AMBERJET® 1200 Na

ENGINEERING DATA SHEET
(H_2SO_4, Co-flow regeneration)

These data provide information to calculate the sodium leakage and operating capacity of AMBERJET 1200 Na used in water demineralisation with co-flow regeneration with sulphuric acid. The properties of AMBERJET 1200 Na are described in the Product Data Sheet PDS 0354 A.
These data are valid for Amberjet 1200 H but the results obtained refer to the Na form and must be corrected for the reversible swelling between the Na and H forms.

SODIUM LEAKAGE

The average sodium leakage is obtained by multiplying the basic leakage value from Table 1 by the correction factors A and B from Tables 2 and 3.

$$\textbf{Leak} = \textbf{Leak}_0 \times A \times B$$

Table 1 : Basic Sodium Leakage versus H_2SO_4 Regenerant Level

H_2SO_4 g/L	Leakage % EMA ($Leak_0$)
60	11.7
70	10.4
80	9.2
100	7.2
120	5.7
140	4.5
160	3.5
200	2.2
240	1.4

Note : Sodium leakage values are expressed as a percentage of the equivalent mineral acidity (EMA).

Table 2 : Leakage Correction Factor A vs Alkalinity to Total Anions Ratio

Alk %	Factor A
0	0.65
20	0.77
40	0.91
60	1.08
80	1.28
99	1.52

Table 3 : Leakage Correction Factor B versus Sodium to Total Cations Ratio

Na %	Factor B
10	0.06
20	0.17
30	0.33
40	0.52
50	0.75
60	1.00
70	1.28
80	1.58
90	1.91

Table 4 : Suggested Operating Conditions

Maximum operating temperature	120°C
Minimum bed depth	800 mm
Service flow rate	5 to 50 BV*/h
Maximum linear velocity	60 m/h
Regenerant	H_2SO_4 in stepped concentrations
Level	60 to 200 g/L
Minimum contact time	20 minutes
Concentration	0.7 to 6 % according to Ca content
Slow rinse	2 BV at regeneration flow rate
Fast rinse	1 to 3 BV at service flow rate

** 1 BV (Bed volume) = 1 m^3 solution per m^3 resin*

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OPERATING CAPACITY

The operating capacity of AMBERJET 1200 Na with sulphuric acid regeneration is obtained by multiplying the basic capacity value from table 5 by the correction factors C to F from tables 6 to 9.

$$Cap = Cap_0 \times C \times D \times E \times F$$

Table 5 : Basic Capacity vs H_2SO_4 Regenerant Level and Sodium to Total Cations Ratio (Co-flow reg.)

% Na / H_2SO_4 (g/L)	0	25	50	75	100
60	0.53	0.56	0.62	0.71	0.85
70	0.57	0.61	0.69	0.79	0.94
80	0.60	0.66	0.75	0.87	1.02
100	0.65	0.73	0.85	0.99	1.15
120	0.68	0.78	0.92	1.09	1.26
140	0.71	0.81	0.97	1.16	1.35
160	0.73	0.83	1.00	1.21	1.42
200	0.76	0.86	1.04	1.28	1.54
240	0.80	0.92	1.10	1.34	1.66

Table 6 : Capacity Correction Factor C versus Alkalinity to Total Anions Ratio

Alk %	Factor C
0	0.93
30	0.97
50	1.00
70	1.03
100	1.08

Table 7 : Capacity Correction Factor D versus Magnesium to Hardness Ratio, Sodium to Total Cations Ratio and Alkalinity to Total Anions Ratio

Mg/TH	**0 % Na**			**50 % Na**			**80 % Na**		
%	0	50	99 % Alk	0	50	99 % Alk	0	50	99 % Alk
0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20	1.11	1.09	1.07	1.06	1.05	1.04	1.02	1.02	1.01
40	1.22	1.18	1.14	1.11	1.09	1.07	1.04	1.04	1.03
60	1.33	1.27	1.21	1.17	1.14	1.11	1.07	1.05	1.04
80	1.44	1.36	1.28	1.22	1.18	1.14	1.09	1.07	1.06
100	1.55	1.45	1.35	1.28	1.23	1.18	1.11	1.09	1.07

Table 8 : Capacity Correction Factor E versus Run Length (Production Time)

Run Time (hours)	0	50	99 % Alk
5	0.96	0.98	1.00
8	0.98	1.00	1.01
10	0.99	1.00	1.01
20	1.01	1.01	1.01
> 25	1.01	1.01	1.02

Table 9 : Capacity Correction Factor F versus Water Temperature

Temperature °C	0	50	99 % Na
5	0.97	0.95	0.92
10	0.99	0.98	0.97
15	1.00	1.00	1.00
20	1.01	1.01	1.02
25	1.01	1.03	1.04
> 30	1.02	1.04	1.06

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AMBERJET® 1200 Na

ENGINEERING DATA SHEET
(H_2SO_4, Reverse flow regeneration)

These data provide information to calculate the sodium leakage and operating capacity of AMBERJET 1200 Na used in water demineralisation with reverse flow (counterflow) regeneration with sulphuric acid.
The properties of AMBERJET 1200 Na are described in the Product Data Sheet PDS 0354 A.
These data are valid for AMBERJET 1200 H but the results obtained refer to the Na form and must be corrected for the reversible swelling between the Na and H forms.

SODIUM LEAKAGE

The average sodium leakage can be read directly from Table 1. In reverse flow regeneration, the leakage is always very low so that in industrial applications a treated water conductivity of about 1 µS/cm or lower can be obtained in most cases.

Table 1 : Average Sodium Leakage versus H_2SO_4 Regenerant Level

H_2SO_4 g/L	Leakage ppm Na
40	0.12
50	0.07
60	0.05
70	0.04
80	0.03

OPERATING CAPACITY

The operating capacity of AMBERJET 1200 Na with sulphuric acid regeneration is obtained by multiplying the basic capacity value from Table 2 by the correction factors A to E from Tables 4 to 8 overleaf.

$$Cap = Cap_0 \times A \times B \times C \times D \times E \times F$$

Table 2 : Basic capacity versus H_2SO_4 Regenerant level

H_2SO_4 g/L	Capacity eq/L (Cap_0)
40	0.62
50	0.72
60	0.80
70	0.87
80	0.93
90	0.99
100	1.03
120	1.11
140	1.18
160	1.24

Table 3 : Suggested Operating Conditions

Maximum operating temperature	120°C
Minimum bed depth	1000 mm (preferably > 1400 mm)
Service flow rate	5 to 50 BV*/h
Maximum linear velocity	60 m/h
Regenerant	H_2SO_4 in stepped concentrations
Level	40 to 160 g /L
Minimum contact time	20 minutes
Concentration	0.7 to 6 % according to Ca content
Slow rinse	2 BV at regeneration flow rate
Fast rinse	1 to 3 BV at service flow rate

** 1 BV (Bed volume) = 1 m^3 solution per m^3 resin*

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Table 4 : Capacity Correction Factor A versus Sodium to Total Cations Ratio

Na %	Factor A
0	0.74
10	0.81
20	0.86
30	0.91
40	0.96
50	1.00
60	1.04
70	1.07
80	1.10
90	1.13
100	1.16

Table 5 : Capacity Correction Factor B vs Alkalinity to Total Anions Ratio

% Alk	Factor B
0	0.94
25	0.98
50	1.00
75	1.02
99	1.03

Table 6 : Capacity Correction Factor C versus Resin Bed Depth

Bed depth mm	Factor C
900	0.94
1200	0.97
1500	1.00
1800	1.03
2000	1.06
2500	1.10

Table 7 : Capacity Correction Factor D versus Water Temperature

Temperature °C	0	50	99 % Na
5	0.97	0.95	0.92
10	0.99	0.98	0.97
15	1.00	1.00	1.00
20	1.01	1.01	1.02
25	1.01	1.03	1.04
> 30	1.02	1.04	1.06

Table 8 : Capacity Correction Factor E vs Run Length (Production Time)

Run Time (hours)	0	50	99 % Alk
5	0.96	0.98	1.00
8	0.98	1.00	1.01
10	0.99	1.00	1.01
20	1.01	1.01	1.01
> 25	1.01	1.01	1.02

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AMBERJET® 1200 Na

ENGINEERING DATA SHEET
(HCl, Co-flow regeneration)

These data provide information to calculate the sodium leakage and operating capacity of AMBERJET 1200 Na used for water demineralisation with co-flow regeneration with hydrochloric acid. The properties of AMBERJET 1200 Na are described in the Product Data Sheet PDS 0354 A.
These data are valid for Amberjet 1200 H but the results obtained refer to the Na form and must be corrected for the reversible swelling between the Na and H forms.

SODIUM LEAKAGE

The average sodium leakage is obtained by multiplying the basic leakage value from Table 1 by the correction factor A from Table 2.

$$\textbf{Leak} = \textbf{Leak}_0 \times \textbf{A}$$

Table 1 : Basic Sodium Leakage versus HCl Regenerant Level

HCl g/L	Leakage % EMA ($Leak_0$)
50	3.9
60	3.0
70	2.5
80	2.0
100	1.5
120	1.2
150	0.9

Note : Sodium leakage values are expressed as a percentage of the equivalent mineral acidity (EMA).

The value obtained in meq/L must be converted to mg/L as Na and eventually to a conductivity value, using the graph supplied in the Memento of Ion Exchange published by Rohm and Haas.

Table 2 : Leakage Correction Factor A versus Sodium to Total Cations Ratio

Na %	Factor A
10	0.15
20	0.30
30	0.50
40	0.75
50	1.00
60	1.30
70	1.70
80	2.20
90	2.80
100	3.60

Table 3 : Suggested Operating Conditions

Maximum operating temperature	120°C
Minimum bed depth	800 mm
Service flow rate	5 to 50 BV*/h
Maximum linear velocity	60 m/h
Regenerant	HCl
Level	50 to 150 g/L
Minimum contact time	20 minutes
Concentration	4 to 10 %
Slow rinse	2 BV at regeneration flow rate
Fast rinse	1 to 3 BV at service flow rate

** 1 BV (Bed volume) = 1 m^3 solution per m^3 resin*

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OPERATING CAPACITY

The operating capacity of AMBERJET 1200 Na with hydrochloric acid is obtained by multiplying the basic capacity value from table 4 by the correction factors B to E from tables 5 to 8.

$$\mathbf{Cap = Cap_0 \times B \times C \times D \times E}$$

Table 4 : Basic Capacity versus HCl Regenerant Level (co-flow regen.)

HCl g/L	Capacity eq/L (Cap_0)
50	0.93
60	1.02
70	1.10
80	1.17
90	1.23
100	1.28
120	1.37
150	1.47

Table 7 : Capacity Correction Factor D versus Water Temperature

Temperature °C	0	50	99 % Na
5	0.97	0.95	0.92
10	0.99	0.98	0.97
15	1.00	1.00	1.00
20	1.01	1.01	1.02
25	1.01	1.03	1.04
> 30	1.02	1.04	1.06

Table 5 : Capacity Correction Factor B versus Sodium to Total Cations Ratio

Na %	Factor B
0	1.00
10	0.98
20	0.97
30	0.97
40	0.98
50	1.00
60	1.02
70	1.05
80	1.09
90	1.13
100	1.16

Table 6 : Capacity Correction Factor C versus Alkalinity to Total Anions Ratio

% Alk	Factor C
0	0.95
30	0.98
50	1.00
70	1.02
99	1.05

Table 8 : Capacity Correction Factor E versus Run Length (Production Time)

Run Time (hours)	0	50	99 % Alk
5	0.96	0.98	1.00
8	0.98	1.00	1.01
10	0.99	1.00	1.01
20	1.01	1.01	1.01
> 25	1.01	1.01	1.02

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AMBERJET® 1200 Na

ENGINEERING DATA SHEET
(HCl, Reverse flow regeneration)

These data provide information to calculate the sodium leakage and operating capacity of AMBERJET 1200 Na used in water demineralisation with reverse flow (counterflow) regeneration with hydrochloric acid.
The properties of AMBERJET 1200 Na are described in the Product Data Sheet PDS 0354 A.
These data are valid for AMBERJET 1200 H but the results obtained refer to the Na form and must be corrected for the reversible swelling between the Na and H forms.

SODIUM LEAKAGE

With reverse flow regeneration, the average sodium leakage is always very low (less than 100 ppb as Na when regenerated with HCl) so that in industrial applications a treated water conductivity of about 1 µS/cm or lower can be obtained in most cases.

OPERATING CAPACITY

The operating capacity of AMBERJET 1200 Na with hydrochloric acid regeneration is obtained by multiplying the basic capacity value from Table 1 by the correction factors A to E from Tables 3 to 7 overleaf.

$$Cap = Cap_0 \times A \times B \times C \times D \times E$$

Table 1 : Basic capacity vs HCl Regenerant Level (reverse flow regeneration)

HCl g/L	Capacity eq/L (Cap_0)
40	1.03
50	1.15
60	1.24
70	1.32
80	1.39
90	1.44
100	1.49
120	1.57

Table 2 : Suggested Operating Conditions

Maximum operating temperature	120°C
Minimum bed depth	1000 mm (preferably > 1400 mm)
Service flow rate	5 to 50 BV*/h
Maximum linear velocity	60 m/h
Regenerant	HCl
Level	40 to 120 g /L
Minimum contact time	20 minutes
Concentration	4 to 10 %
Slow rinse	2 BV at regeneration flow rate
Fast rinse	1 to 3 BV at service flow rate

** 1 BV (Bed volume) = 1 m^3 solution per m^3 resin*

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Table 3 : Capacity Correction Factor A versus Sodium to Total Cation Ratio

Na %	Factor A
0	0.95
10	0.96
20	0.97
30	0.97
40	0.98
50	0.99
60	0.99
70	1.00
80	1.01
90	1.01
100	1.02

Table 4 : Capacity Correction Factor B versus Alkalinity to Total Anions Ratio

% Alk	Factor B
0	0.94
30	0.98
50	1.00
70	1.02
99	1.03

Table 5 : Capacity Correction Factor C versus Resin Bed Depth

Bed depth mm	Factor C
900	0.94
1200	0.97
1500	1.00
1800	1.03
2000	1.06
2500	1.10

Table 6 : Capacity Correction Factor D versus Water Temperature

Temperature °C	0	50	99 % Na
5	0.97	0.95	0.92
10	0.99	0.98	0.97
15	1.00	1.00	1.00
20	1.01	1.01	1.02
25	1.01	1.03	1.04
> 30	1.02	1.04	1.06

Table 7 : Capacity Correction Factor E versus Run Length (Production Time)

Run Time (hours)	0	50	99 % Alk
5	0.96	0.98	1.00
8	0.98	1.00	1.01
10	0.99	1.00	1.01
20	1.01	1.01	1.01
> 25	1.01	1.01	1.02

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AMBERJET® 1200 Na

ENGINEERING DATA SHEET
(Softening, Co-flow regeneration)

These data provide information to calculate the hardness leakage and operating capacity of AMBERJET 1200 Na used for water softening with co-flow regeneration.
The properties of AMBERJET 1200 Na are described in the Product Data Sheet PDS 0354 A.

HARDNESS LEAKAGE

The average hardness leakage is obtained by multiplying the basic leakage value from Table 1 by the correction factors A and B from Tables 2 and 3.

$$\text{Leak} = \text{Leak}_0 \times A \times B$$

Table 1 : Basic Hardness Leakage versus NaCl Regenerant Level

NaCl g/L	Leakage meq/L (Leak_0)
70	0.063
100	0.051
130	0.042
150	0.036
200	0.026
250	0.018

Table 2 : Leakage Correction Factor A vs Total Dissolved Solids Concentration

TDS meq/L	Factor A
< 10	1.0
15	1.9
20	3.0
30	5.8
40	9.1

Table 3 : Leakage Correction Factor B versus Sodium to Total Cations Ratio

Na %	Factor B
< 5	1.0
10	1.3
20	1.6
30	1.9
50	2.5
70	3.1
90	3.7

Table 4 : Suggested Operating Conditions

Maximum operating temperature	120°C
Minimum bed depth	800 mm
Service flow rate	5 to 50 BV*/h
Maximum linear velocity	60 m/h
Regenerant	NaCl
Level	80 to 240 g/L
Minimum contact time	20 minutes
Concentration	10 %
Slow rinse	2 BV at regeneration flow rate
Fast rinse	1 to 3 BV at service flow rate

** 1 BV (Bed volume) = 1 m^3 solution per m^3 resin*

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OPERATING CAPACITY

The operating capacity of AMBERJET 1200 Na in water softening is obtained by multiplying the basic capacity value from table 5 by the correction factors C to F from tables 6 to 9.

$$\mathbf{Cap = Cap_0 \times C \times D \times E \times F}$$

Table 5 : Basic Capacity versus NaCl Regenerant Level (co-flow regeneration)

NaCl g/L	Capacity eq/L (Cap_0)
80	1.07
100	1.19
120	1.28
150	1.40
200	1.56
250	1.68

Table 6 : Capacity Correction Factor C versus Sodium Concentration

Na meq/L	Factor C
< 5	1.00
10	0.98
20	0.95
30	0.92
40	0.89

Table 7 : Capacity Correction Factor D versus Hardness Concentration

TH meq/L	Factor D
< 5	1.00
10	0.98
20	0.93
30	0.88
40	0.83

Table 8 : Capacity Correction Factor E versus Regenerant Concentration

NaCl %	Factor E
3	0.95
5	0.97
10	1.00

Table 9 : Capacity Correction Factor F versus Specific Flow Rate in Production

BV/h	Factor F
5	1.05
10	1.02
15	1.00
20	0.99
30	0.97
40	0.96

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AMBERJET® 1200 Na

ENGINEERING DATA SHEET
(Softening, Reverse flow regeneration)

These data provide information to calculate the hardness leakage and operating capacity of AMBERJET 1200 Na used for water softening with reverse flow regeneration.
The properties of AMBERJET 1200 Na are described in the Product Data Sheet PDS 0354 A.

HARDNESS LEAKAGE

The average hardness leakage is obtained by multiplying the basic leakage value from Table 1 by the correction factors A and B from Tables 2 and 3.

$$\textbf{Leak} = \textbf{Leak}_0 \times A \times B$$

Table 1 : Basic Hardness Leakage versus NaCl regenerant level

NaCl g/L	Leakage meq/L ($Leak_0$)
50	0.014
70	0.013
100	0.010
130	0.008
150	0.007

Table 2 : Leakage Correction Factor A vs Total Dissolved Solids Concentration

TDS meq/L	Factor A
< 10	1.0
15	1.9
20	3.0
30	5.8
40	9.1

Table 3 : Leakage Correction Factor B versus Sodium to Total Cations Ratio

Na %	Factor B
< 5	1.0
10	1.3
20	1.6
30	1.9
50	2.5
70	3.1
90	3.7

Table 4 : Suggested Operating Conditions

Maximum operating temperature	120°C
Minimum bed depth	1000 mm (preferably > 1400 mm)
Service flow rate	5 to 50 BV*/h
Maximum linear velocity	60 m/h
Regenerant	NaCl
Level	50 to 150 g /L
Minimum contact time	20 minutes
Concentration	10 %
Slow rinse	2 BV at regeneration flow rate
Fast rinse	1 to 3 BV at service flow rate

** 1 BV (Bed volume) = 1 m^3 solution per m^3 resin*

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OPERATING CAPACITY

The operating capacity of AMBERJET 1200 Na in water softening is obtained by multiplying the basic capacity value from table 5 by the correction factors C to G from tables 6 to 10.

$$\mathbf{Cap = Cap_0 \times C \times D \times E \times F \times G}$$

Table 5 : Basic Capacity versus NaCl regenerant level (reverse flow regeneration)

NaCl g/L	Capacity eq/L (Cap_0)
50	0.78
60	0.90
70	1.00
80	1.08
90	1.16
100	1.23
120	1.34
150	1.49

Table 6 : Capacity Correction Factor C versus Resin Bed Depth

Bed depth (mm)	Factor C
1000	0.92
1200	0.96
1500	1.02
1800	1.06
2000	1.09
2500	1.15

Table 7 : Capacity Correction Factor D versus Hardness Concentration

TH meq/L	Factor D
< 5	1.00
10	0.98
20	0.93
30	0.88
40	0.83

Table 8 : Capacity Correction Factor E versus Sodium Concentration

Na meq/L	Factor E
< 5	1.00
10	0.98
20	0.95
30	0.92
40	0.89

Table 9 : Capacity Correction Factor F versus Regenerant Concentration

NaCl %	Factor F
3	0.95
5	0.97
10	1.00

Table 10 : Capacity Correction Factor G versus Specific Flow Rate in production

BV/h	Factor G
5	1.05
10	1.02
15	1.00
20	0.99
30	0.97
40	0.96

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AMBERJET® 1500

ENGINEERING DATA SHEET
(H_2SO_4, Reverse flow regeneration)

These data provide information to calculate the sodium leakage and operating capacity of AMBERJET 1500 used in water demineralisation with reverse flow (counterflow) regeneration with sulphuric acid.
The properties of AMBERJET 1500 are described in the Product Data Sheet PDS 0446 A.

SODIUM LEAKAGE

The average sodium leakage can be read directly from Table 1. In reverse flow regeneration, the leakage is always very low so that in industrial applications a treated water conductivity of about 1 µS/cm or lower can be obtained in most cases.

Table 1 : Average Sodium Leakage versus H_2SO_4 Regenerant Level

H_2SO_4 g/L	Leakage ppm Na
40	0.12
50	0.07
60	0.05
70	0.04
80	0.03
100	0.02

OPERATING CAPACITY

The operating capacity of AMBERJET 1500 with sulphuric acid regeneration is obtained by multiplying the basic capacity value from Table 2 by the correction factors A to E from Tables 4 to 8 overleaf.

$$Cap = Cap_0 \times A \times B \times C \times D \times E \times F$$

Table 2 : Basic capacity versus H_2SO_4 Regenerant level

H_2SO_4 g/L	Capacity eq/L (Cap_0)
40	0.62
50	0.73
60	0.82
70	0.90
80	0.97
90	1.03
100	1.09
110	1.14
120	1.18
150	1.30

Table 3 : Suggested Operating Conditions

Maximum operating temperature	120°C
Minimum bed depth	1000 mm (preferably > 1400 mm)
Service flow rate	10 to 120 BV*/h
Maximum linear velocity	120 m/h
Regenerant	H_2SO_4 in stepped concentrations
Level	40 to 150 g /L
Flow rate	4 to 12 BV/h (minimum contact time : 30 minutes)
Concentration	1.5 to 4 %
Slow rinse	2 BV at regeneration flow rate
Fast rinse	1 to 3 BV at service flow rate

** 1 BV (Bed volume) = 1 m^3 solution per m^3 resin*

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Table 4 : Capacity Correction Factor A versus Sodium to Total Cations Ratio

Na %	Factor A
0	0.74
10	0.81
20	0.86
30	0.91
40	0.96
50	1.00
60	1.04
70	1.07
80	1.10
90	1.13
100	1.16

Table 5 : Capacity Correction Factor B vs Alkalinity to Total Anions Ratio

% Alk	Factor B
0	0.94
30	0.98
50	1.00
70	1.02
99	1.03

Table 6 : Capacity Correction Factor C versus Resin Bed Depth

Bed depth mm	Factor C
900	0.94
1200	0.97
1500	1.00
1800	1.03
2000	1.06
2500	1.10

Table 7 : Capacity Correction Factor D versus Water Temperature

Temperature °C	0	50	99 % Na
5	0.97	0.95	0.92
10	0.99	0.98	0.97
15	1.00	1.00	1.00
20	1.01	1.01	1.02
25	1.01	1.03	1.04
> 30	1.02	1.04	1.06

Table 8 : Capacity Correction Factor E vs Run Length (Production Time)

Run Time (hours)	0	50	99 % Alk
5	0.96	0.98	1.00
8	0.98	1.00	1.01
10	0.99	1.00	1.01
20	1.01	1.01	1.01
> 25	1.01	1.01	1.02

Note : All capacity values relate to the resin in its sodium form. In case AMBERJET 1500 H is purchased, a volume correction is required.

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AMBERJET® 1500

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ENGINEERING DATA SHEET
(HCl, Reverse flow regeneration)

These data provide information to calculate the sodium leakage and operating capacity of AMBERJET 1500 used in water demineralisation with reverse flow (counterflow) regeneration with hydrochloric acid.
The properties of AMBERJET 1500 are described in the Product Data Sheet PDS 0446 A.

$$Cap = Cap_0 \times A \times B \times C \times D \times E$$

SODIUM LEAKAGE

With reverse flow regeneration, the average sodium leakage is always very low (less than 100 ppb as Na when regenerated with HCl) so that in industrial applications a treated water conductivity of about 1 µS/cm or lower can be obtained in most cases.

OPERATING CAPACITY

The operating capacity of AMBERJET 1500 with hydrochloric acid regeneration is obtained by multiplying the basic capacity value from Table 1 by the correction factors A to E from Tables 3 to 7 overleaf.

Table 1 : Basic capacity vs HCl Regenerant Level (reverse flow regeneration)

HCl g/L	Capacity eq/L (Cap_0)
40	1.02
50	1.16
60	1.27
70	1.37
80	1.45
90	1.51
100	1.57
110	1.62
120	1.66

Table 2 : Suggested Operating Conditions

Maximum operating temperature	120°C
Minimum bed depth	1000 mm (preferably > 1400 mm)
Service flow rate	10 to 120 BV*/h
Maximum linear velocity	120 m/h
Regenerant	HCl
Level	40 to 120 g /L
Flow rate	4 to 5 BV/h (minimum contact time : 30 minutes)
Concentration	5 to 6 %
Slow rinse	2 BV at regeneration flow rate
Fast rinse	1 to 3 BV at service flow rate

** 1 BV (Bed volume) = 1 m^3 solution per m^3 resin*

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Table 3 : Capacity Correction Factor A versus Sodium to Total Cation Ratio

Na %	Factor A
0	0.95
10	0.96
20	0.97
30	0.97
40	0.98
50	0.99
60	0.99
70	1.00
80	1.01
90	1.01
100	1.02

Table 4 : Capacity Correction Factor B versus Alkalinity to Total Anions Ratio

% Alk	Factor B
0	0.94
30	0.98
50	1.00
70	1.02
100	1.03

Table 5 : Capacity Correction Factor C versus Resin Bed Depth

Bed depth mm	Factor C
900	0.94
1200	0.97
1500	1.00
1800	1.03
2000	1.06
2500	1.10

Table 6 : Capacity Correction Factor D versus Water Temperature

Temperature °C	0	50	99 % Na
5	0.97	0.95	0.92
10	0.99	0.98	0.97
15	1.00	1.00	1.00
20	1.01	1.01	1.02
25	1.01	1.03	1.04
> 30	1.02	1.04	1.06

Table 7 : Capacity Correction Factor E versus Run Length (Production Time)

Run Time (hours)	0	50	99 % Alk
5	0.96	0.98	1.00
8	0.98	1.00	1.01
10	0.99	1.00	1.01
20	1.01	1.01	1.01
> 25	1.01	1.01	1.02

Note : All capacity values relate to the resin in its sodium form. In case AMBERJET 1500 H is purchased, a volume correction is required.

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ENGINEERING DATA SHEET
(Co-flow regeneration)

These data provide information to calculate the silica leakage and operating capacity of AMBERJET 4200 Cl used for water demineralisation with co-flow regeneration.
The properties of AMBERJET 4200 Cl are described in the Product Data Sheet PDS 0347 A.

SILICA LEAKAGE

The average silica leakage is obtained by multiplying the basic leakage value from Table 1 by the correction factors A, B, C and K* from Tables 2 to 4.

$$\mathbf{Leak = Leak_0 \times A \times B \times C \times K}$$

*K (the influence of sodium leakage) can be determined from the graph given in EDS 0299 A.

Table 1 : Basic Silica Leakage versus NaOH Regenerant Level

NaOH g/L	Leakage ppm SiO_2 ($Leak_0$)
60	0.088
70	0.068
80	0.054
100	0.037
120	0.027
150	0.019

Table 2 : Leakage Correction Factor A versus Silica to Total Anions Ratio

SiO_2 %	Factor A
1	0.1
5	0.5
10	1.0
25	2.5
50	5.0
75	7.5

Table 3 : Leakage Correction Factor B versus Water Temperature

Water °C	Factor B
5	0.7
10	0.8
15	1.0
25	1.5
35	2.3
45	3.3

Table 4 : Leakage Correction Factor C versus Regenerant Temperature

NaOH °C	Factor C
10	1.66
15	1.37
25	1.00
35	0.76
45	0.58

TABLE 5 : SUGGESTED OPERATING CONDITIONS

Maximum operating temperature	60°C
Minimum bed depth	700 mm
Service flow rate	5 to 50 BV*/h
Maximum linear velocity	60 m/h
Regenerant	NaOH
Level	60 to 150 g/L
Flow rate	2 to 8 BV/h (minimum contact time : 20 minutes)
Concentration	2 to 5 %
Slow rinse	2 BV at regeneration flow rate
Fast rinse	3 to 6 BV at service flow rate

** 1 BV (Bed volume) = 1 m^3 solution per m^3 resin*

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OPERATING CAPACITY

The operating capacity of AMBERJET 4200 Cl is obtained by multiplying the basic capacity value from table 6 by the correction factors D to G from tables 7 to 10.

$$Cap = Cap_0 \times D \times E \times F \times G$$

Table 6 : Basic capacity versus NaOH Regenerant Level (co-flow regen.)

NaOH g/L	Capacity eq/L (Cap_0)
60	0.59
70	0.64
80	0.68
100	0.74
120	0.80
150	0.85

Table 7 : Capacity Correction Factor D versus Sulphate to Total Anions Ratio

SO_4 %	Factor D
0	0.92
20	0.96
50	1.00
70	1.04
99	1.08

Table 8 : Capacity Correction Factor E versus CO_2 to Total Anions Ratio

CO_2 %	Factor E
0	0.97
20	1.00
30	1.02
50	1.05
75	1.08
99	1.12

Table 9 : Capacity Correction Factor F versus Silica to Total Anions Ratio and NaOH temperature (°C)

	5	25	50	75 % SiO_2
5°C	0.96	0.86	0.74	0.65
15	0.98	0.88	0.79	0.70
25	1.00	0.92	0.84	0.76
35	1.02	0.96	0.87	0.81
45	1.04	0.98	0.93	0.86

Table 10 : Capacity Correction Factor G vs Silica Endpoint (**DSiO_2 = difference between average leakage and endpoint)**

ΔSiO_2 (ppb)	Factor G
50	0.90
100	0.96
200	1.00
300	1.04

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AMBERJET® 4200 Cl

ENGINEERING DATA SHEET
(Reverse flow regeneration)

These data provide information to calculate the silica leakage and operating capacity of AMBERJET 4200 Cl for water demineralisation in reverse flow regenerated units including floating bed and packed bed applications.
The properties of AMBERJET 4200 Cl are described in the Product Data Sheet PDS 0347 A.

SILICA LEAKAGE

The average silica leakage is obtained by multiplying the basic leakage value from Table 1 by the correction factors A, B, C and K* from Tables 2 to 4.

$$\mathbf{Leak = Leak_0 \times A \times B \times C \times K}$$

*K (the influence of sodium leakage) can be determined from the graph given in the EDS 0299 A.

Table 1 : Basic Silica Leakage versus NaOH Regenerant Level

NaOH g/L	Leakage ppm SiO_2 ($Leak_0$)
30	0.022
40	0.015
50	0.010
60	0.008
80	0.005
100	0.003
120	0.002

Table 2 : Leakage Correction Factor A vs Silica to Total Anions Ratio

SiO_2 %	Factor A
1	0.2
5	1.0
10	2.0
25	5.0
50	10.0
75	15.0

Table 3 : Leakage Correction Factor B versus Water Temperature

Water °C	Factor B
5	0.7
10	0.8
15	1.0
25	1.5
35	2.3
45	3.3

Table 4 : Leakage Correction Factor C versus Regenerant Temperature

NaOH °C	Factor C
10	1.65
15	1.37
25	1.00
35	0.76
45	0.58

Table 5 : Suggested Operating Conditions

Maximum operating temperature	60°C
Minimum bed depth	1000 mm (preferably > 1400 mm)
Service flow rate	5 to 50 BV*/h
Maximum linear velocity	60 m/h
Regenerant	NaOH
Level	30 to 120 g/L
Flow rate	2 to 8 BV/h (minimum contact time : 20 minutes)
Concentration	2 to 5 %
Slow rinse	2 BV at regeneration flow rate
Fast rinse	3 to 6 BV at service flow rate

** 1 BV (Bed volume) = 1 m^3 solution per m^3 resin*

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OPERATING CAPACITY

The operating capacity of AMBERJET 4200 Cl is obtained by multiplying the basic capacity value from table 6 by the correction factors D to G from tables 7 to 10.

$$Cap = Cap_0 \times D \times E \times F \times G$$

Table 6 : Basic Capacity versus NaOH Regenerant Level (reverse flow regeneration)

NaOH g/L	Capacity eq/L (Cap_0)
30	0.44
40	0.53
50	0.60
60	0.66
70	0.71
80	0.75
100	0.81
120	0.87

Table 7 : Capacity Correction Factor D versus Sulphate to Total Anions Ratio

SO_4 %	Factor D
0	0.92
20	0.96
50	1.00
70	1.04
99	1.08

Table 8 : Capacity Correction Factor E versus CO_2 to Total Anions Ratio

CO_2 %	Factor E
0	0.97
20	1.00
30	1.02
50	1.05
75	1.08
99	1.12

Table 9 : Capacity Correction Factor F versus Silica to Total Anions Ratio and NaOH Temperature (°C)

	5	25	50	75 % SiO_2
5°C	0.96	0.86	0.74	0.65
15	0.98	0.88	0.79	0.70
25	1.00	0.92	0.84	0.76
35	1.02	0.96	0.87	0.81
45	1.04	0.98	0.93	0.86

Table 10 : Capacity Correction Factor G vs Silica Endpoint **($DSiO_2$ = difference between average leakage and endpoint)**

ΔSiO_2 (ppb)	Factor G
50	0.90
100	0.95
200	1.00
300	1.04

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AMBERJET® 4400

ENGINEERING DATA SHEET
(Reverse flow regeneration)

These data provide information to calculate the silica leakage and operating capacity of AMBERJET 4400 used in water demineralisation with reverse flow (counterflow) regeneration with caustic soda.
The properties of AMBERJET 4400 Cl are described in the Product Data Sheet PDS 0430 A.

SILICA LEAKAGE

The average silica leakage is obtained by multiplying the basic leakage value from Table 1 by the correction factors A, B, C and K* from Tables 2 to 4.

$$\text{Leak} = \text{Leak}_0 \times A \times B \times C \times K$$

*K (the influence of sodium leakage) can be determined from the graph given in the EDS 0299 A.

Table 1 : Basic Silica Leakage versus NaOH Regenerant Level

NaOH g/L	Leakage ppm SiO_2 ($Leak_0$)
40	0.015
50	0.010
60	0.008
80	0.005
100	0.003
120	0.002

Table 2 : Leakage Correction Factor A vs Silica to Total Anions Ratio

SiO_2 %	Factor A
1	0.2
5	1.0
10	2.0
25	5.0
50	10.0
75	15.0

Table 3 : Leakage Correction Factor B versus Water Temperature

Water °C	Factor B
5	0.7
10	0.8
15	1.0
25	1.5
35	2.3
45	3.3

Table 4 : Leakage Correction Factor C versus Regenerant Temperature

NaOH °C	Factor C
10	1.65
15	1.37
25	1.00
35	0.76
45	0.58

Table 5 : Suggested Operating Conditions

Maximum operating temperature	60°C
Minimum bed depth	700 mm (Stratabed), > 1400 mm (single beds)
Service flow rate	5 to 50 BV*/h
Maximum linear velocity	60 m/h
Regenerant	NaOH
Level	40 to 120 g/L
Minimum contact time	30 minutes
Concentration	2 to 4 %
Slow rinse	2 BV at regeneration flow rate
Fast rinse	3 to 6 BV at service flow rate

** 1 BV (Bed volume) = 1 m^3 solution per m^3 resin*

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OPERATING CAPACITY

The operating capacity of AMBERJET 4400 is obtained by multiplying the basic capacity value from table 6 by the correction factors D to G from tables 7 to 10.

$$Cap = Cap_0 \times D \times E \times F \times G$$

Table 6 : Basic Capacity versus NaOH Regenerant Level (reverse flow regeneration)

NaOH g/L	Capacity eq/L (Cap_0)
40	0.54
50	0.61
60	0.67
70	0.72
80	0.77
100	0.84
120	0.90

Table 7 : Capacity Correction Factor D versus Sulphate to Total Anions Ratio

SO_4 %	Factor D
0	0.92
25	0.96
50	1.00
75	1.04
99	1.08

Table 8 : Capacity Correction Factor E versus CO_2 to Total Anions Ratio

CO_2 %	Factor E
0	0.97
20	1.00
30	1.02
50	1.05
75	1.08
99	1.12

Table 9 : Capacity Correction Factor F versus Silica to Total Anions Ratio and NaOH Temperature (°C)

	5	25	50	75 % SiO_2
5°C	0.96	0.86	0.74	0.65
15	0.98	0.88	0.79	0.70
25	1.00	0.92	0.84	0.76
35	1.02	0.96	0.87	0.81
45	1.04	0.98	0.93	0.86

Table 10 : **Capacity Correction Factor G vs Silica Endpoint** (ΔSiO_2 = difference between average leakage and endpoint)

ΔSiO_2 (ppb)	Factor G
50	0.90
100	0.95
200	1.00
300	1.04

Note : All capacity values relate to the resin in its chloride form. In case AMBERJET 4400 OH is purchased, a volume correction is required.

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AMBERJET® 4600 Cl

ENGINEERING DATA SHEET
(Co-flow regeneration)

These data provide information to calculate the silica leakage and operating capacity of AMBERJET 4600 Cl used for water demineralisation with co-flow regeneration. The properties of AMBERJET 4600 Cl are described in the Product Data Sheet PDS 0370 A.

SILICA LEAKAGE

The average silica leakage is obtained by multiplying the basic leakage value from Table 1 by the correction factors A, B, C and K* from Tables 2 to 4.

$$\text{Leak} = \text{Leak}_0 \times A \times B \times C \times K$$

*K (the influence of sodium leakage) can be determined from the graph given in the EDS 0299 A.

Table 1 : Basic Silica Leakage versus NaOH Regenerant Level

NaOH g/L	Leakage ppm SiO_2 ($Leak_0$)
50	0.230
60	0.157
70	0,113
80	0.086
90	0,067
100	0.054

Table 2 : Leakage Correction Factor A vs Silica to Total Anions Ratio

SiO_2 %	Factor A
1	0.2
5	1.0
10	2.0
20	4.0
30	6.0

Table 3 : Leakage Correction Factor B versus Water Temperature

Water °C	Factor B
5	0.7
10	0.8
15	1.0
20	1.2
25	1.5
35	2.2

Table 4 : Leakage Correction Factor C versus Regenerant Temperature

NaOH °C	Factor C
10	1.65
15	1.37
20	1.16
25	1.00
30	0.87

Table 5 : Suggested Operating Conditions

Maximum operating temperature	35°C
Minimum bed depth	700 mm
Service flow rate	5 to 50 BV*/h
Maximum linear velocity	60 m/h
Regenerant	NaOH
Level	40 to 100 g/L
Flow rate	2 to 8 BV/h (minimum contact time : 20 minutes)
Concentration	2 to 5 %
Slow rinse	2 BV at regeneration flow rate
Fast rinse	3 to 6 BV at service flow rate

** 1 BV (Bed volume) = 1 m^3 solution per m^3 resin*

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OPERATING CAPACITY

The operating capacity of AMBERJET 4600 Cl is obtained by multiplying the basic capacity value from table 6 by the correction factors D to G from tables 7 to 10.

$$Cap = Cap_0 \times D \times E \times F \times G$$

Table 6 : Basic capacity versus NaOH Regenerant Level (co-flow regen.)

NaOH g/L	Capacity eq/L (Cap_0)
50	0.79
60	0.84
70	0.87
80	0.90
100	0.94

Table 7 : Capacity Correction Factor D versus Sulphate to Total Anions Ratio

SO_4 %	Factor D
0	0.94
25	0.97
50	1.00
75	1.03
99	1.06

Table 8 : Capacity Correction Factor E versus CO_2 to Total Anions Ratio

CO_2 %	Factor E
0	0.97
20	1.00
30	1.02
50	1.05
75	1.08
99	1.12

Table 9 : Capacity Correction Factor F versus Silica to Total Anions Ratio and NaOH temperature (°C)

	5	10	20	30 % SiO_2
5°C	0.96	0.93	0.87	0.83
10	0.97	0.94	0.89	0.85
15	0.98	0.95	0.91	0.87
20	0.99	0.96	0.92	0.89
25	1.00	0.98	0.94	0.90
30	1.01	0.99	0.96	0.92

Table 10 : Capacity Correction Factor G vs Silica Endpoint **($DSiO_2$ = difference between average leakage and endpoint)**

ΔSiO_2 (ppb)	Factor G
50	0.90
100	0.95
200	1.00
300	1.04

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AMBERJET® 4600 Cl

ENGINEERING DATA SHEET
(Reverse flow regeneration)

These data provide information to calculate the silica leakage and operating capacity of AMBERJET 4600 Cl used for water demineralisation in reverse flow regenerated units including floating bed and packed bed applications
The properties of AMBERJET 4600 Cl are described in the Product Data Sheet PDS 0370 A.

SILICA LEAKAGE

The average silica leakage is obtained by multiplying the basic leakage value from Table 1 by the correction factors A, B, C and K* from Tables 2 to 4.

$$\mathbf{Leak = Leak_0 \times A \times B \times C \times K}$$

*K (the influence of sodium leakage) can be determined from the graph given in the EDS 0299 A.

Table 1 : Basic Silica Leakage versus NaOH Regenerant Level

NaOH g/L	Leakage ppm SiO_2 ($Leak_0$)
30	0.062
40	0.036
50	0.024
60	0.017
70	0.012

Table 2 : Leakage Correction Factor A vs Silica to Total Anions Ratio

SiO_2	Factor A
1	0.2
5	1.0
10	2.0
20	4.0
30	6.0

Table 3 : Leakage Correction Factor B versus Water Temperature

Water °C	Factor B
5	0.7
10	0.8
15	1.0
20	1.2
25	1.5
30	1.8

Table 4 : Leakage Correction Factor C versus Regenerant Temperature

NaOH °C	Factor C
10	1.66
15	1.37
20	1.16
25	1.00
30	0.87

Table 5 : Suggested Operating Conditions

Maximum operating temperature	35°C
Minimum bed depth	1000 mm (preferably > 1400 mm)
Service flow rate	5 to 50 BV*/h
Maximum linear velocity	60 m/h
Regenerant	NaOH
Level	30 to 70 g/L
Flow rate	2 to 8 BV/h (minimum contact time : 30 minutes)
Concentration	2 to 5 %
Slow rinse	2 BV at regeneration flow rate
Fast rinse	3 to 6 BV at service flow rate

** 1 BV (Bed volume) = 1 m^3 solution per m^3 resin*

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OPERATING CAPACITY

The operating capacity of AMBERJET 4600 Cl is obtained by multiplying the basic capacity value from table 6 by the correction factors D to G from tables 7 to 10.

$$\mathbf{Cap = Cap_0 \times D \times E \times F \times G}$$

Table 6 : Basic Capacity versus NaOH Regenerant Level (reverse flow regeneration)

NaOH g/L	Capacity eq/L (Cap_0)
30	0.70
40	0.78
50	0.83
60	0.87
70	0.91
80	0.93

Table 7 : Capacity Correction Factor D versus Sulphate to Total Anions Ratio

SO_4 %	Factor D
0	0.94
25	0.97
50	1.00
75	1.03
99	1.06

Table 8 : Capacity Correction Factor E versus CO_2 to Total Anions Ratio

CO_2 %	Factor E
0	0.97
20	1.00
30	1.02
50	1.05
75	1.08
99	1.12

Table 9 : Capacity Correction Factor F versus Silica to Total Anions Ratio and NaOH Temperature (°C)

	5	10	20	30 % SiO_2
5°C	0.96	0.93	0.87	0.83
10	0.97	0.94	0.89	0.85
15	0.98	0.95	0.91	0.87
20	0.99	0.96	0.92	0.89
25	1.00	0.98	0.94	0.90
30	1.01	0.99	0.96	0.92

Table 10 : Capacity Correction Factor G vs Silica Endpoint **($DSiO_2$ = difference between average leakage and endpoint)**

ΔSiO_2 (ppb)	Factor G
50	0.90
100	0.96
200	1.01
300	1.04

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AMBERLITE® IR120 Na

ENGINEERING DATA SHEET
(H_2SO_4, Co-flow regeneration)

These data provide information to calculate the sodium leakage and operating capacity of Amberlite IR120 Na used in water demineralisation with co-flow regeneration with sulphuric acid.
The properties of Amberlite IR120 Na are described in the Product Data Sheet PDS 0210 A.
These data are valid for Amberlite IR120 H but the results obtained refer to the Na form and must be corrected for the reversible swelling between the Na and H forms.

SODIUM LEAKAGE

The average sodium leakage is obtained by multiplying the basic leakage value from Table 1 by the correction factors A and B from Tables 2 and 3.

$$\text{Leak} = \text{Leak}_0 \times A \times B$$

Table 1 : Basic Sodium Leakage versus H_2SO_4 Regenerant Level

H_2SO_4 g/L	Leakage % EMA ($Leak_0$)
60	11.7
70	10.4
80	9.2
100	7.2
120	5.7
140	4.5
160	3.5
200	2.2
240	1.4

Note : Sodium leakage values are expressed as a percentage of the equivalent mineral acidity (EMA).

Table 2 : Leakage Correction Factor A vs Alkalinity to Total Anions Ratio

Alk %	Factor A
0	0.65
20	0.77
40	0.91
60	1.08
80	1.28
99	1.52

Table 3 : Leakage Correction Factor B versus Sodium to Total Cations Ratio

Na %	Factor B
10	0.06
20	0.17
30	0.33
40	0.52
50	0.75
60	1.00
70	1.28
80	1.58
90	1.91

Table 4 : Suggested Operating Conditions

Maximum operating temperature	120°C
Minimum bed depth	700 mm
Service flow rate	5 to 40 BV*/h
Maximum linear velocity	50 m/h
Regenerant	H_2SO_4 in stepped concentrations
Level	60 to 240 g/L
Flow rate	2 to 20 BV/h (minimum contact time : 30 minutes)
Concentration	0.7 to 6 % according to Ca content
Slow rinse	2 BV at regeneration flow rate
Fast rinse	2 to 4 BV at service flow rate

** 1 BV (Bed volume) = 1 m^3 solution per m^3 resin*

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OPERATING CAPACITY

The operating capacity of Amberlite IR120 Na with sulphuric acid regeneration is obtained by multiplying the basic capacity value from table 5 by the correction factors C to F from tables 6 to 9.

$$Cap = Cap_0 \times C \times D \times E \times F$$

Table 5 : Basic Capacity vs H_2SO_4 Regenerant Level and Sodium to Total Cations Ratio (Co-flow reg.)

H_2SO_4 (g/L) \ % Na	0	25	50	75	100
60	0.53	0.56	0.62	0.71	0.85
70	0.57	0.61	0.69	0.79	0.94
80	0.60	0.66	0.75	0.87	1.02
100	0.65	0.73	0.85	0.99	1.15
120	0.68	0.78	0.92	1.09	1.26
140	0.71	0.81	0.97	1.16	1.35
160	0.73	0.83	1.00	1.21	1.42
200	0.76	0.86	1.04	1.28	1.54
240	0.80	0.92	1.10	1.34	1.66

Table 6 : Capacity Correction Factor C versus Alkalinity to Total Anions Ratio

Alk %	Factor C
0	0.93
25	0.96
50	1.00
75	1.04
99	1.07

Table 7 : Capacity Correction Factor D versus Magnesium to Hardness Ratio, Sodium to Total Cations Ratio and Alkalinity to Total Anions Ratio

Mg/TH	**0 % Na**			**50 % Na**			**80 % Na**		
%	0	50	99 % Alk	0	50	99 % Alk	0	50	99 % Alk
0	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
20	1.11	1.09	1.07	1.06	1.05	1.04	1.02	1.02	1.01
40	1.22	1.18	1.14	1.11	1.09	1.07	1.04	1.04	1.03
60	1.33	1.27	1.21	1.17	1.14	1.11	1.07	1.05	1.04
80	1.44	1.36	1.28	1.22	1.18	1.14	1.09	1.07	1.06
100	1.55	1.45	1.35	1.28	1.23	1.18	1.11	1.09	1.07

Table 8 : Capacity Correction Factor E versus Run Length (Production Time)

Run Time (hours)	0	50	99 % Alk
5	0.91	0.94	0.98
8	0.95	0.97	0.99
10	0.96	0.98	1.00
20	0.99	1.00	1.01
> 25	1.00	1.01	1.01

Table 9 : Capacity Correction Factor F versus Water Temperature

Temperature °C	0	50	100 % Na
5	0.94	0.88	0.82
10	0.97	0.93	0.90
15	0.98	0.97	0.95
20	0.99	0.99	0.98
25	1.00	1.01	1.01
> 30	1.01	1.02	1.03

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AMBERLITE® IR120 Na

ENGINEERING DATA SHEET
(H_2SO_4, Co-flow regeneration)

These data provide information to calculate the sodium leakage and operating capacity of Amberlite IR120 Na used for water demineralisation in reverse flow regenerated units excluding floating bed and packed bed applications. The properties of Amberlite IR120 Na are described in the Product Data Sheet PDS 0210 A.
These data are valid for Amberlite IR120 H but the results obtained refer to the Na form and must be corrected for the reversible swelling between the Na and H forms.

SODIUM LEAKAGE

The average sodium leakage can be read directly from Table 1. In reverse flow regeneration, the leakage is always very low so that in industrial applications a treated water conductivity of about 1 µS/cm or lower can be obtained in most cases.

Table 1 : Average Sodium Leakage versus H_2SO_4 Regenerant level

H_2SO_4 g/L	Leakage ppm Na
40	0.12
50	0.07
60	0.05
70	0.04
80	0.03

OPERATING CAPACITY

The operating capacity of AMBERLITE IR120 Na with sulphuric acid regeneration is obtained by multiplying the basic capacity value from Table 2 by the correction factors A to E from Tables 4 to 8 overleaf.

$$Cap = Cap_0 \times A \times B \times C \times D \times E \times F$$

Table 2 : Basic capacity versus H_2SO_4 Regenerant level

H_2SO_4 g/L	Capacity eq/L (Cap_0)
40	0.53
50	0.62
60	0.71
70	0.77
80	0.83
90	0.89
100	0.93
120	1.02
140	1.08
160	1.14

Table 3 : Suggested Operating Conditions

Maximum operating temperature	120°C
Minimum bed depth	1000 mm (preferably > 1400 mm)
Service flow rate	5 to 40 BV*/h
Maximum linear velocity	50 m/h
Regenerant	H_2SO_4 in stepped concentrations
Level	40 to 150 g /L
Flow rate	2 to 20 BV/h (minimum contact time : 30 minutes)
Concentration	0.7 to 6 % according to Ca content
Slow rinse	2 BV at regeneration flow rate
Fast rinse	2 to 4 BV at service flow rate

** 1 BV (Bed volume) = 1 m^3 solution per m^3 resin*

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Table 4 : Capacity Correction Factor A versus Sodium to Total Cations Ratio

Na %	Factor A
0	0.75
10	0.81
20	0.86
30	0.91
40	0.96
50	1.00
60	1.04
70	1.07
80	1.10
90	1.13
100	1.16

Table 5 : Capacity Correction Factor B vs Alkalinity to Total Anions Ratio

% Alk	Factor B
0	0.94
25	0.97
50	1.00
75	1.02
99	1.03

Table 6 : Capacity Correction Factor C versus Resin Bed Depth

Bed depth mm	Factor C
900	0.94
1200	0.97
1500	1.00
1800	1.03
2000	1.06
2500	1.10

Table 7 : Capacity Correction Factor D versus Water Temperature

Temperature °C	0	50	100 % Na
5	0.94	0.88	0.82
10	0.97	0.93	0.90
15	0.98	0.97	0.95
20	0.99	0.99	0.98
25	1.00	1.01	1.01
> 30	1.01	1.02	1.03

Table 8 : Capacity Correction Factor E vs Run Length (Production Time)

Run Time (hours)	0	50	99 % Alk
5	0.91	0.94	0.98
8	0.95	0.97	0.99
10	0.96	0.98	1.00
20	0.99	1.00	1.01
> 25	1.00	1.01	1.01

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AMBERLITE IR120 Na

ENGINEERING DATA SHEET
(HCl, Reverse-flow regeneration)

These data provide information to calculate the sodium leakage and operating capacity of Amberlite IR120 Na used for water demineralisation in reverse flow regenerated units excluding floating bed and packed bed applications.
The properties of Amberlite IR120 Na are described in the Product Data Sheet PDS 0210 A.
These data are valid for Amberlite IR120 H but the results obtained refer to the Na form and must be corrected for the reversible swelling between the Na and H forms.

SODIUM LEAKAGE

With reverse flow regeneration, the average sodium leakage is always very low (less than 100 ppb as Na when regenerated with HCl) so that in industrial applications a treated water conductivity of about 1 µS/cm or lower can be obtained in most cases.

OPERATING CAPACITY

The operating capacity of Amberlite IR120 Na with hydrochloric acid regeneration is obtained by multiplying the basic capacity value from Table 1 by the correction factors A to E from Tables 3 to 7 overleaf.

$$Cap = Cap_0 \times A \times B \times C \times D \times E$$

Table 1 : Basic capacity vs HCl Regenerant Level (reverse flow regeneration)

HCl g/L	Capacity eq/L (Cap_0)
30	0.88
40	1.03
50	1.15
60	1.24
70	1.32
80	1.39
90	1.44
100	1.49
120	1.57

Table 2 : Suggested Operating Conditions

Maximum operating temperature	120°C
Minimum bed depth	1000 mm (preferably > 1400 mm)
Service flow rate	5 to 40 BV*/h
Maximum linear velocity	50 m/h
Regenerant	HCl
Level	30 to 120 g /L
Flow rate	2 to 5 BV/h (minimum contact time : 30 minutes)
Concentration	5 to 8 %
Slow rinse	2 BV at regeneration flow rate
Fast rinse	2 to 4 BV at service flow rate

** 1 BV (Bed volume) = 1 m^3 solution per m^3 resin*

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Table 3 : Capacity Correction Factor A versus Sodium to Total Cation Ratio

Na %	Factor A
0	0.92
10	0.93
20	0.94
30	0.95
40	0.97
50	0.98
60	0.99
70	1.00
80	1.02
90	1.03
100	1.04

Table 4 : Capacity Correction Factor B versus Alkalinity to Total Anions Ratio

% Alk	Factor B
0	0.94
25	0.97
50	1.00
75	1.02
99	1.03

Table 5 : Capacity Correction Factor C versus Resin Bed Depth

Bed depth mm	Factor C
900	0.94
1200	0.97
1500	1.00
1800	1.03
2000	1.06
2500	1.10

Table 6 : Capacity Correction Factor D versus Water Temperature

Temperature °C	0	50	100 % Na
5	0.94	0.88	0.82
10	0.97	0.93	0.90
15	0.98	0.97	0.95
20	0.99	0.99	0.98
25	1.00	1.01	1.01
> 30	1.01	1.02	1.03

Table 7 : Capacity Correction Factor E versus Run Length (Production Time)

Run Time (hours)	0	50	99 % Alk
5	0.91	0.94	0.98
8	0.95	0.97	0.99
10	0.96	0.98	1.00
20	0.99	1.00	1.01
> 25	1.00	1.01	1.01

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AMBERLITE® IR120 Na

ENGINEERING DATA SHEET
(HCl, Co-flow regeneration)

These data provide information to calculate the sodium leakage and operating capacity of Amberlite IR120 Na used for water demineralisation with co-flow regeneration with hydrochloric acid. The properties of Amberlite IR120 Na are described in the Product Data Sheet PDS 0210 A.
These data are valid for Amberlite IR120 H but the results obtained refer to the Na form and must be corrected for the reversible swelling between the Na and H forms.

Note : Sodium leakage values are expressed as a percentage of the equivalent mineral acidity (EMA).

The value obtained in meq/L must be converted to mg/L as Na and eventually to a conductivity value, using the graph supplied in the Memento of Ion Exchange published by Rohm and Haas

SODIUM LEAKAGE

The average sodium leakage is obtained by multiplying the basic leakage value from Table 1 by the correction factor A from Table 2.

$$\textbf{Leak} = \textbf{Leak}_0 \textbf{ x A}$$

Table 1 : Basic Sodium Leakage versus HCl Regenerant Level

HCl g/L	Leakage % EMA ($Leak_0$)
50	3.9
60	3.0
70	2.5
80	2.0
100	1.5
120	1.2
150	0.9

Table 2 : Leakage Correction Factor A versus Sodium to Total Cations Ratio

Na %	Factor A
10	0.15
20	0.30
30	0.50
40	0.75
50	1.00
60	1.30
70	1.70
80	2.20
90	2.80
100	3.60

Table 3 : Suggested Operating Conditions

Maximum operating temperature	120°C
Minimum bed depth	700 mm
Service flow rate	5 to 40 BV*/h
Maximum linear velocity	50 m/h
Regenerant	HCl
Level	50 to 150 g/L
Flow rate	2 to 5 BV/h (minimum contact time : 30 minutes)
Concentration	5 to 8 %
Slow rinse	2 BV at regeneration flow rate
Fast rinse	2 to 4 BV at service flow rate

** 1 BV (Bed volume) = 1 m^3 solution per m^3 resin*

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OPERATING CAPACITY

The operating capacity of Amberlite IR120 Na with hydrochloric acid is obtained by multiplying the basic capacity value from table 4 by the correction factors B to E from tables 5 to 8.

$$Cap = Cap_0 \times B \times C \times D \times E$$

Table 4 : Basic Capacity versus HCl Regenerant Level (co-flow regen.)

HCl g/L	Capacity eq/L (Cap_0)
50	0.93
60	1.02
70	1.10
80	1.17
100	1.28
120	1.37
150	1.47

Table 7 : Capacity Correction Factor D versus Water Temperature

Temperature °C	0	50	100 % Na
5	0.94	0.88	0.82
10	0.97	0.93	0.90
15	0.98	0.97	0.95
20	0.99	0.99	0.98
25	1.00	1.01	1.01
> 30	1.01	1.02	1.03

Table 5 : Capacity Correction Factor B versus Sodium to Total Cations Ratio

Na %	Factor B
0	1.00
10	0.98
20	0.97
30	0.97
40	0.98
50	1.00
60	1.02
70	1.05
80	1.09
90	1.13
100	1.16

Table 6 : Capacity Correction Factor C versus Alkalinity to Total Anions Ratio

% Alk	Factor C
0	0.95
25	0.98
50	1.00
75	1.03
99	1.05

Table 8 : Capacity Correction Factor E versus Run Length (Production Time)

Run Time (hours)	0	50	99 % Alk
5	0.91	0.94	0.98
8	0.95	0.97	0.99
10	0.96	0.98	1.00
20	0.99	1.00	1.01
> 25	1.00	1.01	1.01

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AMBERLITE® IR120 Na

ENGINEERING DATA SHEET
(Softening, Co-flow regeneration)

These data provide information to calculate the hardness leakage and operating capacity of Amberlite IR120 Na used for water softening with co-flow regeneration.
The properties of Amberlite IR120 Na are described in the Product Data Sheet PDS 0210 A.

HARDNESS LEAKAGE

The average hardness leakage is obtained by multiplying the basic leakage value from Table 1 by the correction factors A and B from Tables 2 and 3.

$$\mathbf{Leak = Leak_0 \times A \times B}$$

Table 1 : Basic Hardness Leakage versus NaCl Regenerant Level

NaCl g/L	Leakage meq/L ($Leak_0$)
80	0.059
100	0.051
120	0.045
150	0.036
200	0.026
250	0.018

Table 2 : Leakage Correction Factor A vs Total Dissolved Solids Concentration

TDS meq/L	Factor A
< 10	1.0
15	1.9
20	3.0
30	5.8
40	9.1

Table 3 : Leakage Correction Factor B versus Sodium to Total Cations Ratio

Na %	Factor B
< 5	1.0
10	1.3
20	1.6
30	1.9
50	2.5
70	3.1
90	3.7

Table 4 : Suggested Operating Conditions

Maximum operating temperature	120°C
Minimum bed depth	700 mm
Service flow rate	5 to 40 BV*/h
Maximum linear velocity	50 m/h
Regenerant	NaCl
Level	80 to 250 g/L
Flow rate	2 to 8 BV/h (minimum contact time : 30 minutes)
Concentration	10 %
Slow rinse	2 BV at regeneration flow rate
Fast rinse	2 to 4 BV at service flow rate

** 1 BV (Bed volume) = 1 m^3 solution per m^3 resin*

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OPERATING CAPACITY

The operating capacity of Amberlite IR120 Na in water softening is obtained by multiplying the basic capacity value from table 5 by the correction factors C to F from tables 6 to 9.

$$Cap = Cap_0 \times C \times D \times E \times F$$

Table 5 : Basic Capacity versus NaCl Regenerant Level (co-flow regeneration)

NaCl g/L	Capacity eq/L (Cap_0)
80	1.01
100	1.13
120	1.22
150	1.34
200	1.48
250	1.60

Table 6 : Capacity Correction Factor C versus Sodium Concentration

Na meq/L	Factor C
< 5	1.00
10	0.98
20	0.95
30	0.92
40	0.89

Table 7 : Capacity Correction Factor D versus Hardness Concentration

TH meq/L	Factor D
< 5	1.00
10	0.98
20	0.93
30	0.88
40	0.83

Table 8 : Capacity Correction Factor E versus Regenerant Concentration

NaCl %	Factor E
3	0.95
5	0.97
10	1.00

Table 9 : Capacity Correction Factor F versus Specific Flow Rate in Production

BV/h	Factor F
5	1.05
10	1.02
15	1.00
20	0.99
30	0.97
40	0.96

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AMBERLITE® IR120 Na

ENGINEERING DATA SHEET
(Softening, Reverse flow regeneration)

These data provide information to calculate the hardness leakage and operating capacity of Amberlite IR120 Na used for water softening in reverse flow regenerated units excluding floating bed and packed bed applications.
The properties of Amberlite IR120 Na are described in the Product Data Sheet PDS 0210 A.

HARDNESS LEAKAGE

The average hardness leakage is obtained by multiplying the basic leakage value from Table 1 by the correction factors A and B from Tables 2 and 3.

$$\text{Leak} = \text{Leak}_0 \times A \times B$$

Table 1 : Basic Hardness Leakage versus NaCl regenerant level

NaCl g/L	Leakage meq/L (Leak_0)
50	0.014
70	0.013
100	0.010
120	0.009
150	0.007

Table 2 : Leakage Correction Factor A vs Total Dissolved Solids Concentration

TDS meq/L	Factor A
< 10	1.0
15	1.9
20	3.0
30	5.8
40	9.1

Table 3 : Leakage Correction Factor B versus Sodium to Total Cations Ratio

Na %	Factor B
< 5	1.0
10	1.3
20	1.6
30	1.9
50	2.5
70	3.1
90	3.7

Table 4 : Suggested Operating Conditions

Maximum operating temperature	120°C
Minimum bed depth	1000 mm (preferably > 1400 mm)
Service flow rate	5 to 40 BV*/h
Maximum linear velocity	50 m/h
Regenerant	NaCl
Level	50 to 150 g /L
Flow rate	2 to 8 BV/h (minimum contact time : 30 minutes)
Concentration	10 %
Slow rinse	2 BV at regeneration flow rate
Fast rinse	2 to 4 BV at service flow rate

** 1 BV (Bed volume) = 1 m^3 solution per m^3 resin*

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OPERATING CAPACITY

The operating capacity of Amberlite IR120 Na in water softening is obtained by multiplying the basic capacity value from table 5 by the correction factors C to G from tables 6 to 10.

$$\mathbf{Cap = Cap_0 \times C \times D \times E \times F \times G}$$

Table 5 : Basic Capacity versus NaCl regenerant level (reverse flow regeneration)

NaCl g/L	Capacity eq/L (Cap_0)
50	0.75
60	0.86
70	0.95
80	1.03
90	1.10
100	1.17
120	1.28
150	1.42

Table 6 : Capacity Correction Factor C versus Resin Bed Depth

Bed depth (mm)	Factor C
1000	0.92
1200	0.96
1500	1.02
1800	1.06
2000	1.09
2500	1.15

Table 7 : Capacity Correction Factor D Hardness Concentration

TH meq/L	Factor D
< 5	1.00
10	0.98
20	0.93
30	0.88
40	0.83

Table 8 : Capacity Correction Factor E versus Sodium Concentration

Na meq/L	Factor E
< 5	1.00
10	0.98
20	0.95
30	0.92
40	0.89

Table 9 : Capacity Correction Factor F versus Regenerant Concentration

NaCl %	Factor F
3	0.95
5	0.97
10	1.00

Table 10 : Capacity Correction Factor G versus Specific Flow Rate in production

BV/h	Factor G
5	1.05
10	1.02
15	1.00
20	0.99
30	0.97
40	0.96

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AMBERLITE® IRA402 Cl

ENGINEERING DATA SHEET
(Co-flow regeneration)

These data provide information to calculate the silica leakage and operating capacity of Amberlite IRA402 Cl used for water demineralisation with co-flow regeneration.
The properties of Amberlite IRA402 Cl are described in the Product Data Sheet PDS 0503 A.

SILICA LEAKAGE

The average silica leakage is obtained by multiplying the basic leakage value from Table 1 by the correction factors A, B, C and K* from Tables 2 to 4.

$$\mathbf{Leak = Leak_0 \times A \times B \times C \times K}$$

*K (the influence of sodium leakage) can be determined from the graph given in EDS 0299 A.

Table 1 : Basic Silica Leakage versus NaOH Regenerant Level

NaOH g/L	Leakage ppm SiO_2 ($Leak_0$)
60	0.088
70	0.068
80	0.054
100	0.037
120	0.027
150	0.019

Table 2 : Leakage Correction Factor A versus Silica to Total Anions Ratio

SiO_2 %	Factor A
1	0.1
5	0.5
10	1.0
25	2.5
50	5.0
75	7.5

Table 3 : Leakage Correction Factor B versus Water Temperature

Water °C	Factor B
5	0.7
10	0.8
15	1.0
25	1.5
35	2.3
45	3.3

Table 4 : Leakage Correction Factor C versus Regenerant Temperature

NaOH °C	Factor C
10	1.65
15	1.37
25	1.00
35	0.76
45	0.58

TABLE 5 : SUGGESTED OPERATING CONDITIONS

Maximum operating temperature	60°C
Minimum bed depth	700 mm
Service flow rate	5 to 40 BV*/h
Maximum linear velocity	50 m/h
Regenerant	NaOH
Level	60 to 150 g/L
Flow rate	2 to 8 BV/h (minimum contact time : 30 minutes)
Concentration	2 to 4 %
Slow rinse	2 BV at regeneration flow rate
Fast rinse	4 to 8 BV at service flow rate

** 1 BV (Bed volume) = 1 m^3 solution per m^3 resin*

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OPERATING CAPACITY

The operating capacity of Amberlite IRA402 Cl is obtained by multiplying the basic capacity value from table 6 by the correction factors D to G from tables 7 to 10.

$$Cap = Cap_0 \times D \times E \times F \times G$$

Table 6 : Basic capacity versus NaOH Regenerant Level (co-flow regen.)

NaOH g/L	Capacity eq/L (Cap_0)
60	0.53
70	0.58
80	0.61
100	0.67
120	0.72
150	0.78

Table 7 : Capacity Correction Factor D versus Sulphate to Total Anions Ratio

SO_4 %	Factor D
0	0.92
25	0.96
50	1.00
75	1.04
99	1.08

Table 8 : Capacity Correction Factor E versus CO_2 to Total Anions Ratio

CO_2 %	Factor E
0	0.97
20	1.00
30	1.02
50	1.05
75	1.08
99	1.12

Table 9 : Capacity Correction Factor F versus Silica to Total Anions Ratio and NaOH temperature (°C)

	5	25	50	75 % SiO_2
5°C	0.96	0.86	0.74	0.65
15	0.98	0.88	0.79	0.70
25	1.00	0.92	0.84	0.76
35	1.02	0.96	0.87	0.81
45	1.04	0.98	0.93	0.86

Table 10 : Capacity Correction Factor G vs Silica Endpoint (**$DSiO_2$ = difference between average leakage and endpoint)**

ΔSiO_2 (ppb)	Factor G
50	0.90
100	0.95
200	1.00
300	1.04

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AMBERLITE® IRA402 Cl

ENGINEERING DATA SHEET
(Reverse- flow regeneration)

These data provide information to calculate the silica leakage and operating capacity of Amberlite IRA402 Cl used in conventional reverse flow systems with downflow loading and upflow regeneration with air or water holddown.
The properties of Amberlite IRA402 Cl are described in the Product Data Sheet PDS 0503 A.

SILICA LEAKAGE

The average silica leakage is obtained by multiplying the basic leakage value from Table 1 by the correction factors A, B, C and K* from Tables 2 to 4.

$$\textbf{Leak} = \textbf{Leak}_0 \times A \times B \times C \times K$$

*K (the influence of sodium leakage) can be determined from the graph given in the EDS 0299 A.

Table 1 : Basic Silica Leakage versus NaOH Regenerant Level

NaOH g/L	Leakage ppm SiO_2 ($Leak_0$)
30	0.022
40	0.015
50	0.010
60	0.008
80	0.005
100	0.003
120	0.002

Table 2 : Leakage Correction Factor A vs Silica to Total Anions Ratio

SiO_2 %	Factor A
1	0.2
5	1.0
10	2.0
25	5.0
50	10.0
75	15.0

Table 3 : Leakage Correction Factor B versus Water Temperature

Water °C	Factor B
5	0.7
10	0.8
15	1.0
25	1.5
35	2.3
45	3.3

Table 4 : Leakage Correction Factor C versus Regenerant Temperature

NaOH °C	Factor C
10	1.65
15	1.37
25	1.00
35	0.76
45	0.58

Table 5 : Suggested Operating Conditions

Maximum operating temperature	60°C
Minimum bed depth	1000 mm (preferably > 1400 mm)
Service flow rate	5 to 40 BV*/h
Maximum linear velocity	50 m/h
Regenerant	NaOH
Level	30 to 120 g/L
Flow rate	2 to 8 BV/h (minimum contact time : 30 minutes)
Concentration	2 to 4 %
Slow rinse	2 BV at regeneration flow rate
Fast rinse	4 to 8 BV at service flow rate

** 1 BV (Bed volume) = 1 m^3 solution per m^3 resin*

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OPERATING CAPACITY

The operating capacity of Amberlite IRA402 Cl is obtained by multiplying the basic capacity value from table 6 by the correction factors D to G from tables 7 to 10.

$$\mathbf{Cap = Cap_0 \times D \times E \times F \times G}$$

Table 6 : Basic Capacity versus NaOH Regenerant Level (reverse flow regeneration)

NaOH g/L	Capacity eq/L (Cap_0)
30	0.40
40	0.48
50	0.54
60	0.60
70	0.64
80	0.68
100	0.74
120	0.79

Table 7 : Capacity Correction Factor D versus Sulphate to Total Anions Ratio

SO_4 %	Factor D
0	0.92
25	0.96
50	1.00
75	1.04
99	1.08

Table 8 : Capacity Correction Factor E versus CO_2 to Total Anions Ratio

CO_2 %	Factor E
0	0.97
20	1.00
30	1.02
50	1.05
75	1.08
99	1.12

Table 9 : Capacity Correction Factor F versus Silica to Total Anions Ratio and NaOH Temperature (°C)

	5	25	50	75 % SiO_2
5°C	0.96	0.86	0.74	0.65
15	0.98	0.88	0.79	0.70
25	1.00	0.92	0.84	0.76
35	1.02	0.96	0.87	0.81
45	1.04	0.98	0.93	0.86

Table 10 : Capacity Correction Factor G vs Silica Endpoint (ΔSiO_2 = difference between average leakage and endpoint)

ΔSiO_2 (ppb)	Factor G
50	0.90
100	0.95
200	1.00
300	1.04

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AMBERLITE® IRA410 Cl

ENGINEERING DATA SHEET
(Co- flow regeneration)

These data provide information to calculate the silica leakage and operating capacity of Amberlite IRA410 Cl used for water demineralisation with co-flow regeneration. The properties of Amberlite IRA410 Cl are described in the Product Data Sheet PDS 0502 A.

SILICA LEAKAGE

The average silica leakage is obtained by multiplying the basic leakage value from Table 1 by the correction factors A, B, C and K* from Tables 2 to 4.

$$\mathbf{Leak = Leak_0 \times A \times B \times C \times K}$$

*K (the influence of sodium leakage) can be determined from the graph given in the EDS 0299 A.

Table 1 : Basic Silica Leakage versus NaOH Regenerant Level

NaOH g/L	Leakage ppm SiO_2 ($Leak_0$)
40	0.370
50	0.230
60	0.160
80	0.085
100	0.055

Table 2 : Leakage Correction Factor A vs Silica to Total Anions Ratio

SiO_2 %	Factor A
1	0.2
5	1.0
10	2.0
20	4.0
30	6.0

Table 3 : Leakage Correction Factor B versus Water Temperature

Water °C	Factor B
5	0.7
10	0.8
15	1.0
20	1.2
25	1.5
30	2.2

Table 4 : Leakage Correction Factor C versus Regenerant Temperature

NaOH °C	Factor C
10	1.65
15	1.37
20	1.16
25	1.00
30	0.87

Table 5 : Suggested Operating Conditions

Maximum operating temperature	35°C
Minimum bed depth	700 mm
Service flow rate	5 to 40 BV*/h
Maximum linear velocity	50 m/h
Regenerant	NaOH
Level	40 to 100 g/L
Flow rate	2 to 8 BV/h (minimum contact time : 30 minutes)
Concentration	2 to 4 %
Slow rinse	2 BV at regeneration flow rate
Fast rinse	4 to 8 BV at service flow rate

** 1 BV (Bed volume) = 1 m^3 solution per m^3 resin*

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OPERATING CAPACITY

The operating capacity of Amberlite IRA410 Cl is obtained by multiplying the basic capacity value from table 6 by the correction factors D to G from tables 7 to 10.

$$Cap = Cap_0 \times D \times E \times F \times G$$

Table 6 : Basic capacity versus NaOH Regenerant Level (co-flow regen.)

NaOH g/L	Capacity eq/L (Cap_0)
40	0.64
50	0.74
60	0.78
70	0.81
80	0.84
100	0.88

Table 7 : Capacity Correction Factor D versus Sulphate to Total Anions Ratio

SO_4 %	Factor D
0	0.94
25	0.97
50	1.00
75	1.03
99	1.06

Table 8 : Capacity Correction Factor E versus CO_2 to Total Anions Ratio

CO_2 %	Factor E
0	0.97
20	1.00
30	1.02
50	1.05
75	1.08
99	1.12

Table 9 : Capacity Correction Factor F versus Silica to Total Anions Ratio and NaOH temperature (°C)

	5	10	20	30 % SiO_2
5°C	0.96	0.93	0.87	0.83
10	0.97	0.94	0.89	0.85
15	0.98	0.95	0.91	0.87
20	0.99	0.96	0.92	0.89
25	1.00	0.98	0.94	0.90
30	1.01	0.99	0.96	0.92

Table 10 : Capacity Correction Factor G vs Silica Endpoint (ΔSiO_2 = difference between average leakage and endpoint))

ΔSiO_2 (ppb)	Factor G
50	0.90
100	0.95
200	1.00
300	1.04

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AMBERLITE® IRA410 Cl

ENGINEERING DATA SHEET
(Reverse flow regeneration)

These data provide information to calculate the silica leakage and operating capacity of Amberlite IRA410 Cl used with reverse flow (counterflow) regeneration.

The properties of Amberlite IRA410 Cl are described in the Product Data Sheet PDS 0502 A.

SILICA LEAKAGE

The average silica leakage is obtained by multiplying the basic leakage value from Table 1 by the correction factors A, B, C and K* from Tables 2 to 4.

$$\textbf{Leak} = \textbf{Leak}_0 \times A \times B \times C \times K$$

*K (the influence of sodium leakage) can be determined from the graph given in the EDS 0299 A.

Table 1 : Basic Silica Leakage versus NaOH Regenerant Level

NaOH g/L	Leakage ppm SiO_2 ($Leak_0$)
30	0.050
40	0.036
50	0.024
60	0.017
80	0.010

Table 2 : Leakage Correction Factor A vs Silica to Total Anions Ratio

SiO_2	Factor A
1	0.2
5	1.0
10	2.0
20	4.0
30	6.0

Table 3 : Leakage Correction Factor B versus Water Temperature

Water °C	Factor B
5	0.7
10	0.8
15	1.0
20	1.2
25	1.5
30	2.2

Table 4 : Leakage Correction Factor C versus Regenerant Temperature

NaOH °C	Factor C
10	1.65
15	1.37
20	1.16
25	1.00
30	0.87

Table 5 : Suggested Operating Conditions

Maximum operating temperature	35°C
Minimum bed depth	1000 mm (preferably > 1400 mm)
Service flow rate	5 to 40 BV*/h
Maximum linear velocity	50 m/h
Regenerant	NaOH
Level	30 to 70 g/L
Flow rate	2 to 8 BV/h (minimum contact time : 30 minutes)
Concentration	2 to 4 %
Slow rinse	2 BV at regeneration flow rate
Fast rinse	4 to 8 BV at service flow rate

** 1 BV (Bed volume) = 1 m^3 solution per m^3 resin*

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OPERATING CAPACITY

The operating capacity of Amberlite IRA410 Cl is obtained by multiplying the basic capacity value from table 6 by the correction factors D to G from tables 7 to 10.

$$\mathbf{Cap = Cap_0 \times D \times E \times F \times G}$$

Table 6 : Basic Capacity versus NaOH Regenerant Level (reverse flow regeneration)

NaOH g/L	Capacity eq/L (Cap_0)
30	0.64
40	0.72
50	0.77
60	0.81
70	0.86
80	0.89

Table 7 : Capacity Correction Factor D versus Sulphate to Total Anions Ratio

SO_4 %	Factor D
0	0.94
25	0.97
50	1.00
75	1.03
99	1.06

Table 8 : Capacity Correction Factor E versus CO_2 to Total Anions Ratio

CO_2 %	Factor E
0	0.97
20	1.00
30	1.02
50	1.05
75	1.08
99	1.12

Table 9 : Capacity Correction Factor F versus Silica to Total Anions Ratio and NaOH Temperature (°C)

	5	10	20	30 % SiO_2
5°C	0.96	0.93	0.87	0.83
10	0.97	0.94	0.89	0.85
15	0.98	0.95	0.91	0.87
20	0.99	0.96	0.92	0.89
25	1.00	0.98	0.94	0.90
30	1.01	0.99	0.96	0.92

Table 10 : Capacity Correction Factor G vs Silica Endpoint (ΔSiO_2 = difference between average leakage and endpoint)

ΔSiO_2 (ppb)	Factor G
50	0.90
100	0.95
200	1.00
300	1.04

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AMBERLITE® IRA458 Cl

ENGINEERING DATA SHEET
(Co- flow regeneration)

These data provide information to calculate the silica leakage and operating capacity of Amberlite IRA458 Cl used in water demineralisation with co-flow regeneration.
The properties of Amberlite IRA458 Cl are described in the Product Data Sheet PDS 0229 A.

SILICA LEAKAGE

The average silica leakage is obtained by multiplying the basic leakage value from Table 1 by the correction factors A, B, C and K* from Tables 2 to 4.

$$\textbf{Leak} = \textbf{Leak}_0 \times A \times B \times C \times K$$

*K (the influence of sodium leakage) can be determined from the graph given in the EDS 0299 A.

Table 1 : Basic Silica Leakage versus NaOH Regenerant Level

NaOH g/L	Leakage ppm SiO_2 ($Leak_0$)
50	0.069
60	0.052
80	0.033
100	0.023
120	0.017
150	0.012

Table 2 : Leakage Correction Factor A versus Silica to Total Anions Ratio

SiO_2	Factor A
1	0.2
5	1.0
10	2.0
20	4.0
30	6.0

Table 3 : Leakage Correction Factor B versus Water Temperature

Water °C	Factor B
5	0.7
10	0.8
15	1.0
20	1.2
25	1.5
30	2.2

Table 4 : Leakage Correction Factor C versus Regenerant Temperature

NaOH °C	Factor C
10	1.65
15	1.37
20	1.16
25	1.00
30	0.87

Table 5 : Suggested Operating Conditions

Maximum operating temperature	35°C
Minimum bed depth	700 mm
Service flow rate	5 to 40 BV*/h
Maximum linear velocity	40 m/h
Regenerant	NaOH
Level	50 to 150 g/L
Flow rate	2 to 8 BV/h (minimum contact time : 30 minutes)
Concentration	2 to 4 %
Slow rinse	2 BV at regeneration flow rate
Fast rinse	4 à 8 BV to service flow rate

** 1 BV (Bed volume) = 1 m^3 solution per m^3 resin*

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OPERATING CAPACITY

The operating capacity of Amberlite IRA458 Cl is obtained by multiplying the basic capacity value from table 6 by the correction factors D to G from tables 7 to 10.

$$Cap = Cap_0 \times D \times E \times F \times G$$

Table 6 : Basic Capacity versus NaOH Regenerant Level (co-flow regeneration)

NaOH g/L	Capacity eq/L (Cap_0)
50	0.60
60	0.65
70	0.69
80	0.72
100	0.77
120	0.81
150	0.84

Table 7 : Capacity Correction Factor D versus Sulphate to Total Anions Ratio

SO_4 %	Factor D
0	0.94
25	0.97
50	1.00
75	1.03
99	1.06

Table 8 : Capacity Correction Factor E versus CO_2 to Total Anions Ratio

CO_2 %	Factor E
0	0.97
20	1.00
30	1.02
50	1.05
75	1.08
99	1.12

Table 9 : Capacity Correction Factor F versus Silica to Total Anions Ratio and NaOH Temperature (°C)

	5	10	20	30 % SiO_2
5°C	0.96	0.93	0.87	0.83
10	0.97	0.94	0.89	0.85
15	0.98	0.95	0.91	0.87
20	0.99	0.96	0.92	0.89
25	1.00	0.98	0.94	0.90
30	1.01	0.99	0.96	0.92

Table 10 : Capacity Correction Factor G vs Silica Endpoint **($DSiO_2$ = difference between average leakage and endpoint)**

ΔSiO_2 (ppb)	Factor G
50	0.90
100	0.95
200	1.00
300	1.04

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AMBERLITE® IRA458RF Cl

ENGINEERING DATA SHEET
(Reverse flow regeneration)

These data provide information to calculate the silica leakage and operating capacity of Amberlite IRA458RF Cl used for water demineralisation with reverse flow (counterflow) regeneration.The properties of Amberlite IRA458RF Cl are described in the Product Data Sheet PDS 0428 A.

SILICA LEAKAGE

The average silica leakage is obtained by multiplying the basic leakage value from Table 1 by the correction factors A, B, C and K* from Tables 2 to 4.

$$\mathbf{Leak = Leak_0 \times A \times B \times C \times K}$$

*K (the influence of sodium leakage) can be determined from the graph given in the EDS 0299 A.

Table 1 : Basic Silica Leakage versus NaOH Regenerant Level

NaOH g/L	Leakage ppm SiO_2 ($Leak_0$)
30	0.035
40	0.020
50	0.014
60	0.011
80	0.007

Table 2 : Leakage Correction Factor A vs Silica to Total Anions Ratio

SiO_2	Factor A
1	0.2
5	1.0
10	2.0
20	4.0
30	6.0

Table 3 : Leakage Correction Factor B versus Water Temperature

Water °C	Factor B
5	0.7
10	0.8
15	1.0
20	1.2
25	1.5
30	2.2

Table 4 : Leakage Correction Factor C versus Regenerant Temperature

NaOH °C	Factor C
10	1.65
15	1.37
20	1.16
25	1.00
30	0.87

Table 5 : Suggested Operating Conditions

Maximum operating temperature	35°C
Minimum bed depth	1000 mm (preferably > 1400 mm)
Service flow rate	5 to 40 BV*/h
Maximum linear velocity	40 m/h
Regenerant	NaOH
Level	30 to 80 g/L
Flow rate	2 to 8 BV/h (minimum contact time : 30 minutes)
Concentration	2 to 4 %
Slow rinse	2 BV at regeneration flow rate
Fast rinse	4 to 8 BV at service flow rate

** 1 BV (Bed volume) = 1 m^3 solution per m^3 resin*

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OPERATING CAPACITY

The operating capacity of Amberlite IRA458RF Cl is obtained by multiplying the basic capacity value from table 6 by the correction factors D to G from tables 7 to 10.

$$Cap = Cap_0 \times D \times E \times F \times G$$

Table 6 : Basic Capacity versus NaOH Regenerant Level (reverse flow regeneration)

NaOH g/L	Capacity eq/L (Cap_0)
30	0.50
40	0.61
50	0.66
60	0.70
70	0.73
80	0.75

Table 7 : Capacity Correction Factor D versus Sulphate to Total Anions Ratio

SO_4 %	Factor D
0	0.94
25	0.97
50	1.00
75	1.03
99	1.06

Table 8 : Capacity Correction Factor E versus CO_2 to Total Anions Ratio

CO_2 %	Factor E
0	0.97
20	1.00
30	1.02
50	1.05
75	1.08
99	1.12

Table 9 : Capacity Correction Factor F versus Silica to Total Anions Ratio and NaOH Temperature (°C)

	5	10	20	30 % SiO_2
5°C	0.96	0.93	0.87	0.83
10	0.97	0.94	0.89	0.85
15	0.98	0.95	0.91	0.87
20	0.99	0.96	0.92	0.89
25	1.00	0.98	0.94	0.90
30	1.01	0.99	0.96	0.92

Table 10 : Capacity Correction Factor G vs Silica Endpoint **($DSiO_2$ = difference between average leakage and endpoint)**

ΔSiO_2 (ppb)	Factor G
50	0.90
100	0.95
200	1.00
300	1.04

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AMBERLITE® IRA478RF Cl

ENGINEERING DATA SHEET
(Reverse- flow regeneration)

These data provide information to calculate the silica leakage and operating capacity of Amberlite IRA478RF Cl used for water demineralisation with reverse flow (counterflow) regeneration.
The properties of Amberlite IRA478RF Cl are described in the Product Data Sheet PDS 0440 A.

SILICA LEAKAGE

The average silica leakage is obtained by multiplying the basic leakage value from Table 1 by the correction factors A, B, C and K* from Tables 2 to 4.

$$\textbf{Leak} = \textbf{Leak}_0 \times A \times B \times C \times K$$

*K (the influence of sodium leakage) can be determined from the graph given in the EDS 0299 A.

Table 1 : Basic Silica Leakage versus NaOH Regenerant Level

NaOH g/L	Leakage ppm SiO_2 ($Leak_0$)
40	0.050
50	0.030
60	0.020
70	0.015

Table 2 : Leakage Correction Factor A versus Silica to Total Anions Ratio

SiO_2 %	Factor A
1	0.3
3	1.0
5	1.5
7	2.0
10	3.0

Table 3 : Leakage Correction Factor B versus Water Temperature

Water °C	Factor B
5	0.7
10	0.8
15	1.0
20	1.2
25	1.5
30	2.2

Table 4 : Leakage Correction Factor A versus Regenerant Temperature

NaOH °C	Factor C
10	1.65
15	1.37
20	1.16
25	1.00
30	0.87

Table 5 : Suggested Operating Conditions

Maximum silica in degassed water	10 % of total anions
Maximum operating temperature	35°C
Minimum bed depth	1400 mm
Service flow rate	5 to 40 BV*/h
Maximum linear velocity	50 m/h
Regenerant	NaOH
Level	40 to 70 g/L
Flow rate	2 to 8 BV/h (minimum contact time : 30 minutes)
Concentration	2 to 4 %
Slow rinse	2 BV at regeneration flow rate
Fast rinse	4 to 8 BV at service flow rate

** 1 BV (Bed volume) = 1 m^3 solution per m^3 resin*

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OPERATING CAPACITY

The operating capacity of Amberlite IRA478RF Cl is obtained by multiplying the basic capacity value from table 6 by the correction factors D to H from tables 7 to 11.

$$Cap = Cap_0 \times D \times E \times F \times G \times H$$

Table 6 : Basic Capacity versus NaOH Regenerant Level (reverse flow regeneration)

NaOH g/L	Capacity eq/L (Cap_0)
40	0.87
50	0.92
60	0.98
70	1.00

Table 7 : Capacity Correction Factor D versus Sulphate to Total Anions Ratio

SO_4 %	Factor D
0	0.94
25	0.97
50	1.00
75	1.03
100	1.06

Table 8 : Capacity Correction Factor E versus CO_2 to Total Anions Ratio

CO_2 %	Factor E
0	0.97
10	0.98
20	1.00
30	1.02

Table 9 : Capacity Correction Factor F versus Silica to Total Anions Ratio

SiO_2 %	Factor F
1	1.02
3	1.01
5	1.00
7	0.99
10	0.98

Table 10 : Capacity Correction Factor G versus Service Flow Rate

BV/h	Factor G
10	1.03
20	1.00
30	0.95
40	0.88

Table 11 : Capacity Correction Factor H vs Silica Endpoint
($DSiO_2$ = difference between average leakage and endpoint

ΔSiO_2 (ppb)	Factor H
50	0.90
100	0.95
200	1.00
300	1.04

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AMBERLITE® IRA67

ENGINEERING DATA SHEET

These data provide information to calculate the operating capacity of Amberlite IRA67 and IRA67RF used for water demineralisation.

The properties of these products are described in the Product Data Sheets PDS 0226 and 0444 A.

OPERATING CAPACITY

The operating capacity is obtained by multiplying the basic capacity value from table 1 by the correction factors A, B and C from tables 2 to 4.

$$Cap = Cap_0 \times A \times B \times C$$

Table 1 : Basic Capacity versus SO_4/FMA* Ratio

SO_4/FMA %	Capacity eq/L (Cap_0)
0	1.26
20	1.29
40	1.32
60	1.34
80	1.37
100	1.39

**FMA = Free Mineral Acidity = Anions of Strong Acids*

Table 2 : Capacity Correction Factor A versus CO_2/Total Anions Ratio

CO_2 %	Factor A
0	0.88
10	0.90
20	0.93
30	0.95
50	1.00

Table 3 : Capacity Correction Factor B versus Water Temperature

Water °C	Factor B
5	0.90
15	1.00
20	1.02
30	1.06
40	1.09

Table 4 : Capacity Correction Factor C versus Run Length (hours)

Run (hours)	Factor C
4	0.90
6	0.94
8	0.96
12	0.98
18	0.99
> 24	1.00

Table 4 : Suggested Operating Conditions

Maximum operating temperature	35°C
Minimum bed depth	700 mm
Service flow rate	5 to 40 BV*/h
Maximum linear velocity	50 m/h
Regenerant	NaOH
Level	130 % of ionic load
Flow rate	2 to 8 BV/h (minimum contact time : 30 minutes)
Concentration	2 to 4 %
Slow rinse	2 BV at regeneration flow rate
Fast rinse	8 to 16 BV at 10 BV/h

** 1 BV (Bed volume) = 1 m^3 solution per m^3 resin*

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AMBERLITE® IRA900 Cl

ENGINEERING DATA SHEET
(Co-flow regeneration)

These data provide information to calculate the silica leakage and operating capacity of Amberlite IRA900 Cl used for water demineralisation with co-flow regeneration.
The properties of Amberlite IRA900 Cl are described in the Product Data Sheet PDS 0295 A.

SILICA LEAKAGE

The average silica leakage is obtained by multiplying the basic leakage value from Table 1 by the correction factors A, B, C and K* from Tables 2 to 4.

$$\mathbf{Leak = Leak_0 \times A \times B \times C \times K}$$

*K (the influence of sodium leakage can be determined from the graph given in EDS 0299 A)

Table 1 : Basic Silica Leakage versus NaOH Regenerant Level

NaOH g/L	Leakage ppm SiO_2 ($Leak_0$)
50	0.120
60	0.088
70	0.068
80	0.054
100	0.037
120	0.027
150	0.019

Table 2 : Leakage Correction Factor A vs Silica to Total Anions Ratio

SiO_2 %	Factor A
1	0.1
5	0.5
10	1.0
25	2.5
50	5.0
75	7.5

Table 3 : Leakage Correction Factor B versus Water temperature

Water °C	Factor B
5	0.7
10	0.8
15	1.0
25	1.5
35	2.3
45	3.3

Table 4 : Leakage Correction Factor C versus Regenerant Temperature

NaOH °C	Factor C
10	1.65
15	1.37
25	1.00
35	0.76
45	0.58

Table 5 : Suggested Operating Conditions

Maximum operating temperature	60°C
Minimum bed depth	700 mm
Service flow rate	5 to 120 BV*/h
Maximum linear velocity	5 to 120 m/h
Regenerant	NaOH
Level	50 to 150 g/L
Flow rate	2 to 8 BV/h (minimum contact time : 30 minutes)
Concentration	2 to 4 %
Slow rinse	2 BV at regeneration flow rate
Fast rinse	4 to 8 BV at service flow rate

** 1 BV (Bed volume) = 1 m^3 solution per m^3 resin*

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OPERATING CAPACITY

The operating capacity of Amberlite IRA900 Cl is obtained by multiplying the basic capacity value from table 6 by the correction factors D to G from tables 7 to 10.

$$Cap = Cap_0 \times D \times E \times F \times G$$

Table 6 : Basic Capacity versus NaOH Regenerant Level (co-flow regeneration)

NaOH g/L	Capacity eq/L (Cap_0)
50	0.37
60	0.41
70	0.44
80	0.46
100	0.50
120	0.52
150	0.55

Table 7 : Capacity Correction Factor D versus Sulphate to Total Anions Ratio

SO_4 %	Factor D
0	0.92
25	0.96
50	1.00
75	1.04
99	1.08

Table 8 : Capacity Correction Factor E versus CO_2 to Total Anions Ratio

CO_2 %	Factor E
0	0.97
20	1.00
30	1.02
50	1.05
75	1.08
99	1.12

Table 9 : Capacity Correction Factor F versus Silica to Total Anions Ratio and NaOH Temperature (°C)

	5	25	50	75 % SiO_2
5°C	0.96	0.86	0.74	0.65
15	0.98	0.88	0.79	0.70
25	1.00	0.92	0.84	0.76
35	1.02	0.96	0.87	0.81
45	1.04	0.98	0.93	0.86

Table 10 : Capacity Correction Factor G vs Silica Endpoint **($DSiO_2$ = difference between average leakage and endpoint)**

ΔSiO_2 (ppb)	Factor G
50	0.90
100	0.95
200	1.00
300	1.04

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ENGINEERING DATA SHEET
(Reverse-flow regeneration)

These data provide information to calculate the silica leakage and operating capacity of Amberlite IRA900RF Cl used for water demineralisation with reverse flow (counterflow) regeneration.
The properties of Amberlite IRA900RF Cl are described in the Product Data Sheet PDS 0445 A.

SILICA LEAKAGE

The average silica leakage is obtained by multiplying the basic leakage value from Table 1 by the correction factors A, B, C and K* from Tables 2 to 4.

$$\text{Leak} = \text{Leak}_0 \times A \times B \times C \times K$$

*K (the influence of sodium leakage can be determined from the graph given in EDS 0299 A)

Table 1 : Basic Silica Leakage versus NaOH Regenerant Level

NaOH g/L	Leakage ppm SiO_2 ($Leak_0$)
30	0.022
40	0.015
50	0.010
60	0.008
80	0.005
100	0.003
120	0.002

Table 2 : Leakage Correction Factor A versus Silica to Total Anions Ratio

SiO_2 %	Factor A
1	0.2
5	1.0
10	2.0
25	5.0
50	10.0
75	15.0

Table 3 : Leakage Correction Factor B versus Water temperature

Water °C	Factor B
5	0.7
10	0.8
15	1.0
25	1.5
35	2.3
45	3.3

Table 4 : Leakage Correction Factor C versus Regenerant Temperature

NaOH °C	Factor C
10	1.65
15	1.37
25	1.00
35	0.76
45	0.58

Table 5 : Suggested Operating Conditions

Maximum operating temperature	60°C
Minimum bed depth	1000 mm (preferably > 1400 mm)
Service flow rate	5 to 40 BV*/h
Maximum linear velocity	50 m/h
Regenerant	NaOH
Level	30 to 120 g/L
Flow rate	2 to 8 BV/h (minimum contact time : 30 minutes)
Concentration	2 to 4 %
Slow rinse	2 BV at regeneration flow rate
Fast rinse	4 to 8 BV at service flow rate

** 1 BV (Bed volume) = 1 m^3 solution per m^3 resin*

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OPERATING CAPACITY

The operating capacity of Amberlite IRA900RF Cl is obtained by multiplying the basic capacity value from table 6 by the correction factors D to G from tables 7 to 10.

$$Cap = Cap_0 \times D \times E \times F \times G$$

Table 6 : Basic Capacity versus NaOH Regenerant Level (reverse flow regeneration)

NaOH g/L	Capacity eq/L (Cap_0)
30	0.30
40	0.35
50	0.39
60	0.42
70	0.45
80	0.47
100	0.51
120	0.53

Table 7 : Capacity Correction Factor D versus Sulphate to Total Anions Ratio

SO_4 %	Factor D
0	0.92
25	0.96
50	1.00
75	1.04
99	1.08

Table 8 : Capacity Correction Factor E versus CO_2 to Total Anions Ratio

CO_2 %	Factor E
0	0.97
20	1.00
30	1.02
50	1.05
75	1.08
99	1.12

Table 9 : Capacity Correction Factor F versus Silica to Total Anions Ratio and NaOH Temperature (°C)

	5	25	50	75 % SiO_2
5°C	0.96	0.86	0.74	0.65
15	0.98	0.88	0.79	0.70
25	1.00	0.92	0.84	0.76
35	1.02	0.96	0.87	0.81
45	1.04	0.98	0.93	0.86

Table 10 : Capacity Correction Factor G vs Silica Endpoint
(DSiO_2 = difference between average leakage and endpoint)

ΔSiO_2 (ppb)	Factor G
50	0.90
100	0.95
200	1.00
300	1.04

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AMBERLITE® IRA910 Cl

ENGINEERING DATA SHEET
(Co-flow regeneration)

These data provide information to calculate the silica leakage and operating capacity of Amberlite IRA910 Cl used in water demineralisation with co-flow regeneration.
The properties of Amberlite IRA910 Cl are described in the Product Data Sheet PDS 0517 A.

SILICA LEAKAGE

The average silica leakage is obtained by multiplying the basic leakage value from Table 1 by the correction factors A, B, C and K* from Tables 2 to 4.

$$\text{Leak} = \text{Leak}_0 \times A \times B \times C \times K$$

*K (the influence of sodium leakage) can be determined from the graph given in the EDS 0299 A.

Table 1 : Basic Silica Leakage versus NaOH Regenerant Level

NaOH g/L	Leakage ppm SiO_2 ($Leak_0$)
40	0.370
50	0.230
60	0.160
80	0.085
100	0.055

Table 2 : Leakage Correction Factor A versus Silica to Total anions ratio

SiO_2 %	Factor A
1	0.2
5	1.0
10	2.0
20	4.0
30	6.0

Table 3 : Leakage Correction Factor B versus Water Temperature

Water °C	Factor B
5	0.7
10	0.8
15	1.0
20	1.2
25	1.5
30	2.2

Table 4 : Leakage Correction Factor C versus Regenerant Temperature

NaOH °C	Factor C
10	1.65
15	1.37
20	1.16
25	1.00
30	0.87

Table 5 : Suggested Operating Conditions

Maximum operating temperature	35°C
Minimum bed depth	700 mm
Service flow rate	5 to 40 BV*/h
Maximum linear velocity	50 m/h
Regenerant	NaOH
Level	40 to 100 g/L
Flow rate	2 to 8 BV/h (minimum contact time : 30 minutes)
Concentration	2 to 4 %
Slow rinse	2 BV at regeneration flow rate
Fast rinse	4 to 8 BV at service flow rate

** 1 BV (Bed volume) = 1 m^3 solution per m^3 resin*

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OPERATING CAPACITY

The operating capacity of Amberlite IRA910 Cl is obtained by multiplying the basic capacity value from table 6 by the correction factors D to G from tables 7 to 10.

$$\mathbf{Cap = Cap_0 \times D \times E \times F \times G}$$

Table 6 : Basic capacity versus NaOH Regenerant Level (co-flow regeneration)

NaOH g/L	Capacity eq/L (Cap_0)
40	0.60
50	0.64
60	0.67
70	0.70
80	0.72
100	0.75

Table 7 : Capacity Correction Factor D versus Sulphate to Total Anions Ratio

SO_4 %	Factor D
0	0.94
25	0.97
50	1.00
75	1.03
99	1.06

Table 8 : Capacity Correction Factor E versus CO_2 to Total Anions Ratio

CO_2 %	Factor E
0	0.97
20	1.00
30	1.02
50	1.05
75	1.08
99	1.12

Table 9 : Capacity Correction Factor F versus Silica to Total Anions Ratio and NaOH Temperature (°C)

	5	10	20	30 % SiO_2
5°C	0.96	0.93	0.87	0.83
10	0.97	0.94	0.89	0.85
15	0.98	0.95	0.91	0.87
20	0.99	0.96	0.92	0.89
25	1.00	0.98	0.94	0.90
30	1.01	0.99	0.96	0.92

Table 10 : Capacity Correction Factor G vs Silica Endpoint **(DSiO_2 = difference between average leakage and endpoint)**

ΔSiO_2 (ppb)	Factor G
50	0.90
100	0.95
200	1.00
300	1.04

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AMBERLITE® IRA96

ENGINEERING DATA SHEET

These data provide information to calculate the operating capacity of Amberlite IRA96, IRA96RF and IRA96SB used in water demineralisation.
The properties of these products are respectively described in the Product Data Sheets PDS 0211, 0441 and 0419 A.

OPERATING CAPACITY

The operating capacity is obtained by multiplying the basic capacity value from table 1 by the correction factors A, B and C from tables 2 to 4.

$$\mathbf{Cap = Cap_0 \times A \times B \times C}$$

Table 1 : Basic Capacity versus SO_4/FMA* Ratio

SO_4/FMA %	Capacity eq/L (Cap_0)
0	1.01
20	1.04
40	1.07
60	1.10
80	1.12
100	1.15

**FMA = Free Mineral Acidity = Anions of Strong Acids*

Table 2 : Capacity Correction Factor A vs Carbon Dioxide Concentration

CO_2 meq/L	Factor A
0.10	0.93
0.25	0.94
0.50	0.96
0.75	0.98
> 1.00	1.00

Table 3 : Capacity Correction Factor B versus Water Temperature

Water °C	Factor B
5	0.90
15	1.00
25	1.05
35	1.08
45	1.10

Table 4 : Capacity Correction Factor C versus Run Length (hours)

Run (hours)	Factor C
4	0.80
6	0.88
8	0.92
12	0.97
18	0.99
> 24	1.00

Table 5 : Suggested Operating Conditions

Maximum operating temperature	100°C
Minimum bed depth	700 mm
Service flow rate	5 to 40 BV*/h
Maximum linear velocity	50 m/h
Regenerant	NaOH
Level	120 % of ionic load
Flow rate	2 to 8 BV/h (minimum contact time : 30 minutes)
Concentration	2 to 4 %
Slow rinse	2 BV at regeneration flow rate
Fast rinse	4 to 8 BV at service flow rate

** 1 BV (Bed volume) = 1 m^3 solution per m^3 resin*

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AMBERLITE® IRC86

ENGINEERING DATA SHEET

These data provide information to calculate the operating capacity of Amberlite IRC86, IRC86RF and IRC86SB used for water dealkalization.
The properties of these products are described in the Product Data Sheets PDS 0234, 0442 and 0443 A.

OPERATING CAPACITY

The operating capacity is obtained by multiplying the basic capacity value from table 1 by the correction factors A and B from tables 2 and 3. The capacity is valid for an endpoint of the run corresponding to a leakage of 10 % of the influent alkalinity.

$$\mathbf{Cap = Cap_0 \times A \times B}$$

Table 1 : Basic Capacity versus Hardness to Alkalinity Ratio

TH / TAlk	Capacity eq / L
0.60	0.83
0.70	0.99
0.80	1.20
0.90	1.46
0.95	1.77
1.00	2.40
1.10	2.50
1.20	2.55
> 1.30	2.60

Table 2 : Capacity Correction Factor A versus Total Cations and Water Temperature

Total Cations meq / L	10°C	15°C	20°C	25°C
2	0.69	0.80	0.90	1.00
4	0.82	0.92	1.00	1.07
6	0.90	0.98	1.06	1.12
8	0.93	1.02	1.09	1.15
> 10	0.94	1.03	1.11	1.17

Table 3 : Capacity Correction Factor B versus Ionic Load

Load = Temporary Hardness (meq/L) x Running time (h)

Load	Factor B
30	0.58
60	0.79
80	0.87
100	0.93
120	0.97
> 140	1.00

Table 4 : Suggested Operating Conditions

Maximum operating temperature	120°C	
Minimum bed depth	700 mm	
Service flow rate	5 to 70 BV* / h	
Maximum linear velocity	50 m / h	
Regenerants	HCl	H_2SO_4
Flow rate (BV / h)	2 to 8	15 to 40
Concentration (%)	2 to 5	0.5 to 0.7
Level	104 to 110 % of theory	
Minimum contact time	30 minutes	
Slow rinse	2 BV at regeneration flow rate	
Fast rinse	2 to 4 BV at service flow rate	

** 1 BV (Bed volume) = 1 m^3 solution per m^3 resin*

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IMAC® HP333

ENGINEERING DATA SHEET

These data provide information to calculate the operating capacity of IMAC HP333 used for water dealkalization.
The properties of these products are described in the Product Data Sheet ITS 0200 A.

OPERATING CAPACITY

The operating capacity is obtained by multiplying the basic capacity value from table 1 by the correction factors A and B from tables 2 and 3. The capacity is valid for an endpoint of the run corresponding to a leakage of 10 % of the influent alkalinity.

$$Cap = Cap_0 \times A \times B$$

Table 1 : Basic Capacity versus Hardness to Alkalinity Ratio

TH/TAlk	Capacity eq/L
0.60	0.79
0.70	0.88
0.80	1.04
0.90	1.41
0.95	1.74
1.00	2.23
1.10	2.33
1.20	2.35
> 1.30	2.36

Table 2 : Capacity Correction Factor A versus Total Cations and Water Temperature

Total Cations meq/L	10°C	15°C	20°C	25°C
2	0.69	0.80	0.90	1.00
4	0.82	0.92	1.00	1.07
6	0.90	0.98	1.06	1.12
8	0.93	1.02	1.09	1.15
> 10	0.94	1.03	1.11	1.17

Table 3 : Capacity Correction Factor B versus Ionic Load

Load = Temporary Hardness (meq/L) x Running time (h)

Load	Factor B
30	0.58
60	0.79
80	0.87
100	0.93
120	0.97
> 140	1.00

Table 4 : Suggested Operating Conditions

Maximum operating temperature	100°C	
Minimum bed depth	700 mm	
Service flow rate	5 to 70 BV*/h	
Maximum linear velocity	50 m/h	
Regenerants	HCl	H_2SO_4
Flow rate (BV/h)	2 to 8	15 to 40
Concentration (%)	2 to 5	0.5 to 0.7
Level	104 to 110 % of theory	
Minimum contact time	30 minutes	
Slow rinse	2 BV at regeneration flow rate	
Fast rinse	2 to 4 BV at service flow rate	

** 1 BV (Bed volume) = 1 m^3 solution per m^3 resin*

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IMAC® HP336

ENGINEERING DATA SHEET

These data provide information to calculate the operating capacity of IMAC HP336 used for water dealkalization.
The properties of these products are described in the Product Data Sheet ITS 0199 A.

OPERATING CAPACITY

The operating capacity is obtained by multiplying the basic capacity value from table 1 by the correction factors A and B from tables 2 and 3. The capacity is valid for an endpoint of the run corresponding to a leakage of 10 % of the influent alkalinity.

$$Cap = Cap_0 \times A \times B$$

Table 1 : Basic Capacity versus Hardness to Alkalinity Ratio

TH/TAlk	Capacity eq/L
0.60	0.79
0.70	0.88
0.80	1.04
0.90	1.41
0.95	1.74
1.00	2.23
1.10	2.33
1.20	2.35
> 1.30	2.36

Table 2 : Capacity Correction Factor A versus Total Cations and Water Temperature

Total Cations meq/L	10°C	15°C	20°C	25°C
2	0.69	0.80	0.90	1.00
4	0.82	0.92	1.00	1.07
6	0.90	0.98	1.06	1.12
8	0.93	1.02	1.09	1.15
> 10	0.94	1.03	1.11	1.17

Table 3 : Capacity Correction Factor B versus Ionic Load

Load = Temporary Hardness (meq/L) x Running time (h)

Load	Factor B
30	0.58
60	0.79
80	0.87
100	0.93
120	0.97
> 140	1.00

Table 4 : Suggested Operating Conditions

Maximum operating temperature	100°C	
Minimum bed depth	700 mm	
Service flow rate	5 to 70 BV*/h	
Maximum linear velocity	50 m/h	
Regenerants	HCl	H_2SO_4
Flow rate (BV/h)	2 to 8	15 to 40
Concentration (%)	2 to 5	0.5 to 0.7
Level	104 to 110 % of theory	
Minimum contact time	30 minutes	
Slow rinse	2 BV at regeneration flow rate	
Fast rinse	2 to 4 BV at service flow rate	

** 1 BV (Bed volume) = 1 m^3 solution per m^3 resin*

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IMAC® HP555

ENGINEERING DATA SHEET
(Co-flow regeneration)

These data provide information to calculate the nitrate leakage and operating capacity of IMAC HP555 used with co-flow regeneration.

The properties of IMAC HP555 are described in the Product Data Sheet ITS 0201 A.

NITRATE LEAKAGE

The average nitrate leakage is obtained by multiplying the basic leakage value from figure 1 by the correction factors A and B from figures 2 and 3.

$$\text{Leak} = \text{Leak}_0 \times A \times B$$

Fig 2 : Leakage Correction Factor A versus Total Anions

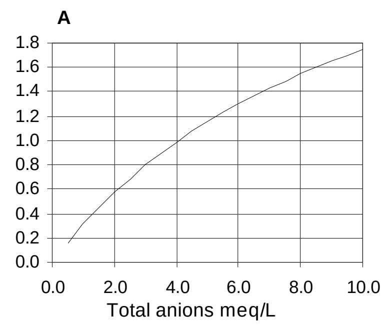

Fig 1 : Basic Nitrate Leakage vs Endpoint

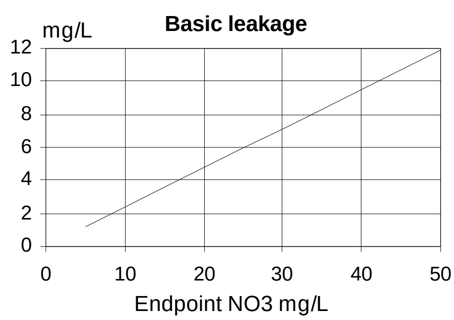

Fig 3 : Leakage Correction Factor B versus Regenerant Dosage

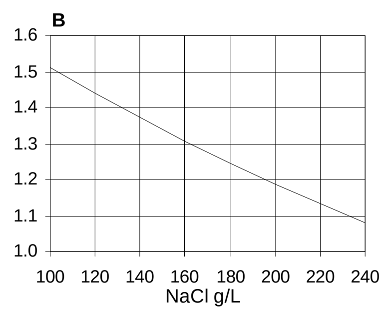

Table 1 : Suggested Operating Conditions (co-flow regeneration)

Maximum operating temperature	50°C
Minimum bed depth	700 mm
Service flow rate	5 to 40 BV*/h
Maximum linear velocity	50 m/h
Regenerant	NaCl
Level	100 to 240 g/L
Flow rate	2 to 8 BV/h (minimum contact time : 30 minutes)
Concentration	6 to 10 %
Slow rinse	2 BV at regeneration flow rate
Fast rinse	2 to 10 BV at service flow rate

** 1 BV (Bed volume) = 1 m^3 solution per m^3 resin*

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OPERATING CAPACITY

The operating capacity of IMAC HP555 is obtained by multiplying the basic capacity value from figure 4 by the correction factors C to E from figures 5 to 7.

$$\text{Cap} = \text{Cap}_0 \times C \times D \times E$$

Fig 4 : Basic Capacity versus Nitrate to Equivalent Mineral Acidity Ratio

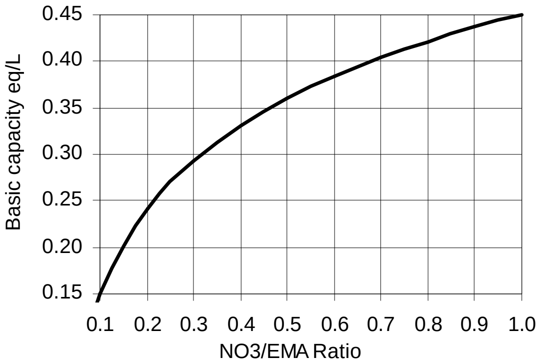


Fig 5 : Capacity Correction Factor C versus Regenerant dosage

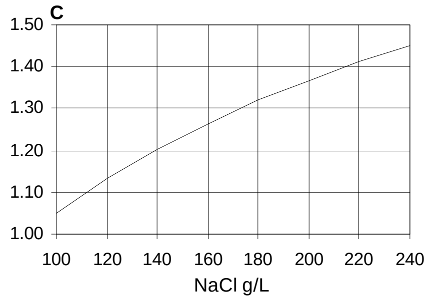


Fig 6 : Capacity Correction Factor D versus Nitrate Leakage Endpoint

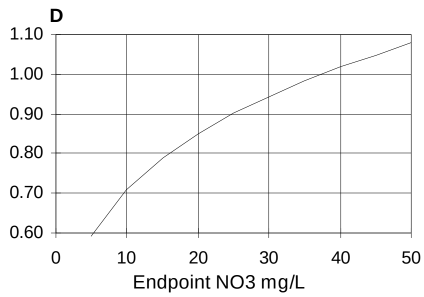
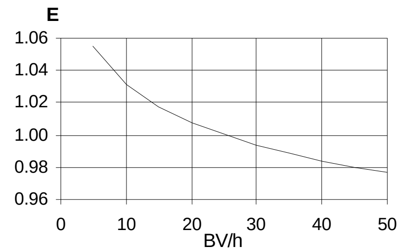


Fig 7 : Capacity Correction Factor E versus Specific Flow Rate



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IMAC® HP555

ENGINEERING DATA SHEET
(Reverse flow regeneration)

These data provide information to calculate the nitrate leakage and operating capacity of IMAC HP555 used with reverse flow regeneration.

The properties of IMAC HP555 are described in the Product Data Sheet ITS 0201 A.

NITRATE LEAKAGE

The average nitrate leakage is obtained by multiplying the basic leakage value from figure 1 by the correction factors A and B from figures 2 and 3.

$$\textbf{Leak} = \textbf{Leak}_0 \times \textbf{A} \times \textbf{B}$$

Fig 2 : Leakage Correction Factor A vs Sulphate to Total Anions Ratio

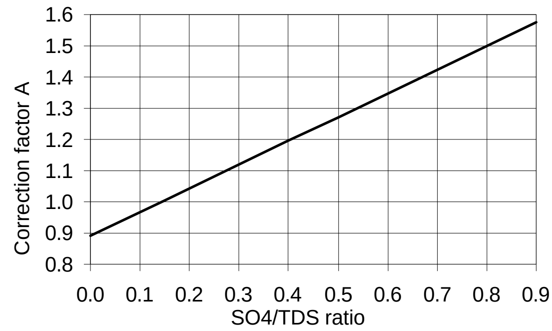

Fig 1 : Basic Nitrate Leakage vs Endpoint

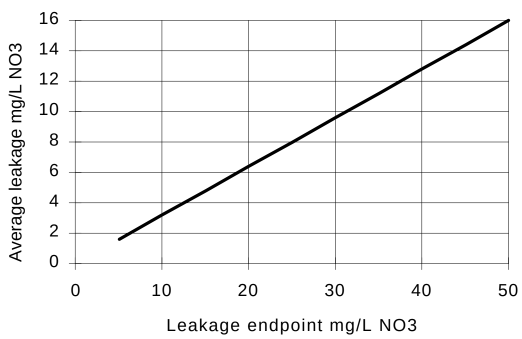

Fig 3 : Leakage Correction Factor B versus Regenerant dosage

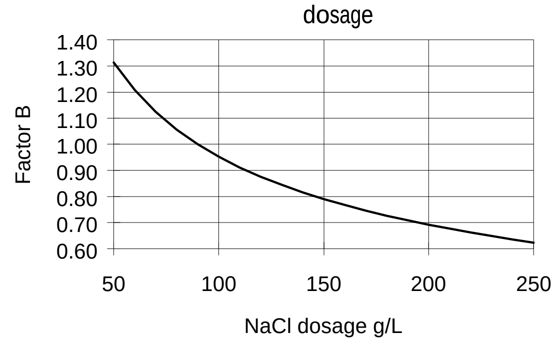

Table 1 : Suggested Operating Conditions

Maximum operating temperature	50°C
Minimum bed depth	1000 mm (preferably > 1400 mm)
Service flow rate	5 to 40 BV*/h
Maximum linear velocity	50 m/h
Regenerant	NaCl
Level	60 to 200 g/L
Flow rate	2 to 8 BV/h (minimum contact time : 30 minutes)
Concentration	6 to 10 %
Slow rinse	2 BV at regeneration flow rate
Fast rinse	2 to 10 BV at service flow rate

** 1 BV (Bed volume) = 1 m^3 solution per m^3 resin*

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OPERATING CAPACITY

The operating capacity of IMAC HP555 is obtained by multiplying the basic capacity value from figure 4 by the correction factors C to E from figures 5 to 7.

$$\mathbf{Cap = Cap_0 \times C \times D \times E}$$

Fig 4 : Basic Capacity versus Nitrate to Equivalent Mineral Acidity Ratio

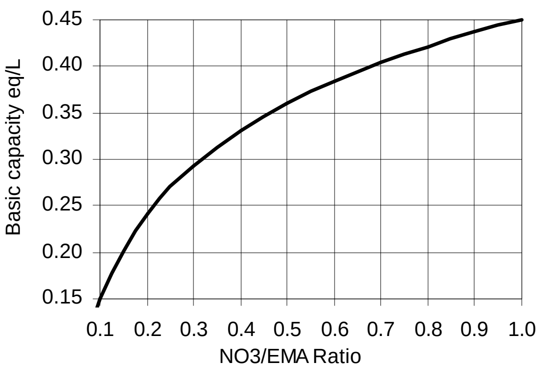


Fig 5 : Capacity Correction Factor C versus Regenerant dosage

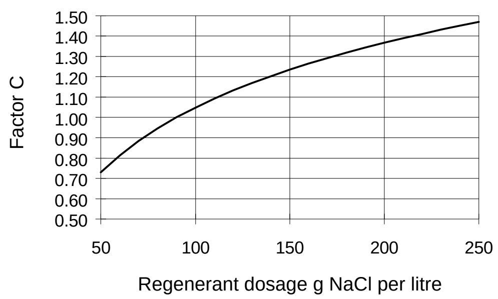


Fig 6 : Capacity Correction Factor D versus Nitrate Leakage Endpoint

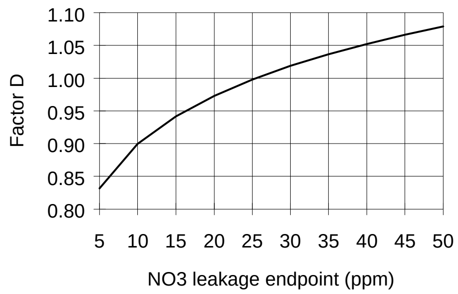
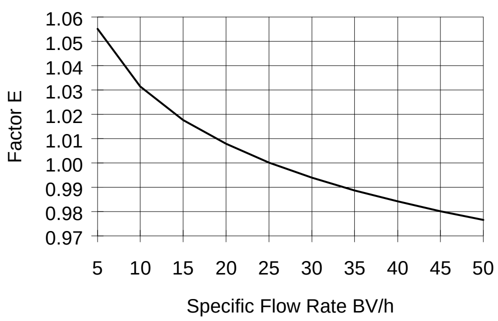


Fig 7 : Capacity Correction Factor E versus Specific Flow Rate



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