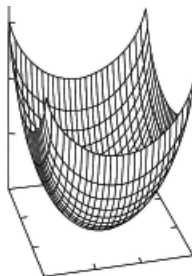


**A 1500 GPD REVERSE OSMOSIS SYSTEM
FOR HOUSEHOLD WATER**



DECEMBER 3. 2002



REMCO ENGINEERING

ENVIRONMENTAL WATER SYSTEMS & CONTROLS

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1.0 OVERVIEW

Reverse Osmosis systems use a semi-permeable membrane to separate dissolved solids (TDS) from water. At normal pressure, water will not pass through the membrane because the very small pore size in the membrane causes the surface tension at the water/membrane interface to be too high for water to flow. Increasing the pressure of the water causes the water to pass through the pores. The higher the pressure, the greater the rate of water flow. The higher the dissolved solids level (TDS), the more pressure it takes to get a particular flow rate with a given membrane. For this reason, membranes are rated at a constant TDS and pressure for a certain flow rate.

Some TDS, which is called the leakage, will seep through the membrane and is usually 0.5% or 1%, depending on membrane type. We optimize all process parameters to provide the best system for a particular installation. Each installation may require pretreatment such as softening, pH adjustment, filtration, or carbon treatment to keep the membranes in peak condition. Remember that RO passes the water as the permeate and concentrates the TDS in the reject stream. In most systems, the ratio is 50 : 50, The High-Efficiency system proposed has a ratio of 70 : 30 . A second stage can be added. If excess capacity is purchased, some of the reject can be plumbed back to the input for a second pass.

This system design and performance quoted is based upon the Well water data from the summary table. A summary of the water analysis that was used for the system design is included at the end of this quotation. Water quality variations from the design basis can alter the actual performance of the system as quoted. Make sure the actual water feed will match this analysis.

2.0 FEED PRETREATMENT

2.1 Well water feed - Prefilter

2.1.1 10" filter housing.

2.1.2 5 micron prefilter

2.2 Solenoid shutoff valve

2.2.1 3/4" brass valve.

2.2.2 Automatic operation

2.2.3 110 V. solenoid

2.3 Low pressure Switch

2.3.1 Protects pump when filter clogs

2.3.2 Interfaced to PLC

2.3.3 110 V. operation



3.0 THE REVERSE OSMOSIS SYSTEM

3.1 Skids -

Remco Engineering skids are all fiberglass with an epoxy coating for superior corrosion resistance and provide a long service life. Resistant to both caustics and acids, the skid will not rust out over their long life expectancy (approx 3" long x 3' wide x 5' high). Other configurations are available.

3.1.1 Fabricated and bonded with structural epoxy

3.1.2 Coated with industrial acid and caustic resistant gray epoxy

3.1.3 Vertical controller - instrument mounting panel



3.2 Components

3.2.1 RO pressure vessels, fiberglass or Stainless steel construction

3.2.2 Oil filled pressure gauges for feed and reject stream pressure

3.2.3 Air operated valve on low pressure side, solenoid operated on high pressure

3.2.4 High efficiency, multistage, stainless steel centrifugal pump.

3.2.5 All high pressure components of stainless steel, fiberglass or CPVC

3.2.6 Nema 4x control panel

3.2.7 Flow meters for permeate, reject and recycle streams.

3.3 RO membranes

Thin film type, spiral wound for high flow (1 - each 4" x 40"). System is sized based on the water analysis shown at the end of the quotation. Total system recovery is 80% with a permeate(clean RO water) flow of 1+ gallons per minute.

3.4 RO Feed Pump

1 hp pump with motor.

3.5 Electrical control panel

Nonmetallic fittings, pushbuttons and lights insure long life and good appearance. Nema 4x fiberglass enclosure seals out fumes. Wired for 120V/60hz

- 3.5.1 Nema 4x enclosure, all corrosion resistant fiberglass
- 3.5.2 All switches Nema 4x
- 3.5.3 Air input fittings
- 3.5.4 Soft start motor controls
- 3.5.5 Microprocessor to monitor system and control interfacing between components.
- 3.5.6 Indicating "on" switch with latching relay
- 3.5.7 Internal circuit breaker, 120V
- 3.5.8 Emergency off mushroom head push-button
- 3.5.9 Nema 4x enclosure with meter
- 3.5.10 On/off switch (Nema 4x) in main electrical enclosure
- 3.5.11 Controller output interlocks PC to set alarm



3.6 RO Water holding tank and house feed pump

- 3.6.1 Polyethylene, 300 gallon capacity (35" x 81)
- 3.6.2 Level control (high, and low)
- 3.6.3 Interfaced to main controller
- 3.6.4 3/4 hp 316 stainless steel turbine type centrifugal pump
- 3.6.5 Supplies 15 gpm @ 30 psi
- 3.6.6 Motor contacts mounted in main control panel
- 3.6.7 Romate 30 gallon pressure tank

3.6.8 Pressure switch to control pump on/off

3.6.9 Contactor interfaced through PLC

4.0 INSTALLATION AND WARRANTY

Remco Engineering provides a skid mounted system as described in this proposal, including skid mounted system and any associated feed tanks where noted, hardware, control hardware, software, mechanical, and electrical assembly and installation. If desired Remco Engineering can provide all mechanical and electrical installation labor and material.

4.1 Optional Installation (non-union)

- 4.1.1 Full installation supervision, all components placed on fiberglass & epoxy skid. Other subcontractor to place skid in position and bring utilities to within 6 ft. of system. We will instruct local labor in the correct procedures to hookup and finish installation of the system (tank interconnects, level control wiring, and tank filling)
- 4.1.2 Full startup and installation with Remco supervision
- 4.1.3 Training
- 4.1.4 Manuals, schematics, troubleshooting guide
- 4.1.5 All mechanical installation
- 4.1.6 All electrical installation (excluding power supply)
- 4.1.7 All necessary equipment rentals (by others)
- 4.1.8 General Layout

4.2 Warranty

- 4.2.1 Limited one year parts warranty
- 4.2.2 Limited 90 day labor warranty

5.0 SYSTEMS MAINTENANCE

Any system of this magnitude requires periodic and normal maintenance. A well-designed industrial product should be easy to maintain and work on. This principle applies not only to individual product but also to the interaction of that product with other elements of a system and to the overall system design. The Remco Engineering system design and products have several maintenance advantages.

Periodic maintenance

We recommend a periodic maintenance schedule. A Remco Engineering system has these items to check on this schedule:

- ◆ Verify sensor calibration weekly
- ◆ Daily check for water leak and identify and repair immediately
- ◆ Follow routine maintenance requirements of manufacturers of equipment furnished by Remco Engineering as part of the system.

6.0 INVESTMENT SUMMARY

The scope of supply is to provide a fully functional, turnkey system. The system includes a computer optimized Reverse Osmosis System with pretreatment filtration and associated components with an integrated control system.

6.1 System pricing

ITEM	DESCRIPTION	VALUE
1.	Complete, 1 gpm, automated Reverse Osmosis system rated at 1500gpd	US\$ 8,230.00
2.	Increase to 2gpm	US\$ 9,840.00
3.	RO water holding tank and pressurization tank, pump with controls	US\$ Included
4.	2 cu. ft softener interlocked to RO to prevent fouling (strongly suggested)	US\$ 932.00
5.	Operating, Instruction Manuals & Documentation (2 copies)	US\$ Included
Total Project Value		US\$

6.2 Clarifications

6.2.1 Prices quoted are valid for 30 days

6.2.2 50% down with order
 50% upon ready for shipment
 Delivery 4-6 weeks ARO. FOB our facilities, Ojai, California

6.2.3 Copyrighted control software remains the sole property of Remco Engineering. A license to use the control software for one system is granted upon receipt of all payments.

6.2.4 Supervision of installation and training is available as an option. Travel including airfare, ground transportation, lodging and all out-of-pocket expenses will be billed at actual rates. Two (2) days are included, additional days are available at \$850.00/day.

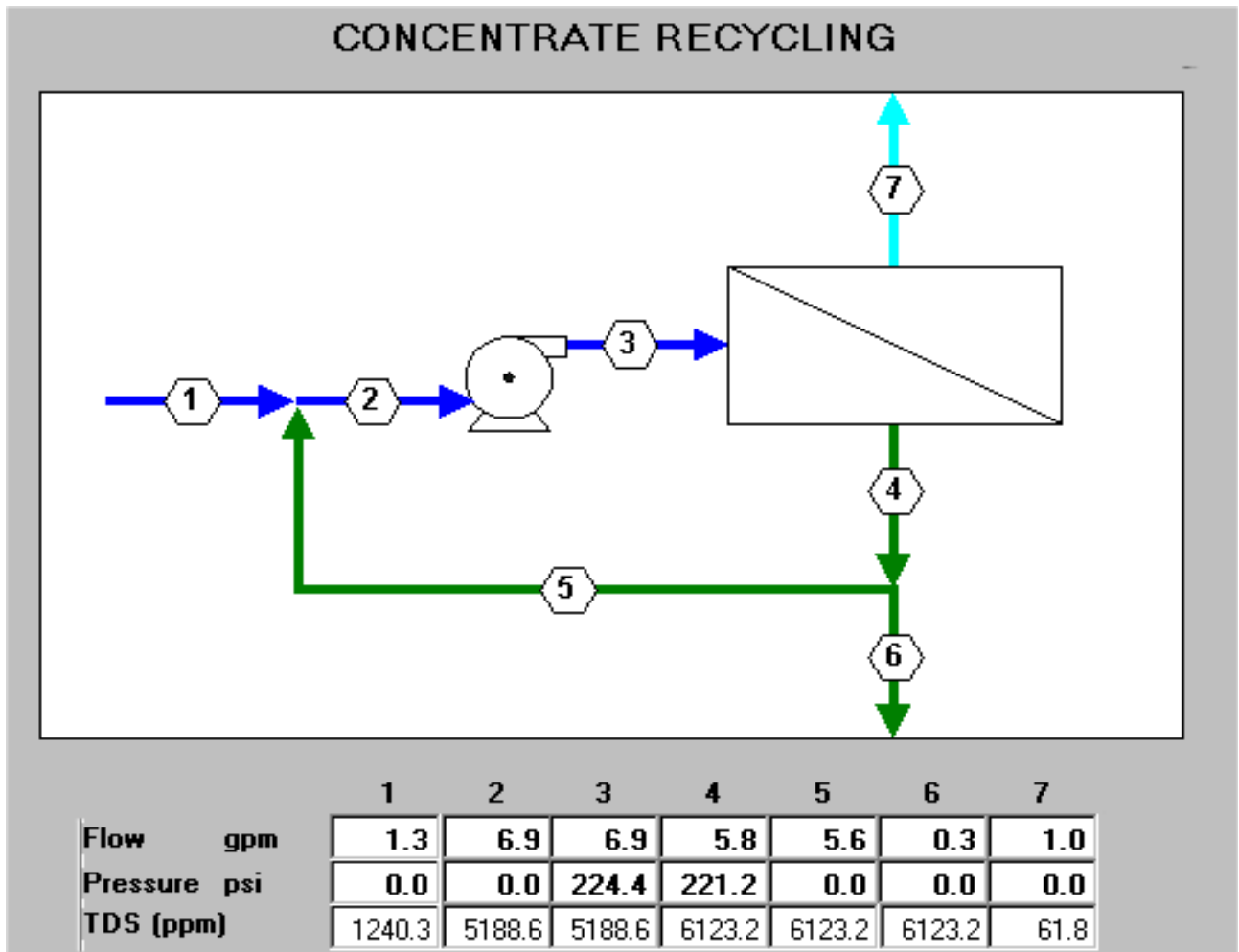
6.2.5 Utilities required include 40 amps, 3 phase 230/460 V electrical, 80 gpm @40 psi filter backwash water (city water), and 20 cfm dry air at 80 psi. Lack of utilities at arrival of installer will incur day labor charges of \$850/day

6.2.6 Other terms per attached Remco Sales Agreement

6.2.7 NO CHEMICALS are included within the scope of our supply.

7.0 DESIGN SUMMARY

The following data is calculated from the parameters furnished by you. Incomplete or erroneous data may change the system operating parameters. Please check the following input data against your own analysis.



CONCENTRATE RECIRCULATION

RO program licensed to: Remco Engineering

Calculation created by: Bob Mesick

Project name: Permeate flow: 1500.0 gpd
 HP Pump flow: 6.9 gpm Raw water flow: 1875.0 gpd
 Recommended pump press.: 253.4 psi Total system recovery: 80.0 %
 Feed pressure: 224.4 psi Permeate recovery ratio: 15.2 %
 Feedwater Temperature: 20.0 C(68F) Concentrate recirculation: 8000.0 gpd
 Raw water pH: 7.89 Element age: 5.0 years
 Acid dosage, ppm (100%): 0.0 H2SO4 Flux decline % per year: 7.0
 Acidified feed CO2: 7.8 Salt passage increase, %/yr: 10.0
 Average flux rate: 17.6 gfd Feed type: Well water

Stage	Perm. Flow	Flow/Vessel Feed	Conc	Flux	Beta	Conc.&Throt. Pressures	Element Type	Elem. Array No.
	gpm	gpm	gpm	gfd		psi psi		
1-1	1.0	6.9	5.8	17.6	1.16	221.2 0.0	ESPA2-4040	1 1x1

	Raw water		Feed water		Permeate		Concentrate	
Ion	mg/l	CaCO3	mg/l	CaCO3	mg/l	CaCO3	mg/l	CaCO3
Ca	72.0	179.6	303.6	757.1	1.0	2.4	357.8	892.2
Mg	28.0	115.2	118.1	485.8	0.4	1.5	139.1	572.6
Na	254.0	552.2	1059.5	2303.2	16.1	35.1	1246.4	2709.5
K	21.0	26.9	87.3	111.9	1.7	2.1	102.6	131.6
NH4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ba	0.050	0.0	0.211	0.2	0.001	0.0	0.248	0.2
Sr	0.000	0.0	0.000	0.0	0.000	0.0	0.000	0.0
CO3	1.0	1.7	4.2	7.0	0.0	0.0	21.3	35.4
HCO3	327.0	268.0	1360.1	1114.8	25.1	20.5	1599.2	1310.8
SO4	160.0	166.7	675.0	703.1	1.7	1.8	795.6	828.7
Cl	310.0	437.2	1298.9	1832.0	13.3	18.7	1529.1	2156.7
F	0.1	0.3	0.4	1.1	0.0	0.0	0.5	1.3
NO3	0.1	0.1	0.4	0.3	0.0	0.0	0.5	0.4
SiO2	67.0		281.0		2.5		330.9	
TDS	1240.3		5188.6		61.8		6123.2	
pH	7.9		8.5		6.8		8.8	

	Raw water	Feed water	Concentrate
CaSO4 / Ksp * 100:	3%	18%	22%
SrSO4 / Ksp * 100:	0%	0%	0%

REVERSE OSMOSIS SYSTEM

BaSO4 / Ksp * 100: 200% 1146% 1393%
 SiO2 saturation: 52% 216% 255%
 Langelier Saturation Index 0.54 2.36 2.75
 Stiff & Davis Saturation Index 0.54 2.15 2.50
 Ionic strength 0.02 0.10 0.11
 Osmotic pressure 10.5 psi 44.0 psi 51.8 psi

Permeate flow: 1500.0 gpd

HP Pump flow: 6.9 gpm Raw water flow: 1875.0 gpd
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Stage	Perm. Flow	Flow/Vessel Feed	Flux	Beta	Conc.&Throt. Pressures	Element Type	Elem. Array No.
	gpm	gpm	gfd		psi psi		
1-1	1.0	6.9	5.8	17.6	1.16	221.2 0.0	ESPA2-4040 1 1x1

Stg no.	Elem no.	Feed pres psi	Pres drop psi	Perm flow gpm	Perm Flux gfd	Beta	Perm sal TDS	Conc osm pres	Concentrate CaSO4	SrSO4	saturation BaSO4	level SiO2	Lang.
1-1	1	224.4	3.2	0.9	14.8	1.13	117.4	77.3	34	0	2307	382	3.0

CONCENTRATE RECIRCULATION

RO program licensed to: Remco Engineering

Calculation created by: Bob Mesick

Project name: Hidden Valley Permeate flow: 1500.0 gpd
 HP Pump flow: 6.9 gpm Raw water flow: 1875.0 gpd
 Recommended pump press.: 253.4 psi Total system recovery: 80.0 %
 Feed pressure: 224.4 psi Permeate recovery ratio: 15.2 %
 Feedwater Temperature: 20.0 C(68F) Concentrate recirculation: 8000.0 gpd
 Raw water pH: 7.89 Element age: 5.0 years
 Acid dosage, ppm (100%): 0.0 H2SO4 Flux decline % per year: 7.0
 Acidified feed CO2: 7.8 Salt passage increase, %/yr: 10.0
 Average flux rate: 17.6 gfd Feed type: Well water

 *** THE FOLLOWING PARAMETERS EXCEED HYDRANAUTICS DESIGN LIMITS: ***

Concentrate saturation of SiO₂ too high (255%)
 Concentrate Langelier Saturation Index too high (2.75)

The following are recommended general guidelines for designing a reverse osmosis system using Hydranautics membrane elements. Please consult Hydranautics for specific recommendations for operation beyond the specified guidelines.

Feed and Concentrate flow rate limits

Element diameter	Maximum feed flow rate	Minimum concentrate rate
2.5 inches	6 gpm (22.7 lpm)	1.5 gpm (5.7 lpm)
4.0 inches	16 gpm (60.6 lpm)	3 gpm (11.3 lpm)
6.0 inches	30 gpm (113.5 lpm)	7 gpm (26.5 lpm)
8.0 inches	75 gpm (283.9 lpm)	12 gpm (45.4 lpm)
8.5 inches	85 gpm (321.7 lpm)	14 gpm (53.0 lpm)

Concentrate polarization factor (beta) should not exceed 1.2

Saturation limits for sparingly soluble salts in concentrate

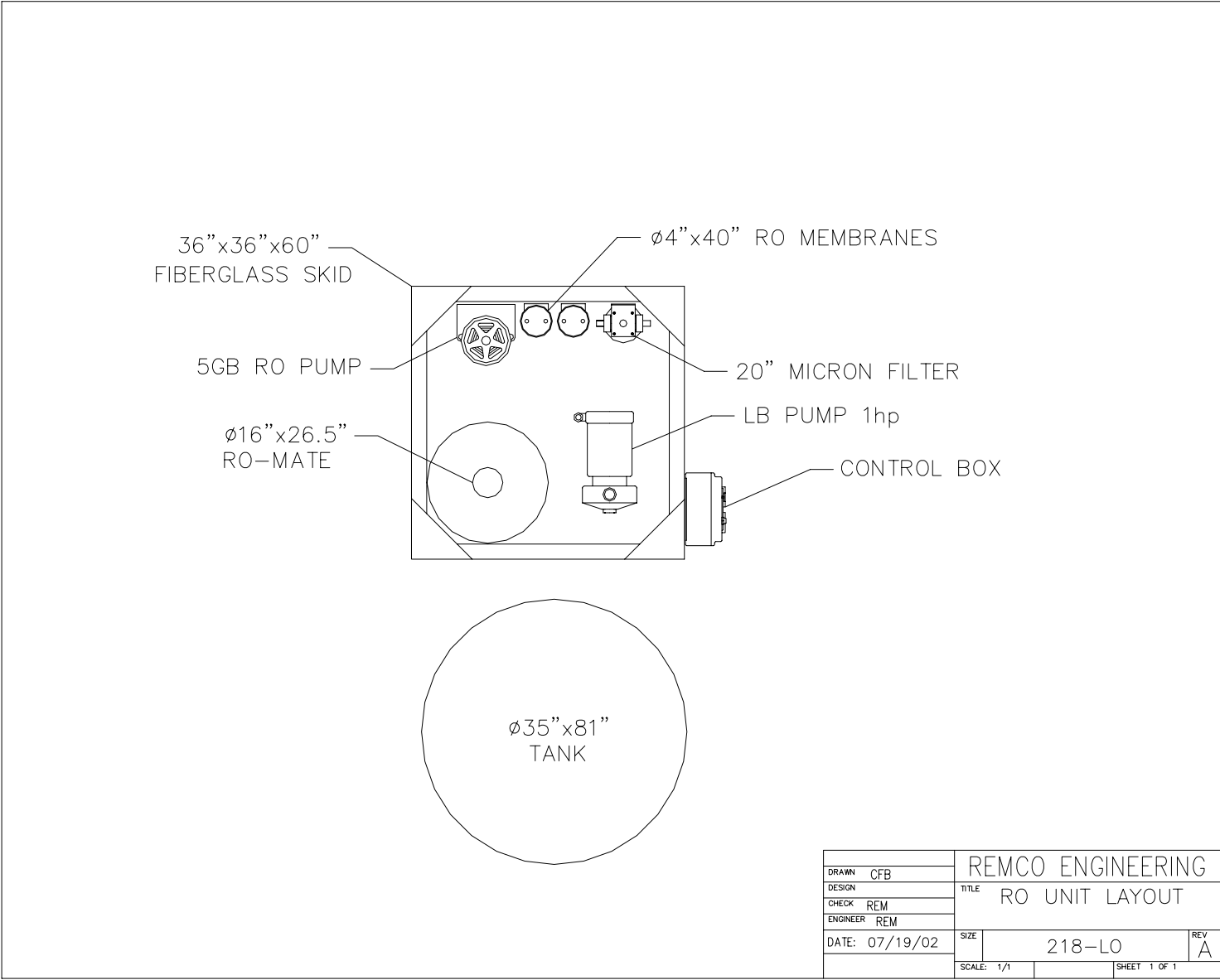
Soluble salt	Saturation
BaSO ₄	6000%
CaSO ₄	230%
SrSO ₄	800%
SiO ₂	100%

Langelier Saturation Index for concentrate should not exceed 1.8

The above saturation limits only apply when using effective scale inhibitor. Without scale inhibitor, concentrate saturation should not exceed 100%.

Note: With water softener, foulants are removed except for silica. Silica is removed by filtration before system. Reducing recovery rate will minimize silica fouling if it is a problem over time.

8.0 DRAWINGS



DRAWN	CFB	REMCO ENGINEERING	
DESIGN		TITLE	RO UNIT LAYOUT
CHECK	REM		
ENGINEER	REM		
DATE:	07/19/02	SIZE	218-LO
		SCALE:	1/1
			SHEET 1 OF 1
		REV	A