ION EXCHANGE
Refreshing the Planet

INDION® GS 3000

Description

INDION GS 3000 is a controlled particle size strong base Type 1 anion exchange resin, containing quaternary ammonium groups. It is based on crosslinked polystyrene and has a gel structure with high mechanical strength.

Applications

INDION GS 3000 is effective in removing weak acids like carbonic and silicic acid along with strong acids. It is recommended for use in two stage/multiple stage or mixed bed deionising units for producing high quality demineralised water with lowest possible residual silica. Being a high strength gel resin, it is recommended for use in condensate polishing. It is also recommended for speciality non-water applications such as caprolactum purification.

INDION GS 3000 is used in combination with strong acid cation resin INDION 2250..

Characteristics

Appearance	:	Translucent pale yellow beads
Matrix	:	Styrene divinylbenzene copolymer
Functional Group	:	Benzyl trimethyl amine
Ionic form as supplied	:	Chloride
Total exchange capacity	:	1.3 meq/ml, minimum
Moisture holding capacity	:	48 - 58 %
Shipping weight *	:	650 kg/m^3, approximately
Bead strength	:	300 g (avg)
Fines Content (< 0.42 mm)	:	0.5%, maximum
Uniformity co - efficient	:	1.2, maximum
Effective size	:	0.50 to 0.65 mm
Maximum operating temperature	:	60 ^{o}C in OH form 80 ^{o}C in Cl form
Operating pH range	:	0 to 14
Volume change	:	Cl to OH, 25 - 30 % 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.

This technical literature describes typical operating data and operating exchange capacities of INDION GS 3000 when used in :

- Two stage de-ionising (co-flow and counter current regeneration).
- Multiple stage de-ionising using thoroughfare regeneration
- Mixed bed de-ionising

Typical operating data

Two stage/multiple stage de-ionising	Co-flow regeneration	Counter current regeneration (CCR)
Bed depth	0.75 - 1.50 m	1.0 m ,minimum
Treatment flowrate	60m^3/h m^2, maximum.	60m^3/h m^2, maximum.
Pressure loss	Refer Fig. 17	Refer Fig. 17
Bed expansion........................	Refer Fig. 16	Refer Fig. 16
Backwash	3 m^3/h m^2 for 5 minutes or till effluent is clear	3 m^3/h m^2 for 5 minutes or till effluent is clear *
Regenerant	Sodium hydroxide (2 - 4% w/v)	Sodium hydroxide (2 - 4% w/v)
Regenerant flowrate	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 - 3 bv at regenerant flow rate	2 - 3 bv at regenerant flow rate
Final rinse	4 - 6 bv at service flow rate	3 - 4 bv at service flow rate

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

Operating exchange capacity

Two stage de-ionising

The operating exchange capacity of INDION GS 3000 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 anions (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.

  The operating exchange capacities are given in figures 6 & 7 when SiO_2/TA, is 60 % & 70 % respectively, for counter current regeneration.
- Silica content (SiO_2/TA, %) in water to be treated.

  Refer Figure 3 and 4 for capacity deduction data to be applied to basic operating exchange capacities obtained form Figure 1 and 2 respectively.
- Exhaustion rate

  The operating capacity data is related to exhaustion time greater than 10 hours. Figure 5 shows the correction factor to be applied on operating capacity (after capacity deduction for silica content) with exhaustion time for both co-flow and counter current regeneration.

Multiple stage de-ionising

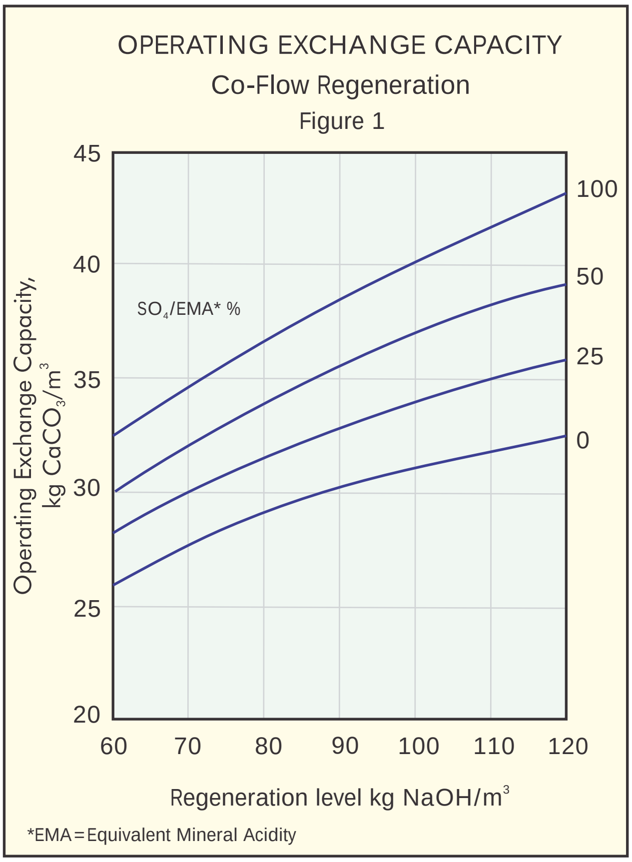
Multiple de-ionising system generally consists of strong acid cation exchanger INDION 2250 H in the first stage. This is followed by a weak base anion exchanger INDION 850, preceded or followed by a degasser and a strong base anion exchanger INDION GS 3000 in series. In such a system INDION GS 3000 treats 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. The method is commonly referred to as “thoroughfare regeneration”.

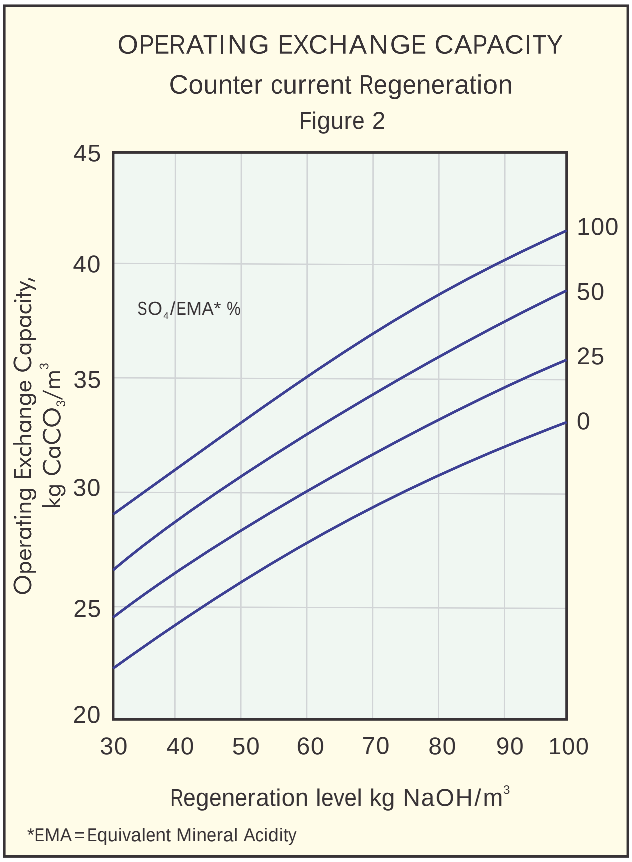
- Refer Figure 8 (coflow) and 9, 10 (0.1 & 0.2 ppm silica end point - CCR) for operating capacities of INDION GS 3000 when used in co-flow and countercurrent thoroughfare modes respectively.

Mixed bed de-ionising

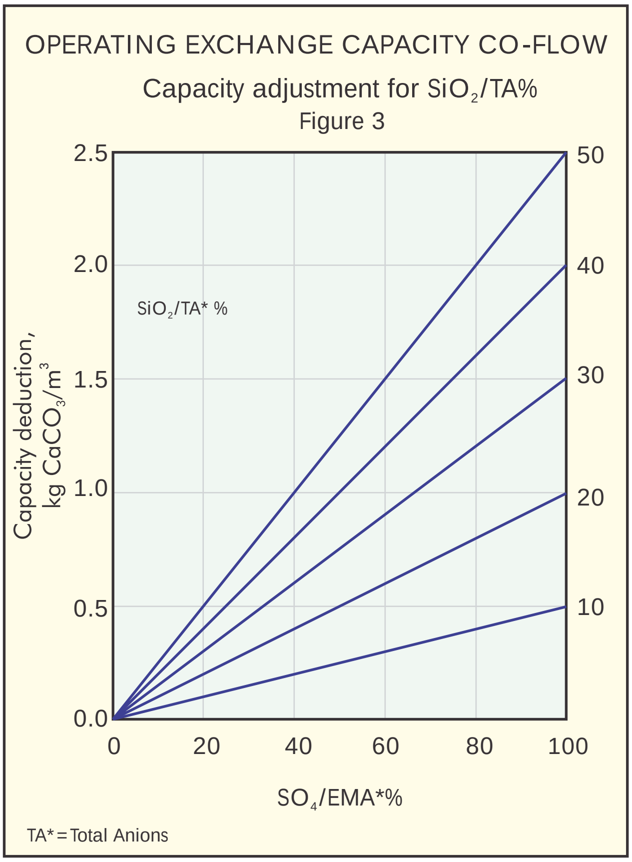
When used as the anion exchanger in mixed bed de-ionising systems the capacity of INDION GS 3000 is independent of the feed water composition and therefore corresponds to the zero curves in Figure 1. No correction for silica content of the Feed water need be made, although the amount loaded on the resin 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 (Figure 15).



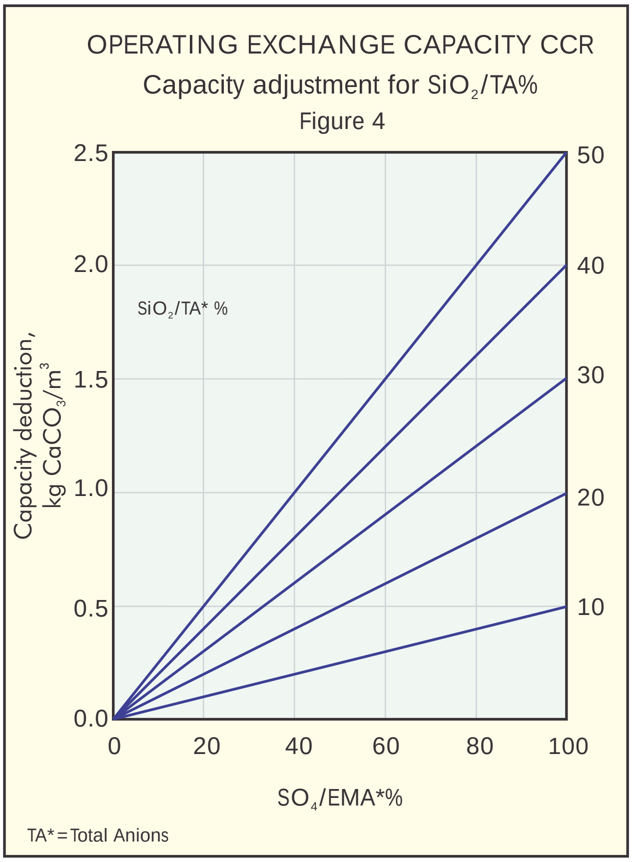
OPERATING EXCHANGE CAPACITY
Co-Flow Regeneration
Figure 1
Operating Exchange Capacity, kg $CaCO_3/m^3$
SO_4/EMA* %
100
50
25
0
45
40
35
30
25
20
60
70
80
90
100
110
120
Regeneration level kg NaOH/m^3
*EMA = Equivalent Mineral Acidity



OPERATING EXCHANGE CAPACITY
Counter current Regeneration
Figure 2
Operating Exchange Capacity, kg $CaCO_3/m^3$
SO_4/EMA* %
100
50
25
0
45
40
35
30
25
20
30
40
50
60
70
80
90
100
Regeneration level kg NaOH/m^3
*EMA = Equivalent Mineral Acidity



OPERATING EXCHANGE CAPACITY CO-FLOW
Capacity adjustment for SiO_2/TA%
Figure 3
Capacity deduction, kg $CaCO_3/m^3$
SiO_2/TA* %
50
40
30
20
10
2.5
2.0
1.5
1.0
0.5
0.0
0
20
40
60
80
100
SO_4/EMA*%
TA* = Total Anions



OPERATING EXCHANGE CAPACITY CCR
Capacity adjustment for SiO_2/TA%
Figure 4
Capacity deduction, kg $CaCO_3/m^3$
SiO_2/TA* %
50
40
30
20
10
2.5
2.0
1.5
1.0
0.5
0.0
0
20
40
60
80
100
SO_4/EMA*%
TA* = Total Anions

Treated water quality

Two stage/multiple stage de-ionising

The quality of treated water from a two stage/ multiple stage de-ionising plant using INDION GS 3000 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 micro siemens /cm at 20°C.

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

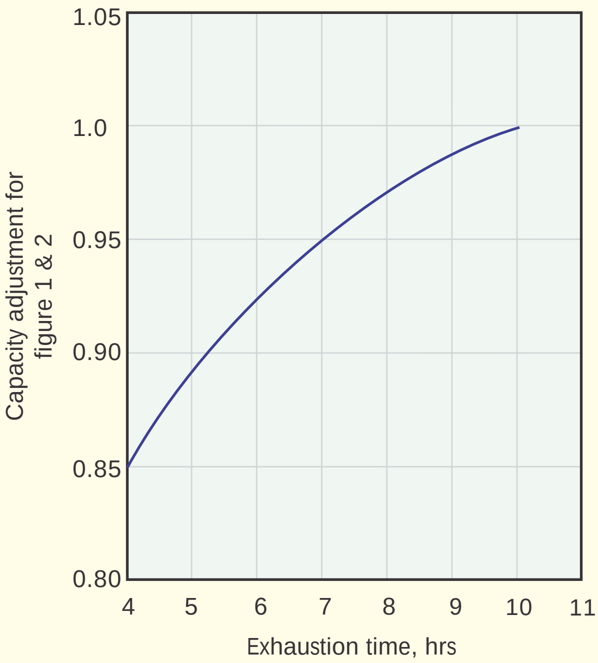
Figures 11 & 12 - Co-flow regeneration

Figures 13 & 14- Countercurrent regeneration

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

CAPACITY ADJUSTMENT FOR EXHAUSTION HOURS

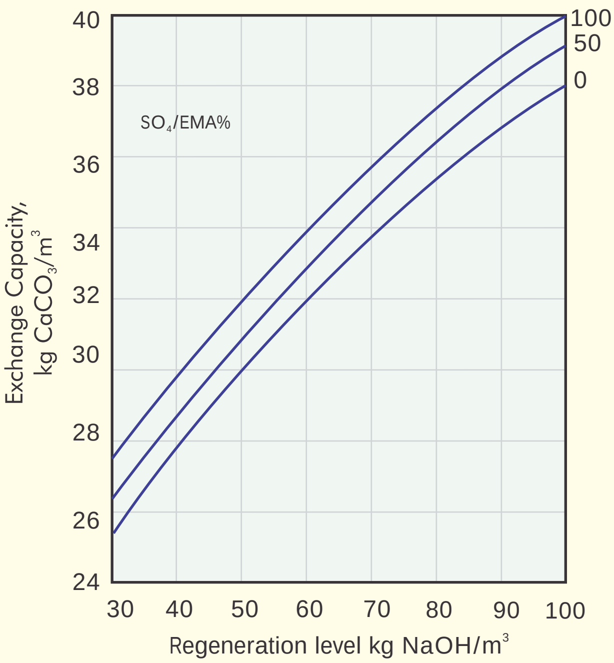
Figure 5



OPERATING EXCHNAGE CAPACITY CCR

SiO_2/TA= 60%

Figure 6

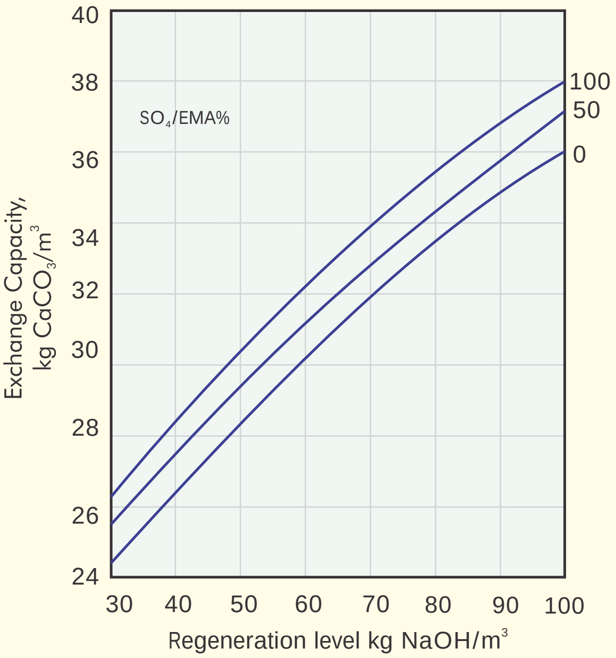


End point SiO_2 = 0.2ppm

OPERATING EXCHNAGE CAPACITY CCR

$SiO_2/TA = 70\%$

Figure 7

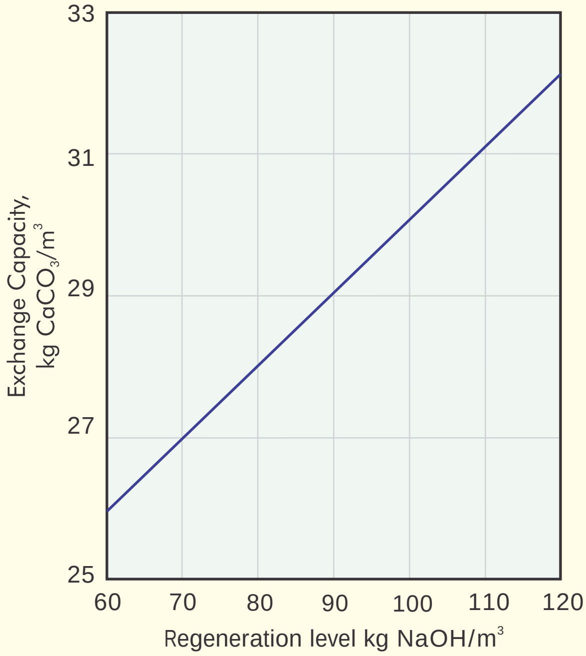


End point = 0.2ppm SiO_2

OPERATING EXCHNAGE CAPACITY
THOROUGHFARE CO-FLOW

$SiO_2/TA > 80\%$ & Regn. Temp 35^{0}C

Figure 8

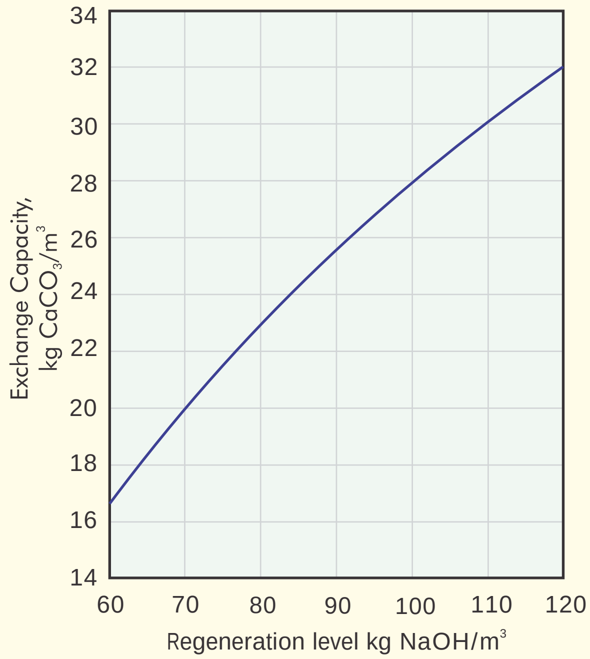


End point = 0.2ppm SiO_2

OPERATING EXCHNAGE CAPACITY
THOROUGHFARE CCR

$SiO_2/TA > 80\%$ & Regn. Temp 35^{0}C

Figure 9

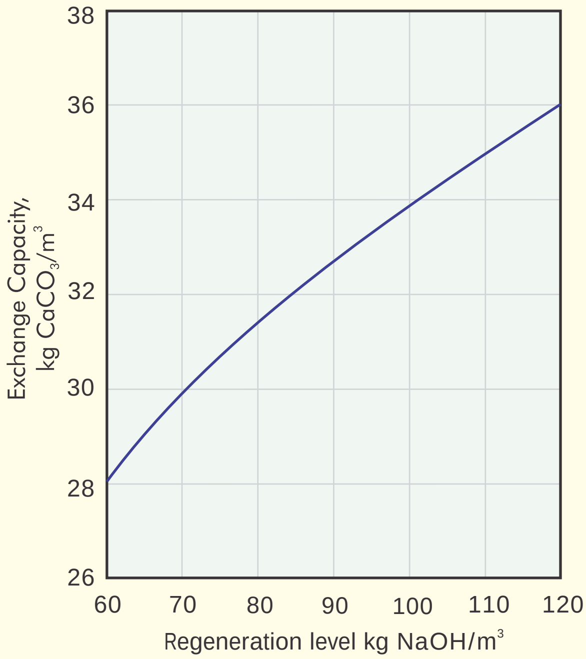


End point = 0.1ppm SiO_2

OPERATING EXCHNAGE CAPACITY
THOROUGHFARE CCR

$SiO_2/TA > 80\%$ & Regn. Temp 35^{0}C

Figure 10

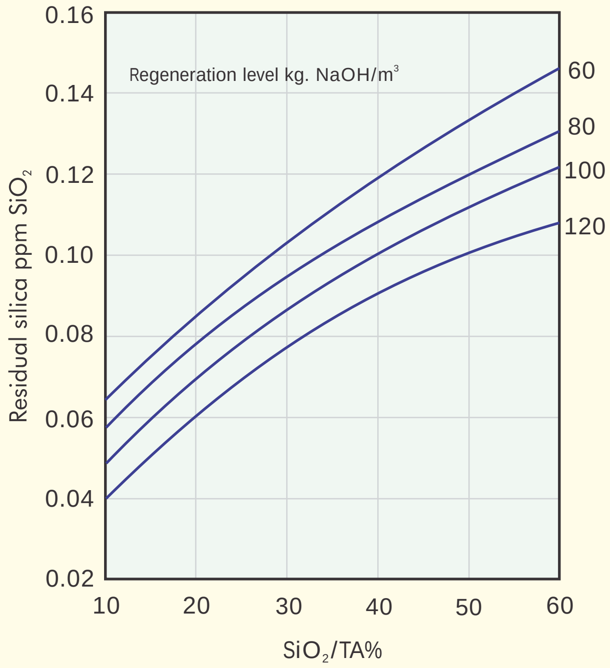


End point = 0.2ppm SiO_2

TREATED WATER QUALITY CO-FLOW

Residual silica - regeneration temp. 25°C

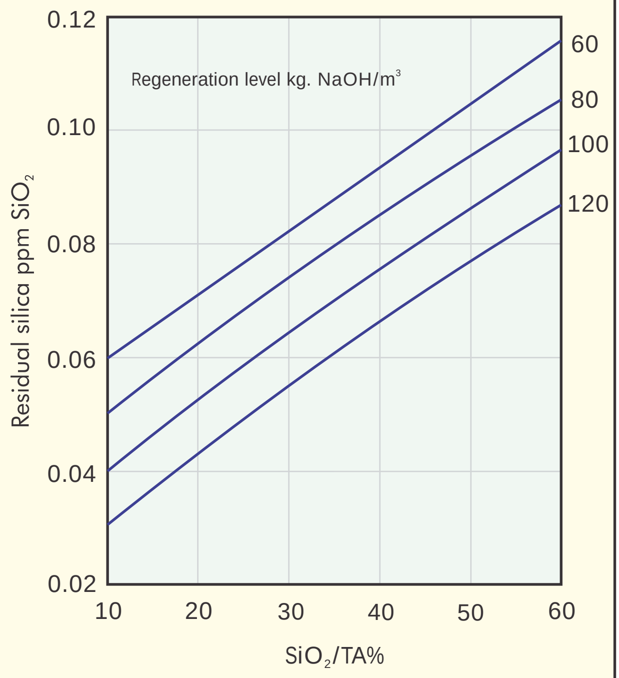
Figure 11



TREATED WATER QUALITY CO-FLOW

Residual silica - regeneration temp. 40°C

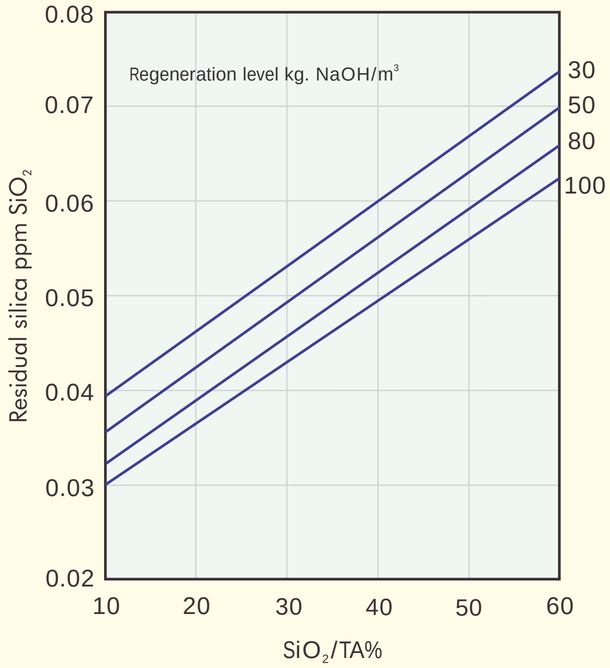
Figure 12



TREATED WATER QUALITY CCR

Residual silica - regeneration temp. 25°C

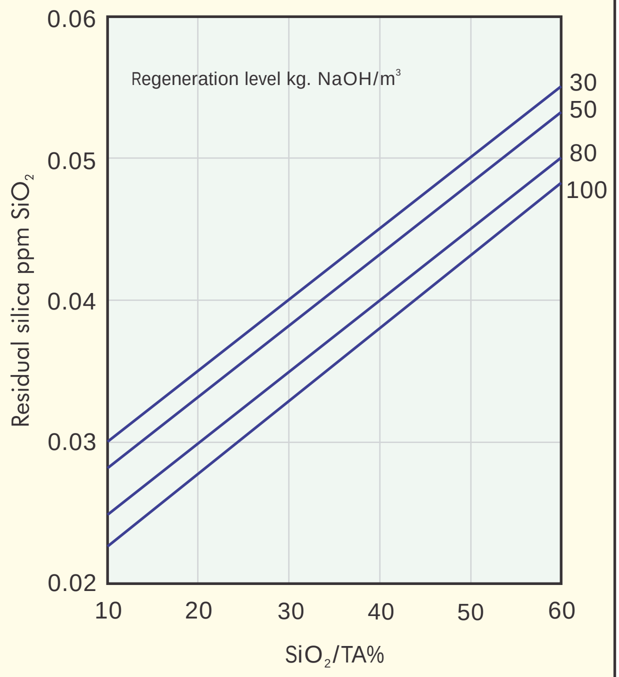
Figure 13

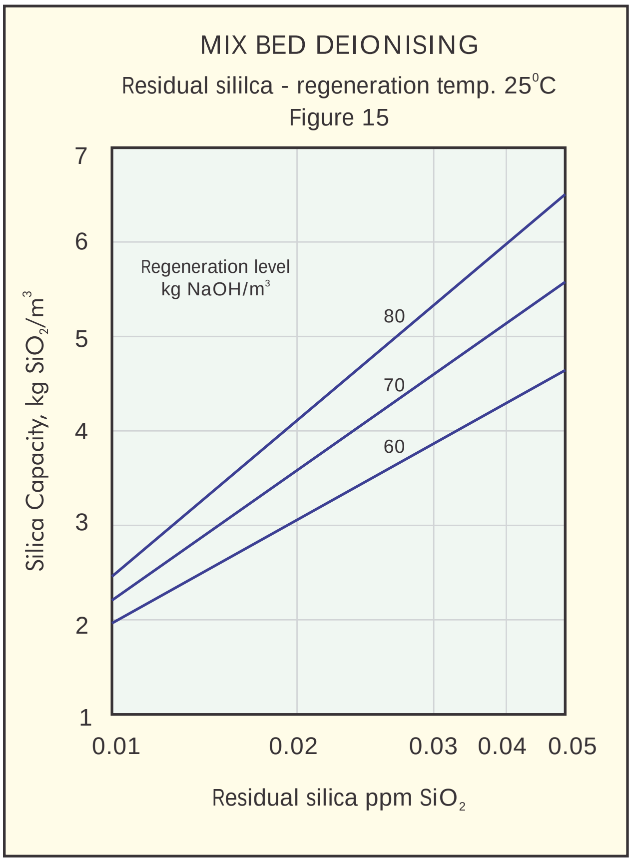


TREATED WATER QUALITY CCR

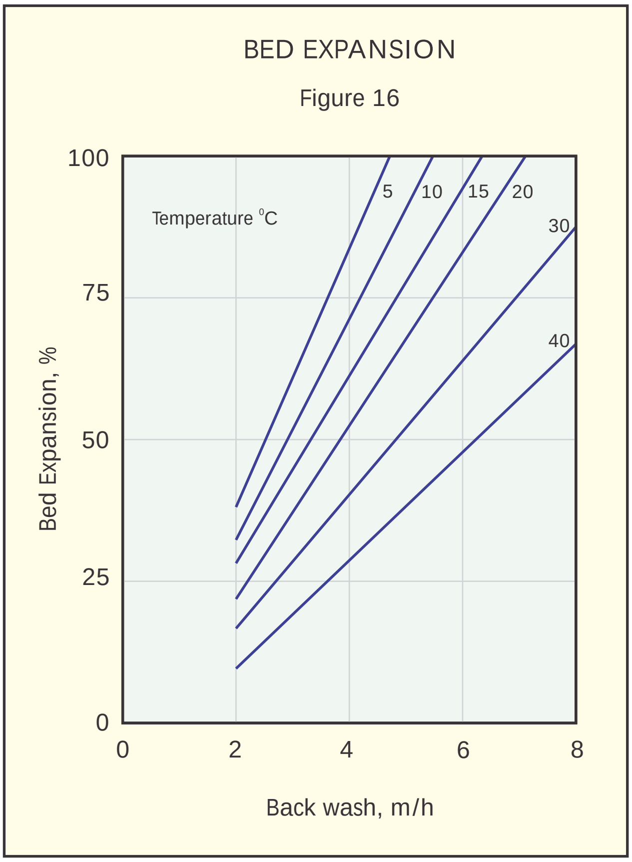
Residual silica - regeneration temp. 40°C

Figure 14

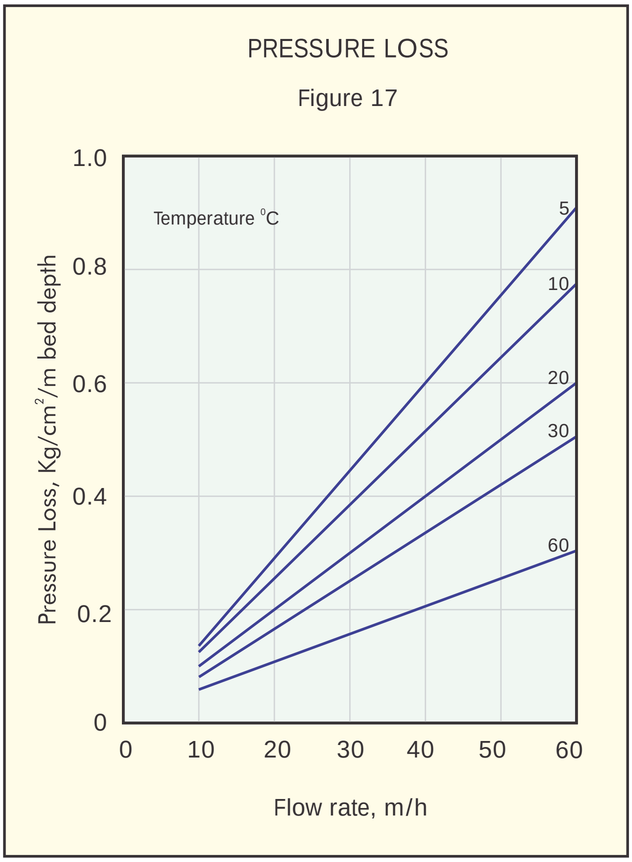




MIX BED DEIONISING
Residual sililca - regeneration temp. 25°C
Figure 15
Regeneration level
kg NaOH/m³
80
70
60
Silica Capacity, kg SiO₂/m³
1
2
3
4
5
6
7
0.01
0.02
0.03
0.04
0.05
Residual silica ppm SiO₂



BED EXPANSION
Figure 16
Temperature °C
5
10
15
20
30
40
Bed Expansion, %
0
25
50
75
100
0
2
4
6
8
Back wash, m/h



PRESSURE LOSS
Figure 17
Temperature °C
5
10
20
30
60
Pressure Loss, Kg/cm²/m bed depth
0
0.2
0.4
0.6
0.8
1.0
0
10
20
30
40
50
60
Flow rate, m/h

Mixed bed de-ionsing

A correctly designed and operated mixed bed unit using INDION GS 3000 with INDION 2250 strong acid cation exchanger resin will produce treated water with a conductivity of 0.5 micro siemens /cm or less. When the mixed bed unit is preceded by two-stage de-ionising, conductivity of 0.1 micro siemens /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 GS 3000 and the silica loading during the treatment cycle. This loading can be calculated from 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 15. This graph gives the maximum silica loading that INDION GS 3000 will tolerate at various regeneration levels indicated to maintain the required residual silica .

Typical operating data

Mixed bed de-ionising

Total Bed depth	1.0 - 2.4 m using INDION GS 3000 and INDION 2250 resin
Rising space	75% of bed depth
Treatment flowrate	60 m/h, 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 GS 3000 Hydrochloric acid/Sulphuric acid for INDION 2250
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 down	Before re-mixing the resin, the water level should be lowered to approximately 0.4 m above the bed.
Bed remix	2 m^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^3/h m^2 , 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	1cft/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.

ION EXCHANGE

Refreshing the Planet

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