

Reverse Osmosis System Analysis for FILMTEC™ Membranes

ROSA v6.1.4 ConfigDB U238786\_55

Project: LonzaUSP

Case: 1

Michael Molloy, Qualification Process Solutions, LLC

4/30/2007

**Project Information:**

**System Details**

Feed Flow to Stage 1	12.87 gpm	Pass 1 Permeate Flow	1.22 gpm	Osmotic Pressure:	
Raw Water Flow to System	1.87 gpm	Pass 1 Recovery	65.12 %	Feed	10.85 psig
Feed Pressure	151.00 psig	Feed Temperature	16.0 C	Concentrate	33.59 psig
Fouling Factor	0.85	Feed TDS	952.59 mg/l	Average	22.22 psig
Chem. Dose	None	Number of Elements	4	Average NDP	96.08 psig
Total Active Area	360.00 ft²	Average Pass 1 Flux	4.87 gfd	Power	1.06 kW
Water Classification: Surface Supply SDI < 3				Specific Energy	14.47 kWh/kgal

Stage	Element	#PV	#Ele	Feed Flow (gpm)	Feed Press (psig)	Recirc Flow (gpm)	Conc Flow (gpm)	Conc Press (psig)	Perm Flow (gpm)	Avg Flux (gfd)	Perm Press (psig)	Boost Press (psig)	Perm TDS (mg/l)
1	RO-4040-FF	1	1	12.87	146.00	11.00	12.48	140.71	0.39	6.21	40.00	151.00	35.81
2	RO-4040-FF	1	1	12.48	135.71	0.00	12.15	130.63	0.33	5.31	40.00	0.00	42.73
3	RO-4040-FF	1	1	12.15	125.63	0.00	11.87	120.73	0.28	4.42	40.00	0.00	52.04
4	RO-4040-FF	1	1	11.87	115.73	0.00	11.65	110.96	0.22	3.54	40.00	0.00	65.27

Pass Streams (mg/l as Ion)													
Name	Feed	Adjusted Feed		Concentrate				Permeate					
		Initial	After Recycles	Stage 1	Stage 2	Stage 3	Stage 4	Stage 1	Stage 2	Stage 3	Stage 4	Total	
NH4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
K	5.10	5.10	11.99	12.33	12.62	12.88	13.08	1.26	1.47	1.75	2.12	1.58	
Na	130.00	368.34	1056.97	1089.46	1118.79	1144.37	1165.67	12.79	15.30	18.68	23.50	16.76	
Mg	100.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ca	43.00	0.10	0.29	0.30	0.31	0.32	0.32	0.00	0.00	0.00	0.00	0.00	0.00
Sr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Ba	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CO3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HCO3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NO3	6.70	6.70	15.04	15.45	15.81	16.11	16.36	1.94	2.27	2.69	3.26	2.44	
Cl	172.00	567.39	1628.16	1678.21	1723.39	1762.78	1795.61	19.70	23.56	28.77	36.20	25.81	
F	0.80	0.80	2.29	2.36	2.42	2.48	2.52	0.03	0.04	0.05	0.06	0.04	
SO4	0.15	0.15	0.44	0.45	0.47	0.48	0.48	0.00	0.00	0.00	0.00	0.00	0.00
SiO2	4.00	4.00	11.65	12.01	12.34	12.62	12.86	0.07	0.08	0.10	0.13	0.09	
Boron	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TDS	461.76	952.59	2726.84	2810.57	2886.15	2952.03	3006.91	35.81	42.73	52.04	65.27	46.73	
pH	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00

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### Design Warnings

-None-

### Solubility Warnings

-None-

### Stage Details

Stage	Element	Recovery	Perm Flow (gpm)	Perm TDS (mg/l)	Feed Flow (gpm)	Feed TDS (mg/l)	Feed Press (psig)
Stage 1	Element	Recovery	0.39	35.81	12.87	2726.84	146.00
1		0.03					
Stage 2	Element	Recovery	0.33	42.73	12.48	2810.57	135.71
1		0.03					
Stage 3	Element	Recovery	0.28	52.04	12.15	2886.15	125.63
1		0.02					
Stage 4	Element	Recovery	0.22	65.27	11.87	2952.03	115.73
1		0.02					

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**Scaling Calculations**

	Raw Water	Adjusted Feed	Concentrate
pH	7.00	7.00	7.00
Langelier Saturation Index	-7.94	-10.60	-9.94
Stiff & Davis Stability Index	-7.51	-10.16	-9.89
Ionic Strength (Molal)	0.02	0.02	0.05
TDS (mg/l)	461.76	952.59	3006.91
HCO <sub>3</sub>	0.00	0.00	0.00
CO <sub>2</sub>	0.00	0.00	0.00
CO <sub>3</sub>	0.00	0.00	0.00
CaSO <sub>4</sub> (% Saturation)	0.00	0.00	0.00
BaSO <sub>4</sub> (% Saturation)	0.05	0.00	0.00
SrSO <sub>4</sub> (% Saturation)	0.00	0.00	0.00
CaF <sub>2</sub> (% Saturation)	3.66	0.01	0.27
SiO <sub>2</sub> (% Saturation)	3.20	3.20	12.02
Mg(OH) <sub>2</sub> (% Saturation)	0.00	0.00	0.00

To balance: 395.39 mg/l Cl added to feed.