ION EXCHANGE
Refreshing the Planet

INDION® 225

Sulphuric acid Regeneration

Description

INDION 225 is a premium grade strong acid cation exchange resin containing sulphonic acid groups.

It is based on cross-linked polystyrene and has a gel structure. The resin has high capacity and excellent kinetics.

Applications

De-ionising

INDION 225 in hydrogen form is used as a first step in de-ionising. Technical data for co-flow and counter current regeneration is given in this literature.

Characteristics

Appearance	:	Golden yellow beads
Matrix	:	Styrene divinylbenzene copolymer
Functional Group	:	Sulphonic acid
Ionic form as supplied	:	Hydrogen
Total exchange capacity	:	1.8 meq/ml, minimum
Moisture holding capacity	:	49 -55 %
Shipping weight *	:	780 kg/m^3 approximately
Particle size range	:	0.3 to 1.2 mm
> 1.2 mm	:	5.0%, maximum
< 0.3 mm	:	1.0%, maximum
Uniformity co-efficient	:	1.7, maximum
Effective size	:	0.45 to 0.55 mm
Maximum operating temperature	:	120°C
Operating pH range	:	0 to 14
Volume change	:	Na to H, 8% approximately
Resistance to reducing agents	:	Good
Resistance to oxidizing agents	:	Generally good, chlorine should be absent

* Weight of resin, as supplied, occupying 1 m^3 in a unit after backwashing & draining.

Two stage de-ionising

Two stage de-ionising uses two units in series - the first one containing INDION 225 as cation exchanger and second containing strong base anion exchanger Type I resins such as INDION FFIP/GS 300/810 or Type II resins such as INDION NIP/GS 400/820.

Mixed bed de-ionsing

When treated water of highest possible quality is required, INDION 225 strong acid cation exchange resin is used with INDION FFIP in a mixed bed unit. A mixed bed is often operated as the last unit in a de-ionising stream to act as a polisher for producing water of highest quality.

Typical operating data

Two stage de-ionising	Co-Flow	Counter Current (CCR)
Minimum bed depth	0.75 m	1.0 m
Treatment flowrate	45 $m^3/h\ m^2$, maximum	45 $m^3/h\ m^2$, maximum
Pressure loss	Refer Figure 16	Refer Figure 16
Bed expansion	Refer Figure 15	Refer Figure 15
Backwash............................	9 $m^3/h\ m^2$ for 5 minutes	9 $m^3/h\ m^2$ till effluent is clear*
Regenerant	Sulphuric acid (1.5-5.0% w/v)	Sulphuric acid (1.5-5.0% w/v)
	Refer figure 7	Refer figure 11
Regenerant flowrate	Refer figure 8	3-18 $m^3/h\ m^2$
Regenerant injection time	20-50 minutes	20 minutes, minimum
Slow rinse	2.5 m^3/m^3 at injection flowrate	2-3m^3/m^3 at injection flowrate
Final rinse...........................	7.5 m^3/m^3 at 10 $m^3/h\ m^2$ or at treatment flowrate	3 m^3/m^3 approximately at treatment flowrate

* After a set number of regenerations

Operating Exchange capacity

Co-flow regeneration

The operating exchange capacity of INDION 225 depends on the following factors:

- Regeneration level
- Sodium content of feed
- Calcium content of feed
- Alkalinity of feed

Figures 1, 2, 3, 4, 5 and 6 give operating exchange capacity of INDION 225, when used in co-flow regeneration mode.

Counter-current regeneration

The operating exchange capacity depends on the following factors:

- Regeneration level employed
- Sodium content of feed
- Alkalinity of feed

Figures 10 and 12 give operating exchange capacity and correction factor for INDION 225 in counter current regeneration mode.

Regeneration

Co-flow regeneration

The concentration of Sulphuric acid used in regeneration is of prime importance and is determined by calcium content of feed.

Precipitation of calcium sulphate in resin bed should be avoided.

Stepwise concentration

The use of stepwise concentration method of regeneration offers more advantages than the constant rate system. Most of the polyvalent ions are removed in the first phase by means of dilute acid enabling use of acid of higher concentration subsequently. The technique gives a higher capacity compared to the constant concentration, besides minimising the dilution water requirement. The concentration of acid during regeneration should be as follows:

For first 32 kg/m^3 at concentration shown in Figure 7

- For the next equal quantity-at 1.5 times the initial concentration but not exceeding 5% w/v.
- Any excess regenerant at 5% w/v.

Counter current regeneration

The concentration of acid used depends on calcium content of feed. Refer figure 11.

For acid dilution and rinsing decationised water must be used.

To prevent the disturbance of the resin bed during upward acid injection and up rinse, use of down flow of water is employed. Alternatively, a downward air pressure can also be used for the same purpose. Backwashing of complete bed during every regeneration is not desirable and only subsurface wash must be employed.

Thoroughfare regeneration

When the alkaline hardness is high, use of INDION 236, weak acid cation exchanger preceding INDION 225 is recommended.

In such cases, the regeneration can be conducted first through strong acid cation exchanger followed by weak acid cation exchanger. The waste acid from the strong acid cation exchanger is utilized to regenerate the weak acid cation exchanger. This process improves the utilisation of acid and minimises the effluent while obtaining highest quality treated water. This process is commonly referred to as "Thoroughfare Regeneration".

Treated Water Quality

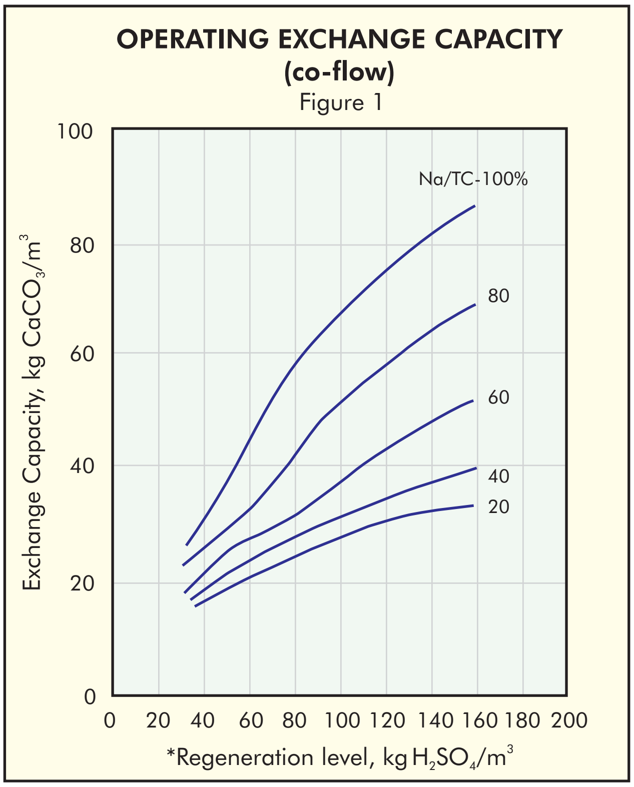
Leakage of sodium ions in treated water from a strongly acidic cation exchanger depends on :

- Sodium content of feed
- Regeneration level employed

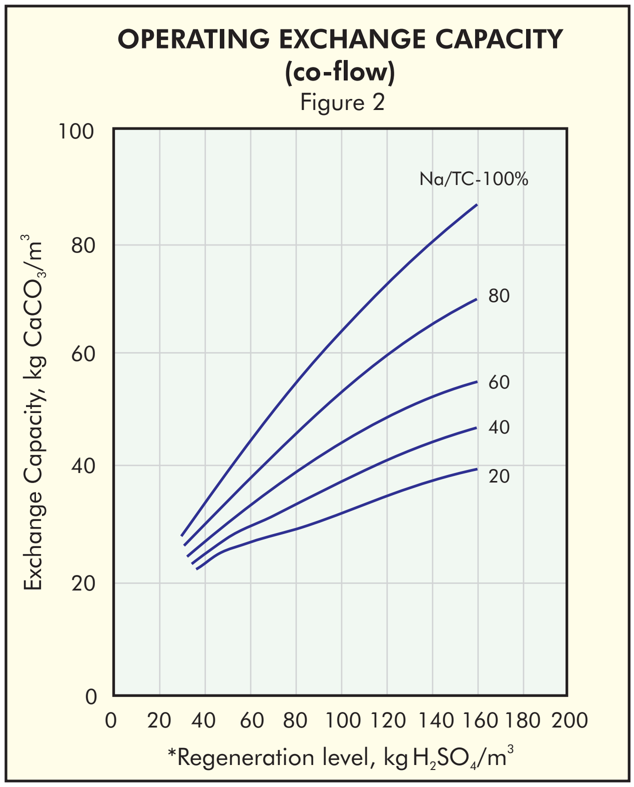
Refer to figure 9 for leakage characteristics of INDION 225 in co-flow mode of regeneration.

The exchange capacities of INDION 225 in counter current mode of regeneration are shown in figure 10. These are based on end point of one ppm of sodium slip expressed as $CaCO_3$. For sodium slip less than one ppm consult us.

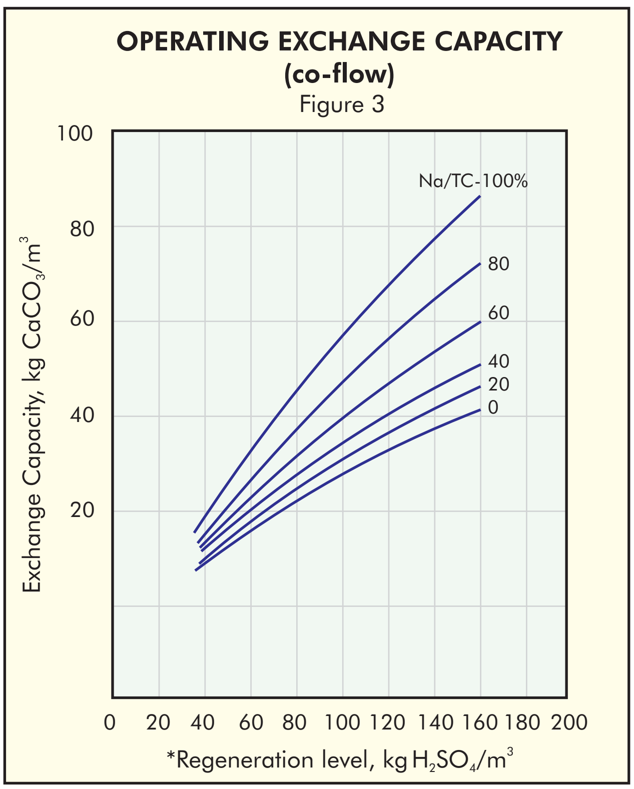
Figure 13 shows typical sodium leakage profile for co-flow and counterflow regeneration.



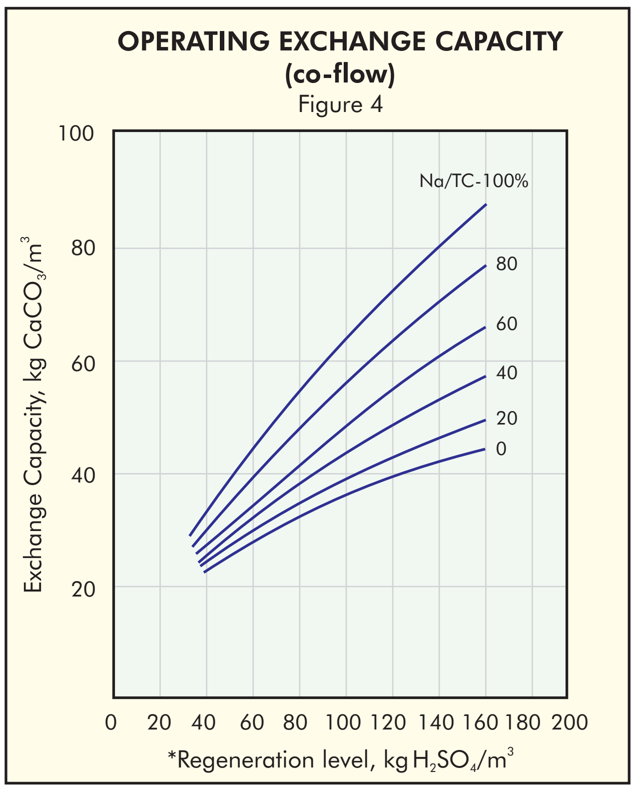
Alkalinity = 0%
Mg/TH = 0%



Alkalinity = 0%
Mg/TH = 25%

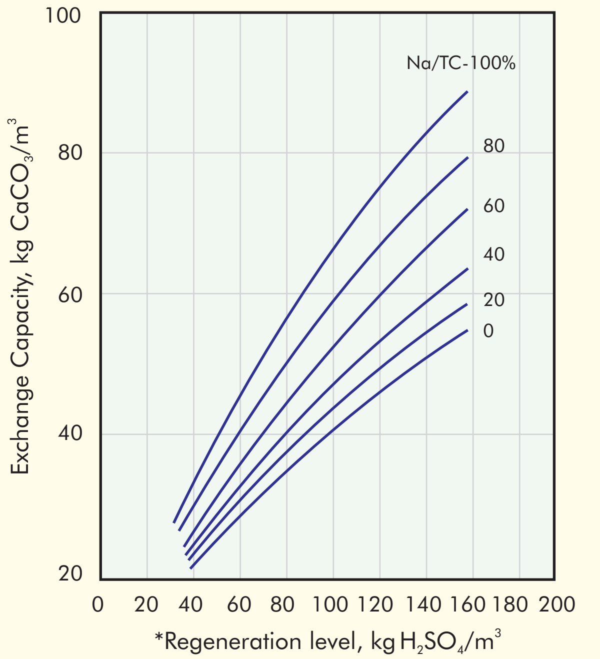


Alkalinity = 0%
Mg/TH = 50%



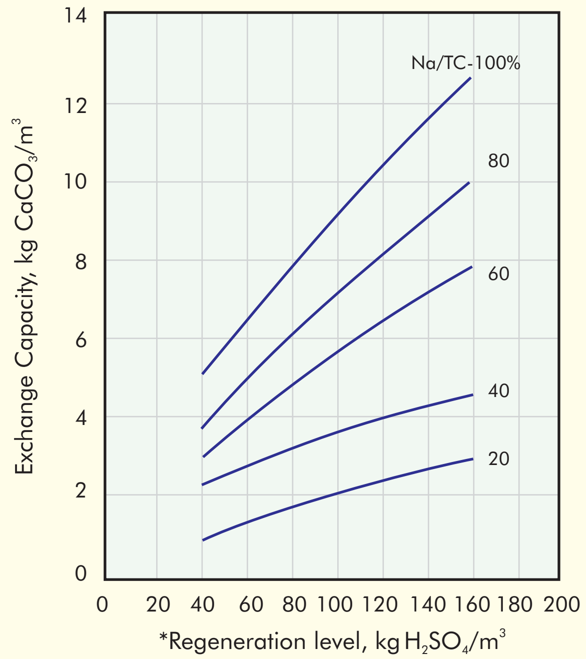
Alkalinity = 0%
Mg/TH = 75%

OPERATING EXCHANGE CAPACITY
(co-flow)
Figure 5



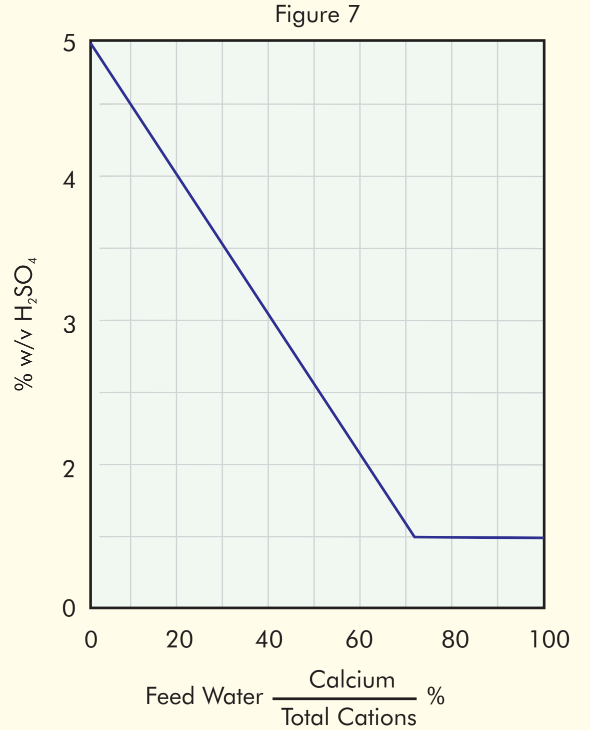
Alkalinity = 0%
Mg/TH = 100%

OPERATING EXCHANGE CAPACITY
(co-flow)
Figure 6

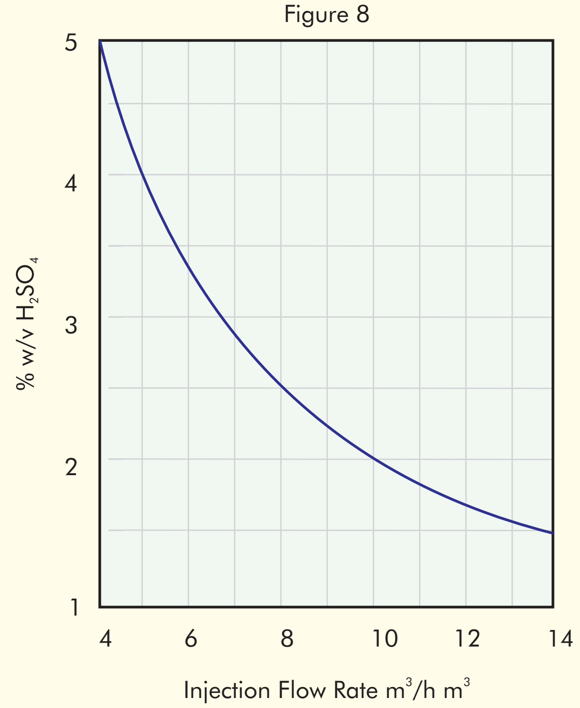


Alkalinity = 100%

ACID CONCENTRATION
(Co-Flow)
Figure 7

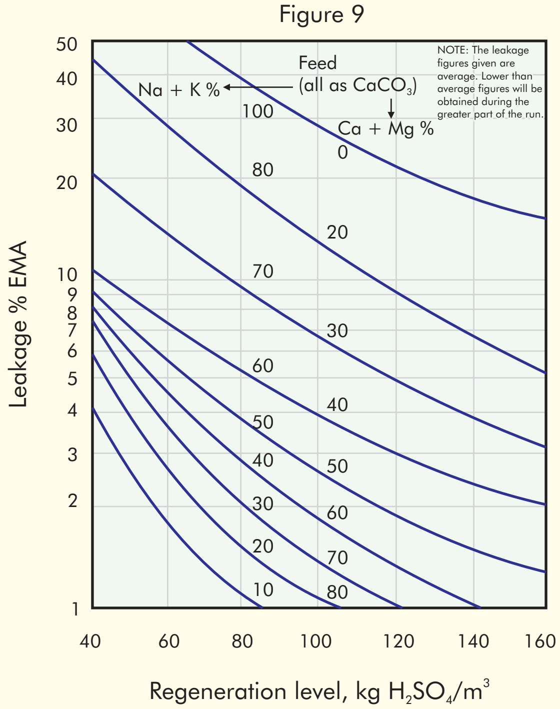


INJECTION FLOW RATE
(Co-Flow)
Figure 8



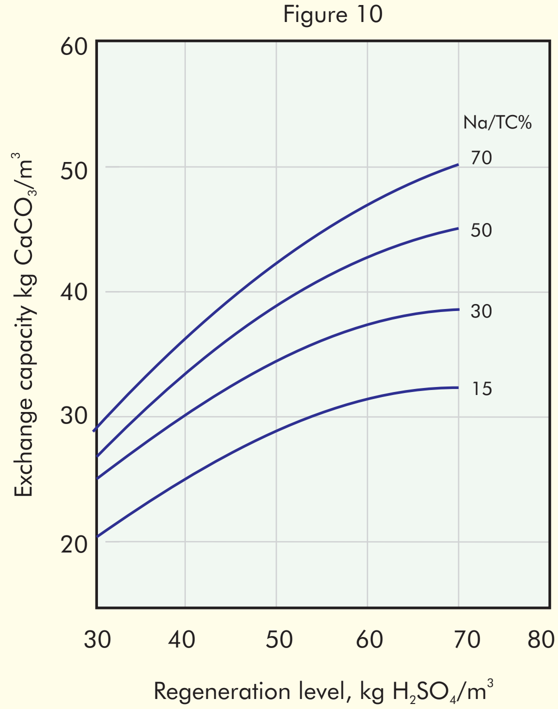
LEAKAGE CHARACTERISTICS (Co-Flow)

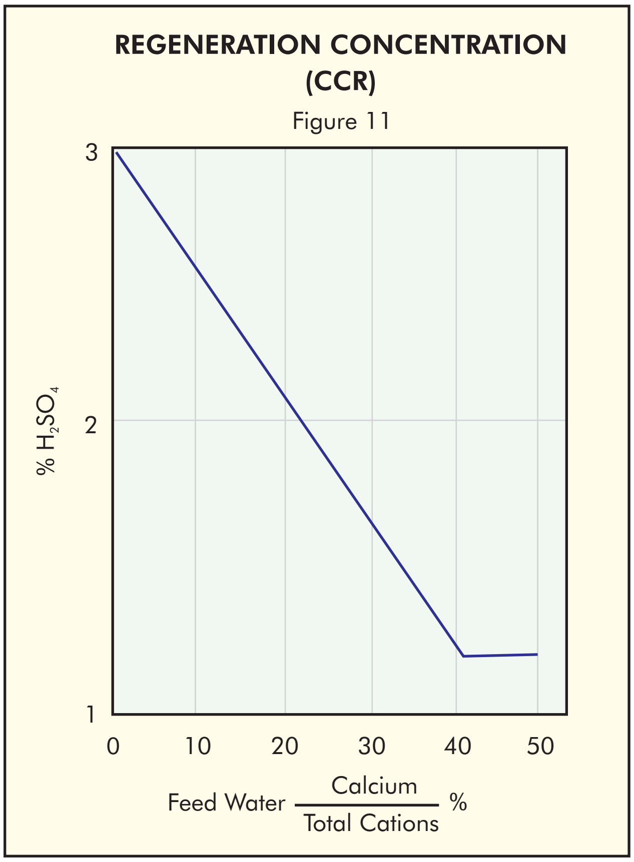
Figure 9

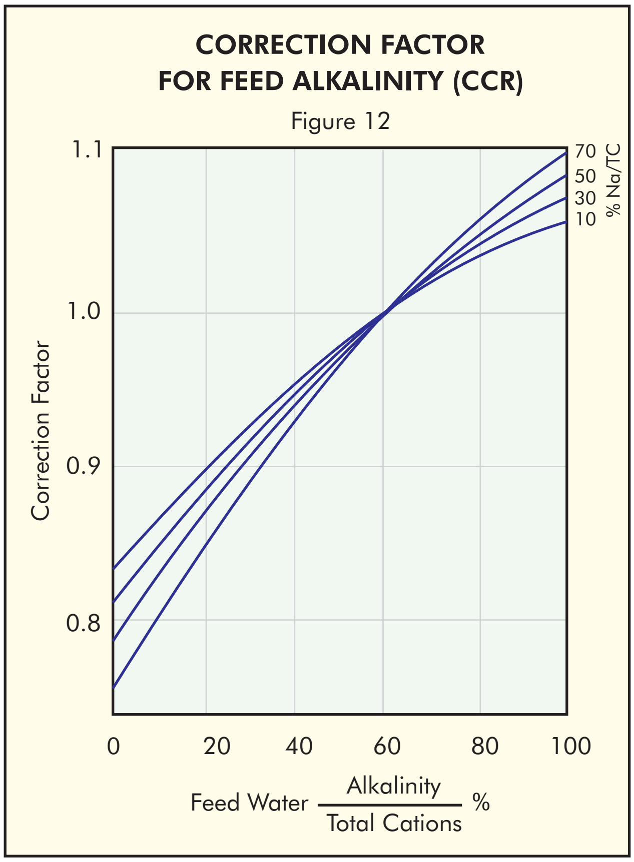


OPERATING EXCHANGE CAPACITY (CCR)

Figure 10







Mixed bed de-ionsing

When used as the cation exchanger in a mixed bed unit, the variation in operating capacity of INDION 225 due to variations in the compositions of feed water is less than in two stage operation. For practical purposes, feed waters may be classified as :

- Ion exchange softened or demineralised
- Low ionic load influent

In the first case INDION 225 may be regenerated with Sulphuric acid at 5% and in the second case with Sulphuric acid at 1.5%.

Figure 14 gives operating exchange capacity of INDION 225 when used in mixed bed de-ionising.

Typical operating data

Mixed bed de-ionising

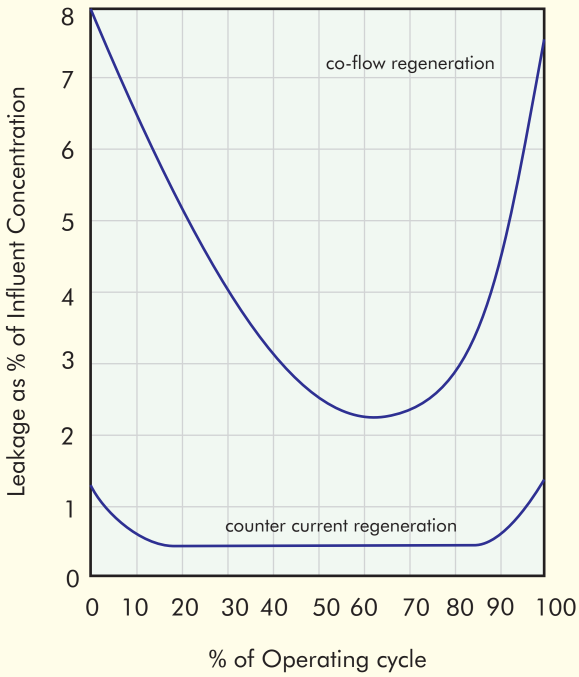
Total bed depth....................................	1.0 - 2.4 m using INDION 225 and INDION FFIP
Rising space	75% of bed depth
Treatment flowrate..................................	60 $m^3/h\ m^2$, maximum
Pressure loss..	1.2 kg/cm^2, maximum when using INDION 225 with INDION FFIP
Bed separation......................................	9 $m^3/h\ m^2$, for 10 minutes
Bed settlement	Allow 5 minutes after separation before commencing injection of regeneration
Acid injection rate	3-18 $m^3/h\ m^2$
Acid injection time	15 minutes for 1.5% 7.5 minutes for 5%, minimum
Down flow	1.5 $m^3/h\ m^2$
Acid rinse	2 m^3/m^3 in 10-15 minutes
Down flow	1.5 $m^3/h\ m^2$
Alkali injection rate	3-18 $m^3/h\ m^2$ for 10-15 minutes with 2-6% w/v
Up flow	4.5 $m^3/h\ m^2$
Alkali rinse	4 m^3/m^3 in 10-15 minutes
Upflow	4.5 $m^3/h\ m^2$
Unit drain down	Before remixing the resins, the water level should be lowered to approximately 0.4 m above the bed.
Bed re-mix	2 m^3/minute m^2 oil free air at 0.4 kg/cm^2 pressure air 10 minutes
Settle bed, refill unit, final rinse.............	These operations should be carried out in such a way to avoid separation of the two resins . Final rinse to satisfactory water quality should be effected at the treatment flowrate or at 24 $m^3/h\ m^2$ whichever is greater. Total time required is normally about 5-10 minutes depending upon end point conductivity required.

NOTE: The information on regeneration given above constitutes the sequential mode of regeneration of the resins in the mixed bed.

The resins in the mixed bed may be regenerated simultaneously also. In this case the alkali flows downward as before while the acid flows counter current from bottom at the same time. The injection of regenerants is then followed by the simultaneous rinse of the two beds. The simultaneous mode of regeneration eliminates the individual down flow and up flow of water used in the sequential work and also saves time. Match the injection and rinse flowrates for each resin. The steps prior to injection and post regenerant rinse remain the same.

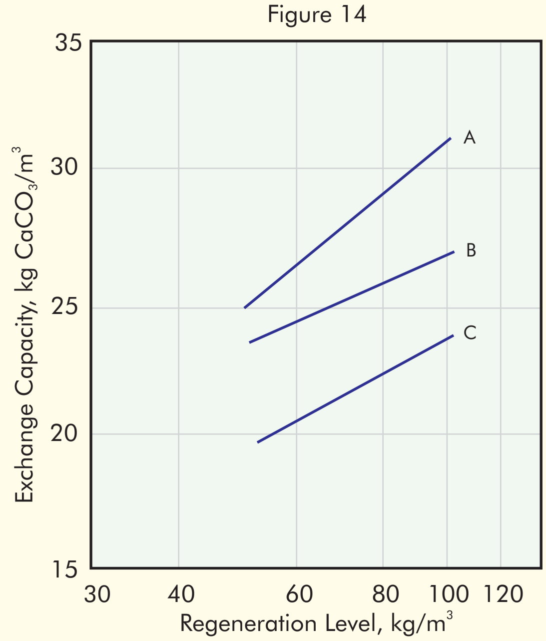
SODIUM LEAKAGE PROFILE (TYPICAL)

Figure 13



OPERATING EXCHANGE CAPACITY MIXED BED DE-IONISING

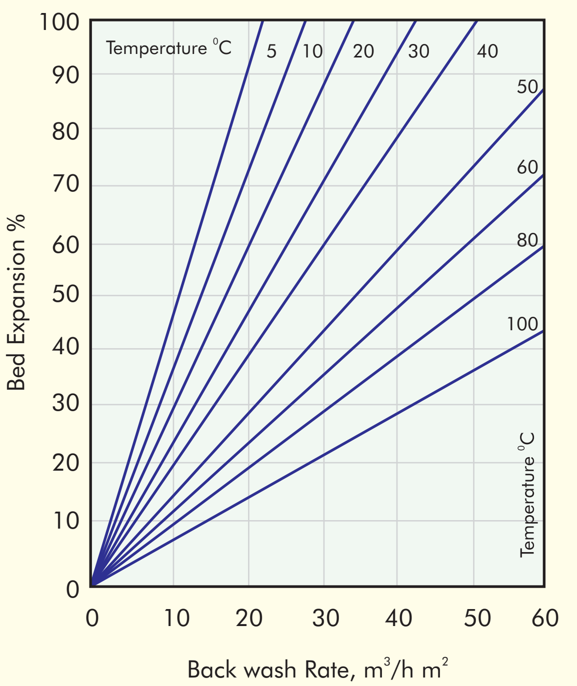
Figure 14



A = 5% Acid, Ion Exchange softened or demineralised load.
B = 1.5% Acid, where alkalinity greater than 50% of total cation.
C = 1.5% Acid, feed where alkalinity less than 50% of total cation.

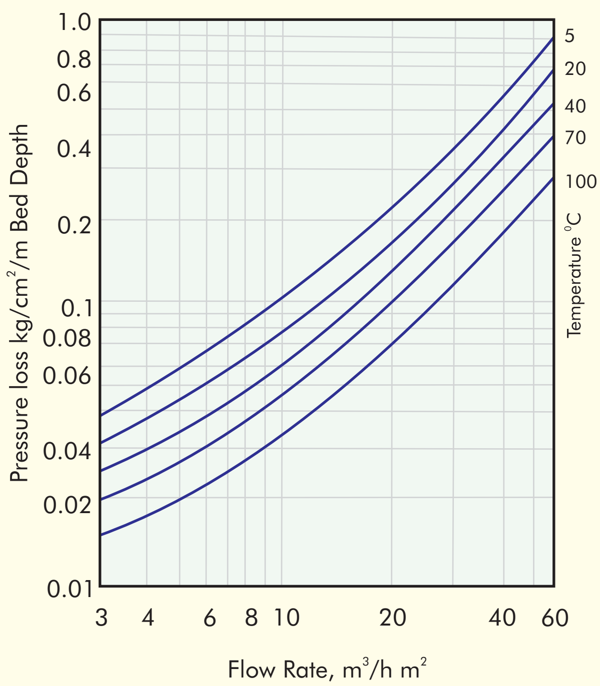
BED EXPANSION

Figure 15



PRESSURE LOSS

Figure 16



Use of good quality regenerants

All ion exchange resins are subject to fouling and blockage of active groups by precipitated iron. Hence the iron content in the feed water should be low and the regenerant must be essentially free from iron and heavy metals. All resins are prone to oxidative attack, resulting in problems such as loss of physical strength. Therefore, the regenerant should have as low chlorine content as possible. Good quality regenerant of technically or chemically pure grade should be used to obtain best results.

Packing

HDPE lined bags	25/50 lts	LDPE bags	1 cft/25 lts
Super sack	1000 lts	Super sack	35 cft
MS drums		Fiber drums	
with liner bags	180 lts	with liner bags	7 cft

Storage

Ion exchange resins require proper care at all times. The resin must never be allowed to become dry.

Regularly open the plastic bags and check the condition of the resin when in storage. If not moist, add enough clean demineralised water and keep it in completely moist condition. Always keep the resin drum in the shade. Recommended storage temperature is between 20° C and 40° C

Safety

Acid and alkali solutions are corrosive and should be handled in a manner that will prevent eye and skin contact. If any oxidising agents are used, necessary safety precautions should be observed to avoid accidents and damage to the resin.

INDION range of Ion Exchange resins are produced in a state-of-the-art ISO 9001 and ISO 14001 certified manufacturing facilities at Ankleshwar, in the state of Gujarat in India.

To the best of our knowledge the information contained in this publication is accurate. Ion Exchange (India) Ltd. maintains a policy of continuous development and reserves the right to amend the information given herein without notice.

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