PUROLITE®

ION EXCHANGE RESINS

ISO 9002 BSI REGISTERED FIRM FM 40352

A-850

Strong Base Type I Acrylic Anion Exchange Resin

(For use in demineralization of water contianing organic matter)

Technical Data

PRODUCT DESCRIPTION

Purolite A-850 is a gel-type I strong base anion exchange resin with an acrylic matrix. The acrylic matrix ensures excellent removal of organic matter from a water supply in conjunction with its reversible removal upon regeneration. This resin is regenerated very efficiently with lower levels of sodium hydroxide than those required for a polystyrene based type I resin, and yet it has a comparable ability to remove weaker acids including carbonic acid and silica. Its use in combination with a polystyrene based resin (for instance in a mixed bed positioned after the anion unit) can often result in the removal of a wider spectrum of organic compounds than either type of anion resin alone.

Typical Physical & Chemical Characteristics	
Polymer Matrix Structure	Crosslinked Gel Acrylic
Physical Form and Appearance	Transparent White Spherical Beads
Whole Bead Count	95% min.
Functional Groups	Quaternary Ammonium
Ionic Form, as shipped	Cl^-
Shipping Weight (approx.)	720 g/l (45 lb/ft^3)
Screen Size Range:	
- U.S. Standard Screen	16 - 50 mesh, wet
Particle Size Range	+1.2 mm <5%, -0.3 mm <1%
Moisture Retention, Cl^- form	57 - 62%
Irreversible Swelling	10% max.
Reversible Swelling $Cl^- \rightarrow OH^-$	15% max.
Specific Gravity, moist Cl^- Form	1.08
Total Exchange Capacity, Cl^- form,	1.25 eq/l min.
Operating Temperature, Cl^- Form	40ºC (100ºF) max.
pH Range, Stability	No Limitations

Standard Operating Conditions (Co-Current Regeneration)				
Operation	**Rate**	**Solution**	**Minutes**	**Amount**
Service	8 - 24 BV/h 1 - 3 gpm/ft³	Decationized water	per design	per design
Backwash	Refer to Fig. 2	Decationized water 20ºC (70ºF)	5 - 20	1.5 - 6 BV 10 - 35 gal/ft³
Regeneration	4 - 8 BV/h 0.5 - 1 gpm/ft³	2 - 8% NaOH	30 - 45	50 - 150 g/l 4 - 10 lb/ft³
Rinse, (slow)	4 - 8 BV/h 0.5 - 1 gpm/ft³	Decationized water	60 approx.	2 - 4 BV 15 - 30 gal/ft³
Rinse, (fast)	8 - 24 BV/h 1 - 3 gpm/ft³	Decationized water	15 - 40 To desired end point	3 - 6 BV 25 - 45 gal/ft³
Backwash Expansion 50% to 75% Design Rising Space 100% Minimum bed depth 700 mm (27.5 in) "Gallons" refer to U.S. Gallon = 3.785 litres				

REGENERATION

Purolite A-850 is supplied in the chloride form and before use must be regenerated with a good grade of sodium hydroxide. A double regeneration is recommended for the first cycle. The conditions for standard regeneration are given in the table above. Where the silica content is high it is recommended that the temperature and (if necessary) the quantity of sodium hydroxide are elevated, in order to prevent build-up of silica. However the maximum operating temperature given under “Product Description” should not be exceeded. Operation at a temperature of 5°C below the maximum is usually adequate to ensure efficient silica removal.

Standard Operating Conditions (Counter Current Regeneration)				
Operation	**Rate**	**Solution**	**Minutes**	**Amount**
Service	8 - 40 BV/h 1 - 5 gpm/ft³	Decationized water	per design	per design
Regeneration (CCR)	Refer to Fig. 2	2 - 4% NaOH	30 - 60	48 - 104 g/l 3 - 6.5 lb/ft³
Rinse, (slow) (CCR)	2 - 4 BV/h 0.25 - 0.5 gpm/ft³	Decationized water	30 - 60	2 - 4 BV 15 - 30 gal/ft³
Rinse, (fast) (service flow)	10 - 40 BV/h 1.25 - 5 gpm/ft³	Decationized water	20 - 40	8 - 10 BV 60 - 75 gal/ft³
Backwash Expansion 50% to 75% Design Rising Space 100% Minimum bed depth 1200 mm (48 in) "Gallons" refer to U.S. Gallon = 3.785 litres				

OPERATING CAPACITY

The Operating Capacity of **Purolite A-850** is a function of a number of variables including the quantity and temperature of regenerant, the percentage of sulphate to total anions, the silica to total anions in the feed solution, the flow rate and the mode of regeneration (co-current or counter current).

Figures 3 through 6 give curves for the calculation of operating capacity and silica leakage using co-current regeneration, and Figures 7 through 10 give similar curves for counter-current regeneration. Figures 10 and 11 give corrections applicable to both regeneration modes.

An example of how to use the curves:

If the regeneration mode, level and service flow rate are known, the capacity and leakage curves with their correction factors may be used directly to determine the operating capacity of the resin in the unit and the silica residual in the treated water.

INFLUENT WATER ANALYSIS

	ppm as $CaCO_3$	Total Anions %
Cl	50	45
SO_4	50	45
HCO_3	5	5
SiO_2	5	5
Total	110	100

TREATMENT

Regeneration with NaOH at	: 96 g/l
Countercurrent flow at temperature	: 30°C (86°F)
Flow rate	: 16 BV/h
Sodium leakage	: 40 ppb
End point SiO_2 leakage	: 100 ppb

CAPACITY CALCULATION

For regeneration level of 96 g/l NaOH at 45% SO_4, base capacity (C_B) = 0.89 eq/l (counter-current, Fig. 7)
Correction factor for regeneration temperature (with reference to % silica to total anions Fig. 9)
$C_1 = 0.96$
Correction factor for silica end-point leakage of 100 ppb, (Fig. 11)
$C_2 = 0.97$
Hence operating capacity
$= C_B \times C_1 \times C_2$
0.89 x 0.98 x 0.97 = 0.85 eq/l
Applying the customary engineering design factor of 0.9, the operating capacity obtainable
= 0.85 x 0.9 = 0.77 eq/l

SILICA LEAKAGE

Base silica leakage Bs for 96 g NaOH/l at 5% SiO_2/Total Anions
= 3 ppb (Fig. 8)
Correction factor for Na leakage
$K_1 = 0.98$ (Fig. 10)
Correction factor for regeneration temperature
$K_2 = 0.88$ (Fig. 12)
Operational silica leakage (Ts)
$= Bs/(K_1 \times K_2) = 3/(0.98 \times 0.88)$
= 3.5 ppb

PLANT DESIGN

If the operating capacity for throughput purposes depends upon the required silica leakage, the base silica leakage Bs should first be calculated by correcting the total silica leakage Ts using the correction factors K_1 for sodium leakage of the cation unit from Fig. 6 (co-current) or Fig 10 (counter-current) and K_2 for temperature of regeneration (Fig. 12).

$$Bs = Ts \times K_1 \times K_2$$

From Fig. 4 or Fig. 8, as appropriate, the quantity of regenerant needed to achieve the required silica leakage Bs may be determined. The capacity obtainable at the given regeneration level is then found from Figs. 3 or 7 respectively. Resin volume should be calculated in order that the flow rate and the cycle time are satisfactory. The matching of the cation and anion plant may be done in the usual way.

Where leakage of silica is not important, base operating capacity curves may be used directly. In doing so the maximum correction factor C_2 from Fig. 11 (1.05) should be used.

REGENERATION
COUNTER-CURRENT MODE

To obtain the lowest concentrations of silica in the treated water, **Purolite A-850** should be regenerated with sodium hydroxide of a good grade. To fully utilize the high capacity and prevent the build-up of any unwanted contaminants it is preferable to use at least 48 g NaOH/liter (3 lbs/ft^3) of resin. Above this level the quantity is chosen according to the operating capacity required, as given in Fig. 7. The rinse at the slow flow rate performs a double function. As well as serving as the regenerant displacement, it also ensures satisfactory elution of organic matter particularly if the period is extended to approximately one hour. This procedure can also improve the efficiency of the final rinse. Care should be taken that good quality decationized water is used for rinsing, thus avoiding the possibility of contamination of the freshly regenerated resin at the outlet of the bed. When using the correct procedures the rinse characteristics closely approach those of polystyrene resins.

HYDRAULIC CHARACTERISTICS

The pressure drop (or headloss) across a properly classified bed of ion exchange resin depends on the particle size distribution, bed depth, and void volume of the exchange material as well as on the flowrate and viscosity (and hence on the temperature) of the influent solution. Factors affecting any of these parameters, for example the presence of particulate matter filtered out by the bed, abnormal compressibility of the resin, Or the incomplete classification of the bed will have an adverse effect and result in an increased headloss.

Depending on the quality of the influent water, the application and the design of the plant, service flow rates may vary from 8 - 40 bed volumes/hour.

Typical pressure drop data is given in Fig. 1.

Fig. 1 PRESSURE DROP VS FLOW RATE

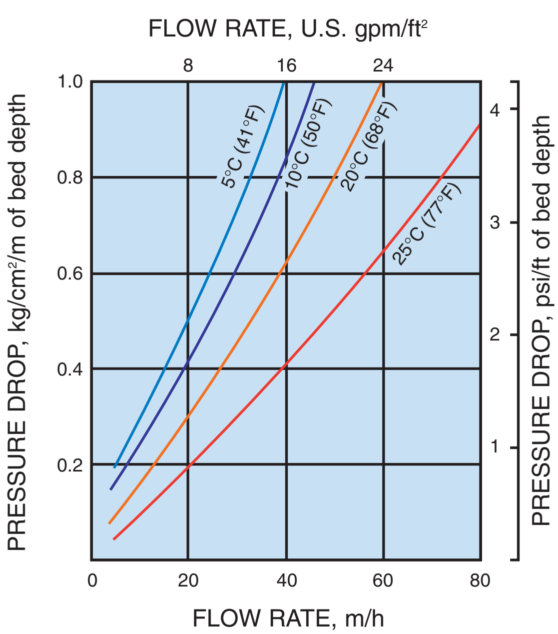
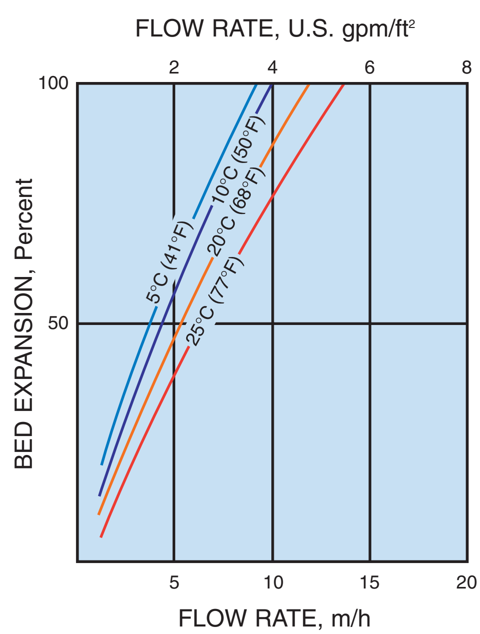


Fig. 2 BACKWASH EXPANSION



During upflow backwash, the resin bed should be expanded in volume by between 50 and 70%. This operation will free it from any particulate matter, clear the bed of bubbles and voids, and reclassify the resin particles, ensuring minimum resistance to flow. Bed expansion increases with flow rate and decreases with temperature, as shown in Fig. 2 for the exhausted form of the resin. Care should always be taken to avoid resin loss by over-expansion of the bed.

Conversion of Units	
1 m/h (cubic meters per square meter per hour)	= 0.341 gpm/ft^2 = 0.409 U.S. gpm/ft^2
1 kg/cm^2/m (kilograms per square cm per meter of bed)	= 4.33 psi/ft = 1.03 atmos/m = 10 ft H_2O/ft

PROPERTIES OF STRONGLY BASED ACRYLIC RESINS

Purolite A-850 is particularly recommended where the water to be treated is high in organic matter. Many surface waters have high levels which are subject to seasonal variation. Such organic compounds require excess sodium hydroxide for their effective removal. Resins with a polystyrene matrix have a high selectivity for these contaminants and can eventually become irreversibly fouled and/or require frequent cleaning with alkaline brine solutions. Changes of regeneration level on a seasonal basis to cope with such difficulties are not often practical and operating performance can deteriorate prematurely. The acrylic matrix of **Purolite A- 850** has excellent kinetics for the uptake of such organic matter, which adequately compensates for the lower selectivity. The advantage of the lower selectivity is found in the regeneration, where removal is more efficient and hence resin fouling is considerably reduced. Occasional cleaning with alkaline brine will ensure that performance is maintained even where seasonal variation in the organic matter content exists. The more flexible resin structure also provides for good efficiency of regeneration of the anions of salts removed by demineralization. Indeed this removal is equal to that found for type 2 strong base anion (SBA) resins. Furthermore the uptake of weak acids such as carbonic acid and silica (as mentioned earlier) are comparable to that of conventional polystyrene type I SBA resins.

The typical order of selective uptake of these ions is as follows:

$$SiO_2 < HCO_3 < Cl < NO_3 < SO_4$$

Also, the divalent sulphate ion is (as usual) more efficiently regenerated. Hence a correction to operating capacity has to be made for changing sulphate/total anions ratio in the feed. This is covered more fully later under operating performance.

Another benefit of **Purolite A-850** is its efficiency for silica removal (comparable to a conventional type I SBA resin). Hence low leakage levels can be combined with high operating capacity.

APPLICATIONS

As can be seen from the above, the main use of **Purolite A-850** is in the demineralization of water high in organic matter when it is placed following a strong acid cation resin. As a result of its high regeneration efficiency it may be used to replace a conventional weak/strong base resin pair. The weak base resin would normally protect the conventional SBA resin from organic fouling. Such protection may no longer be a requirement. For the same reasons it is often possible to dispense with an organic trap resin as a pretreatment.

Purolite A-850 may be used in conjunction with styrene resins which, for example may be placed in mixed beds after the acrylic anion unit. In this way a wider spectrum of organics is removed and such systems provide a more consistent protection for the mixed bed over a longer period of operation.

Color removal from various solutions may also be achieved using **Purolite A-850**, however the macroporous counterpart **Purolite A-860** is generally recommended where colour bodies including ones of high molecular weight are present, as for example in the refining of sugar solutions.

PUROLITE A-850, CO-CURRENT REGENERATION

Fig. 3 OPERATING CAPACITY

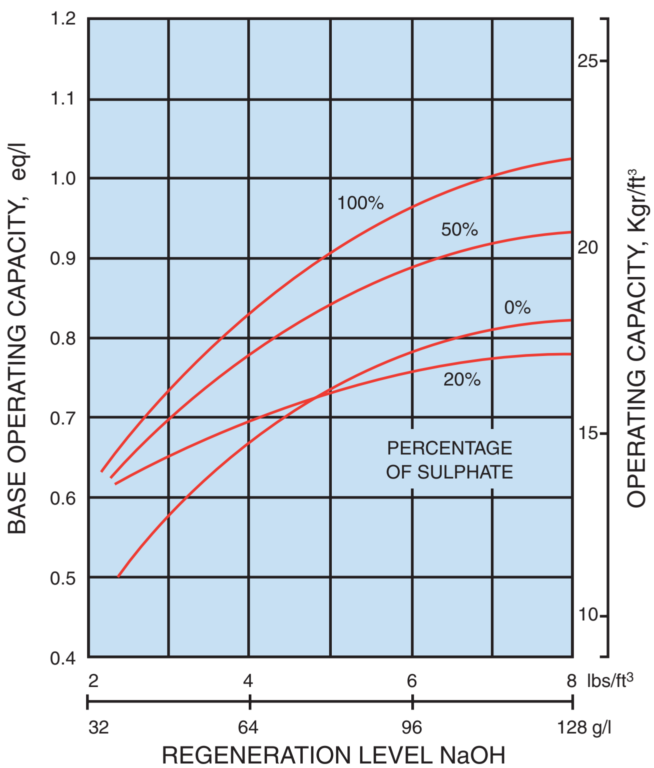


Fig. 4 SILICA LEAKAGE

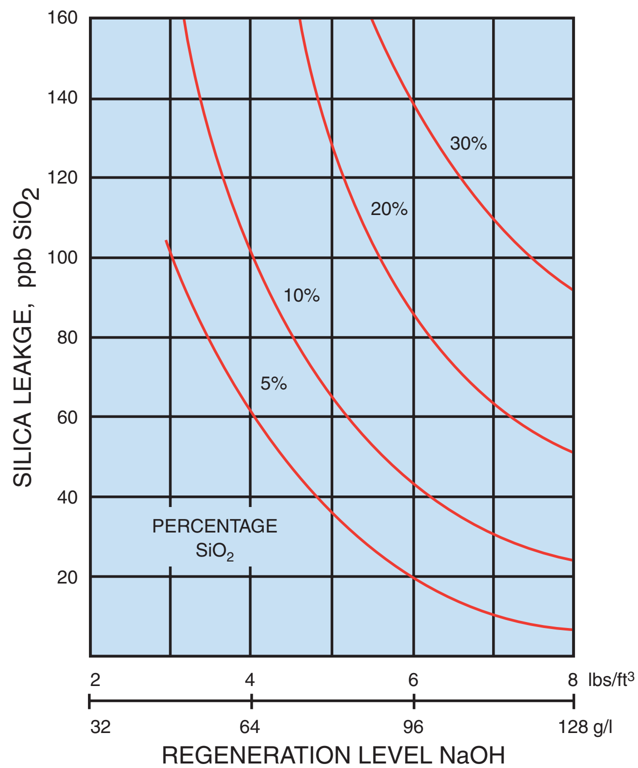


Fig. 5 CORRECTION FACTOR FOR TEMPERATURE OF REGENERANT

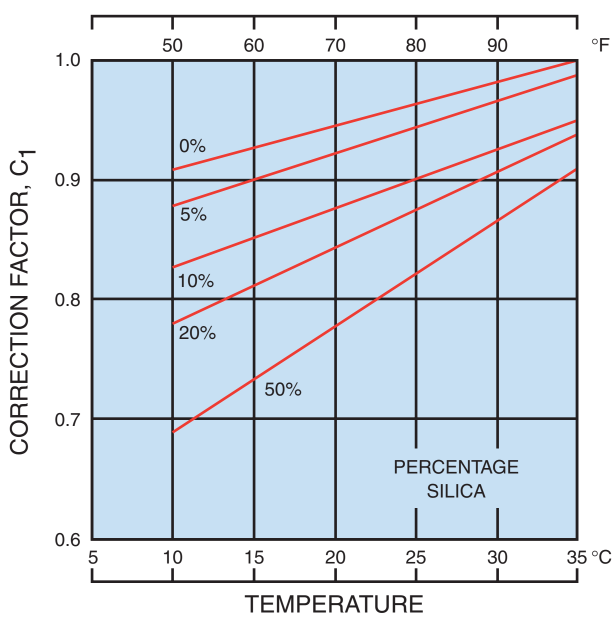
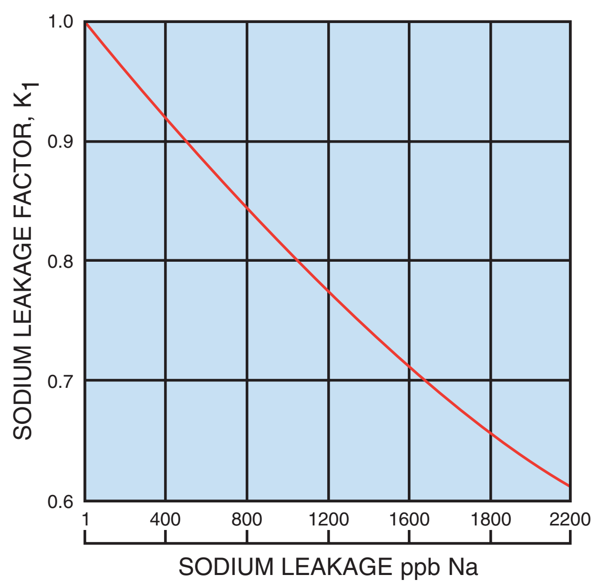


Fig. 6 CORRECTION FACTOR FOR SODIUM LEAKAGE



PUROLITE A-850, COUNTER-CURRENT REGENERATION

Fig. 7 OPERATING CAPACITY

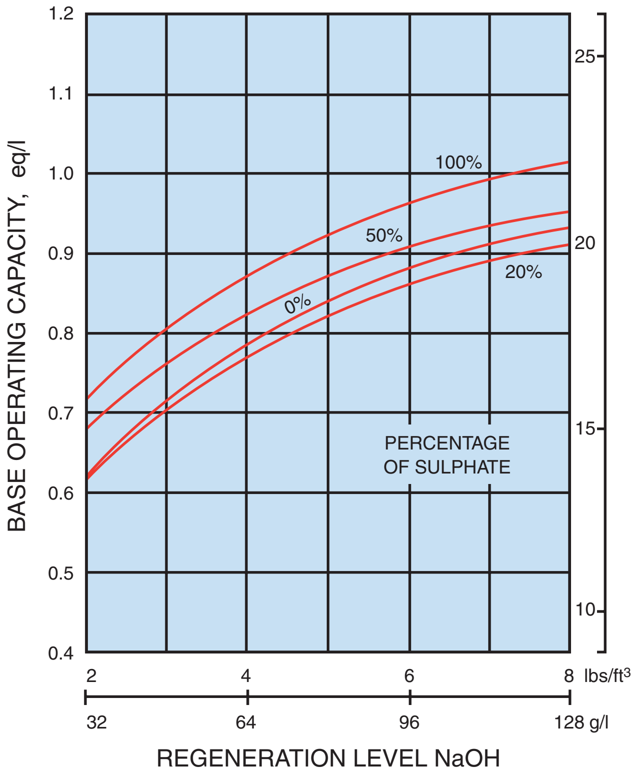


Fig. 8 SILICA LEAKAGE

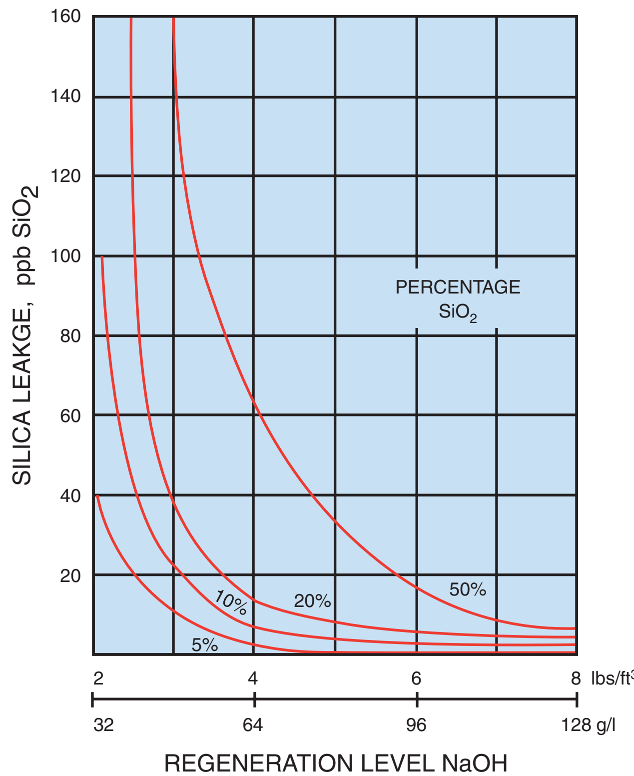


Fig. 9 CORRECTION FACTOR FOR TEMPERATURE OF REGENERANT

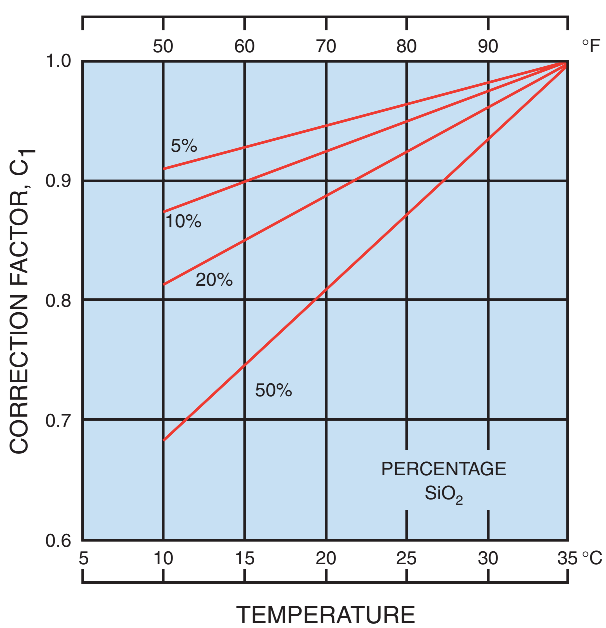
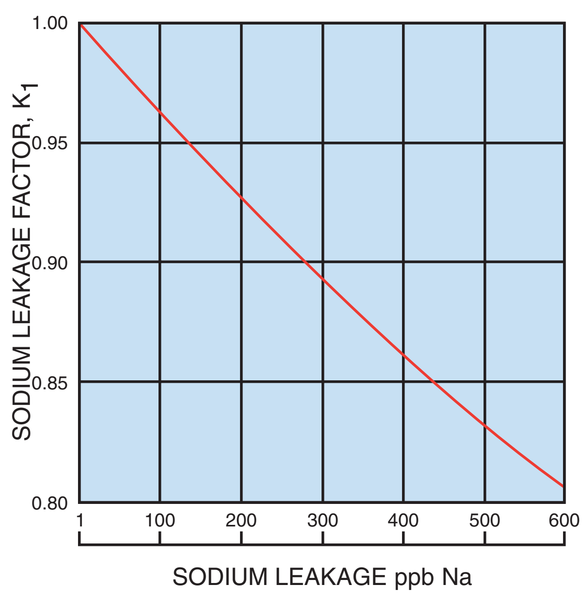


Fig. 10 CORRECTION FACTOR FOR SODIUM LEAKAGE



PUROLITE A-850, CO- AND COUNTER-CURRENT REGENERATION

Fig. 11 CORRECTION FACTOR FOR SILICA END-POINT LEAKAGE

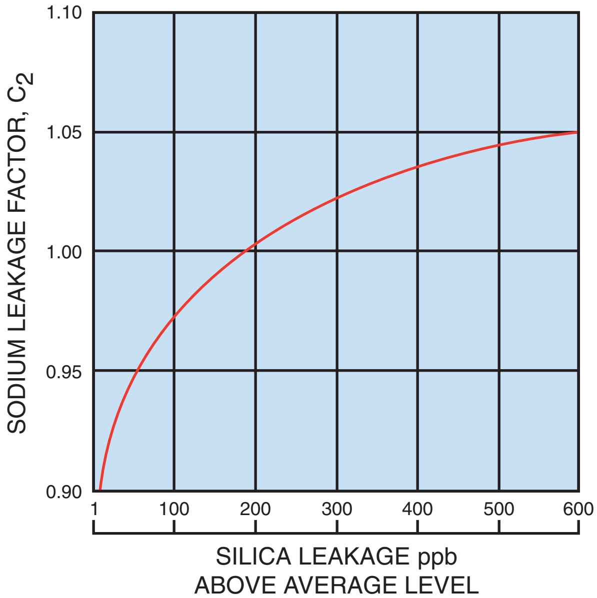
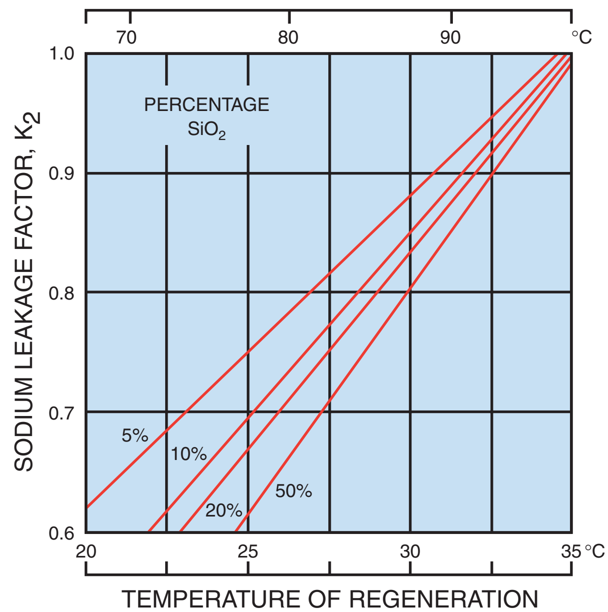


Fig. 12 SILICA LEAKAGE CORRECTION FACTOR FOR TEMPERATURE OF REGENERANT



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