PUROLITE®
ION EXCHANGE RESINS

ISO 9002 BSI REGISTERED FIRM FM 40352

C-100E

Strong Acid Cation Exchange Resin

(For use in water softening applications)

Technical Data

PRODUCT DESCRIPTION

Purolite C-100E is a high purity premium grade bead form conventional gel polystyrene sulphonate cation exchange resin designed expressly for the treatment of foodstuffs, beverages, potable waters, and water used in the processing of food. Its specification is such that it will exceed the relevant EEC requirements, and the resin is in compliance with the U.S. Food & Drug Administration Code of Federal Regulations section 21, paragraph 173.25; for use in the treatment of foods for human consumption. Its high bead integrity, excellent chemical and physical stability, and very low extractibles content play a large part in its successful employment in these areas.

Typical Physical & Chemical Characteristics	
Polymer Matrix Structure	Crosslinked Polystyrene Divinylbenzene
Physical Form and Appearance	Clear spherical beads
Whole Bead Count	90% min.
Functional Groups	$R\text{-}SO_3^-$
Ionic Form, as shipped	Na^+
Shipping Weight (approx.)	850 g/l (53 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, Na^+ form	46 - 50%
Swelling $Na^+ \rightarrow H^+$ $Ca^{++} \rightarrow Na^+$	5% max. 8% max.
Specific Gravity, moist Na^+ Form	1.27
Total Exchange Capacity, Na^+ form, wet, volumetric dry, weight	 1.9 eq/l min. 4.5 eq/kg min.
Operating Temperature, Na^+ Form	150ºC (300ºF) max.
pH Range, Stability, Na^+ Form	0 - 14
pH Range Operating, Na^+ Form	6 - 10

Standard Operating Conditions (Co-current Softening of Water)				
Operation	**Rate**	**Solution**	**Minutes**	**Amount**
Service	8 - 40 BV/h 1.0 - 5.0 gpm/ft^3	Influent water	per design	per design
Backwash	Refer to Fig. 2	Influent water 5º- 30ºC (40º - 80ºF)	5 - 20	1.5 - 4 BV 10 - 20 gal/ft^3
Regeneration	2 - 7 BV/h 0.25 - 0.90 gpm/ft^3	8 - 20% NaCl	15 - 60	60 - 320 g/l 4 -10 lb/ft^3
Rinse, (slow)	2 - 7 BV/h 0.25 - 0.90 gpm/ft^3	Influent water	30 approx.	2 - 4 BV 15 - 30 gal/ft^3
Rinse, (fast)	8 - 40 BV/h 1.0 - 5.0 gpm/ft^3	Influent water	30 approx.	3 - 10 BV 24 - 45 gal/ft^3
Backwash Expansion 50% to 75% Design Rising Space 100% "Gallons" refer to U.S. Gallon = 3.785 liters				

OPERATING PERFORMANCE

The operating performance of **Purolite C-100E** in the sodium cycle depends on:

a) The amount and concentration of regenerant used.

b) The total hardness of the water to be treated and its sodium content.

c) The flowrate of the influent water through the bed.

Performance is usually assessed in terms of the residual hardness in the treated water (traditionally expressed as ppm of $CaCO_3$, where 1 ppm $CaCO_3$ corresponds to a divalent cation concentration of 0.02 meq/l). In municipal water softening, low regeneration levels and high efficiency of removal of the hardness is usually required, since acceptable water quality is usually obtained by a split-stream operation in which a fully-softened stream is blended with the raw water to give the final product. Under beverage manufacturing conditions, or in industrial use for food processing, a suitable treated water, with less than 5 ppm of hardness, can be obtained with a level of 70-80 kg salt per cubic meter (4.5 - 5 lb/ft^3) of resin. In ordinary domestic softening, residual hardness at these comparatively low levels is not usually required, and quite high flowrates are often in use with negligible effect on the operating capacity. The most efficient use of regenerant can be achieved by using high concentrations of salt, and giving adequate contact time; the subsequent displacement of the spent regenerant from the bed should also be slow, but the final removal of excess salt should be carried out at normal service flow rates.

Hardness leakage under the standard operating conditions is normally less than 1% of the total hardness of the influent water, and the operating capacities are not significantly affected unless the raw water contains more than about 25% of its exchangable cations as sodium (or other univalent) ions.

Both the operating capacity and the average leakage of hardness during the run may be calculated for a wide range of conditions from the data given in Figs. 3 through 6.

HYDRAULIC CHARACTERISTICS

The pressure drop (headloss) across a properly classified bed of ion-exchange resin depends on the particle size distribution, bed depth, and void volume of the exchanger; and on the flowrate and viscosity (and hence on the temperature) of the influent solution. Anything affecting any of these parameters, for example the presence of particulate matter filtered out by the bed, abnormal compaction of the resin bed, or the incomplete classification of the resin will have an adverse effect, and result in an increased headloss. Typical values of pressure drop across a bed of **Purolite C-100E** are given for a range of operating flow rates in Fig. 1.

Fig. 1 PRESSURE DROP VS FLOW RATE

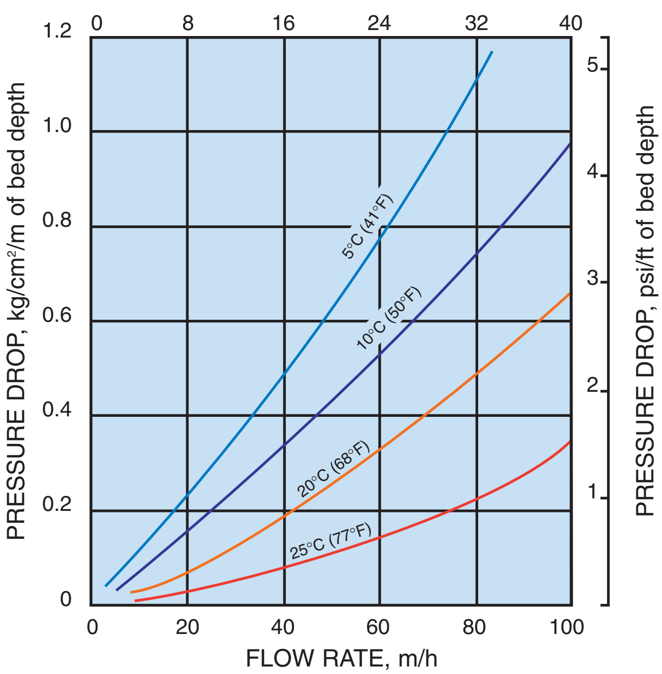
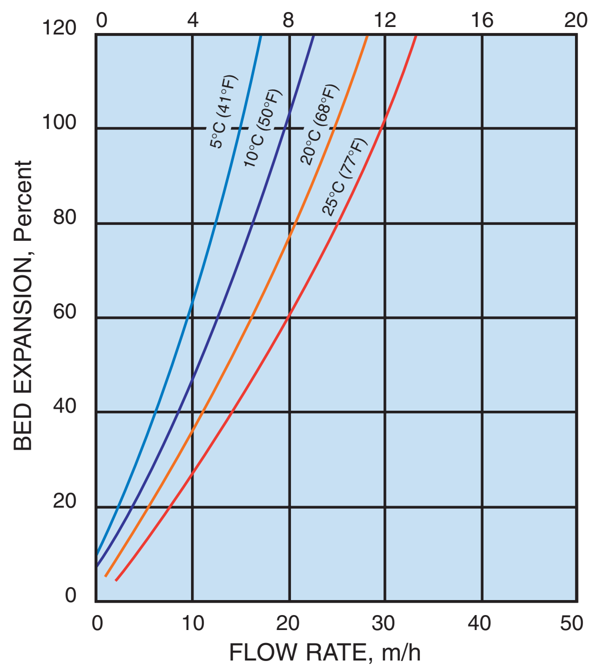


Fig. 2 BACKWASH EXPANSION



During upflow backwash, the resin bed should be expanded in volume by between 50 and 75%, in order to free it from any particulate matter from the influent solution, to clear the bed of bubbles and voids, and to reclassify the resin particles as much as possible, ensuring minimum resistance to flow. Backwash should be commenced gradually to avoid an initial surge with consequent carryover of resin particles. Bed expansion increases with flow rate and decreases with temperature, as shown in Fig. 2, above. Care should always be taken to avoid resin loss by accidental overexpansion of the bed.

Conversion of Units	
1 m/h (cubic meters per square meter per hour)	= 0.341 gpm/ft² = 0.409 U.S. gpm/ft²
1 kg/cm²/m (kilograms per square cm per meter of bed)	= 4.33 psi/ft = 1.03 atmos/m = 10 ft H_2O/ft

CHEMICAL AND THERMAL STABILITY

Purolite C-100E is insoluble in dilute or moderately concentrated acids, alkalies, and in all common solvents. However, exposure to significant amounts of free chlorine, "hypochlorite" ions, or other strong oxidizing agents over long periods of time will eventually break down the crosslinking. This will tend to increase the moisture retention of the resin, decreasing its mechanical strength, as well as generating small amounts of extractable breakdown products. Like all conventional polystyrene sulphonated resins, it is thermally stable to higher than 150°C (300°F) in the alkali (for instance, sodium) or alkaline earth (calcium and magnesium) salt forms. The free acid form tends to hydrolyse in water at temperatures appreciably higher than 120°C (250°F) thereby losing capacity, as the functional groups are gradually replaced by hydroxyl groups.

OPERATING CAPACITY CALCULATION

If the regeneration level, influent water analysis, and service flowrate are known, the capacity and leakage curves may be used directly to determine the operating capacity of the resin in the unit and the residual hardness in the treated water. A specific example of the application of these curves is given below:

INFLUENT WATER

Cation analysis in:	ppm $CaCO_3$	meq/l	gr/U.S. gal
Total hardness	400	8	23
Sodium (& univalents)	100	2	5.8
TDS (total dissolved solids)	500	10	28.8

TREATMENT

Regeneration with: 160 g/l [10 lb/ft^3] of NaCl
Service Flowrate: 25 m/h [10 U.S. gpm/ft^2]
Leakage endpoint: 5 ppm above permanent (kinetic) leakage figure.

CAPACITY is calculated as follows:

Fig. 3 ➔ Base Operating Capacity, C_B, @ 160 g/l (10 lb/ft^3) NaCl = 1.45 eq/1 (31.7 kgr/ft^3)
Fig. 4 ➔ correction factor, C_1 for 25 m/h & TDS 500 = 0.96
Hence calculated Operating Capacity, C_B x C_1 = 1.39 eq/1 (30.4 kgr/ft^3).

After applying the conventional 90% "design factor" the value of 1.25 eq/1 may be quoted as a design operating capacity. This corresponds to a figure of 27.3 kgr/ft^3 (1.25 eq/1 x 21.85 kgr/ft^3 per eq/l).

LEAKAGE is calculated as follows:

Fig. 5 ➔ Base Leakage @ 160 g/l NaCl [or 10 lb/ft^3] = 2.3 ppm $CaCO_3$
Fig. 6 ➔ correction factor, K_1, for a TDS value of 500 = 1.1
Hence permanent (kinetic) leakage = 2.3 x 1.1 = 2.5 ppm $CaCO_3$

NOTES:

i) The curves given are in fact based on an endpoint leakage of 5 ppm over and above the observed kinetic leakage; operating capacities will differ somewhat if a different criterion is used.
ii) The curves given are applicable only to influent monovalent ion contents less than or equal to the hardness content; if the water to be treated is atypical in this or other parameters, please contact your local sales office for assistance.

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(SOFTENING)

Fig. 3 OPERATING CAPACITY, C_B

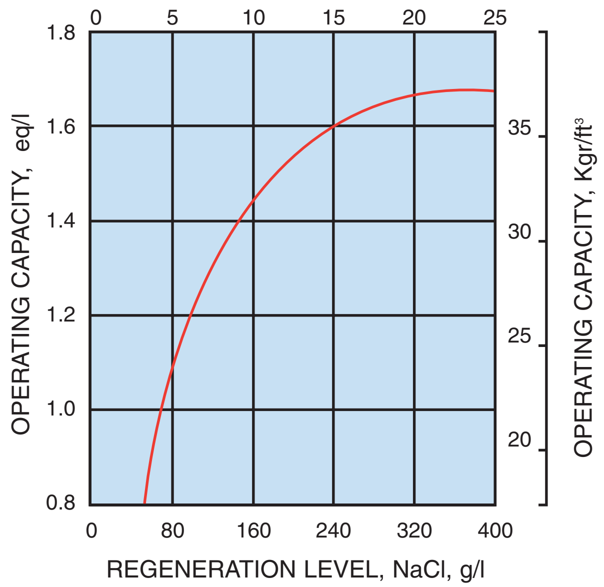


Fig. 4 EFFECT OF FLOW RATE & TDS ON OPERATING CAPACITY

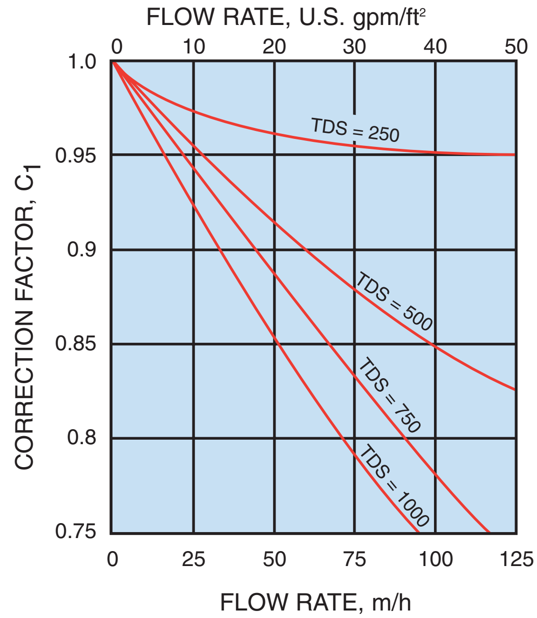


Fig. 5 HARDNESS LEAKAGE

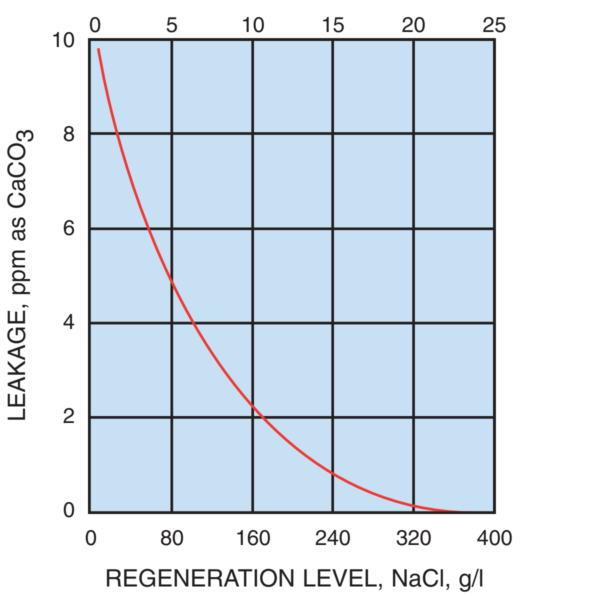
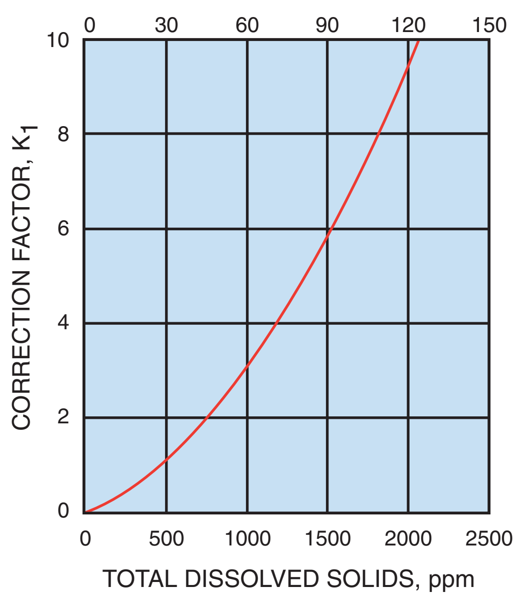


Fig. 6 CORRECTION FOR TDS



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