ION EXCHANGE
Refreshing the Planet

INDION® 810

Description

INDION 810 is a macroporous strongly basic Type- I anion exchange resin. It is a high capacity, new generation resin based on crosslinked polystyrene matrix and has quaternary ammonium functional groups.

INDION 810 is produced by a unique manufacturing technique, which gives it the optimum porosity and improved kinetics. It gives higher operating exchange capacity due to greater utilisation of the exchange sites as compared to other conventional macroporous resins. This feature, combined with its high basicity, permits absorption of large sized soluble organic molecules and their subsequent elution during regeneration.

Thus, while INDION 810 ensures complete removal of soluble organics from the water, it exhibits excellent resistance to organic fouling as compared to other conventional resins. INDION 810 has very good stability against physical and chemical attrition. This results in lesser fines generation and therefore higher operating life for the resin.

INDION 810 is generally employed in demineralising application of raw waters containing high organic levels and also for use under rigorous conditions such as in condensate polishing. INDION 810 is recommended for use in the anion column as well as in the mixed bed column where it can act as an efficient polisher in combination with strong acid cation exchange resin INDION 225 H.

Characteristics

Appearance	:	Off white to brown opaque beads
Matrix	:	Styrene divinyl benzene copolymer
Functional Group	:	Benzyl trimethyl amine
Ionic form as supplied	:	Chloride
Total exchange capacity	:	1.0 meq/ml, minimum
Moisture holding capacity	:	56 - 63 %
Shipping weight *	:	650 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	:	60 °C in OH form 90 °C in Cl form
Operating pH range	:	0 to 14
Volume change	:	Cl to OH, 15-20 %
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 and draining.

Applications

De-ionising

Two stage de-ionising

INDION 810 is used as the anion exchanger in the second stage of a de-ionising pair with INDION 225 cation exchange resin in the first stage.

When used in a two stage de-ionising plant, upstream of a mixed bed unit, INDION 810 will protect the strong base anion exchanger in the latter unit against organic fouling. At the same time it will assist in the production of final treated water with a low residual of organic matter and silica.

Multiple stage de-ionising

INDION 810 is recommended as the anion exchanger in a multiple stage de-ionising train with strong acid cation exchange resin and weak base anion exchange resin in the preceding stages to keep operating costs low.

Regeneration and silica removal efficiency are enhanced if a warm regenerant solution is used. Where plant operating conditions allow, INDION 810 can be regenerated in this manner.

Mixed bed de-ionising

If treated water with the lowest possible level of silica residual is required, two stage/multiple stage treatments should be followed by mixed bed de-ionising using INDION 810.

Typical operating data

Two stage de-ionising	Co-Flow	Counter Current (CCR)
Bed depth	0.75 m, minimum	1.0 m, minimum
Treatment flow rate	60 $m^3/h\ m^2$, maximum	60 $m^3/h\ m^2$, maximum
Pressure loss	Refer figure 14	Refer figure 14
Bed Expansion	Refer figure 15	Refer figure 15
Backwash	3 $m^3/h\ m^2$ for 5 minutes or till effluent is clear	3 $m^3/h\ m^2$ till effluent is clear*
Regenerant	Sodium Hydroxide (2 - 4% w/v)	Sodium Hydroxide (2 - 4% w/v)
Regenerant flow rate	4.5 - 18 $m^3/h\ m^2$	4.5 - 18 $m^3/h\ m^2$
Regenerant injection time	30 minutes	30 minutes
Slow rinse	2.5 to 3 bv** at regenerant flow rate	2 to 3 bv at regenerant flow rate
Final rinse	7.5 bv at service flow	5 bv at service flow rate

* After a set number of regenerations
** 1 bv (bed volume) = 1 m^3 fluid/m^3 of resin.

Operating Exchange capacity

Two stage de-ionising

The operating exchange capacity of INDION 810 in two stage de-ionising system is dependent upon :

- The regeneration level employed and the composition of water to be treated, specifically the concentration of mineral acid anion (SO_4/EMA, %).

  The operating exchange capacities are shown as a function of regeneration level for various percentages of SO_4/EMA in figure 1 for co-flow regeneration and in figure 2 for counter current regeneration when silica content in water is 10%.

  Refer figure 3 for co-flow regeneration and figure 4 for counter current regeneration when silica content in water is $\geq$ 20%. Refer figure 7 when silica content is equal to 70%.
- Silica content (SiO_2/TA,%) in water to be treated

  Refer figure 5 for capacity deduction data to be applied to basic operating exchange capacities obtained from figure 3 and 4 respectively for co-flow and counter current regeneration.
- Exhaustion rate.

  The operating capacity data is related to exhaustion time greater than 10 hours. figure 6 shows the correction factor to be applied to operating capacity (after capacity deduction for silica content) with exhaustion time for both co-flow and counter current regeneration.

Multiple stage de-ionising

Multiple de-ionising system generally consists of strong acid cation exchanger INDION 225 H in the first stage. This is followed by a weak base anion exchanger INDION 850, preceded or followed by a degasser and a strong base anion exchanger INDION 810 in series. In such system INDION 810 treats influent water containing predominantly weak acids like silica and carbon dioxide.

In multiple stage de-ionising, the regeneration process for weak base anion exchanger and strong base anion exchanger can be conducted in series in the direction of strong base to weak base anion exchanger to improve overall regeneration efficiency. The useful capacity will be high and silica leakage will be low as the strong base resin receives all the sodium hydroxide required for both exchangers. The regenerant injection is followed by a slow rinse with water to transfer the residual caustic present in the strong base anion exchanger to the weak base anion exchanger. This method is commonly referred to as "thoroughfare regeneration"

- Refer figure 12 and 13 for operating capacities of INDION 810 when used in co-flow and counter current thoroughfare modes respectively.

Mixed bed de-ionising

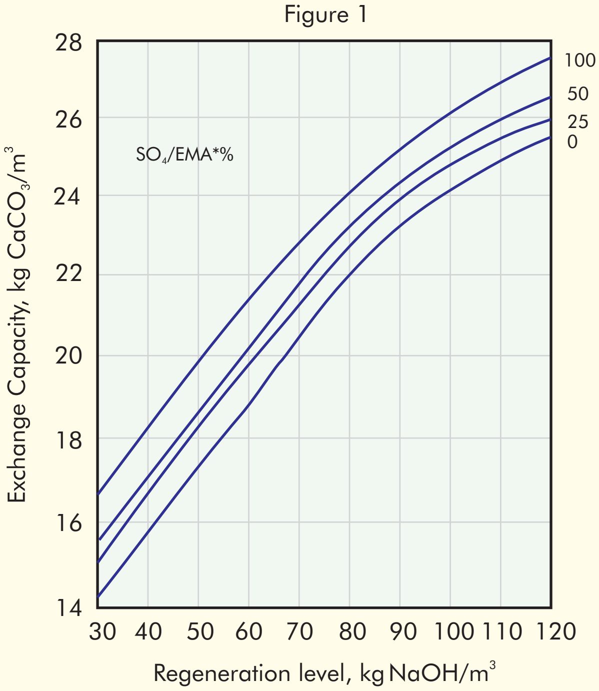
When used as the anion exchanger in mixed bed de-ionising systems the capacity of INDION 810 is independent of the feed water composition and therefore corresponds to the zero curve in figure 1. No correction for silica content of the Feed water need be made, although the amount loaded on the resin and hence the volume of water treated between regenerations may need to be adjusted in order to obtain satisfactory silica residual in the treated water (refer fig 16).

OPERATING EXCHANGE CAPACITY

co-flow regeneration at

$SiO_2/TA=10\%$

Figure 1



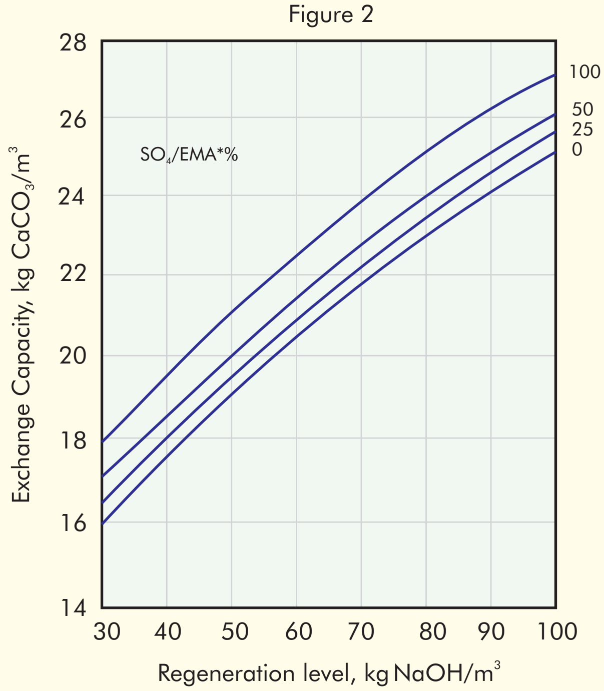
EMA*=Equivalent Mineral Acidity

OPERATING EXCHANGE CAPACITY

counter current regeneration at

$SiO_2/TA=10\%$

Figure 2



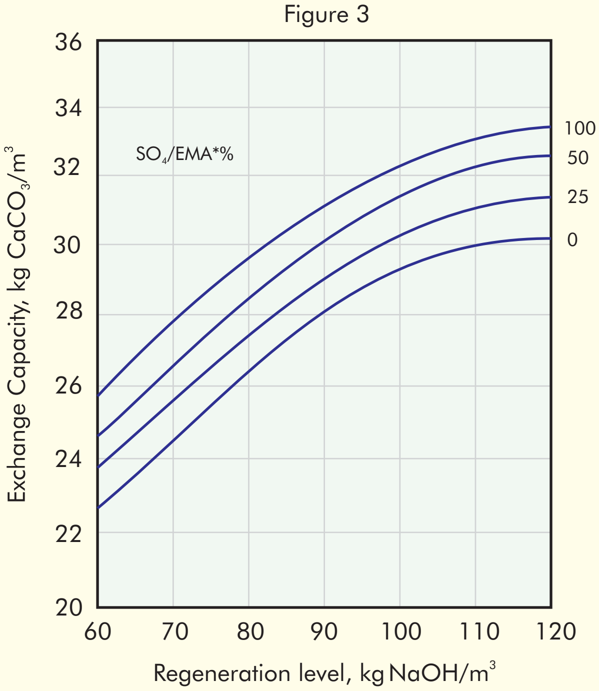
EMA*=Equivalent Mineral Acidity

OPERATING EXCHANGE CAPACITY

co-flow regeneration at

$SiO_2/TA=20\%$ & above

Figure 3



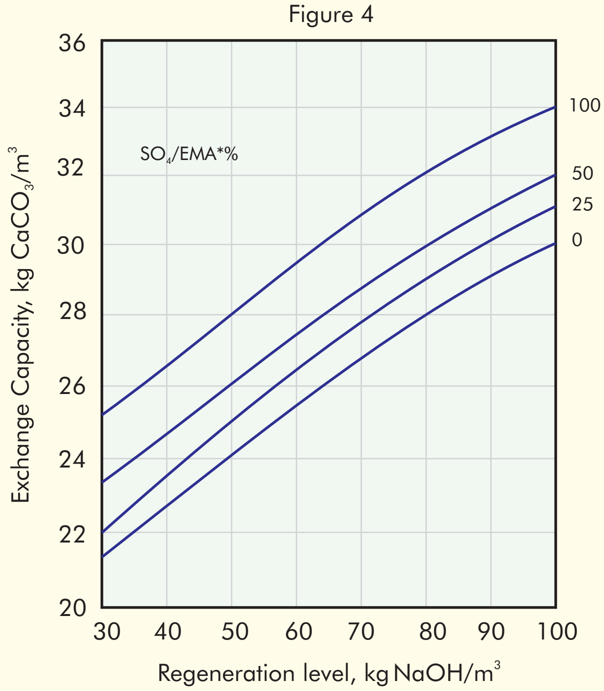
EMA*=Equivalent Mineral Acidity

OPERATING EXCHANGE CAPACITY

counter current regeneration at

$SiO_2/TA=20\%$ & above

Figure 4



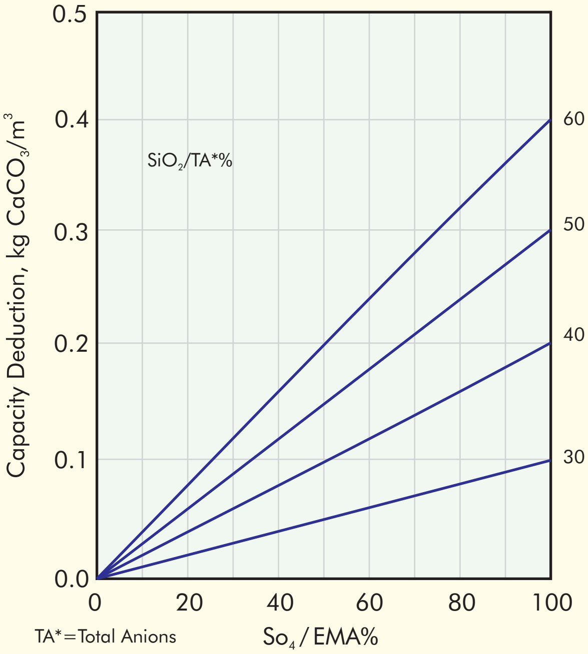
EMA*=Equivalent Mineral Acidity

OPERATING EXCHANGE CAPACITY CCR & CO-FLOW

Capacity Adjustment for SiO_2/TA%

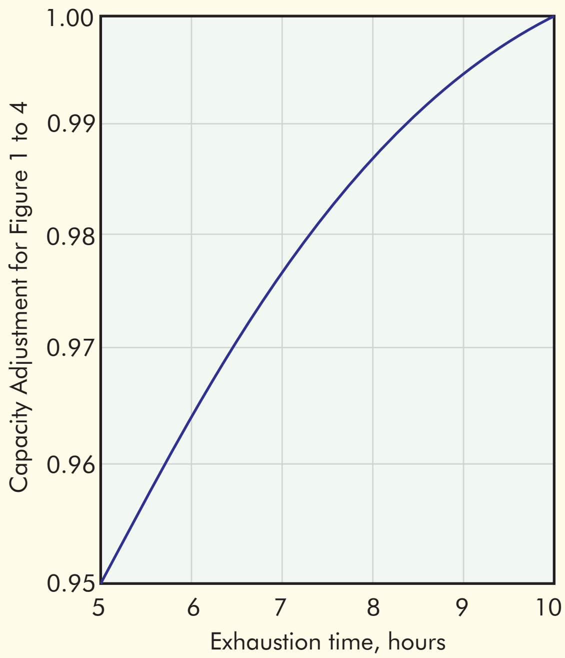
(Basic Graphs Figure 3 & 4)

Figure 5



CAPACITY ADJUSTMENT FOR EXHAUSTION HOURS

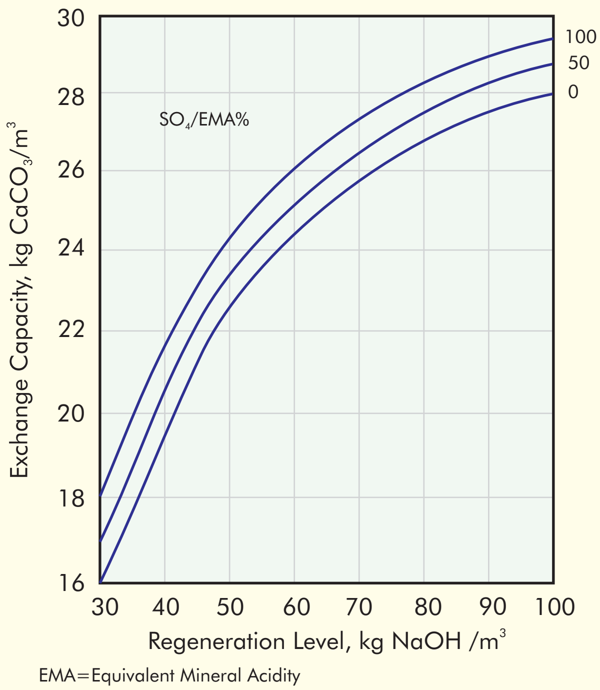
Figure 6



OPERATING EXCHANGE CAPACITY CCR

SiO_2/TA% = 70%

Figure 7



Treated water quality

Two stage/Multiple stage de-ionising

The quality of treated water from two stage de-ionising/multiple stage plant using INDION 810 as the anion exchanger is determined by:

- Regeneration level employed.
- Temperature of the regenerant.
- Level of sodium ion leakage from the cation exchanger.
- Silica to total anion ratio of water fed to the anion exchanger.

Sodium ions leaking from the cation exchanger are converted to NaOH as the water passes through the anion exchanger.

Each ppm of sodium leakage, expressed as $CaCO_3$, increases conductivity of the water leaving the anion exchanger by approximately 5 microsiemens/cm at 20°C.

The values for residual silica in the treated water at various regeneration levels and temperatures can be obtained from:

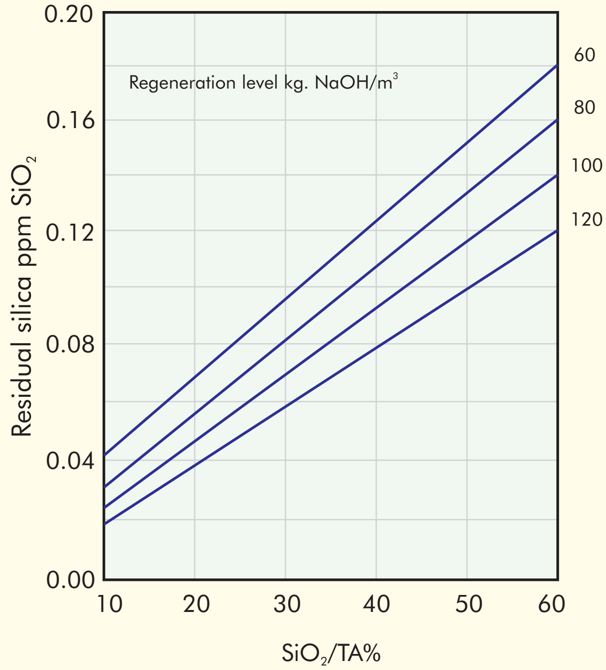
figure 8 & 9 Coflow regeneration.
figure 10 & 11 Countercurrent regeneration.

These values assume zero sodium slip and for every ppm of sodium leakage as $CaCO_3$, the residual silica increases by 15%.

TREATED WATER QUALITY CO-FLOW

Residual silica - regeneration temp. 25°C

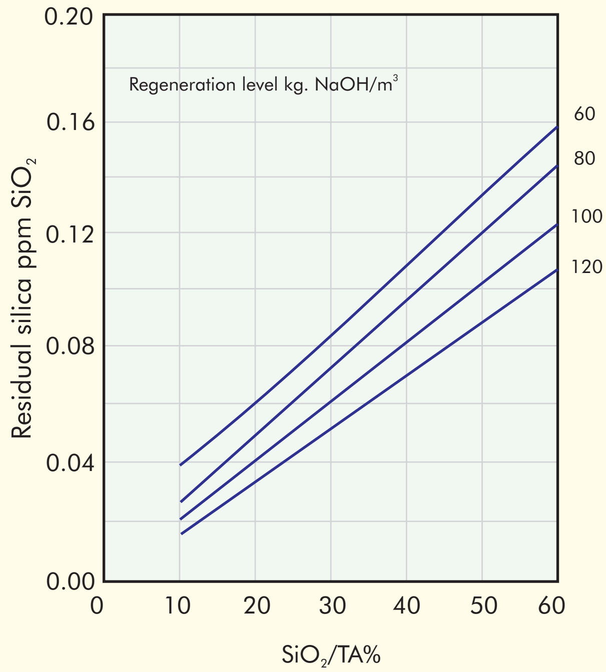
Figure 8



TREATED WATER QUALITY CO-FLOW

Residual silica - regeneration temp. 40°C

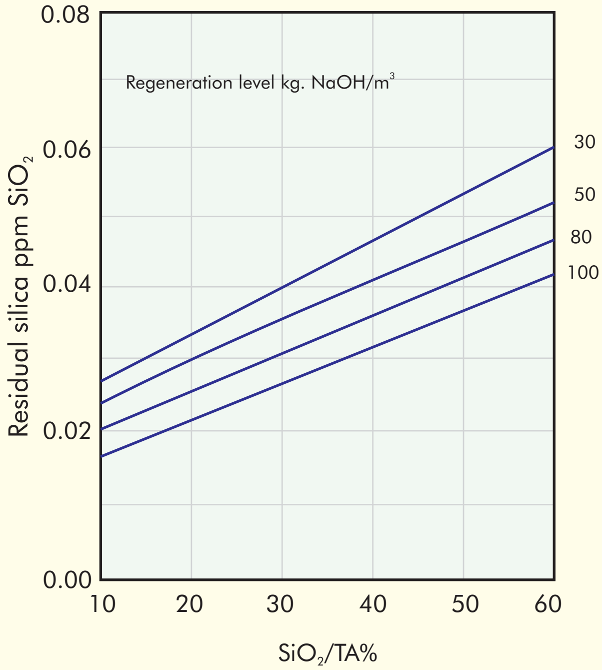
Figure 9



TREATED WATER QUALITY CCR

Residual silica - regeneration temp. 25°C

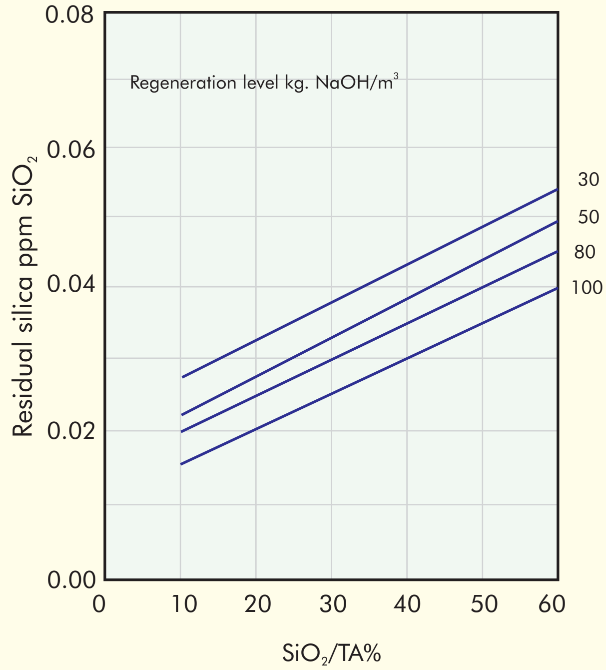
Figure 10



TREATED WATER QUALITY CCR

Residual silica - regeneration temp. 40°C

Figure 11

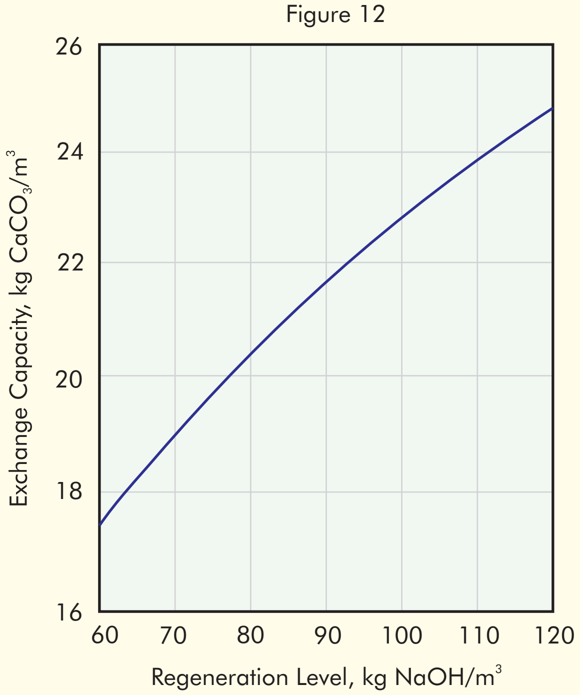


OPERATING EXCHANGE CAPACITY CO-FLOW

Op. Capacity at SiO_2/TA > 80% &

Regeneration Temp.35°C

Figure 12



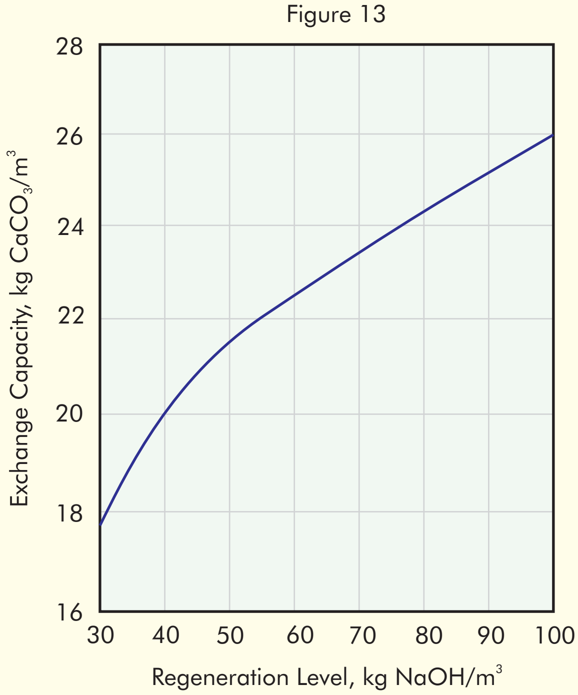
End point = 0.2 ppm SiO_2

OPERATING EXCHANGE CAPACITY CCR

Op. Capacity at SiO_2/TA > 80% &

Regeneration Temp.35°C

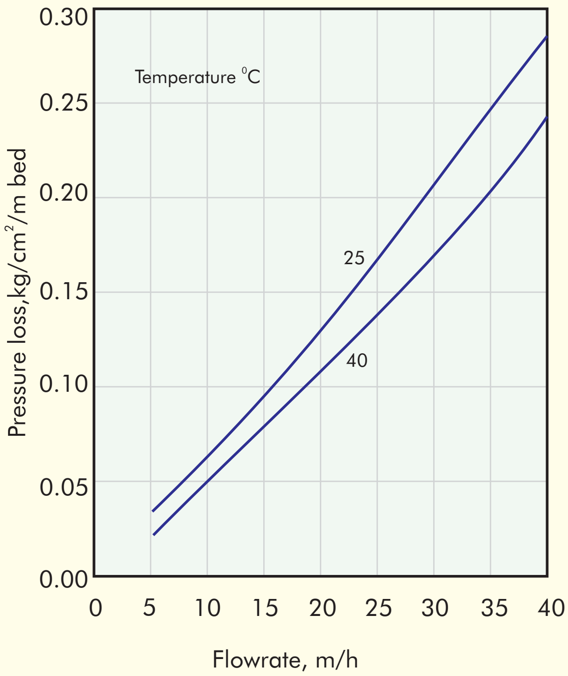
Figure 13



End point = 0.2 ppm SiO_2

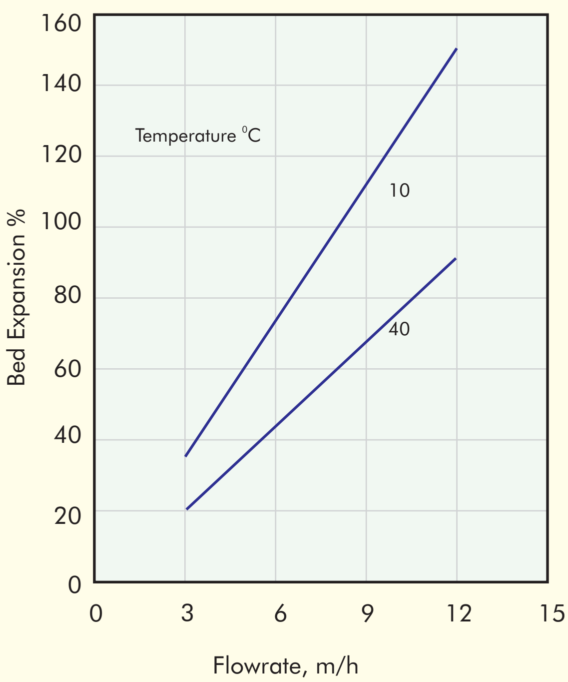
PRESSURE LOSS

Figure 14



BED EXPANSION

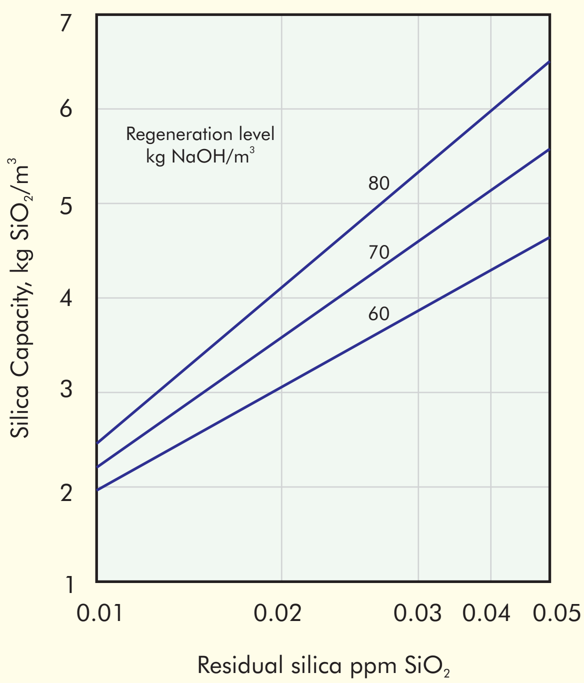
Figure 15



MIX BED DEIONISING

Residual sililca - regeneration temp. 25°C

Figure 16



Mixed Bed De-ionising

A correctly designed and operated mixed bed unit using INDION 810 with INDION 225 strong acid cation exchange resin will produce treated water with a conductivity of 0.5 microsiemens/cm or less. When the mixed bed unit is preceded by two-stage de-ionising, conductivity of 0.1 microsiemens/cm is easily achieved.

The silica content of the treated water from a mixed bed unit depends upon the level and temperature of the regenerant used for INDION 810 and the silica loading during the treatment cycle. This loading can be calculated form the silica content of the feed water and the volume of treated water per cycle.

To maintain any desired residual silica level in the treated water, reference should be made to figure 16. These graphs gives the maximum silica loading that INDION 810 will tolerate at various regeneration level and temperature indicated to maintain the required residual silica.

Typical operating data

Mixed bed de-ionising

Total bed depth..........................	1.0 - 2.4 m using INDION 810 and INDION 225 resin
Rising space	75% of bed depth
Treatment flowrate.......................	60 $m^3/h\ m^2$, maximum
Pressure loss............................	1.2 Kg/cm^2, maximum
Bed separation...........................	9 $m^3/h\ m^2$, for 10 minutes
Bed settlement	Allow 5 minutes after separation before commencing injection of regenerant.
Regenerant	Sodium hydroxide for INDION 810
	Hydrochloric acid/Sulphuric acid for INDION 225
Acid injection rate	4.5 - 18 $m^3/h\ m^2$, for 6 - 10 minutes with 2-5% w/v acid
Down flow	1.5 $m^3/h\ m^2$
Acid rinse	2 bv
Down flow	1.5 $m^3/h\ m^2$
Alkali Injection rate	4.5 - 18 $m^3/h\ m^2$ for 10 - 15 minutes with 2 - 5% w/v alkali
Upflow	4.5 $m^3/h\ m^2$
Alkali rinse	4 bv in 10 - 15 minutes
Upflow	4.5 $m^3/h\ m^2$
Unit drain drown	Before re mixing the resin, the water level should be lowered to approximately 0.4 m above the bed.
Bed remix	2m^3/minute m^2 oil free air at 0.4 kg/cm^2 g pressure for 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 flow rate, or at 24 m/h, whichever is greater. Total time required is normally about 5 - 10 minutes depending upon end point conductivity required.

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 sodium hydroxide must be essentially free from iron and heavy metals. All resins, especially the anion exchangers are prone to oxidative attack resulting in problems such as loss of capacity, resin clumping, etc. Therefore sodium hydroxide should have as low a chlorate content as possible. Good quality regenerant of technical 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 with liner bags	180 lts	Fiber drums 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.

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