

WATER MANAGEMENT REFERENCE GUIDE

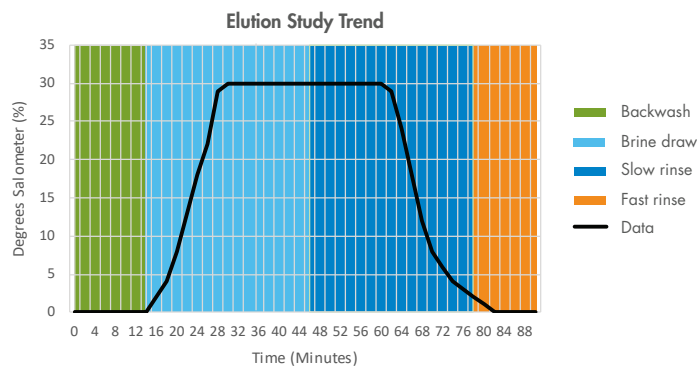
SOFTENER SYSTEMS

- Ion exchange is the reversible reaction that removes undesired ions for other desired ions. Regeneration uses higher concentrations of desired ions to displace the undesired to drain. The affinity of the resin removes items besides calcium and magnesium; here is an affinity sequence for strong cation resin typically used in sodium cycle softening:



- Softeners sized on capacity between regeneration (**need minimum of 8 hours for brine to saturate**) and hydraulic flow rate need to be above 2 gpm/ft² to prevent likelihood of channeling (cause premature hardness leakage) and typically below 20 gpm/ft² to minimize pressure drop and hardness leakage.
- Total hardness is the addition of calcium and magnesium concentrations in the water and need to be represented in common units (ppm CaCO₃ or grains).
- Resin capacity based on salt dosage for softening applications (Rule of thumb for Table 1-1, actual capacities based on multitude of water variables).
- Channeling is the result of low flow causing a path that short circuits the rest of the resin bed.
- Softeners increase intervals of maintenance on humidifier and RO systems by minimizing scale formation.

FIGURE 1-1: ELUTION STUDY TREND: SALT CONCENTRATION THROUGHOUT STEPS OF REGENERATION



	Salt Dosage (lbs NaCl per cubic foot of resin)	Resin Capacity per Cubic Foot (grains)	
Water efficiency ↓	6	20,000	Salt efficiency ↑
	8	24,000	
	10	27,000	
	12	29,000	
	15	30,000	

Note: DriSteem softeners are designed for dosage at 10 lbs NaCl per cubic ft of resin.

Basis of design, optimization done at site based on site conditions (min)	
Backwash	15
Brine draw	30
Slow rinse	30
Fast rinse	10
Total time	90

FIGURE 1-2: EXPECTED MEDIA RESIN LIFE: 5-10 YEARS



DECHLORINATOR SYSTEMS

Activated carbon filter

- Activated carbon removes an array of things from water based on the principal of adsorption. Things it can remove are: chlorine, chloramines, VOC's, color, heavy metals, and hydrogen sulfide.
- Chlorine removal is important for RO systems to maintain membrane life.
- Sizing for a dechlorinator is based on a term called **empty bed contact time** (EBCT). The required time for chlorine is typically 2 - 3 minutes. The formula for determining the amount of carbon needed:

$$\text{EBCT (minutes)} = (\text{Activated Carbon Volume (ft}^3\text{)} \times 7.48 \text{ gal/ft}^3 / (\text{Flow Rate (gal/minute)}))$$
- Backwash removes particulates from the filter to lower the differential pressure across the filter bed.
 - Backwash flux rate for activate carbon: hydraulic flow rate of flux rate (10 - 12 GPM/ft²)

FIGURE 2-1: EXPECTED CARBON LIFE: 6 MONTHS - 1+ YEARS



REVERSE OSMOSIS (RO) SYSTEMS

- RO piping material depends on application but a common list of acceptable materials include PVC, CPVC, PP, HDPE, PVDF, 304SS, and 316SS.
- RO systems work on the principal of adding pressure to the inlet side to send water containing little TDS through a semi permeable membrane.
- Standard energy brackish RO membranes reject ~99.5% of salts on average. Extra low energy rejects ~98% of salts on average to minimize energy usage. DriSteem utilizes extra low energy.
- Temperature ↑
Flow (at same pump pressure output) ↑
- Dissolved solids ↑
Flow (at same pump pressure output) ↓

Scale	Calcium carbonate
	Calcium sulfate
	Barium sulfate
	Strontium sulfate
	Magnesium silicate
	Calcium fluoride
Transition metals	Aluminum
	Iron
	Manganese
Organics	(Water variable)
Oxidizers (Biocides)	Sodium hypochlorite (12.5% bleach)
	Chlorine dioxide
	Ozone
	Hydrogen peroxide
Suspended solids	Dirt
	Debris from install (i.e. plastic or metal shavings)
Biological film/growth	(Water variable)

**FIGURE 3-1: EXPECTED RO MEMBRANE LIFE:
3-5 YEARS (MODEL 400 SERIES) / 1 YEAR (MODEL 200 SERIES)**



FIGURE 3-2: EXPECTED RO SEDIMENT FILTER LIFE: ½-1 MONTH



Conductivity	pH
Temperature	TSS/Turbidity/SDI
Calcium	Magnesium
Total alkalinity	Fluoride
Sulfate	Silica
Barium	Strontium
Sodium	Potassium
Chloride	Iron
Manganese	Free Chlorine

IMPORTANT RO TERMINOLOGY

Crossflow velocity

Is the fluid flow that is not sent through the membrane to the permeate side. Maintaining a design crossflow velocity keeps solids from forming on the outer membrane surface.

Array

Is an arrangement of membranes based on the stages and amount of vessels in each stage.

Silt density index (SDI)

An index that is used to measure the fouling of a .45 micron filter.

RO stage

RO systems can have multiple stages. Each stage in the array receives feed water from the previous stage.

Membrane capacity rule of thumb (50°F [10°C])

1 x 2.5" diameter membrane ≈ 12 gph permeate
1 x 4" diameter membrane ≈ 0.9 - 1 gpm permeate

$$\text{Inlet (GPM)} = \text{Permeate (GPM)} + \text{Reject (GPM)}$$

Table 4-1: General water equations/ conversion factors

500 pph = 1 GPM
7.48 gallons = 1 cubic foot
1 grains/gallon = 17.1 ppm
Density of Water at Sea Level (68°F) = 8.34 lbs/gallon
Rectangle Volume (ft ³) = Length (ft) x Width (ft) x Height (ft)
Cylinder Volume (ft ³) = ((Diameter (in))/24) ² x π x Height (ft)
Cylindrical Surface Area (ft ²) = ((Diameter (in))/24) ² xπ
Dosage (ppm) = Feed (lbs/day)/Volume (gal/day) x 1,000,000 x 8.34 (lbs/gal)
Degrees F = (1.8 x °C)+32°F
1 psi = 2.31' H ₂ O Water
Resistivity (MΩ·cm) = 1/Conductivity (μS/cm)
Softener related conversion factors
Calcium Conversion: 2.5 ppm Calcium as Ca = 1 ppm Calcium as Calcium Carbonate (CaCO ₃)
Magnesium Conversion: 4.1 ppm Magnesium as Mg = 1 ppm Magnesium as Calcium Carbonate (CaCO ₃)

VISIT THE ON-LINE HUMIDIFICATION UNIVERSITY CENTER

Check out our web site to learn more about properly applying humidification systems, types of humidifiers on the market today, and current humidification issues.

You'll also find information on **DriCalc**® — DriSteem's exclusive software that sizes loads, selects equipment, writes specifications, and creates equipment schedules for DriSteem products.

www.dristeem.com



DRI-STEEM Corporation

DriSteem U.S. operations are ISO 9001:2015 certified

U.S. Headquarters:
 14949 Technology Drive
 Eden Prairie, MN 55344
 800-328-4447 or 952-949-2415
 952-229-3200 (fax)

European office:
 Marc Briers
 Grote Hellekensstraat 54 b
 B-3520 Zonhoven
 Belgium
 +3211823595 (voice)
 +3211817948 (fax)
 E-mail: marc.briers@dristeem.com

Continuous product improvement is a policy of DriSteem Corporation; therefore, product features and specifications are subject to change without notice.

DriSteem is a registered trademark of Research Products Corporation and are filed for trademark registration in Canada and the European community.

Product and corporate names used in this document may be trademarks or registered trademarks. They are used for explanation only without intent to infringe.

© 2019 Research Products Corporation



Form No. WTS-QRG-EN-0319