ION EXCHANGE
Refreshing the Planet

# INDION® GS 400

## Description

INDION GS 400 is strong base Type II anion exchange resin, based on cross linked polystyrene matrix with benzyl dimethyl ethanol amine functional groups. It has a gel structure with high physical strength. INDION GS 400 has high operating exchange capacity & excellent regeneration efficiency.

INDION GS 400 is recommended as the anion exchange resin in the second stage of a de-ionising pair with the cation exchange resin INDION 225 H in the first stage.

INDION GS 400 is particularly recommended for use in a two stage de-ionising plant for removal of mineral acid anions and some silica, while keeping the running cost down. If treated water with lowest possible level of residual silica is desired, this two stage treatment should be followed by mixed bed de-ionising using a strong acid cation resin INDION 225 H and a strong base Type I anion resin INDION GS 300.

## Characteristics

| | | |
|---|---|---|
| Appearance | : | Light yellowish to light brown colour beads |
| Matrix | : | Styrene divinylbenzene copolymer |
| Functional Group | : | Benzyl dimethyl ethanolamine |
| Ionic form as supplied | : | Chloride |
| Total exchange capacity | : | 1.2 meq/ml, minimum |
| Moisture holding capacity | : | 45 - 51 % |
| Shipping weight * | : | 670 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 | : | 40°C in OH form<br>75°C in Cl form |
| Operating pH range | : | 0 to 14 |
| Volume change | : | Cl to OH, 10 - 15 % maximum |
| 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.

## Two stage de-ionising

This technical literature describes typical operating data and operating exchange capacities of INDION GS 400 when used:

- Two stage de-ionising (Co-flow and countercurrent regeneration technique.)

### 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 Figure 9 | Refer Figure 9 |
| Bed expansion ....................... | Refer Figure 10 | Refer Figure 10 |
| Backwash............................... | $3\ m^3/h\ m^2$ for 5 min 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 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 .............................. | 2.5 to 3 bv at regenerant flow rate | 2 to 3 bv at regenerant flow rate |
| Final rinse.............................. | 6 bv at service flow rate | 5 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

Indion GS 400 is recommended as the anion exchanger in the second stage of a de-ionising pair with INDION 225 H cation exchange resin in the first stage.

Indion GS 400 is particularly recommended for use in a two-stage de-ionising plant for the removal of mineral acid anions and some silica, while keeping running costs down. If treated water with the lowest possible level of residual silica is required, two stage treatment should be followed by mixed bed de-ionising using a strong acid cation resin INDION 225H & Type I strong base anion exchange resin such as INDION GS 300.

The Operating exchange capacity of INDION GS 400 in two stage de-ionising system is dependent upon:

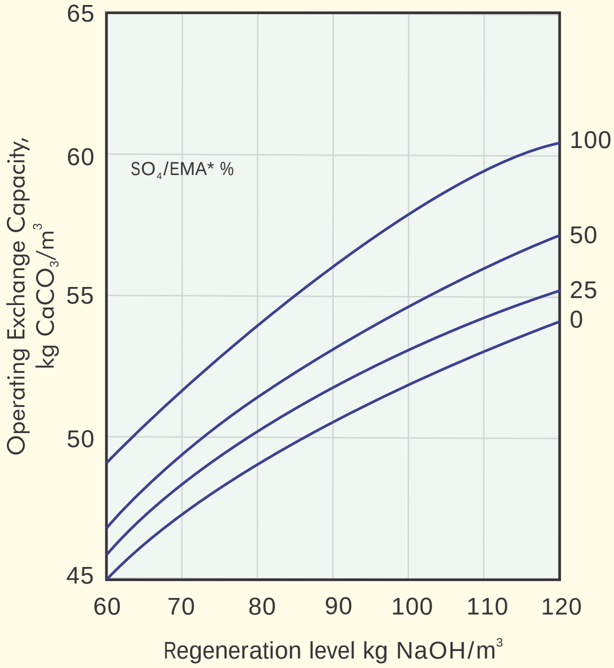
- The regeneration level employed and the composition of water to be treated, specifically the concentration of mineral acid anions ($SO_4$/EMA %)
- The operating exchange capacities are shown as a function of regeneration level for various percentages of $SO_4$/EMA in Figure 1 for co-flow regeneration and in Figure 2 for counter current regeneration.
- Silica content ($SiO_2$/TA %) in water to be treated.
- Refer Figure 3 for capacity deduction data to be applied to basic operating exchange capacities in co-flow and counter current mode obtained from Figure 1 and 2 respectively.
- In co-flow mode if feed $SiO_2$/TA ratio is 40% or more, then the operating capacity values obtained from Figure 1, should be derated further by 20 per cent and the capacity deduction from Figure 3 increased by 20 percent.
- Exhaustion time

  The operating capacity data is related to exhaustion time greater than 10 hours. Figure 4 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.

EXCHANGE CAPACITY

Co-flow Regeneration

Figure 1




*EMA = Equivalent Mineral Acidity

## Treated water quality

### Two stage de-ionising

The quality of treated water from a two stage deionising plant using INDION GS 400 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 5 & 6 Co-flow regeneration

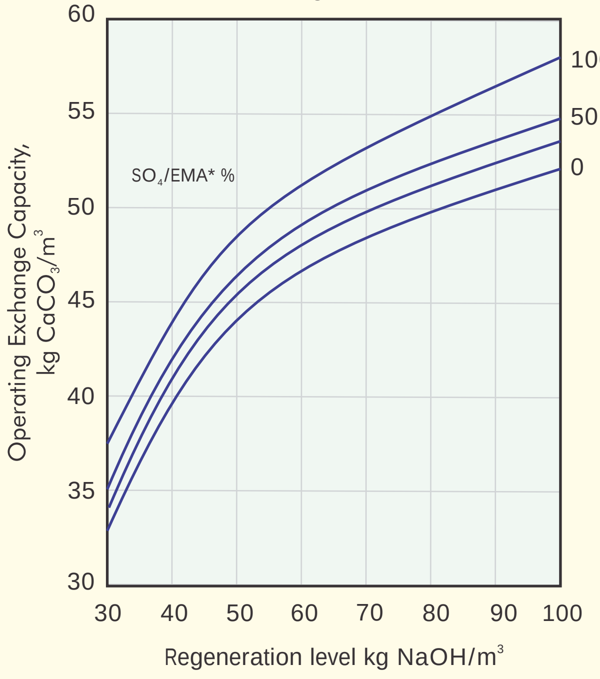
Figure 7 & 8 Counter current regeneration

These values assume zero sodium slip and for every ppm of sodium leakage as $CaCO_3$, the residual silica increases by 25%.

EXCHANGE CAPACITY

Counter current Regeneration

Figure 2

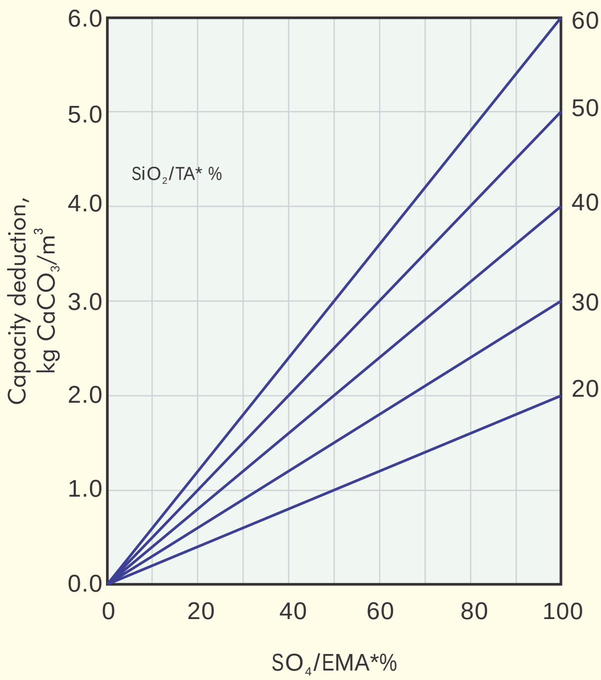



*EMA=Equivalent Mineral Acidity

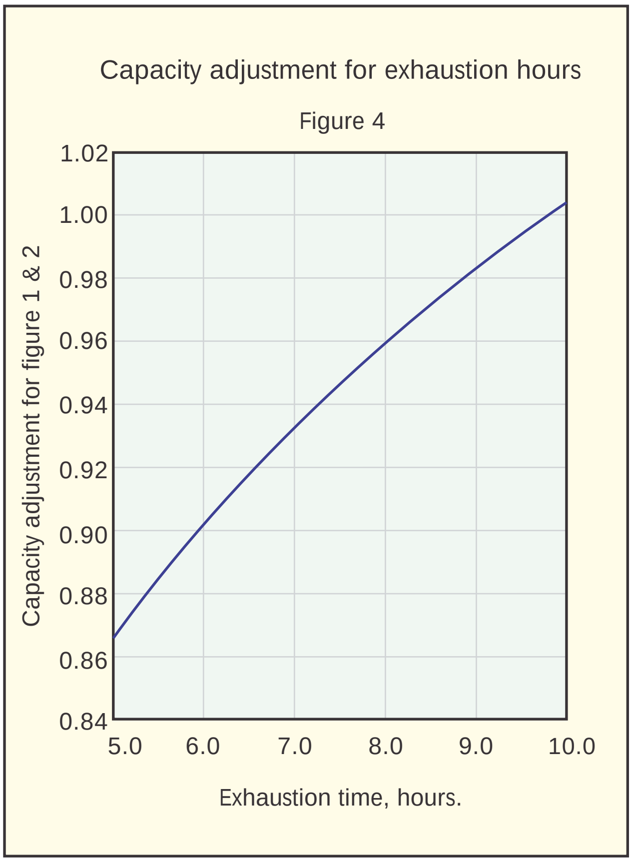
EXCHANGE CAPACITY CO-FLOW

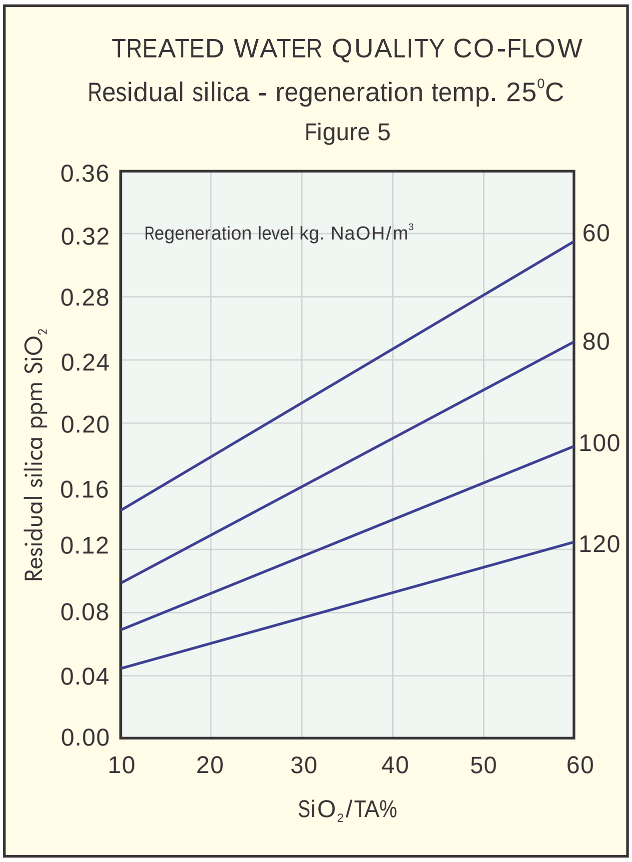
Capacity adjustment for $SiO_2$/TA%

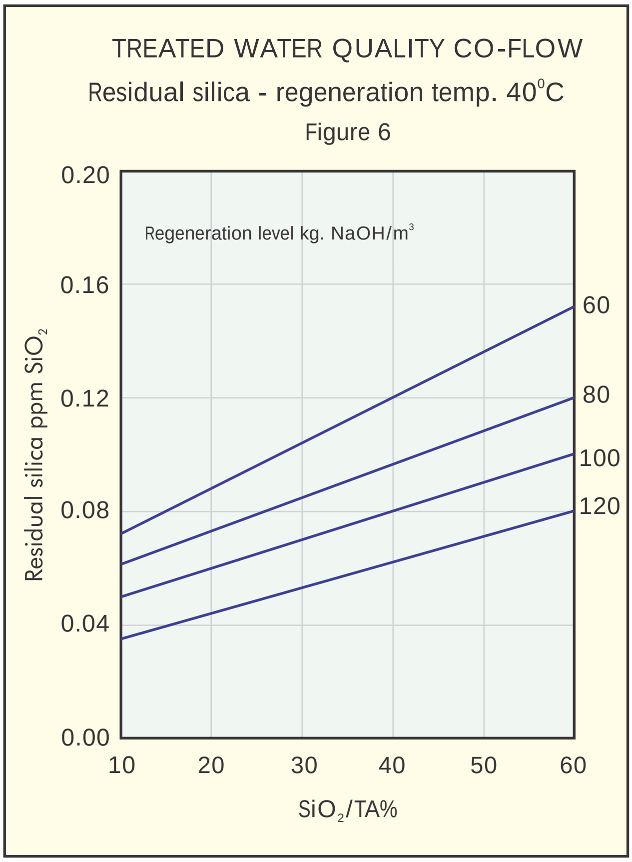
Figure 3

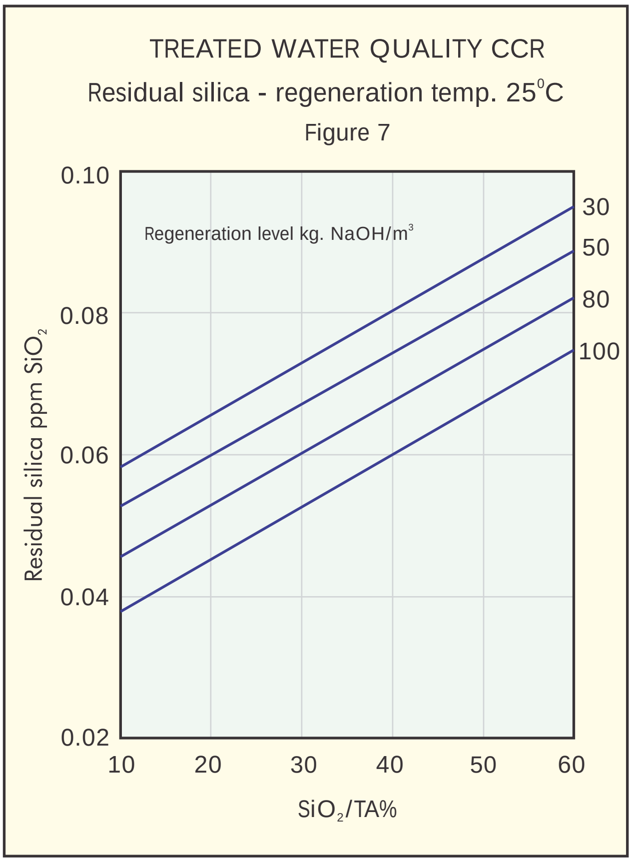



TA*=Total Anions

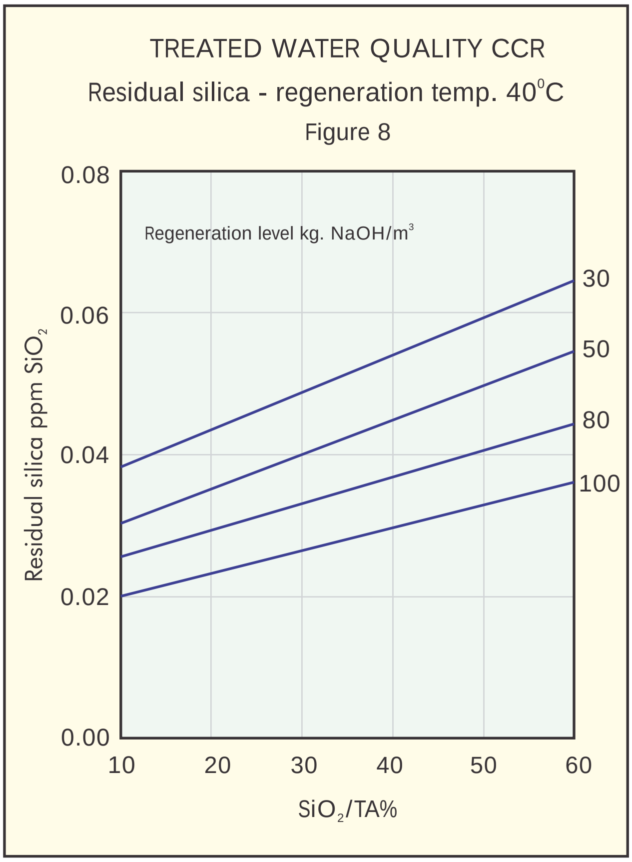

Capacity adjustment for exhaustion hours
Figure 4
1.02
1.00
0.98
0.96
0.94
0.92
0.90
0.88
0.86
0.84
Capacity adjustment for figure 1 & 2
5.0
6.0
7.0
8.0
9.0
10.0
Exhaustion time, hours.


TREATED WATER QUALITY CO-FLOW
Residual silica - regeneration temp. 25°C
Figure 5
Regeneration level kg. NaOH/m3
60
80
100
120
0.36
0.32
0.28
0.24
0.20
0.16
0.12
0.08
0.04
0.00
Residual silica ppm SiO2
10
20
30
40
50
60
SiO2/TA%

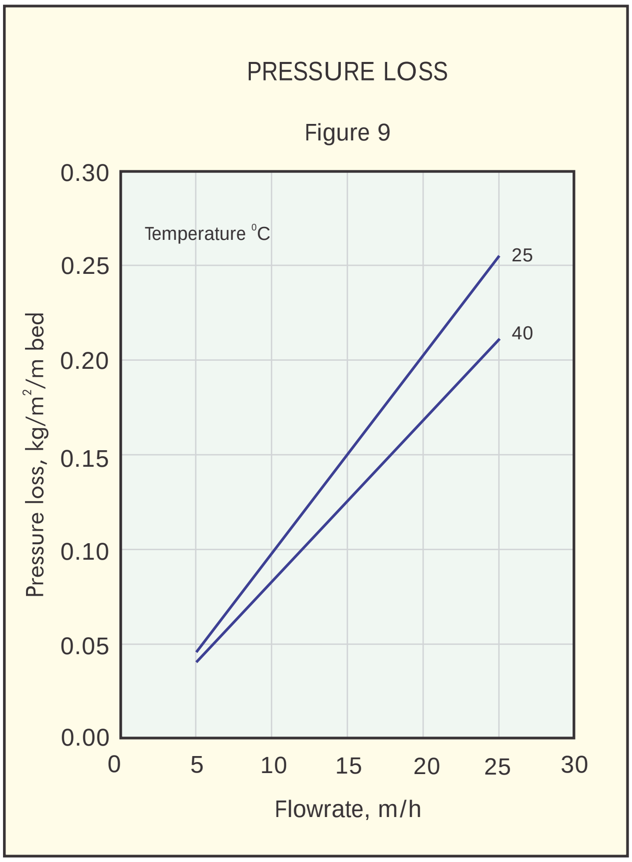

TREATED WATER QUALITY CO-FLOW
Residual silica - regeneration temp. 40°C
Figure 6
Regeneration level kg. NaOH/m3
60
80
100
120
0.20
0.16
0.12
0.08
0.04
0.00
Residual silica ppm SiO2
10
20
30
40
50
60
SiO2/TA%

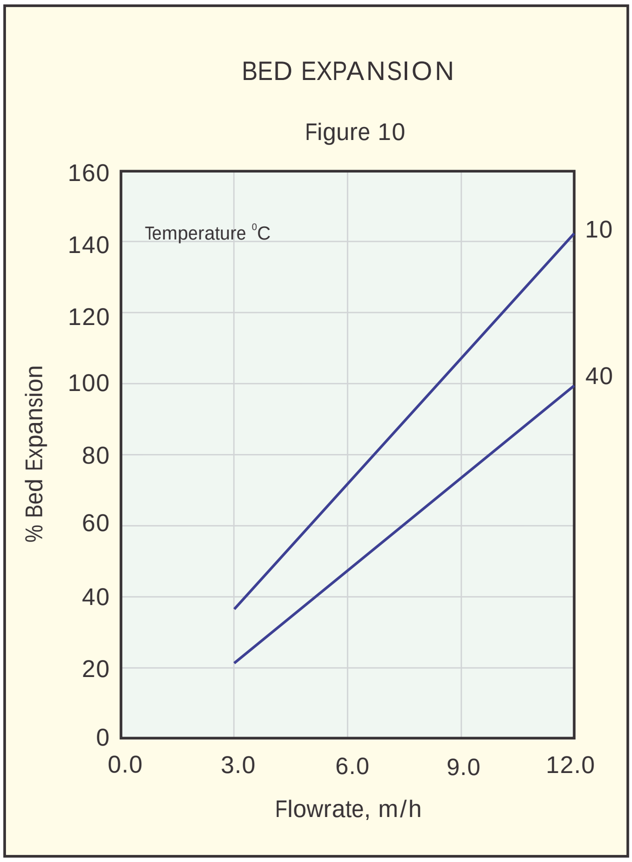


TREATED WATER QUALITY CCR
Residual silica - regeneration temp. 25°C
Figure 7
Regeneration level kg. NaOH/m³
Residual silica ppm SiO₂
0.10
0.08
0.06
0.04
0.02
10
20
30
40
50
60
SiO₂/TA%
30
50
80
100

TREATED WATER QUALITY CCR
Residual silica - regeneration temp. 40°C
Figure 8
Regeneration level kg. NaOH/m³
Residual silica ppm SiO₂
0.08
0.06
0.04
0.02
0.00
10
20
30
40
50
60
SiO₂/TA%
30
50
80
100


PRESSURE LOSS
Figure 9
Temperature °C
25
40
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Pressure loss, kg/m²/m bed
0
5
10
15
20
25
30
Flowrate, m/h


BED EXPANSION
Figure 10
Temperature °C
10
40
160
140
120
100
80
60
40
20
0
% Bed Expansion
0.0
3.0
6.0
9.0
12.0
Flowrate, m/h

## 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 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$^{\circ}$C and 40$^{\circ}$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.



ION EXCHANGE

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