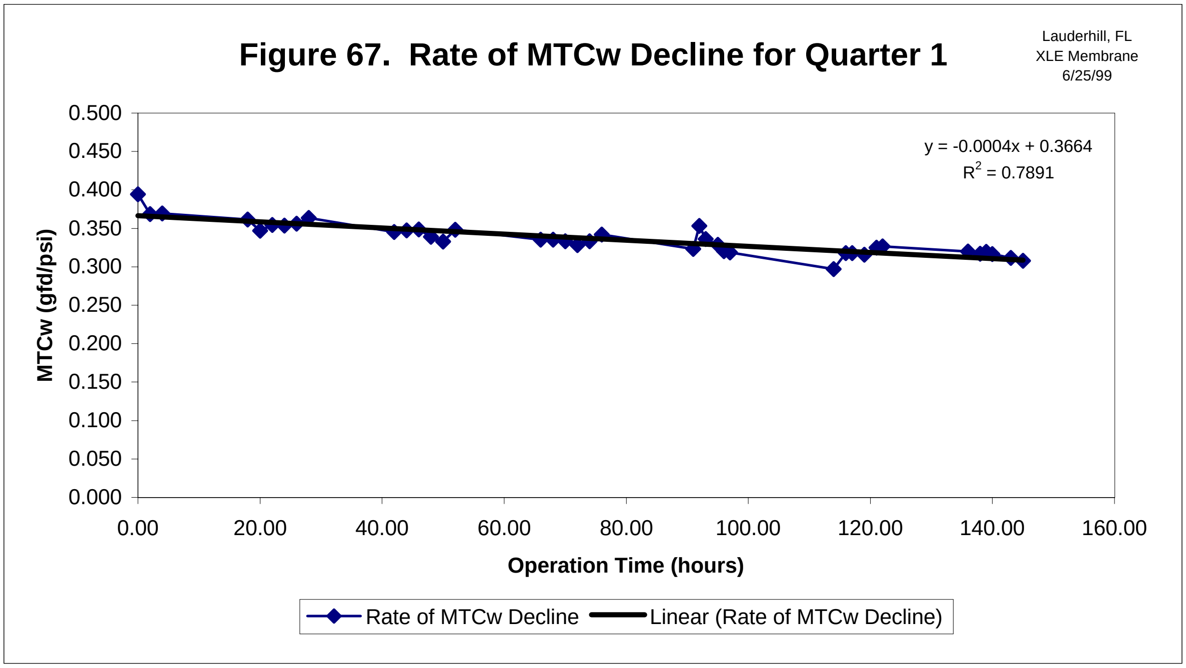


Figure 67. Rate of MTCw Decline for Quarter 1
Lauderhill, FL
XLE Membrane
6/25/99
y = -0.0004x + 0.3664
R^2 = 0.7891
MTCw (gfd/psi)
0.500
0.450
0.400
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
Operation Time (hours)
Rate of MTCw Decline
Linear (Rate of MTCw Decline)

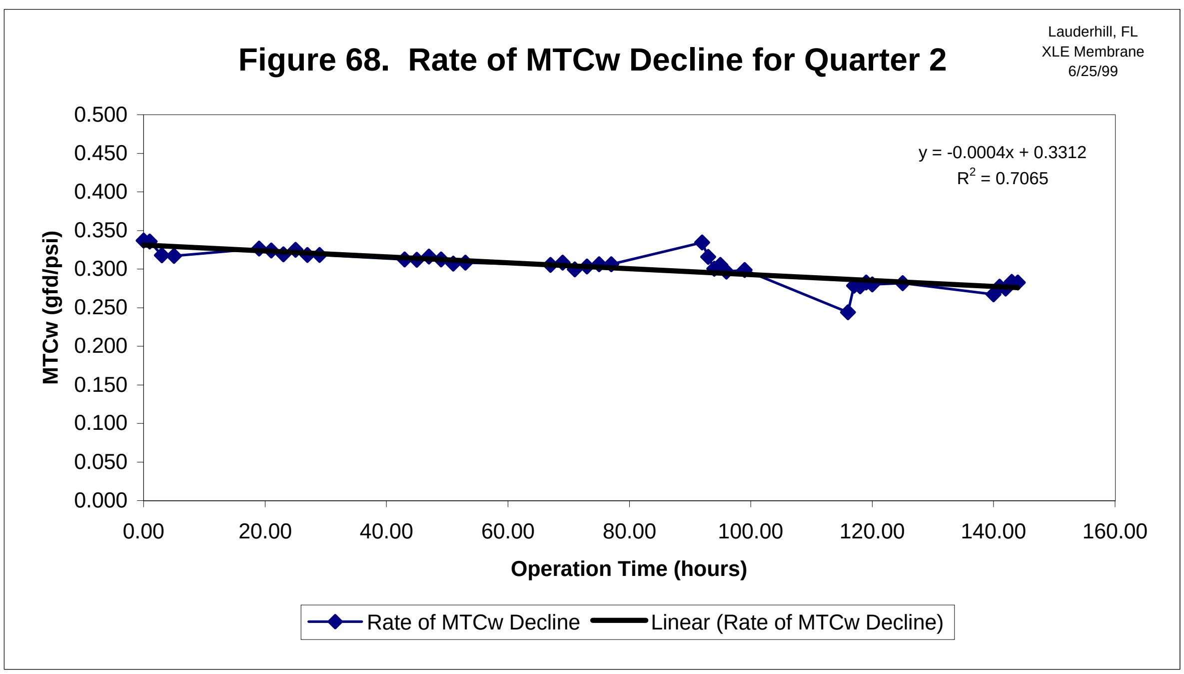


Figure 68. Rate of MTCw Decline for Quarter 2
Lauderhill, FL
XLE Membrane
6/25/99
y = -0.0004x + 0.3312
R^2 = 0.7065
MTCw (gfd/psi)
0.500
0.450
0.400
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
Operation Time (hours)
Rate of MTCw Decline
Linear (Rate of MTCw Decline)

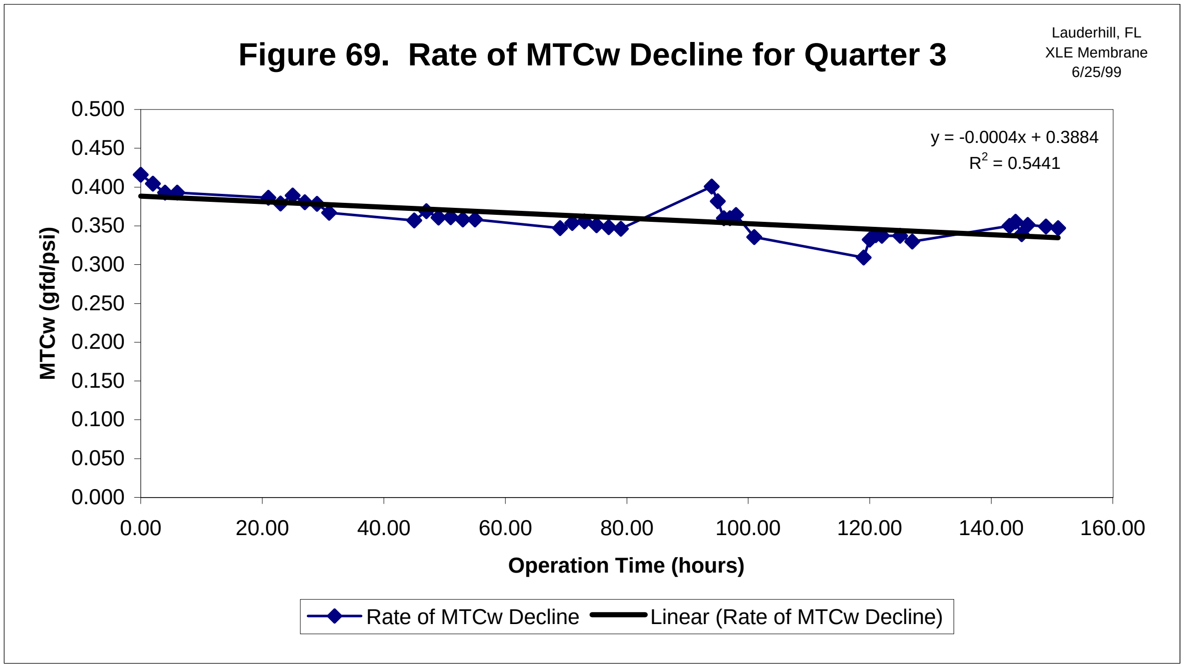


Figure 69. Rate of MTCw Decline for Quarter 3
Lauderhill, FL
XLE Membrane
6/25/99
y = -0.0004x + 0.3884
R^2 = 0.5441
MTCw (gfd/psi)
0.500
0.450
0.400
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
Operation Time (hours)
Rate of MTCw Decline
Linear (Rate of MTCw Decline)

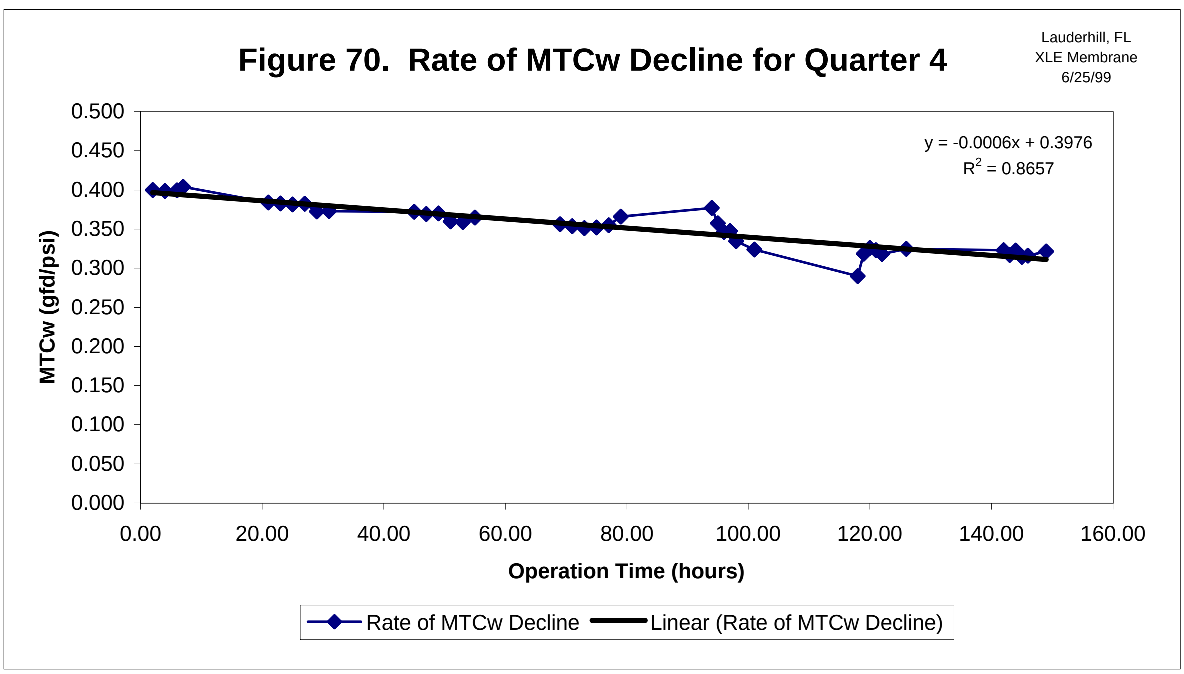


Figure 70. Rate of MTCw Decline for Quarter 4
Lauderhill, FL
XLE Membrane
6/25/99
y = -0.0006x + 0.3976
R^2 = 0.8657
MTCw (gfd/psi)
0.500
0.450
0.400
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
Operation Time (hours)
Rate of MTCw Decline
Linear (Rate of MTCw Decline)

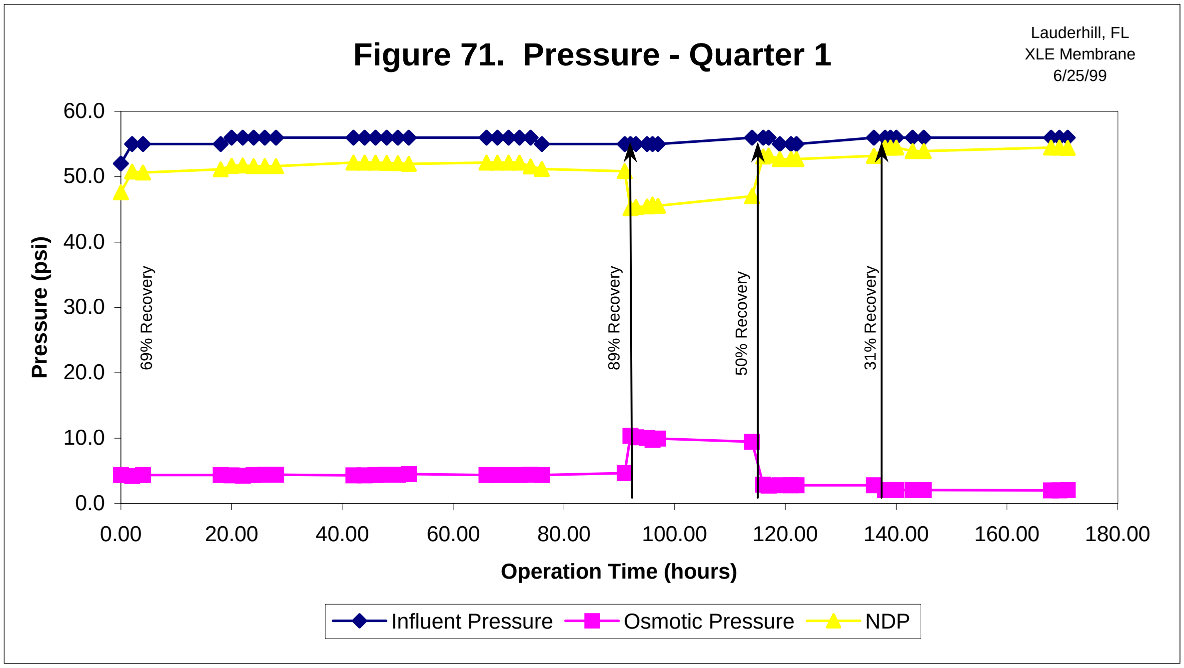


Figure 71. Pressure - Quarter 1
Lauderhill, FL
XLE Membrane
6/25/99
Pressure (psi)
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
Operation Time (hours)
69% Recovery
89% Recovery
50% Recovery
31% Recovery
Influent Pressure
Osmotic Pressure
NDP

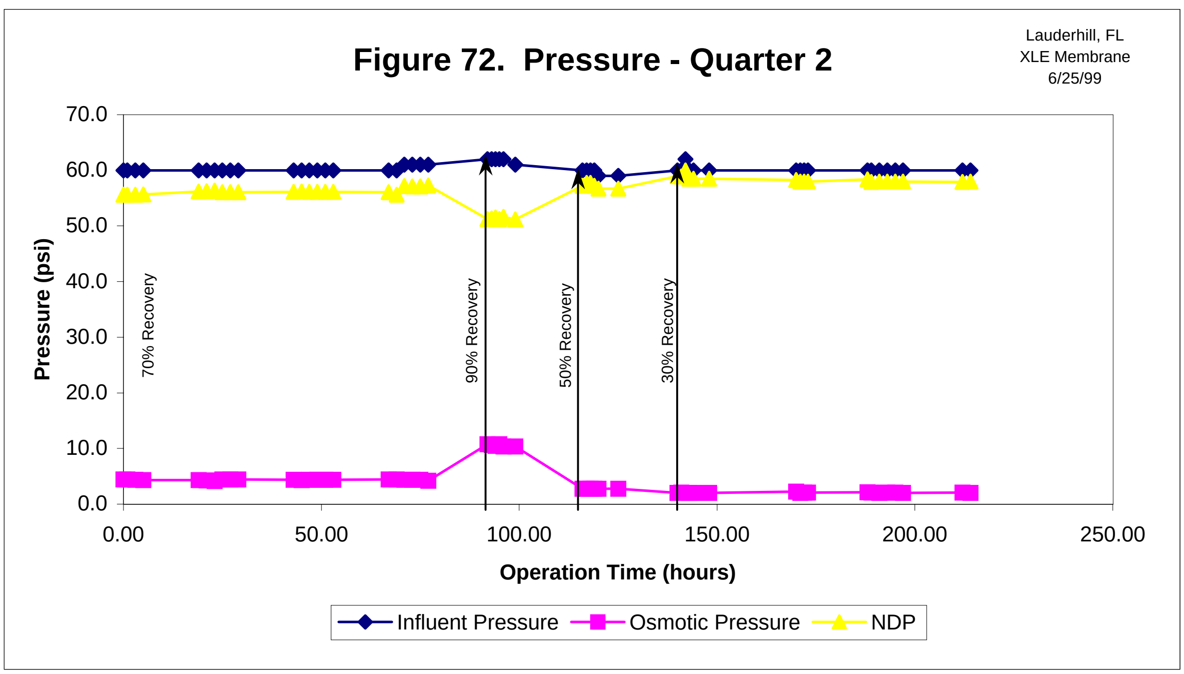


Figure 72. Pressure - Quarter 2
Lauderhill, FL
XLE Membrane
6/25/99
Pressure (psi)
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
0.00
50.00
100.00
150.00
200.00
250.00
Operation Time (hours)
70% Recovery
90% Recovery
50% Recovery
30% Recovery
Influent Pressure
Osmotic Pressure
NDP

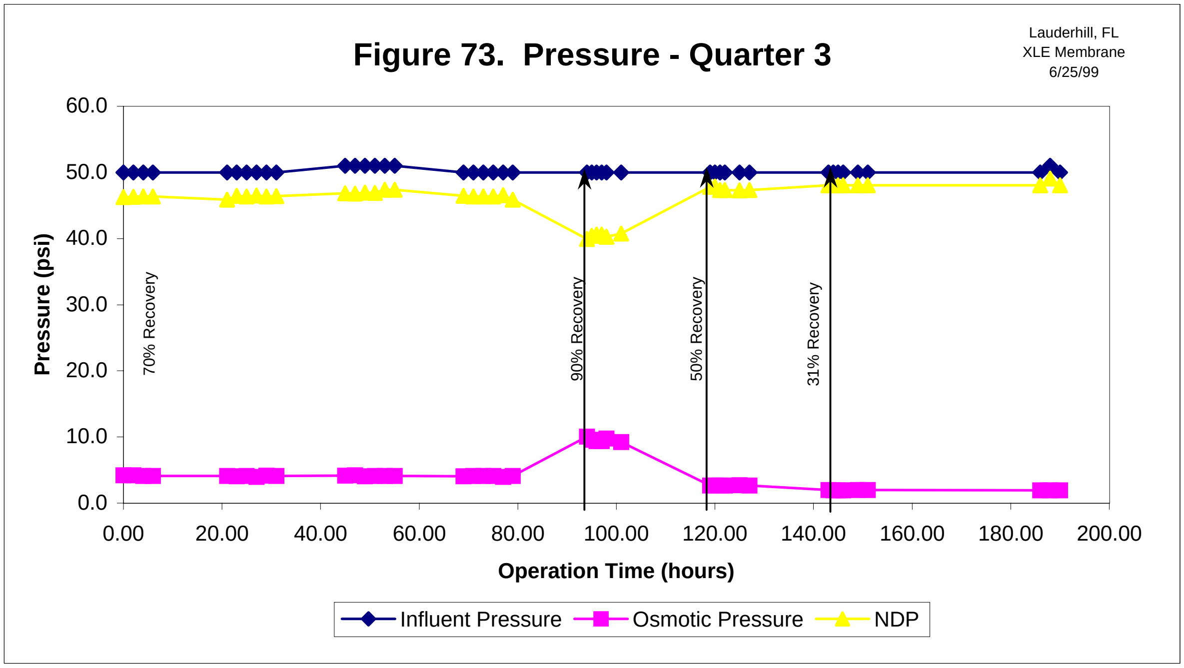
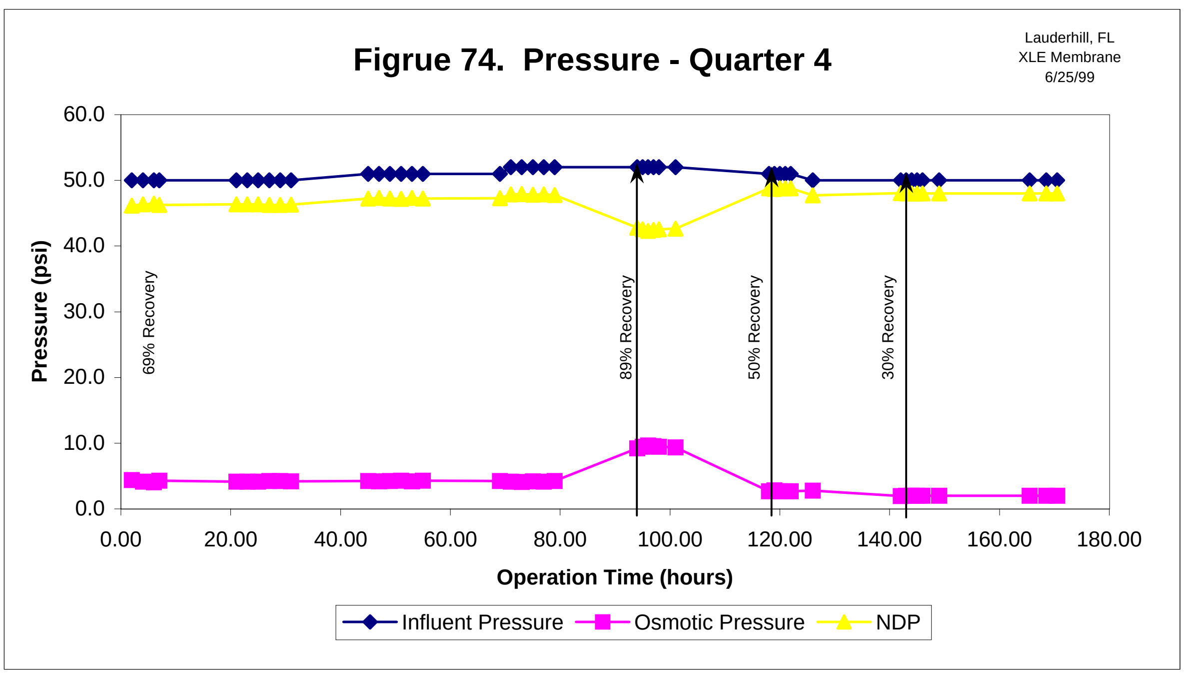


Figure 73. Pressure - Quarter 3
Lauderhill, FL
XLE Membrane
6/25/99
Pressure (psi)
60.0
50.0
40.0
30.0
20.0
10.0
0.0
70% Recovery
90% Recovery
50% Recovery
31% Recovery
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
Operation Time (hours)
Influent Pressure
Osmotic Pressure
NDP


Figrue 74. Pressure - Quarter 4
Lauderhill, FL
XLE Membrane
6/25/99
Pressure (psi)
60.0
50.0
40.0
30.0
20.0
10.0
0.0
69% Recovery
89% Recovery
50% Recovery
30% Recovery
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
Operation Time (hours)
Influent Pressure
Osmotic Pressure
NDP

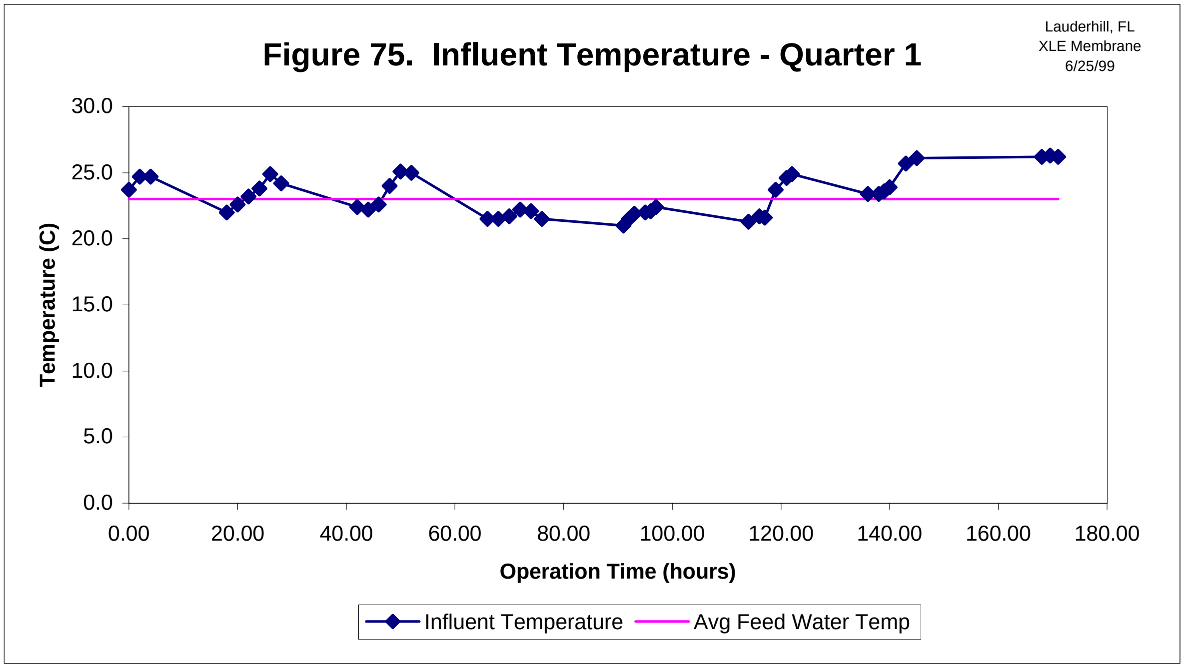


Figure 75. Influent Temperature - Quarter 1

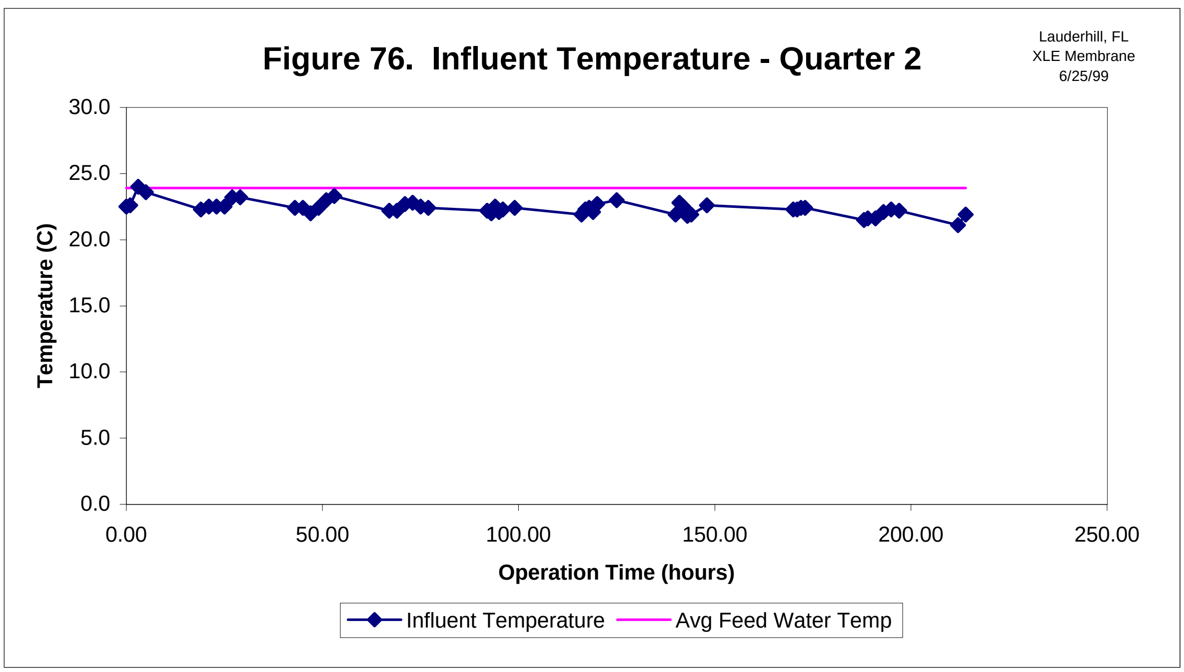


Figure 76. Influent Temperature - Quarter 2

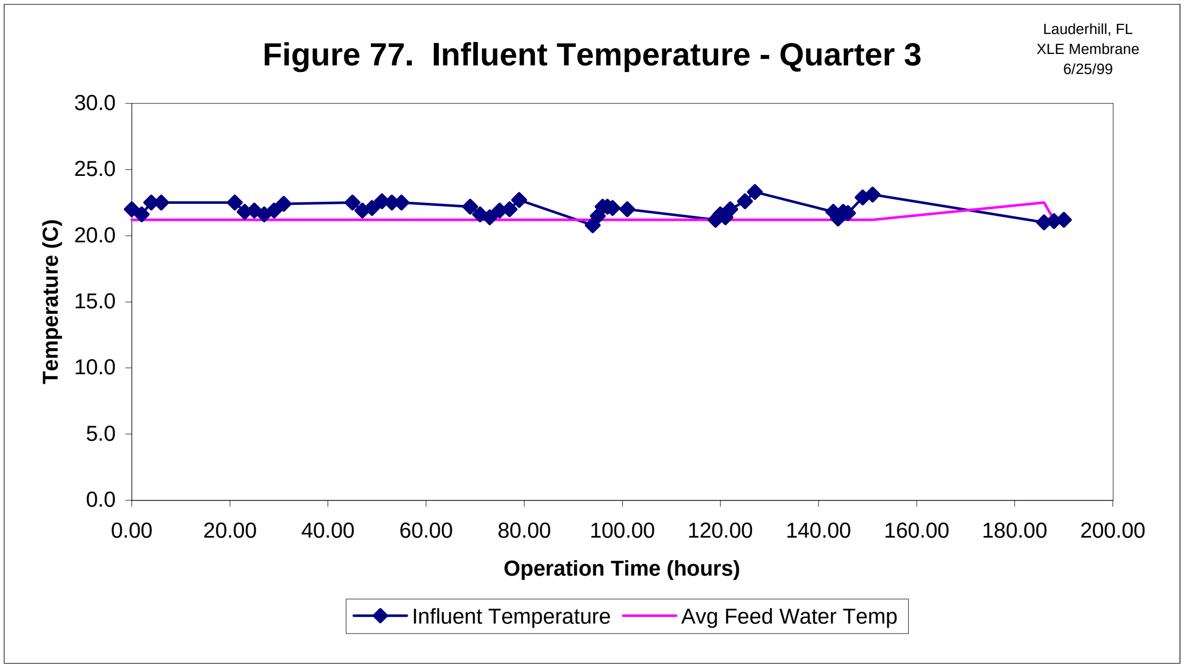


Figure 77. Influent Temperature - Quarter 3
Lauderhill, FL
XLE Membrane
6/25/99
Temperature (C)
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
Operation Time (hours)
Influent Temperature
Avg Feed Water Temp

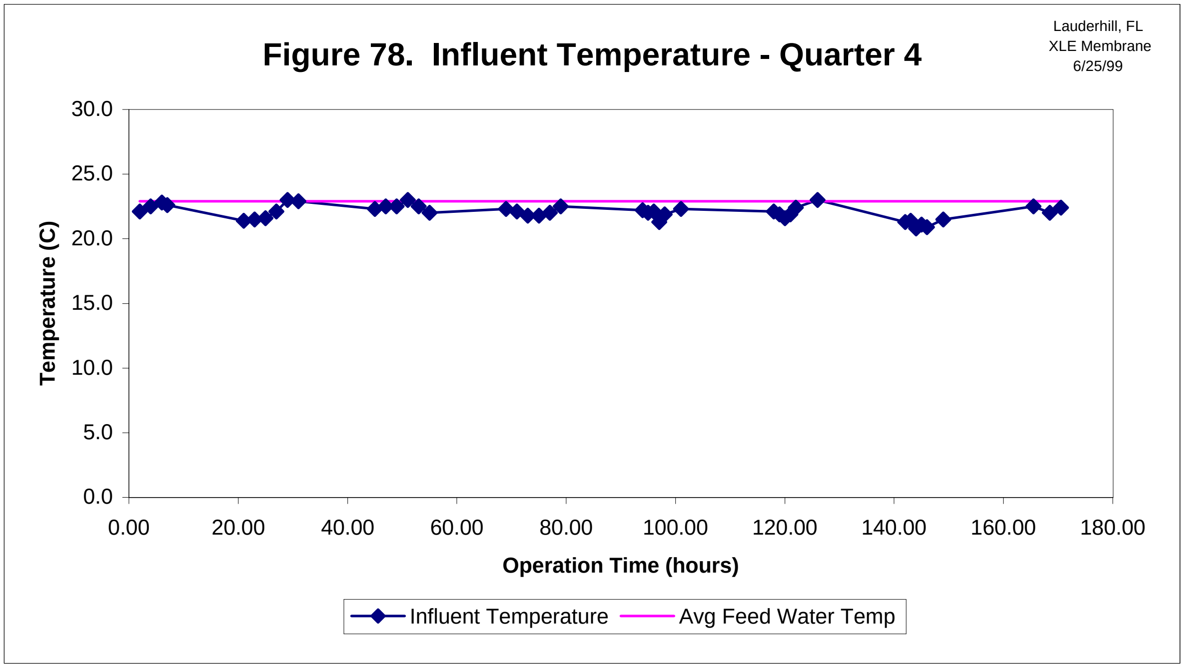


Figure 78. Influent Temperature - Quarter 4
Lauderhill, FL
XLE Membrane
6/25/99
Temperature (C)
30.0
25.0
20.0
15.0
10.0
5.0
0.0
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
Operation Time (hours)
Influent Temperature
Avg Feed Water Temp

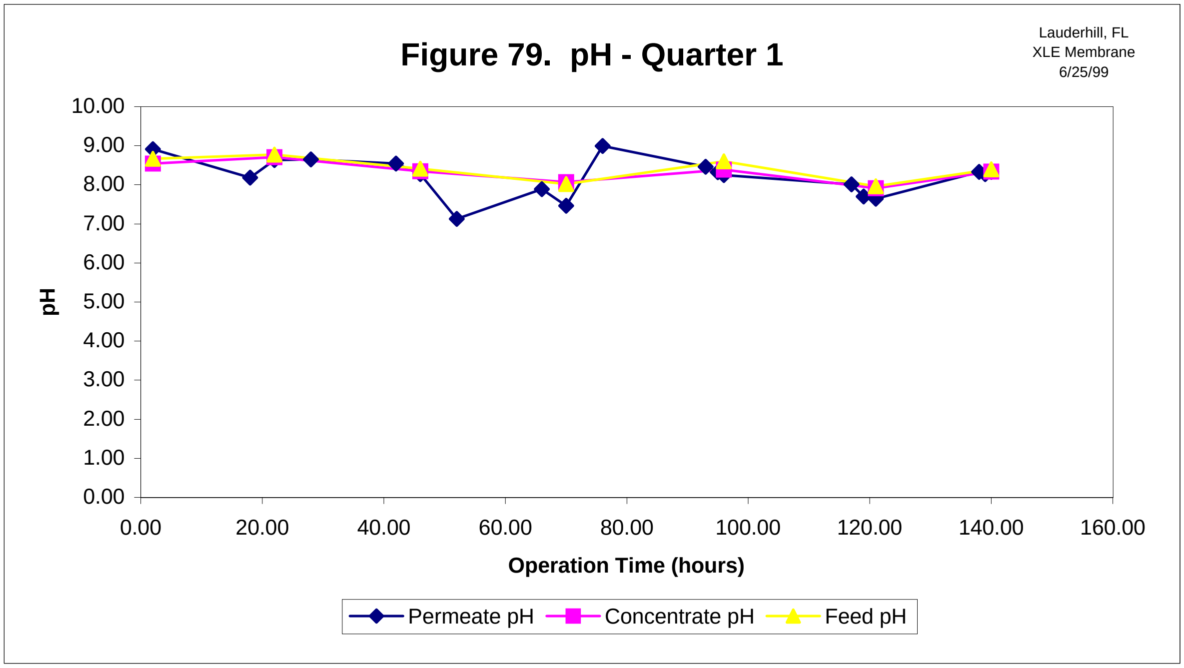


Figure 79. pH - Quarter 1
Lauderhill, FL
XLE Membrane
6/25/99
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
pH
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
Operation Time (hours)
Permeate pH
Concentrate pH
Feed pH

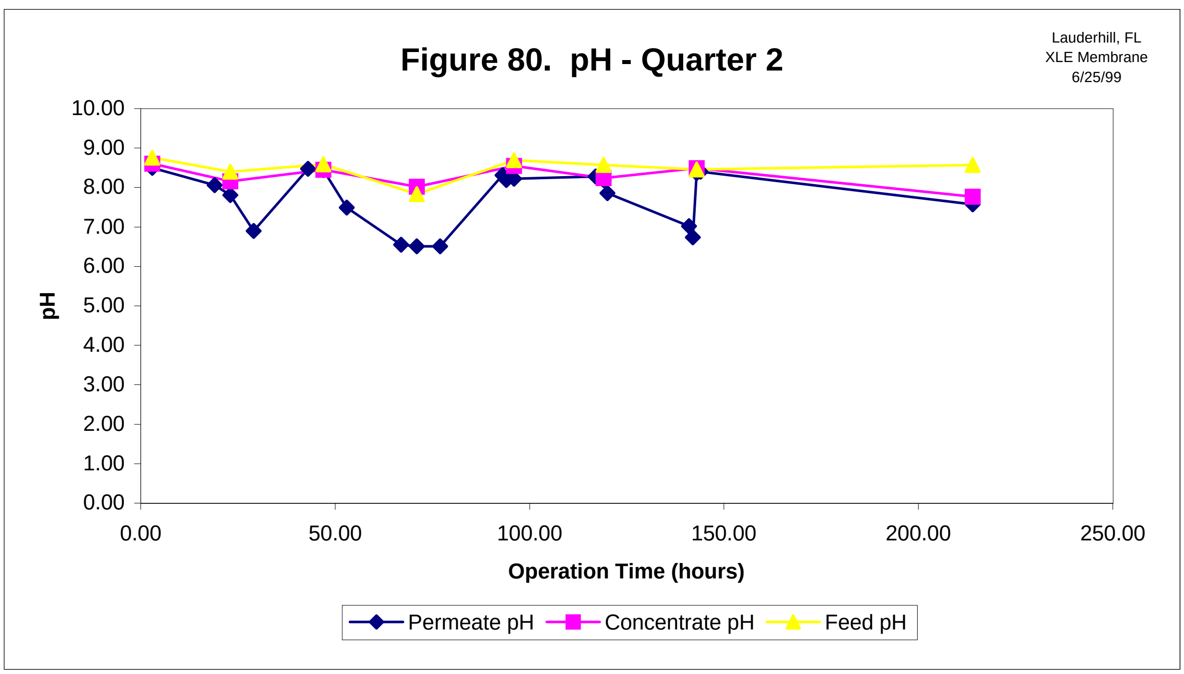


Figure 80. pH - Quarter 2
Lauderhill, FL
XLE Membrane
6/25/99
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
pH
0.00
50.00
100.00
150.00
200.00
250.00
Operation Time (hours)
Permeate pH
Concentrate pH
Feed pH

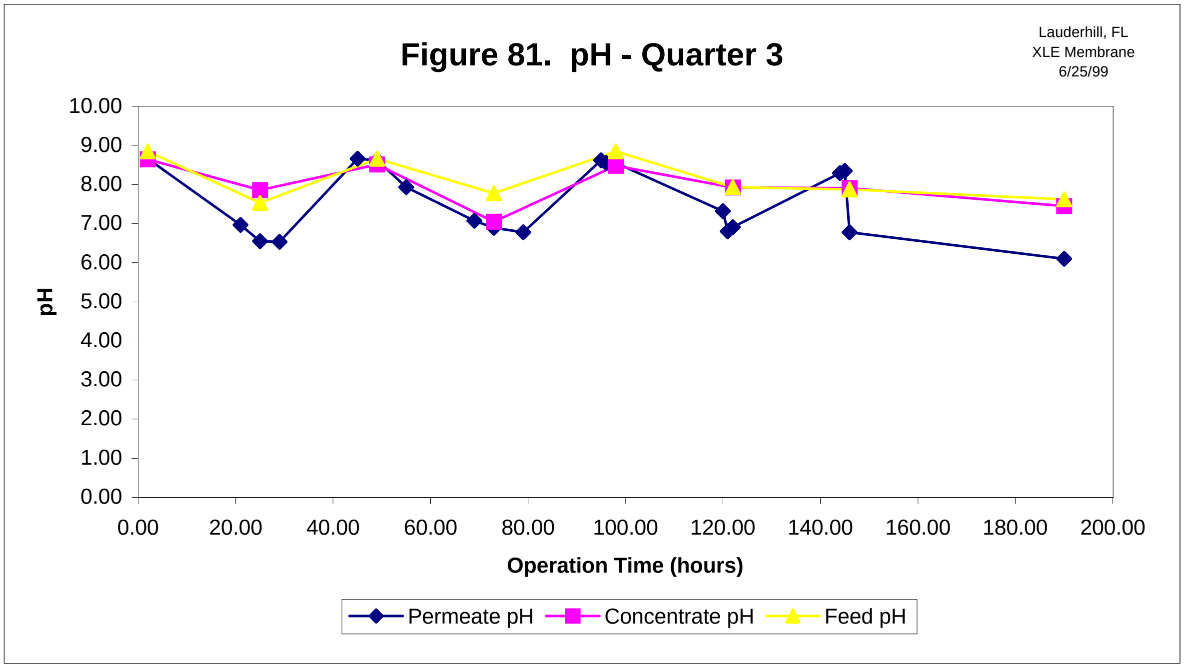


Figure 81. pH - Quarter 3
Lauderhill, FL
XLE Membrane
6/25/99
pH
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
Operation Time (hours)
Permeate pH
Concentrate pH
Feed pH

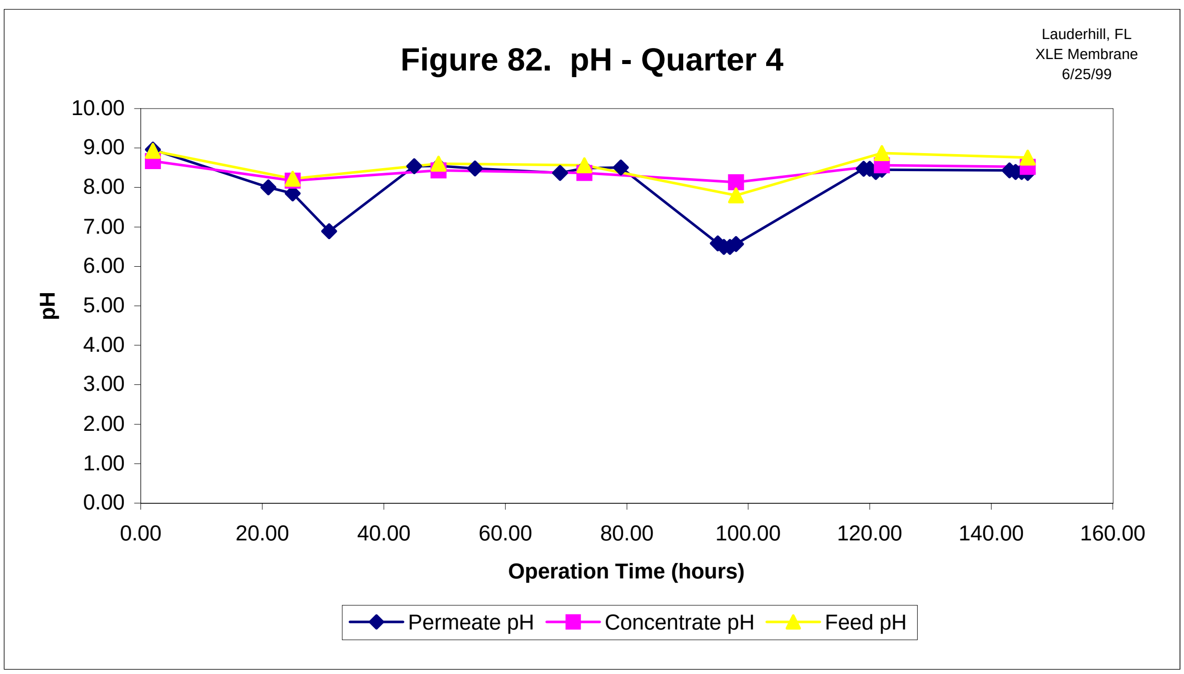


Figure 82. pH - Quarter 4
Lauderhill, FL
XLE Membrane
6/25/99
pH
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
Operation Time (hours)
Permeate pH
Concentrate pH
Feed pH

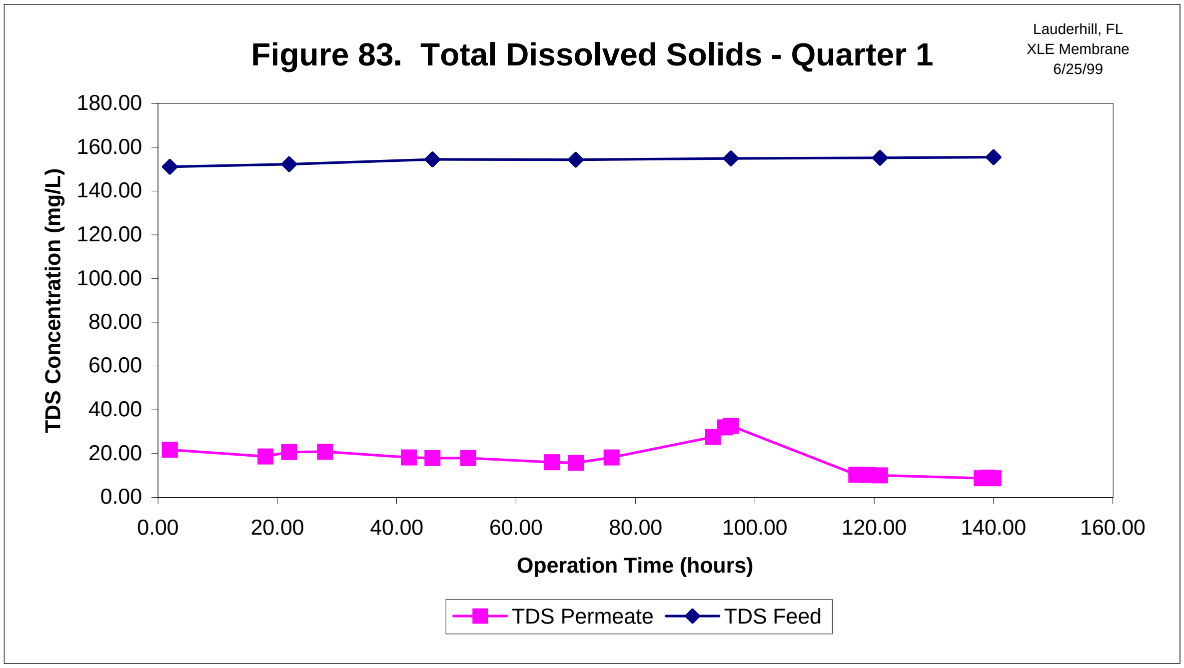


Figure 83. Total Dissolved Solids - Quarter 1
Lauderhill, FL
XLE Membrane
6/25/99
TDS Concentration (mg/L)
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
Operation Time (hours)
TDS Permeate
TDS Feed

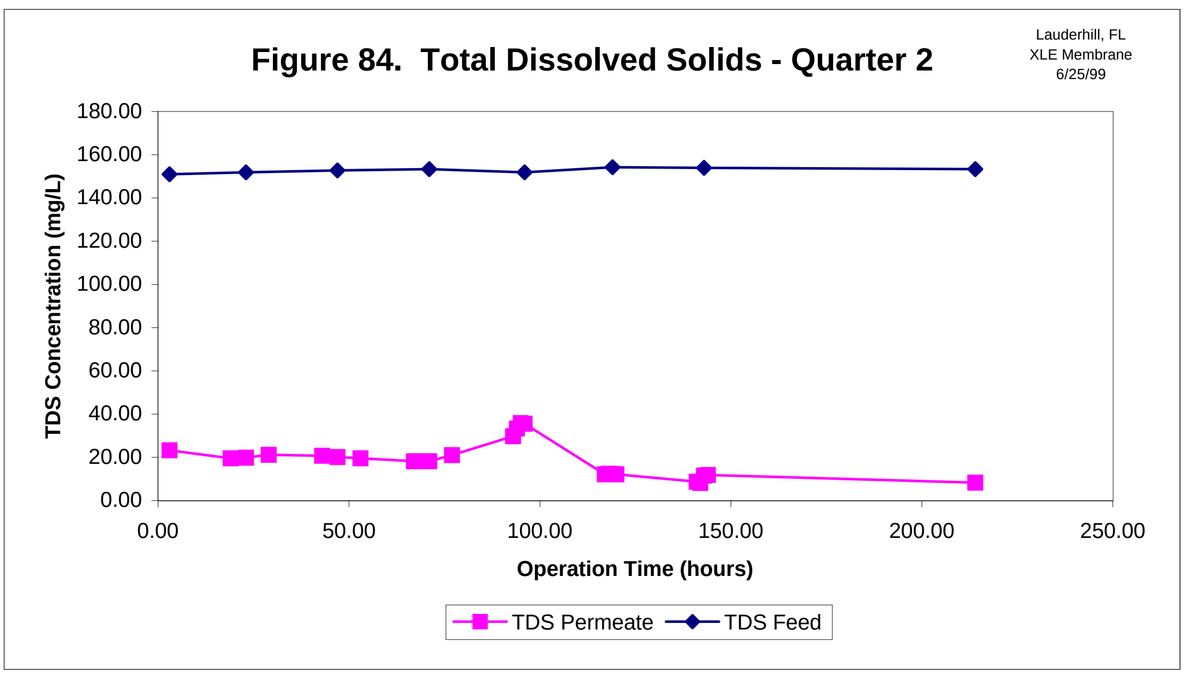
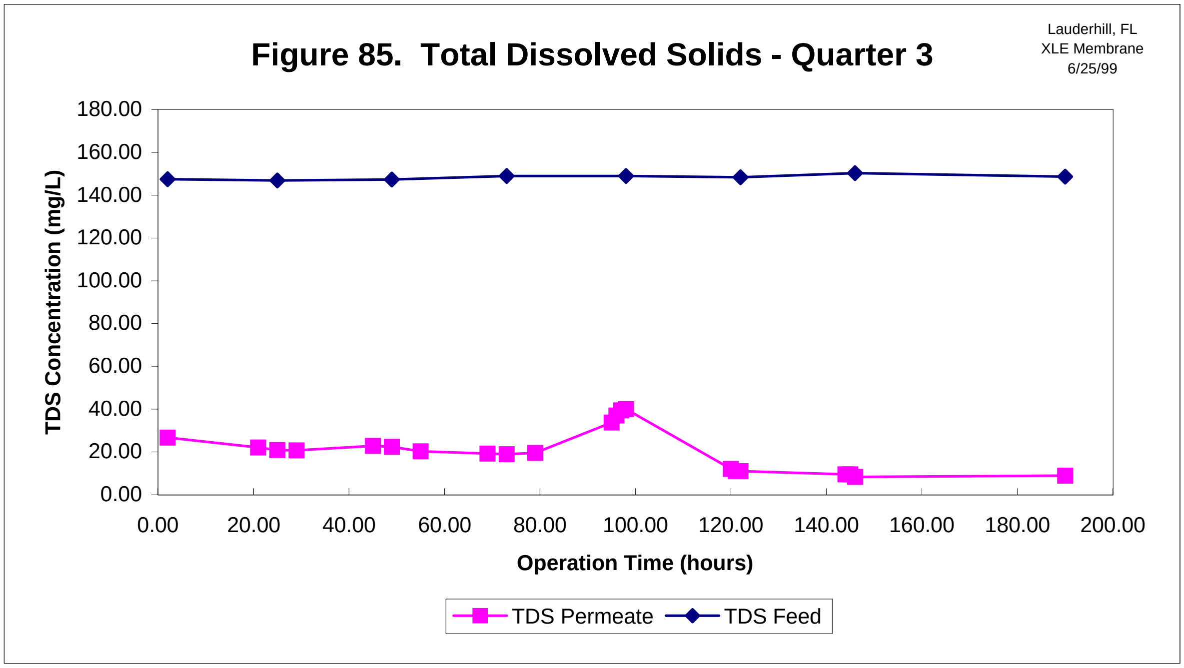
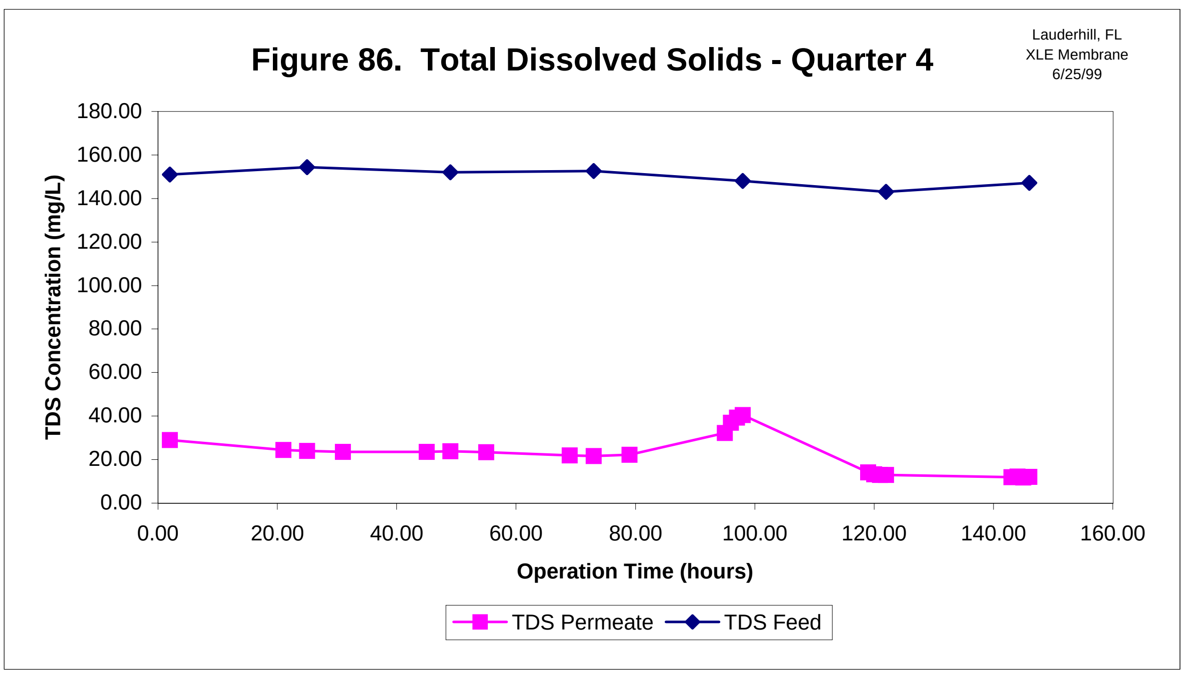


Figure 84. Total Dissolved Solids - Quarter 2
Lauderhill, FL
XLE Membrane
6/25/99
TDS Concentration (mg/L)
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
0.00
50.00
100.00
150.00
200.00
250.00
Operation Time (hours)
TDS Permeate
TDS Feed



Lauderhill, FL
XLE Membrane
6/25/99
Figure 85. Total Dissolved Solids - Quarter 3
TDS Concentration (mg/L)
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
Operation Time (hours)
TDS Permeate
TDS Feed



Lauderhill, FL
XLE Membrane
6/25/99
Figure 86. Total Dissolved Solids - Quarter 4
TDS Concentration (mg/L)
180.00
160.00
140.00
120.00
100.00
80.00
60.00
40.00
20.00
0.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
Operation Time (hours)
TDS Permeate
TDS Feed

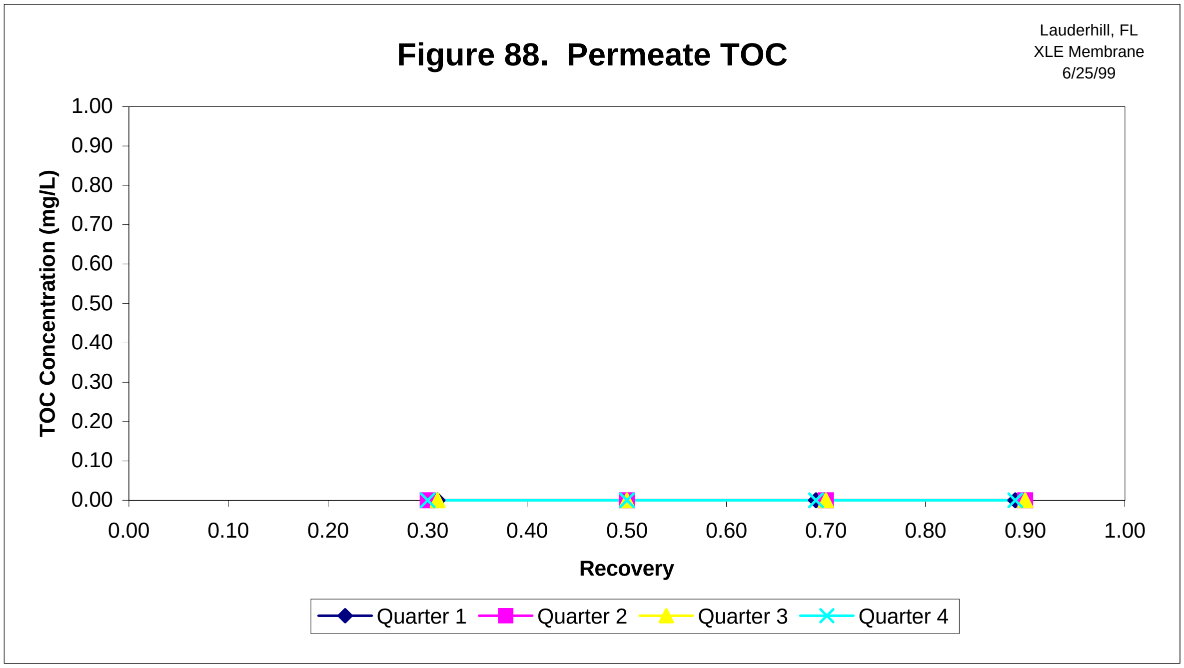


Figure 88. Permeate TOC
Lauderhill, FL
XLE Membrane
6/25/99
TOC Concentration (mg/L)
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00
Recovery
Quarter 1
Quarter 2
Quarter 3
Quarter 4

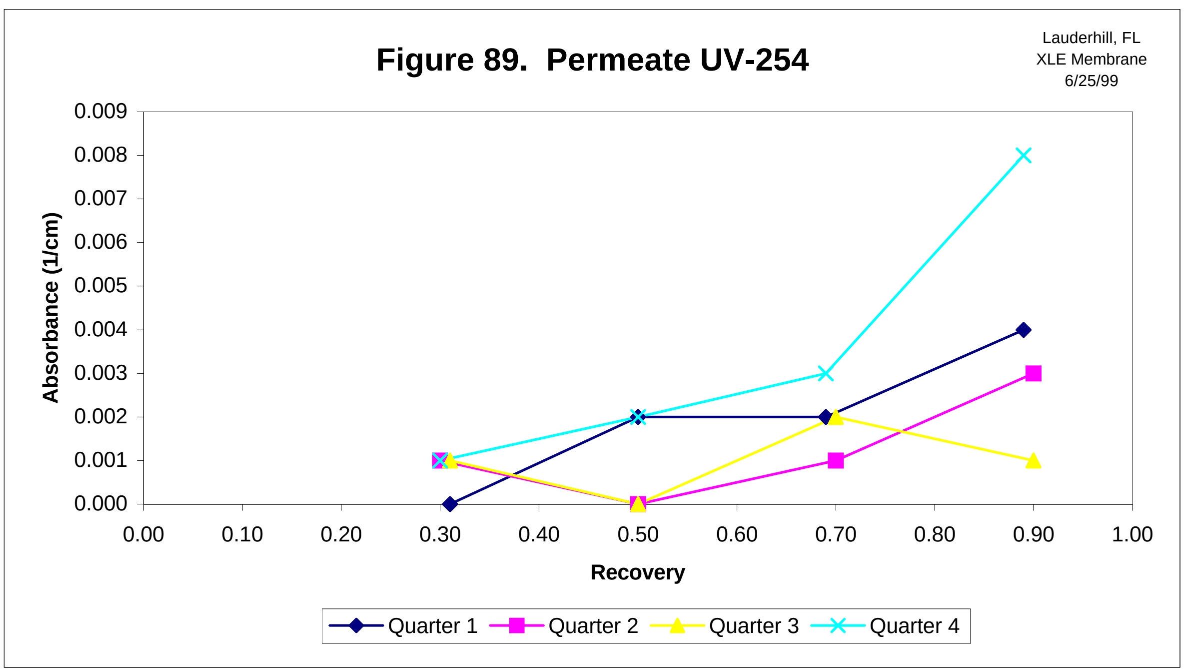


Figure 89. Permeate UV-254
Lauderhill, FL
XLE Membrane
6/25/99
Absorbance (1/cm)
0.009
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0.000
0.00 0.10 0.20 0.30 0.40 0.50 0.60 0.70 0.80 0.90 1.00
Recovery
Quarter 1
Quarter 2
Quarter 3
Quarter 4

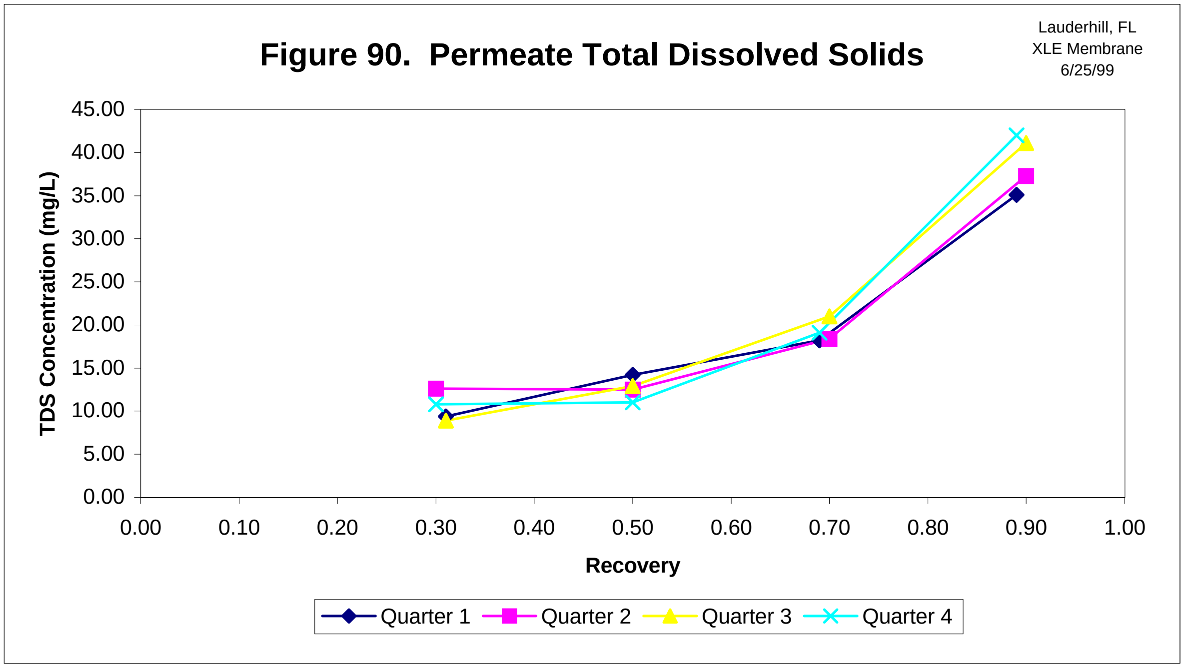


Figure 90. Permeate Total Dissolved Solids
Lauderhill, FL
XLE Membrane
6/25/99
TDS Concentration (mg/L)
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Recovery
Quarter 1
Quarter 2
Quarter 3
Quarter 4

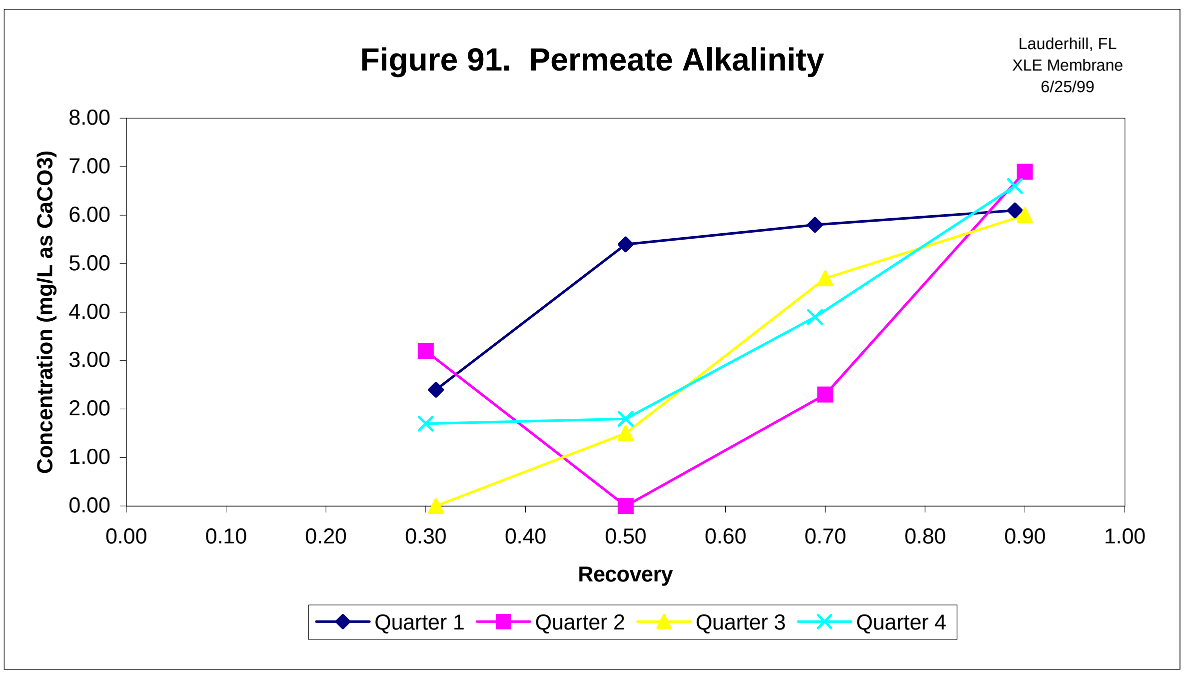


Figure 91. Permeate Alkalinity
Lauderhill, FL
XLE Membrane
6/25/99
Concentration (mg/L as CaCO3)
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Recovery
Quarter 1
Quarter 2
Quarter 3
Quarter 4

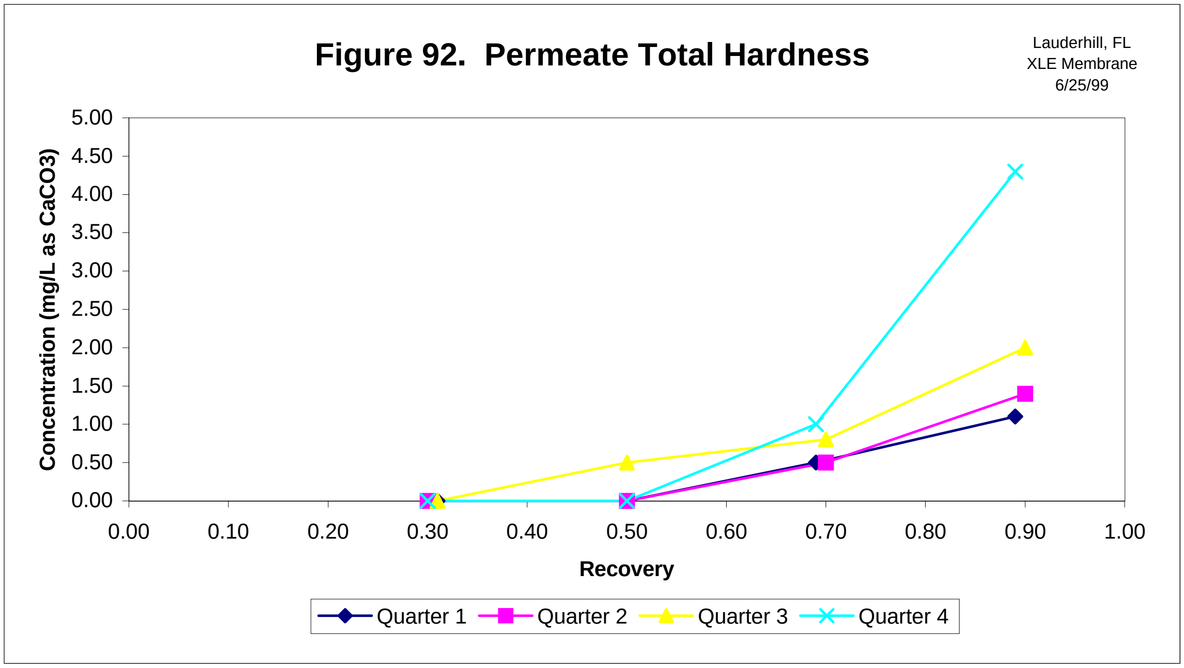


Figure 92. Permeate Total Hardness
Lauderhill, FL
XLE Membrane
6/25/99
Concentration (mg/L as CaCO3)
5.00
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Recovery
Quarter 1
Quarter 2
Quarter 3
Quarter 4

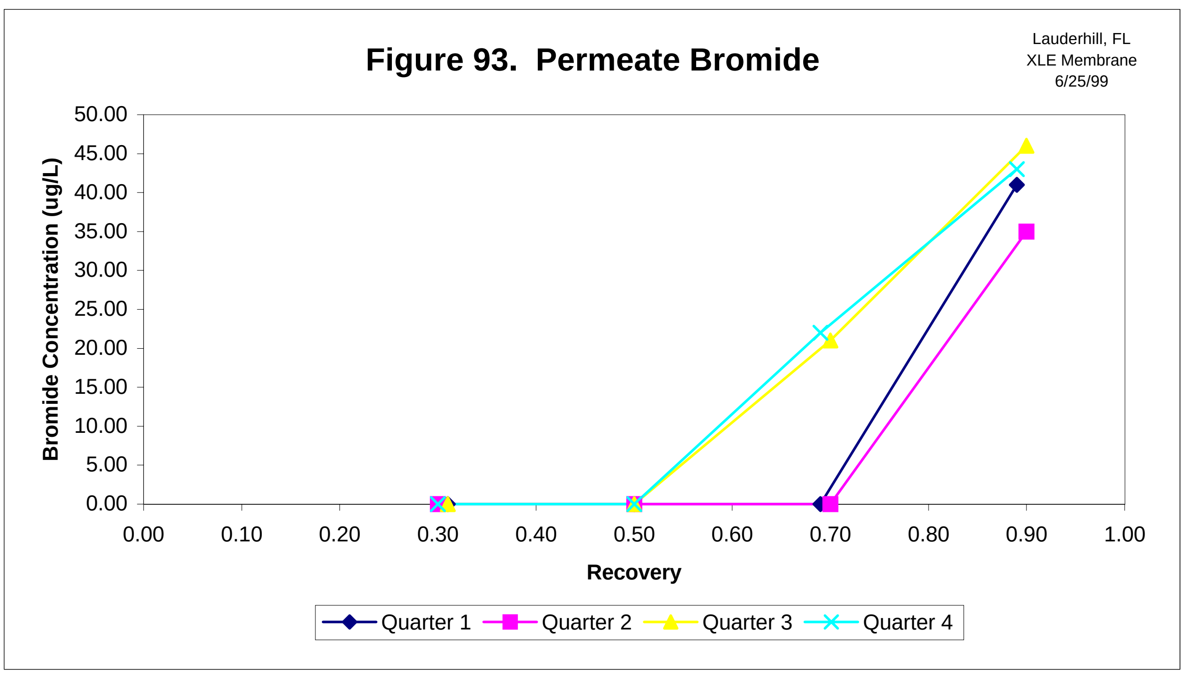


Figure 93. Permeate Bromide
Lauderhill, FL
XLE Membrane
6/25/99
Bromide Concentration (ug/L)
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Recovery
Quarter 1
Quarter 2
Quarter 3
Quarter 4

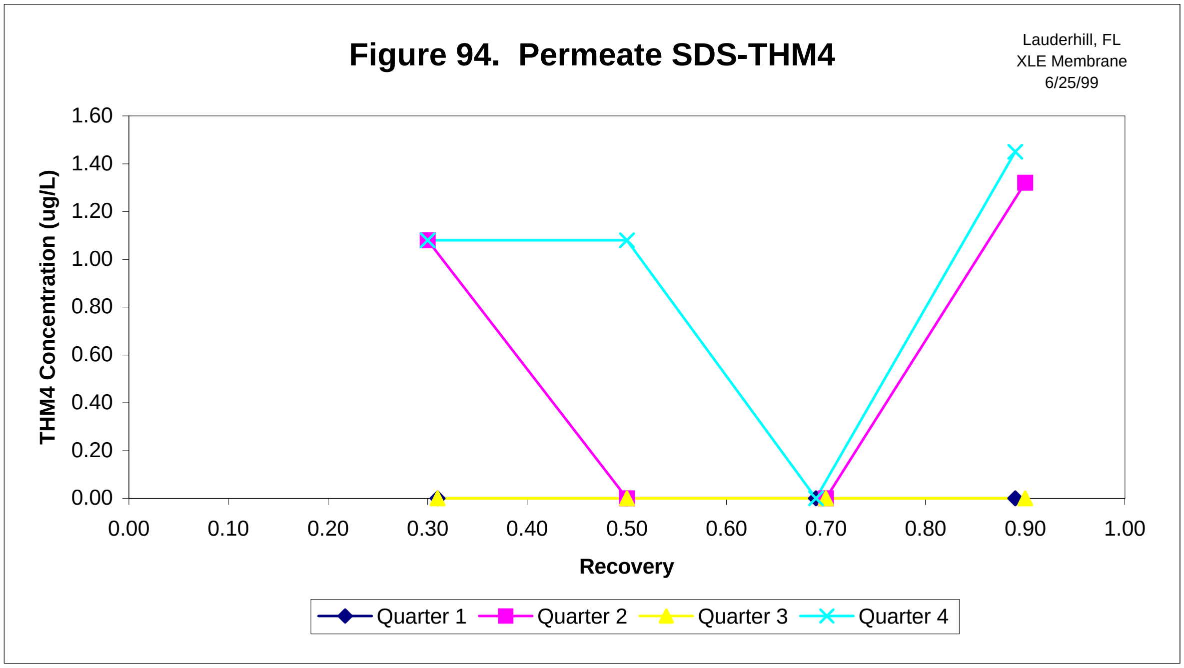


Figure 94. Permeate SDS-THM4
Lauderhill, FL
XLE Membrane
6/25/99
THM4 Concentration (ug/L)
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Recovery
Quarter 1
Quarter 2
Quarter 3
Quarter 4

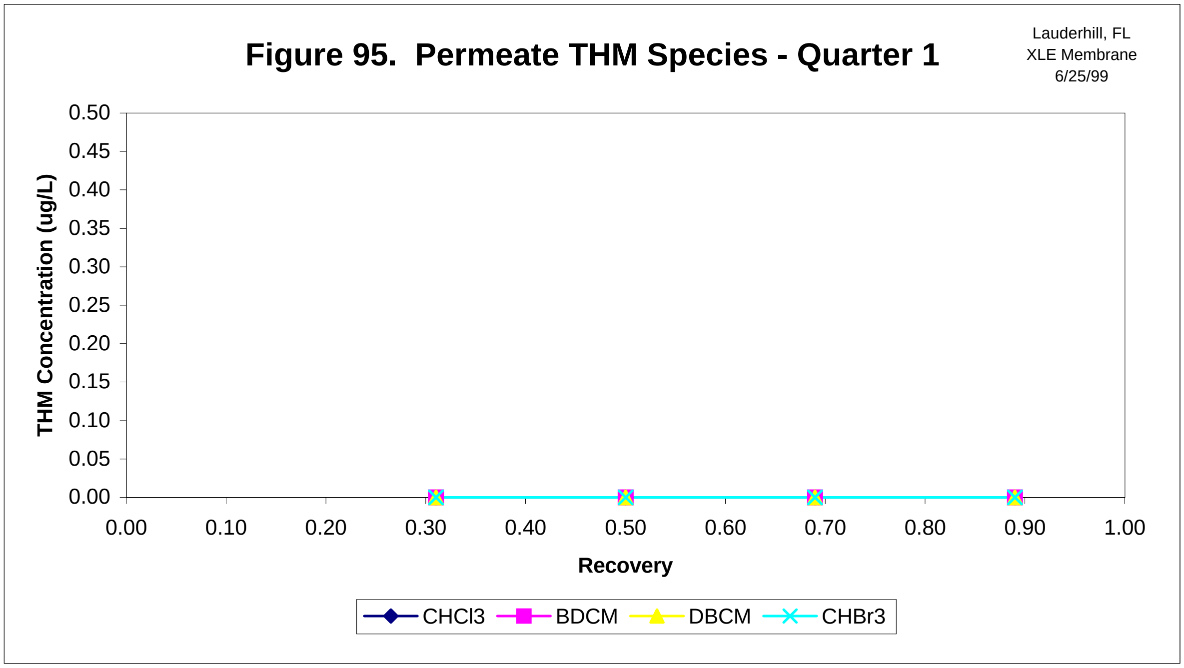


Figure 95. Permeate THM Species - Quarter 1
Lauderhill, FL
XLE Membrane
6/25/99
THM Concentration (ug/L)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Recovery
CHCl3
BDCM
DBCM
CHBr3

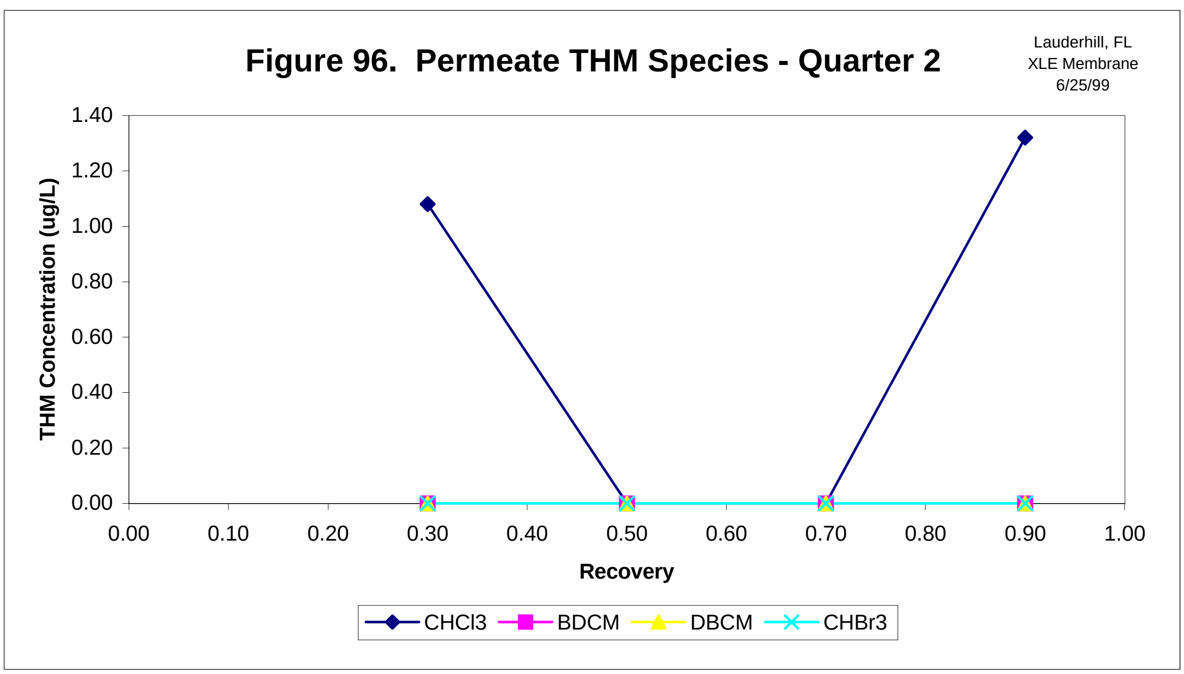


Figure 96. Permeate THM Species - Quarter 2
Lauderhill, FL
XLE Membrane
6/25/99
THM Concentration (ug/L)
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Recovery
CHCl3
BDCM
DBCM
CHBr3

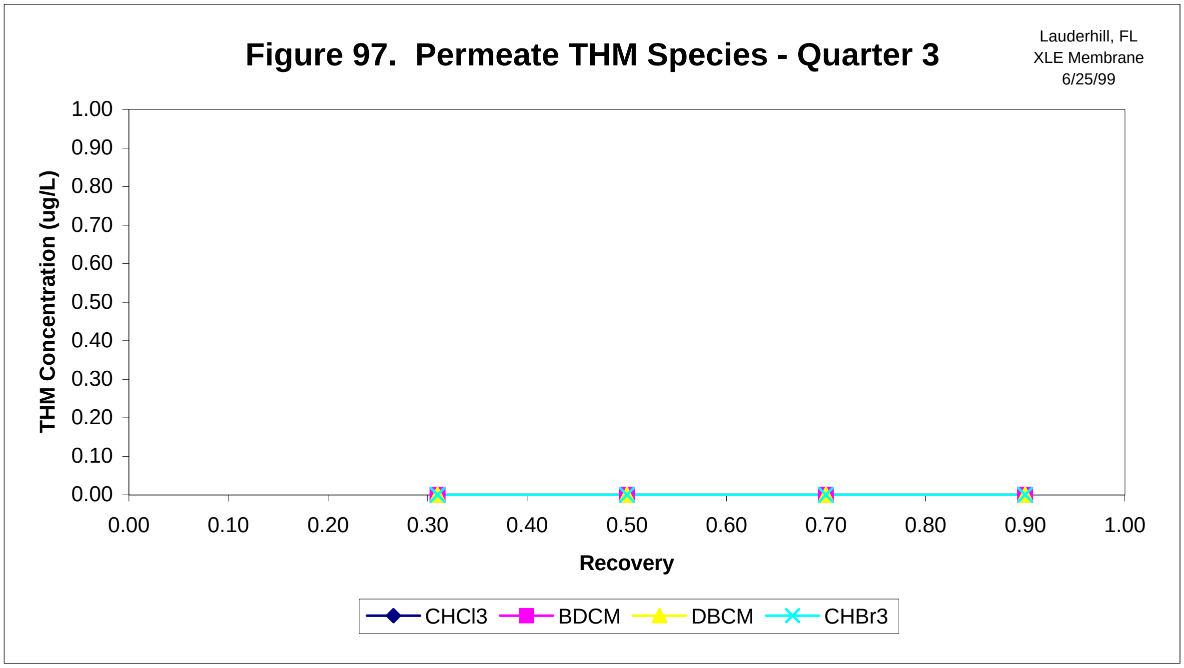


Figure 97. Permeate THM Species - Quarter 3
Lauderhill, FL
XLE Membrane
6/25/99
THM Concentration (ug/L)
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Recovery
CHCl3
BDCM
DBCM
CHBr3

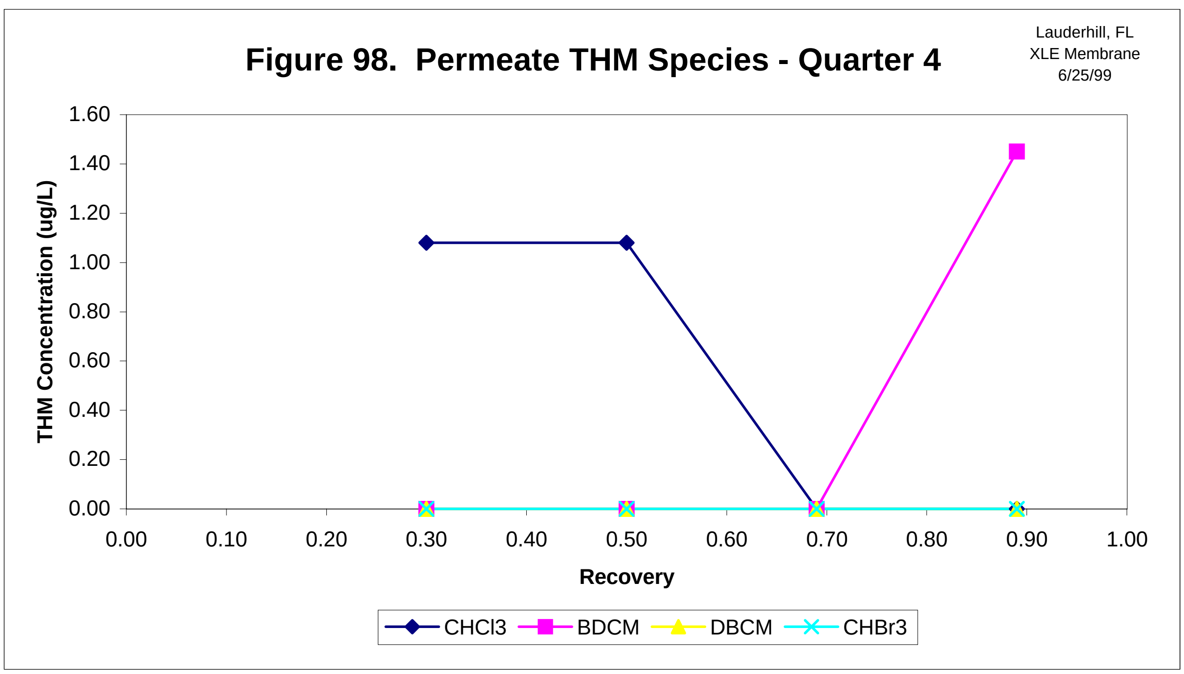


Figure 98. Permeate THM Species - Quarter 4
Lauderhill, FL
XLE Membrane
6/25/99
THM Concentration (ug/L)
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Recovery
CHCl3
BDCM
DBCM
CHBr3

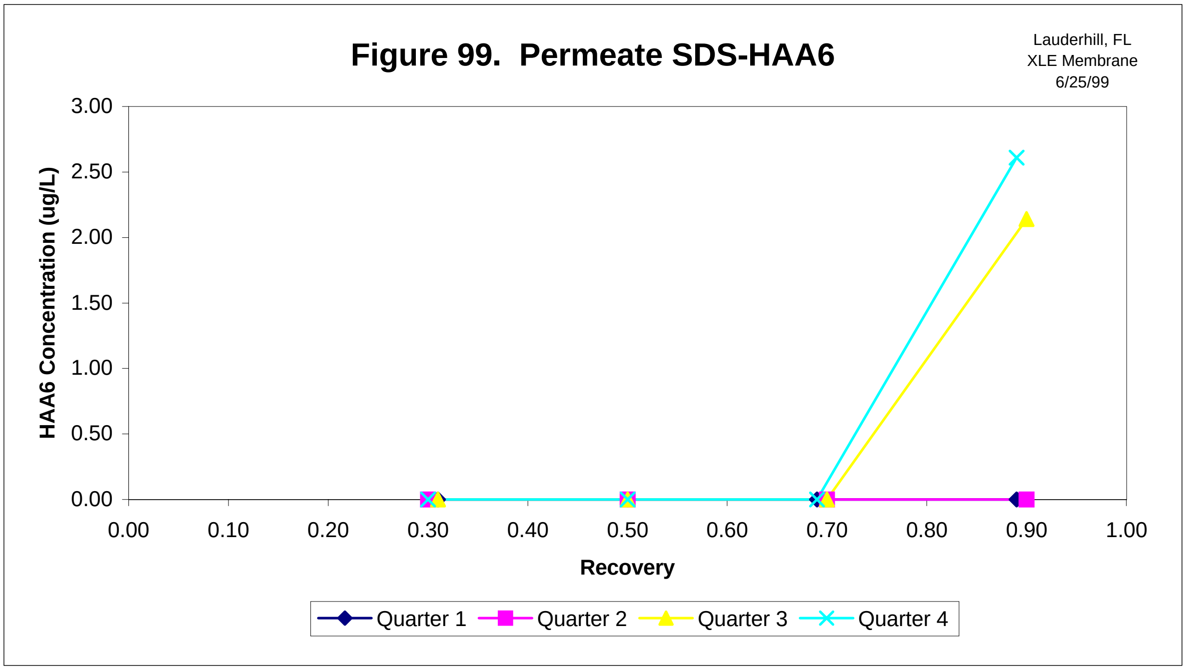


Figure 99. Permeate SDS-HAA6
Lauderhill, FL
XLE Membrane
6/25/99
HAA6 Concentration (ug/L)
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Recovery
Quarter 1
Quarter 2
Quarter 3
Quarter 4

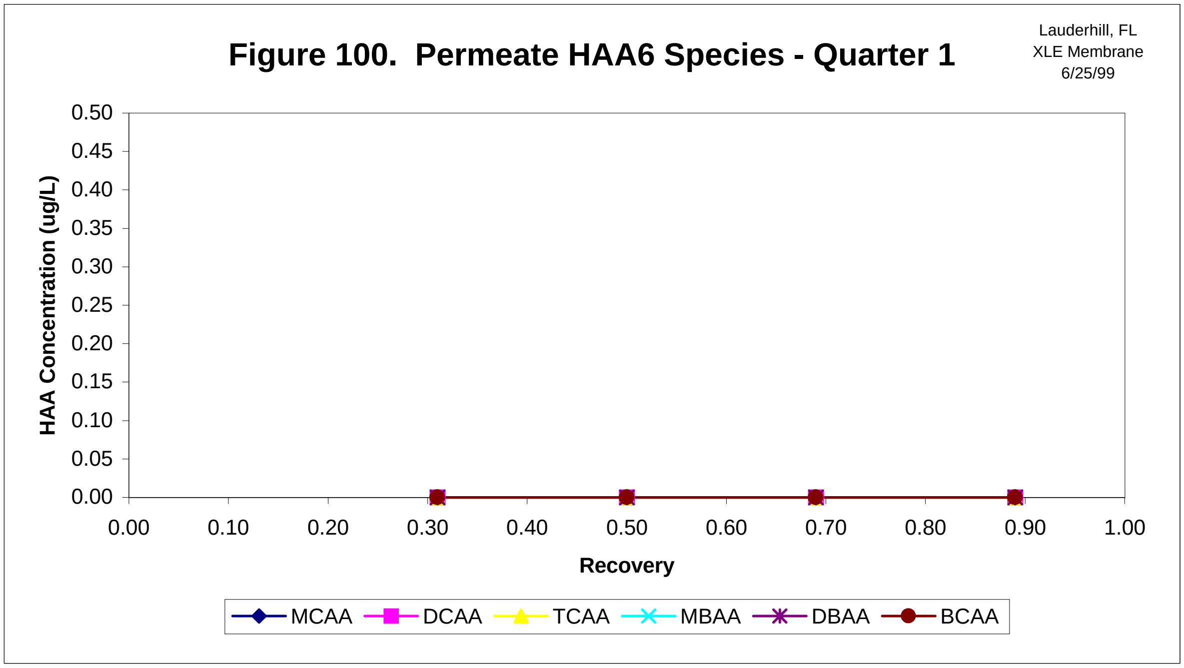


Figure 100. Permeate HAA6 Species - Quarter 1
Lauderhill, FL
XLE Membrane
6/25/99
HAA Concentration (ug/L)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Recovery
MCAA
DCAA
TCAA
MBAA
DBAA
BCAA

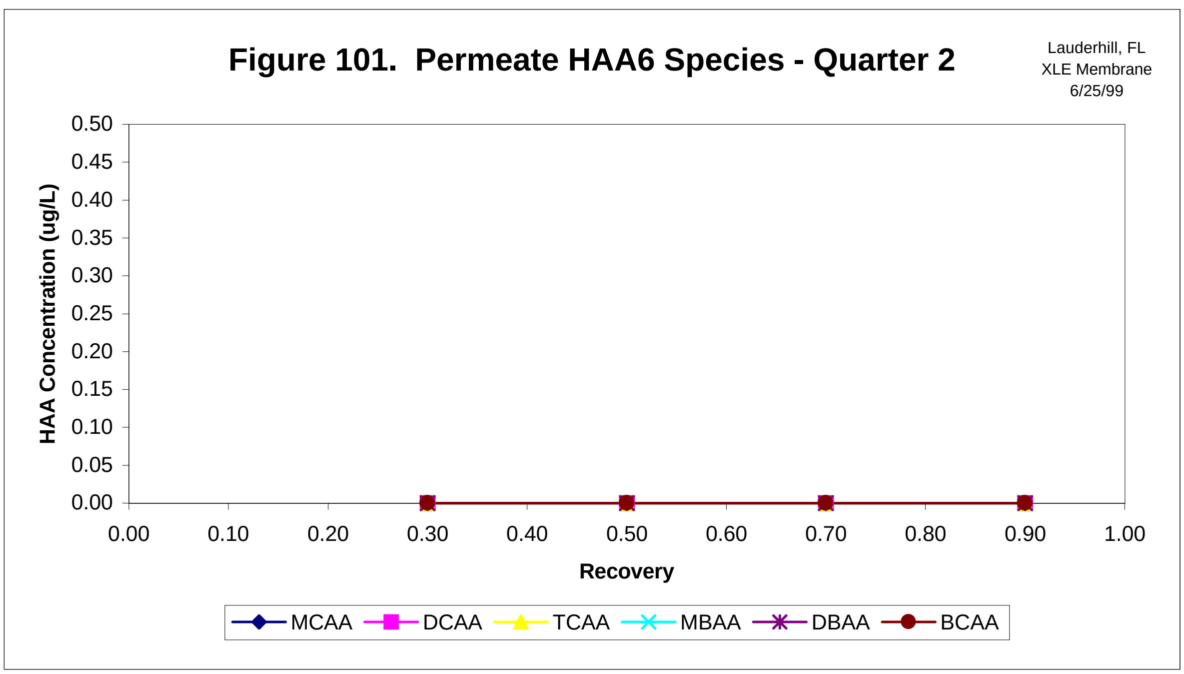


Figure 101. Permeate HAA6 Species - Quarter 2
Lauderhill, FL
XLE Membrane
6/25/99
HAA Concentration (ug/L)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Recovery
MCAA
DCAA
TCAA
MBAA
DBAA
BCAA

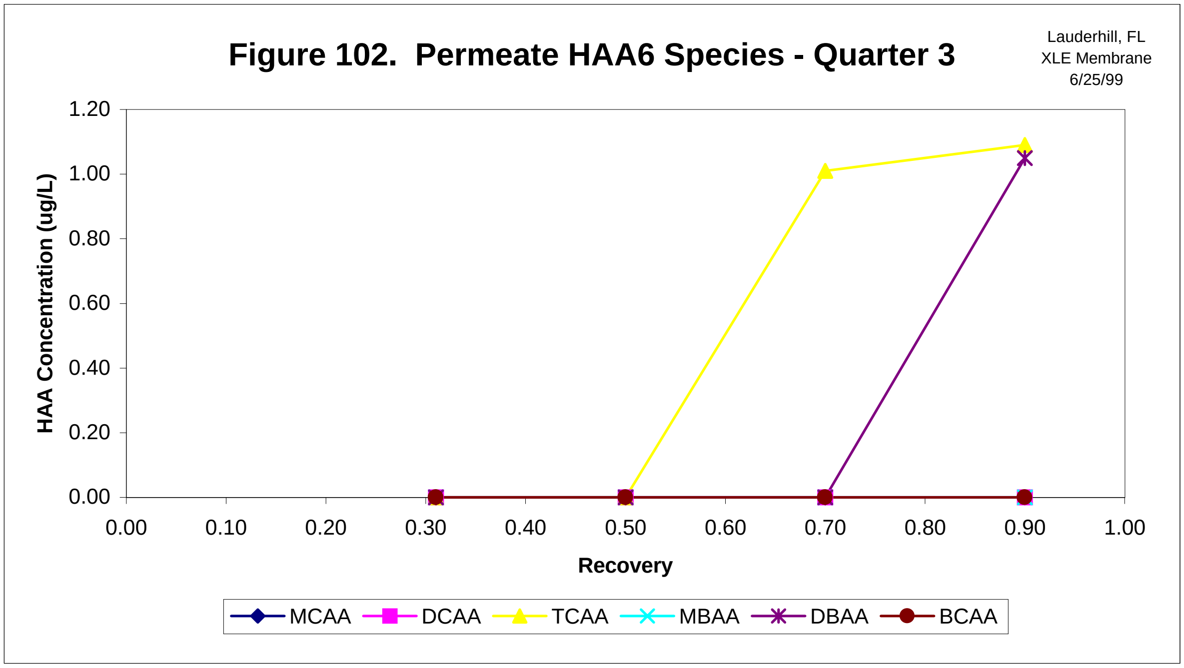


Figure 102. Permeate HAA6 Species - Quarter 3
Lauderhill, FL
XLE Membrane
6/25/99
HAA Concentration (ug/L)
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Recovery
MCAA
DCAA
TCAA
MBAA
DBAA
BCAA

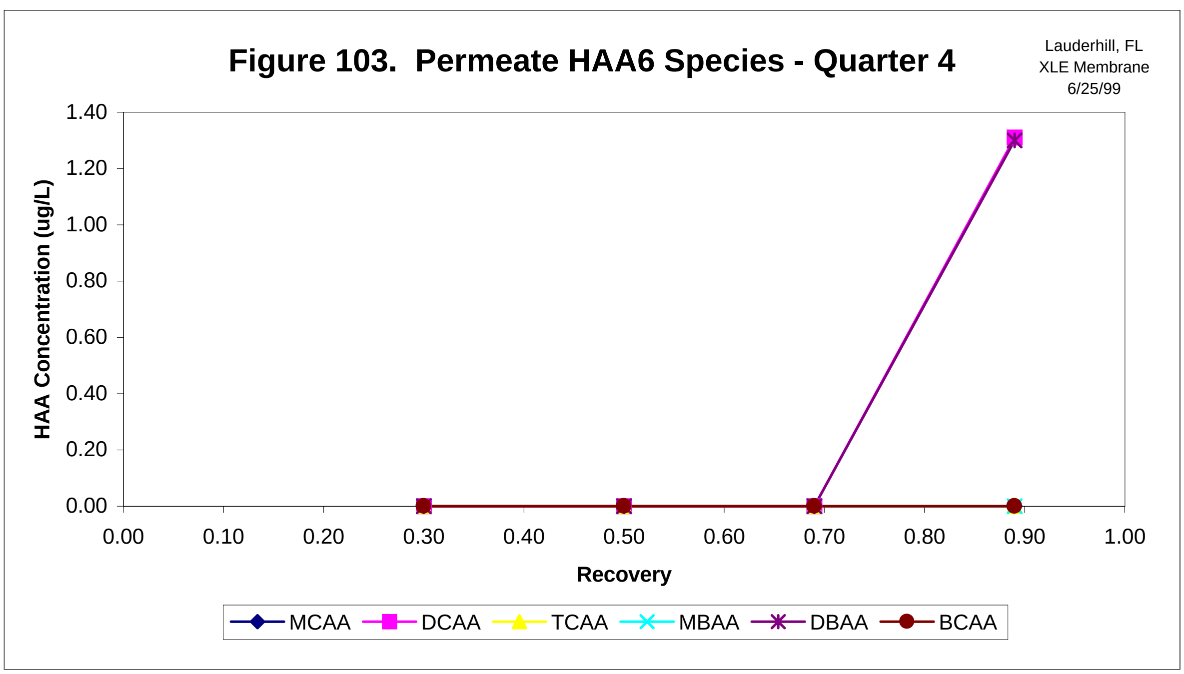


Figure 103. Permeate HAA6 Species - Quarter 4
Lauderhill, FL
XLE Membrane
6/25/99
HAA Concentration (ug/L)
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
1.00
Recovery
MCAA
DCAA
TCAA
MBAA
DBAA
BCAA

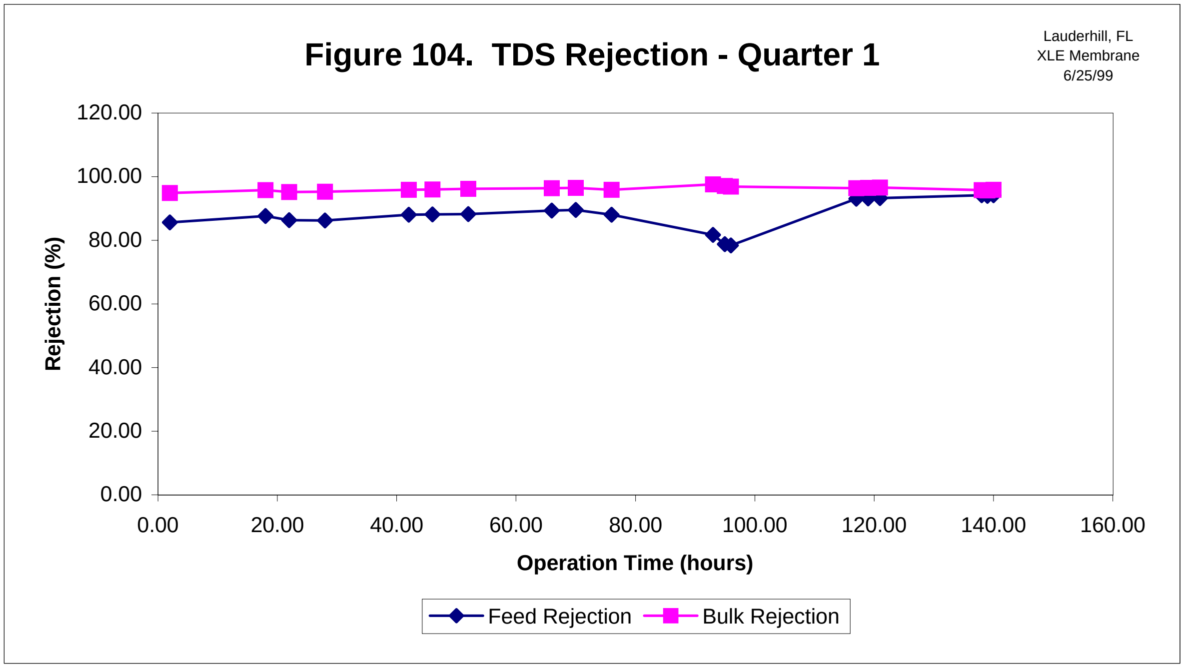


Figure 104. TDS Rejection - Quarter 1
Lauderhill, FL
XLE Membrane
6/25/99
Rejection (%)
120.00
100.00
80.00
60.00
40.00
20.00
0.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
Operation Time (hours)
Feed Rejection
Bulk Rejection

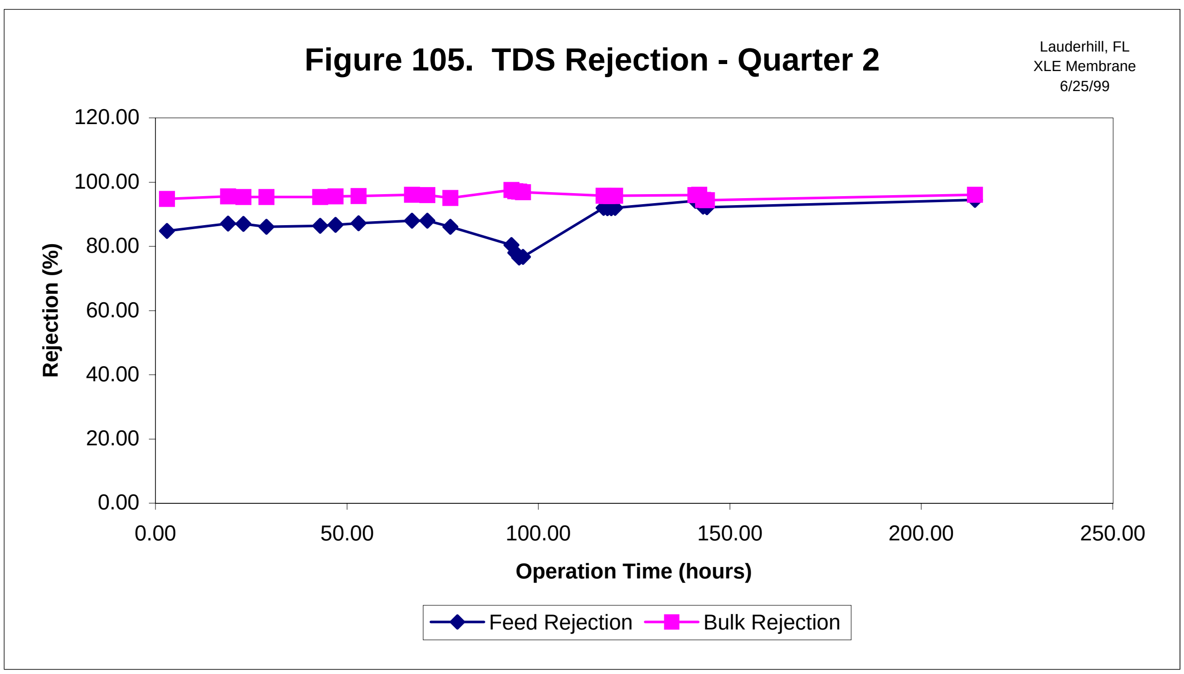


Figure 105. TDS Rejection - Quarter 2
Lauderhill, FL
XLE Membrane
6/25/99
Rejection (%)
120.00
100.00
80.00
60.00
40.00
20.00
0.00
0.00
50.00
100.00
150.00
200.00
250.00
Operation Time (hours)
Feed Rejection
Bulk Rejection

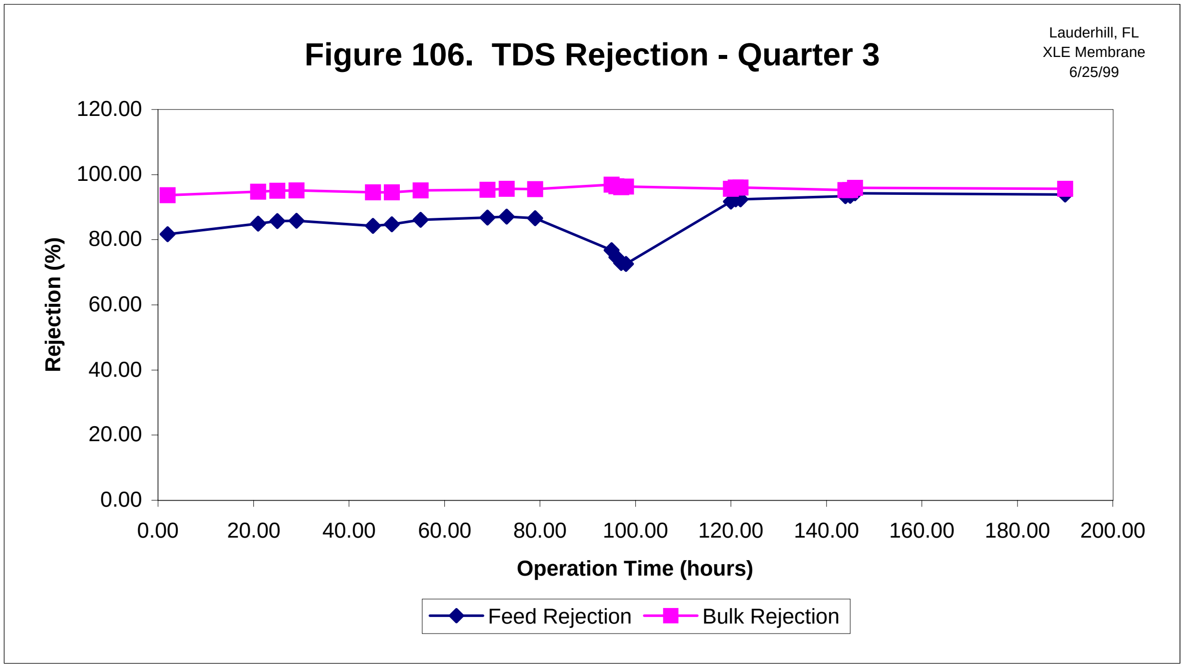


Figure 106. TDS Rejection - Quarter 3
Lauderhill, FL
XLE Membrane
6/25/99
120.00
100.00
80.00
60.00
40.00
20.00
0.00
Rejection (%)
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
180.00
200.00
Operation Time (hours)
Feed Rejection
Bulk Rejection

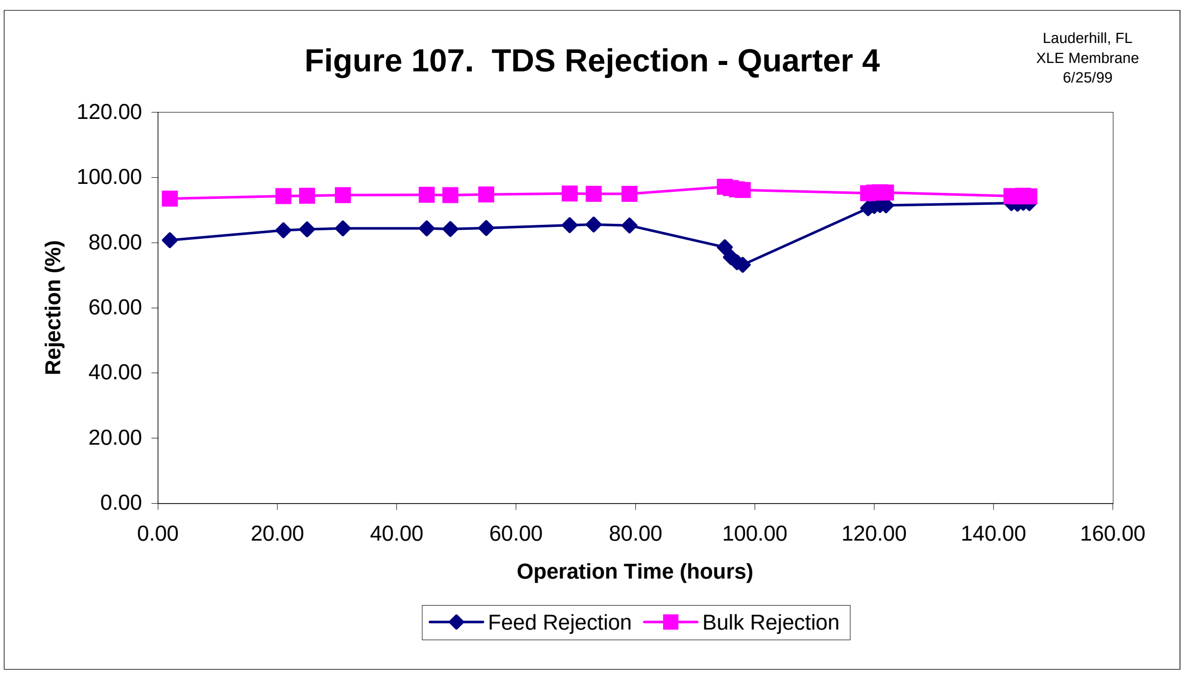


Figure 107. TDS Rejection - Quarter 4
Lauderhill, FL
XLE Membrane
6/25/99
120.00
100.00
80.00
60.00
40.00
20.00
0.00
Rejection (%)
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
Operation Time (hours)
Feed Rejection
Bulk Rejection

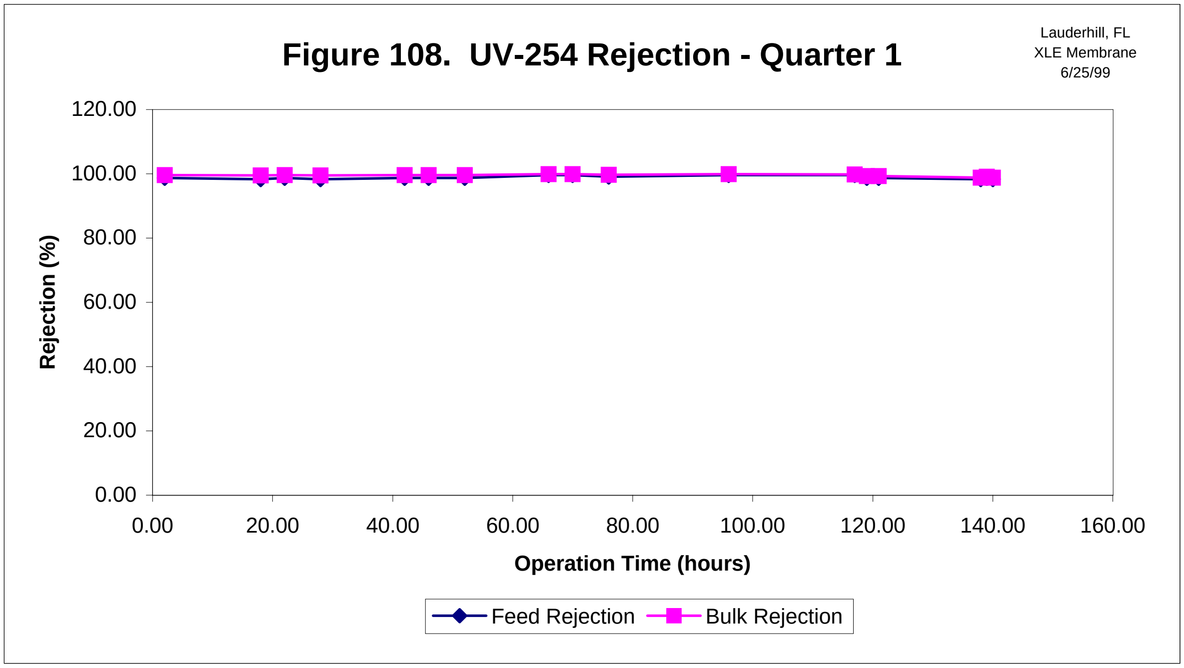


Figure 108. UV-254 Rejection - Quarter 1
Lauderhill, FL
XLE Membrane
6/25/99
Rejection (%)
120.00
100.00
80.00
60.00
40.00
20.00
0.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
Operation Time (hours)
Feed Rejection
Bulk Rejection

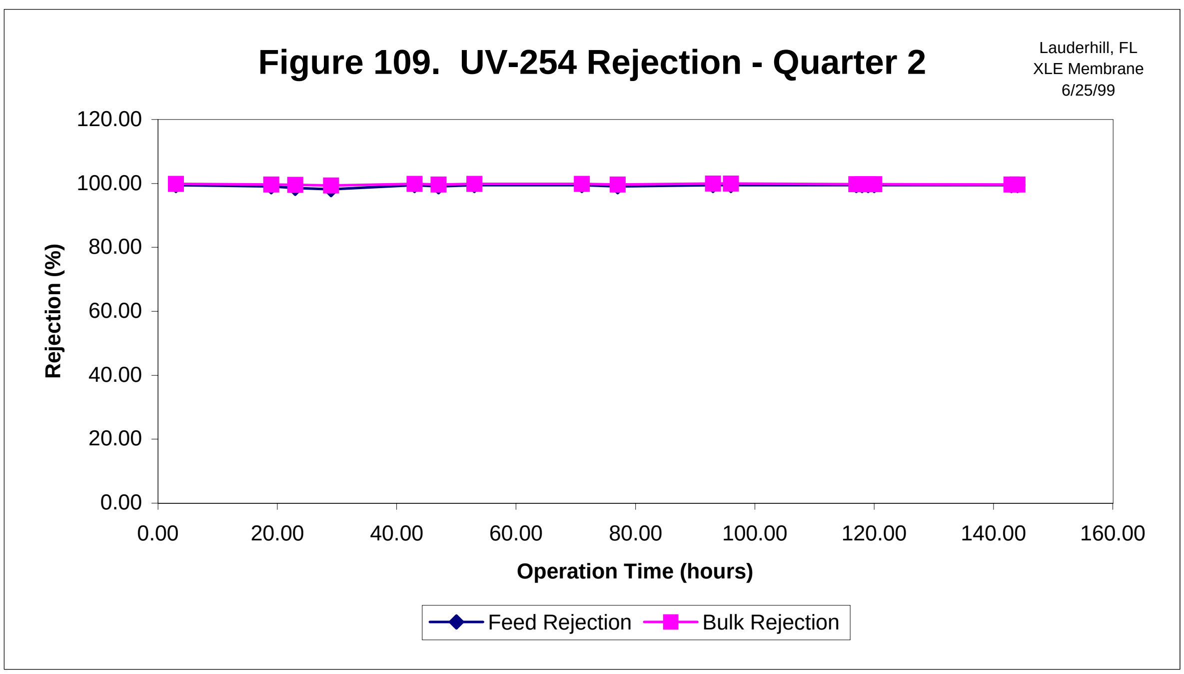


Figure 109. UV-254 Rejection - Quarter 2
Lauderhill, FL
XLE Membrane
6/25/99
Rejection (%)
120.00
100.00
80.00
60.00
40.00
20.00
0.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
Operation Time (hours)
Feed Rejection
Bulk Rejection

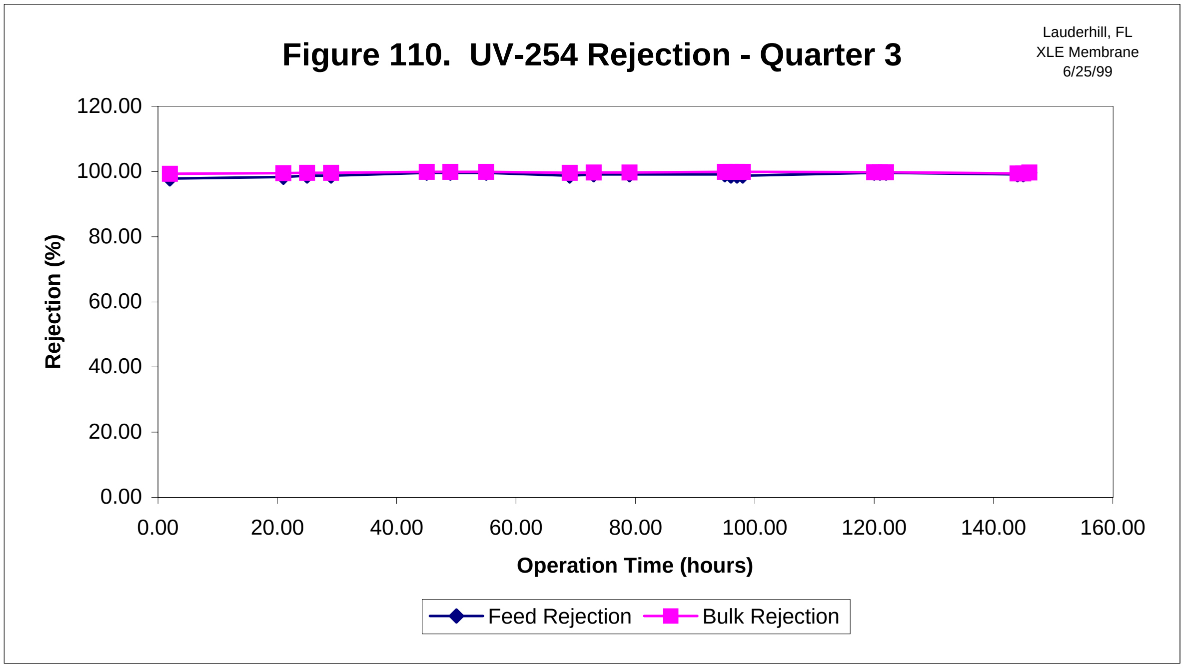


Figure 110. UV-254 Rejection - Quarter 3
Lauderhill, FL
XLE Membrane
6/25/99
Rejection (%)
120.00
100.00
80.00
60.00
40.00
20.00
0.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
Operation Time (hours)
Feed Rejection
Bulk Rejection

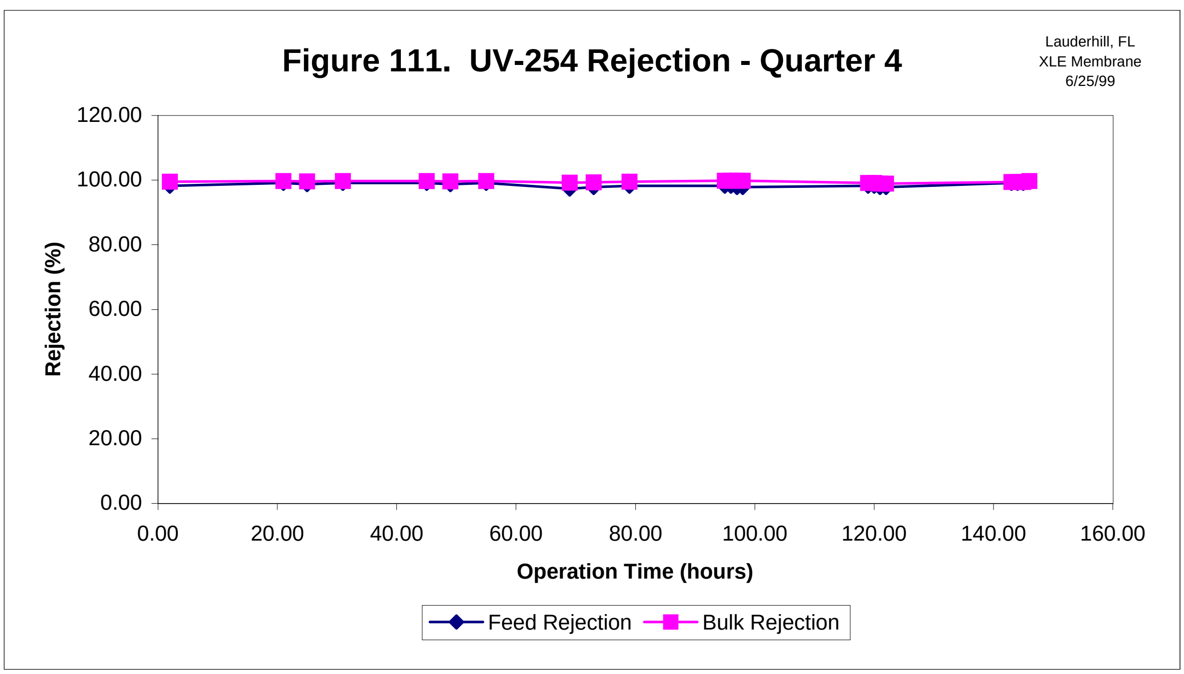


Figure 111. UV-254 Rejection - Quarter 4
Lauderhill, FL
XLE Membrane
6/25/99
Rejection (%)
120.00
100.00
80.00
60.00
40.00
20.00
0.00
0.00
20.00
40.00
60.00
80.00
100.00
120.00
140.00
160.00
Operation Time (hours)
Feed Rejection
Bulk Rejection