

**Figure 1.2**  
**Typical Membrane Element**  
**Rejections/Passages**

**SALTS**

**CATIONS**

Name	Symbol	Percent Rejection	Percent Passage (Avg)	Maximum Concentration Percent
Sodium	Na <sup>+</sup>	94-96	5	5-10
Calcium	Ca <sup>+2</sup>	96-98	3	*
Magnesium	Mg <sup>+2</sup>	96-98	3	*
Potassium	K <sup>+1</sup>	94-96	5	5-10
Iron	Fe <sup>+2</sup>	98-99	2	*
Manganese	Mn <sup>+2</sup>	98-99	2	*
Aluminum	Al <sup>+3</sup>	99+	1	10-20
Ammonium	NH <sub>4</sub> <sup>+1</sup>	88-95	8	3-8
Copper	Cu <sup>+2</sup>	98-99	1	10-20
Nickel	Ni <sup>+2</sup>	98-99	1	10-20
Zinc	Zn <sup>+2</sup>	98-99	1	10-20
Strontium	Sr <sup>+2</sup>	96-99	3	-
Hardness	Ca & Mg	96-98	3	*
Cadmium	Cd <sup>+2</sup>	96-98	3	10-20
Silver	Ag <sup>+1</sup>	94-96	5	*
Mercury	Hg <sup>+2</sup>	96-98	3	-

**ANIONS**

Chloride	Cl <sup>-1</sup>	94-95	4	5-8
Bicarbonate	HCO <sub>3</sub> <sup>-1</sup>	95-96	4	5-10
Sulfate	SO <sub>4</sub> <sup>-2</sup>	99+	1	5-15
Nitrate	NO <sub>3</sub> <sup>-1</sup>	85-95	10	3-6
Fluoride	F <sup>-1</sup>	94-96	5	5-8
Silicate	SiO <sub>2</sub> <sup>-2</sup>	80-95	10	-
Phosphate	PO <sub>4</sub> <sup>-3</sup>	99+	1	10-20
Bromide	Br <sup>-1</sup>	94-96	5	5-8
Borate	B <sub>4</sub> O <sub>7</sub> <sup>-2</sup>	35-70**	-	-
Chromate	CrO <sub>4</sub> <sup>-2</sup>	90-98	6	8-12
Cyanide	CN <sup>-1</sup>	90-95**	-	4-12
Sulfite	SO <sub>3</sub> <sup>-2</sup>	98-99	1	5-15
Thiosulfate	S <sub>2</sub> O <sub>3</sub> <sup>-2</sup>	99+	1	10-20

\* Must watch for precipitation; other ion controls maximum concentration

\*\* Extremely dependent on pH; tends to be an exception to the rule

The following are typical rejections and passages for various salts and organics using the SEPA<sup>fi</sup>-HR membrane at 400 psig (27.6 bar) operating pressure. Modules made with this membrane, such as the OSMD<sup>fi</sup>-HR, can be expected to give these same passages. As can be seen, multivalent ions tend to have less passage than do monovalent ions. If monovalent ions are combined with multivalent ions to form a salt, the passage will be controlled by the multivalent ion. In RO all ions must be combined as the salt form before passages can be considered.

For estimating purposes, to obtain the expected permeate quality when handling a solution of salts, take a simple average of the feed concentration and the concentrate concentration and multiply this figure by the average percent passage to calculate the average concentration of the permeate. Salts or organics that are complexed with organics of large molecular weights will tend to act like the organics with which they are complexed.

**NOTE:** The actual permeate water quality will vary with the inlet water quality and can only be verified by actual analysis of the permeate stream.

To estimate passage of salts for membrane elements other than SEPA-HR, take the passage for the SEPA-HR and multiply by the factor for the passage for the particular membrane element. The factors are:

SEPA-SR is 1.6 times SEPA-HR passage  
 SEPA-PR is 2.5 times SEPA-HR passage

Operation of the SEPA-HR membrane element at pressures over 400 psig (27.6 barg) will reduce salt passage slightly. Operation at 200 psig (13.8 bar) will increase the passage of monovalent ions by approximately 2.0 times and the passage of multivalent ions will increase by 1.5 times the 400 psig (27.6 bar) passage.

For SEPA membrane elements with larger pores than the SEPA-PR it is recommended that actual tests be run prior to estimating the permeate quality.

The maximum concentrations given in the table are the approximate concentrations resulting in an osmotic pressure of 500 psi (34.5 barg) for the solution.

Compounds such as CaSO<sub>4</sub> which have specific solubility limits can be controlled with proper addition of dispersants. Check with the factory for more information on Omnic's special line of dispersants

**ORGANICS**

	Molecular Weight	Percent Rejection	Maximum Concentration Percent
Sucrose Sugar	342	99.9	30-35
Lactose Sugar	360	99.9	30-35
Protein	10,000 Up	99.9	50-80
Glucose	180	99.0	15-20
Phenol	94	***	-
Acetic Acid	60	***	-
Formaldehyde	30	***	-
Dyes	400 to 900	99.9	-
Biochemical			
Oxygen Demand (BOD)		90.0-99.9	
Chemical			-
Oxygen Demand (COD)		99.9	
Urea	60	40-60	Reacts similar to a salt
Bacteria & Virus	50,000 to 500,000	99.9+	-
Pyrogen	1,000 to 5,000	99.9+	-

\*\*\* Permeate is enriched in material due to preferential passage through the membrane.

**GASES, DISSOLVED**

Carbon Dioxide	CO <sub>2</sub>	30-50%
Oxygen	O <sub>2</sub>	Enriched in permeate
Chlorine	Cl <sub>2</sub>	30-70%