ION EXCHANGE RESINS

DUOLITE C 20 ENGINEERING DATA SHEET

(HCl, Counter- current regeneration)



Duolite C 20 is strong acid Cation Exchange Resin. These data provide information to calculate the sodium leakage and operating capacity of Duolite C 20 used with reverse flow (counter current) regeneration with hydrochloric acid.

The properties of Duolite C 20 are described in the Product Data Sheet.

SODIUM LEAKAGE

With counter current 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 mS / cm or lower can be obtained in most cases.

OPERATING CAPACITY

The operating capacity of Duolite C 20 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 versus HCIRegenerant Level (ReverseFlow Regeneration)						
HCl g/L	Capacity eq / L (Cap ₀)					
30	0.80					
40	1.03					
50	1.15					
60	1.24					
70	1.32					
80	1.39					
90	1.44					
100	1.49					

1.57

120

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

TABLE 2 : Suggested Operating Conditions

Maximum operating temperature	120°c
Minimum bed depth	1000 mm **
Service flow rate	5 to 40 BV* / hr
Maximum linear velocity	50 m / hr
Regenerant	HCl
Level	30 to 120 g/L
Flow rate	2 to 5 BV/ hr (minimum contact time 30 minutes)
Concentration	4% to 8%
Slow rinse	Minimum 2 BV at regeneration flow rate
Fast rinse	Same as service flow rate.
* 1 BV (Bed Volume) = 1 m^3 solution per m	1 ³ resin

** For selection of lower bed depth contact Auchtel representative

Influent Lim	itations	- Nil			TABLE 4 :	Capacity versus All Anions Ra	Correction kalinity to atio.	Factor B Total
					% A	lk	Fac	ctor B
				i I	0		C).94
TABLE 3	: Capacity (Correction	Factor A		25		C).97
	Versus Soc	lium to To	al Cations		50		1	.00
	ratio.				75		1	.02
%N	Na	Fac	tor A		99		1	.03
0)	0	.92	ΙĒ	TABLE 5 -	Canacity	Correction	Eactor C
10)	0	.93		TABLE 5.		sin Bod D	onth
20)	0	.94					epui
30)	0	.95		Bed Do	epth	Fac	ctor C
40)	0	.96		IIIII	L		
50)	0	.98		900		0.94	
60)	0.99			1200		0.96	
70)	1.00			1500		1	.00
80)	1.01			1800		1	04
90)	1.03			2000		1	.07
100)	1.04			2500		1	.10
TABLE 6:	: Capacity Co versus wat	orrection I er Tempe	Factor D rature		TABLE 7 :	Capacity versus Ru Time)	Correction un Length (Factor E Production
⁰ C	0	50	99% Na		Run Time		50	000/ 411-
5	0.95	0.89	0.84		(hours)	U	50	9970 AIK
10	0.95	0.05	0.94		5	0.92	0.95	0.97
15	1.00	1.00	1.00		8	0.94	0.96	0.98
20	1.00	1.03	1.04		10	0.96	0.97	0.90
25	1.03	1.05	1.08		20	0.90	0.07	1.00
>30	1.04	1.07	1.11		> 25	0.20	1.00	1.00
	1.01	1.07			> 23	0.99	1.00	1.00

SAFE USE INFORMATION

A material Safety Data Sheet is available for each product. To obtain a copy contact your Auchtel representative. Ion exchange resins and polymeric adsorbants, as produced, contain manufacturing by-products. the user must determine the extent to which these by-products must be removed for any particular use and to establish methods to ensure that the appropriate level of purity is achieved for that use. The user must ensure compliance with all prudent safety standards and regulatory requirements governing the application. Except where otherwise stated, Auchtel does recommend its ion exchange resins or polymeric adsorbants as suitable or appropriately pure for any particular use. Consult your Auchtel technical representative for further information.

CAUTION

Acidic and basic regenerant solutions are corrosive and should be handled in manner that will prevent eye and skin contact. Nitric acid and other strong oxidizing agents can cause explosive type reactions when mixed with Ion Exchange Resins.Proper design of process equipment to prevent rapid buildup of pressure is necessary if use of an oxidizing agent such as nitric acid is contemplated. Before using strong oxidizing agents in contact with Ion Exchange Resins, consult sources knowledgeable in the handling of these materials.

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Auchtel ProductsLtd.,142 C,Victor House, N.M.Joshi Marg, Lower Parel(w),Mumbai-400 013 Tel. 91-22-493 3975, Fax. 91-22-493 9755, 497 4211 E-mail - auchtel@vsnl.com C:\LABORATO\LIT`TURE.48 REV 02 / MAY 2 K DUOLITE C 20 HCL CCR

ION EXCHANGE RESINS

DUOLITE C 20

ENGINEERING DATA SHEET

 $(H_2SO_4 \text{ counter current regeneration})$



Duolite C 20 is strong acid Cation Exchange Resin. These data provide information to calculate the sodium leakage and operating capacityof Duolite C 20 used with reverse flow (counter current) regeneration with sulphuric acid.

The properties of Duolite C 20 are described in the Product Data Sheet.

SODIUM LEAKAGE

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

TABLE 1 : Average Sodium Leakage versusH2SO4 RegenerantLevel				
$H_2SO_4 g / L$	Leakage ppm Na			
40	0.12			
50	0.07			
60	0.05			
70	0.04			
80	0.03			

OPERATING CAPACITY

The operating capacity of Duolite C 20 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.

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

TABLE 2 : Basic Capacity versus H2SO4Regenerant Level					
$H_2SO_4 g/L$	Capacity eq / L (Cap ₀)				
40	0.65				
50	0.73				
60	0.79				
70	0.85				
80	0.90				
90	0.94				
100	0.98				
120	1.05				
140	1.10				
160	1.15				

TABLE 3 : Suggested Operating Conditions

Maximum operating temperature	120°C
Minimum bed depth	1000 mm **
Service flow rate	5 to 40 BV* / hr
Maximum linear velocity	50 m / hr
Regenerant	H_2SO_4
Level	40 to 160 g / L
Flow rate	2 to 10 BV/ hr (minimum contact time:30 minutes)
Concentration	0.7 to 6% according to Ca content
Slow rinse	Minmum 2 BV at regeneration flow rate
Fast rinse	Same as service flow rate.
* 1 BV (Bed Volume) = 1 m^3 solution per t ** For selection of lower bed depth contact	n ³ resin Auchtel representative

Influent LimitationsFree chlorine- Nil			TA	BLE 5: v F	Capacity versus Alk Ratio.	Correction alinity to To	Factor B otal Anions	
					% A	lk	Fac	ctor B
TABLE 4	Capacity (Versus Soc Ratio. Na	Correction I dium to Tota Fac	Factor A al Cations tor A		0 25 50 75 99		0 0 1 1 1	0.92 0.96 0.00 0.04 0.07
	0 10 20		.74 .81 .86	ТА	BLE 6 : v	Capacity (versus Res	Correction F	Factor C th.
	30 40 50	000	.91 .96		Bed De	e pth	Fac	tor C
	30 60	1.00			900		0.94	
	70 1.04 70 1.07			1200		0.96		
	80 1.07			1500		1	.00	
	90	1	13		180	00	1	.04
-	100	1	.15		200 250	00	1	.07 .10
TABLE 7	7 : Capacity (versus	Correction F water Temp	actor D perature	ТА	BLE 8 : versus	Capacity s Run Leng	Correction gth (Produc	Factor E ction Time)
⁰ C	0	50	99% Na	Ru	ın Time	0	50	99% Alk
5	0.95	0.89	0.84	(1	ours)			
10	0.98	0.96	0.94		5	0.92	0.95	0.97
15	1.00	1.00	1.00		8	0.94	0.96	0.98
20	1.02	1.03	1.04		10	0.96	0.97	0.99
25	1.03	1.05	1.08		20	0.98	0.99	1.00
>30	1.04	1.07	1.11	>	> 25	0.99	1.00	1.00

SAFE USE INFORMATION

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CAUTION

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ION EXCHANGE RESINS

DUOLITE C 20 ENGINEERING DATA SHEET

(HCI, Co - current regeneration)



Duolite C 20 is strong acid Cation Exchange Resin. These data provide information to calculate the sodium leakage and operating capacity of Duolite C 20 used with coflow regeneration with hydrochloric acid.The properties of Duolite C 20 are described in the Product Data Sheet.

Note: Na+ leakage values are expressed as a percentage of the Equivalent Mineral Acidity(EMA)Value obtained in meq/L must be converted to mg / L as Na⁺.

- Nil

Influent Limitations

120

150

Free chlorine

TABLE 1 : Basic Sodium Leakage versus HCl Regenerant Level HCl g / L Leakage % EMA (Leak₀) 50 3.9 60 3.0 70 2.5 80 2.0 100 1.5

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.

$Leak = Leak_0 \times A$

TABLE 2: Leakage Correction FactorAversus Sodium to Total Cations Ratio.				
% Na	Factor A			
10 20 30 40	0.15 0.30 0.50 0.75			
50 60 70 80 90 100	1.00 1.30 1.70 2.20 2.80 3.60			

TABLE 3 : Suggested Operating Conditions

1.2

0.9

Maximum operating temperature.	$-120^{\circ} c$
Minimum bed depth	_ 700 mm
Service flow rate	_ 5 to 40 BV* / hr
Maximum linear velocity	_ 50 m / hr
Regenerant	_ HCl
Level	_ 50 to 150 g / L
Flow rate	2 to 5 BV/ hr (minimum contact time : 30 minutes)
Concentration	_ 4% to 8%
Slow rinse	_ Minimum 2 BV at regeneration flow rate
Fast rinse	Same as service flow rate.

OPERATING CAPACITY

The operating capacity of Duolite C 20 with hydrochloric acid regeneration is obtained by multiplying basic capacity value from Table 4 by the correction Factors B to E from Tables 5 to 8.

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

					80			1.09
TABLE 4 : E	TABLE 4 : Basic Capacity versus HCI Regenerant level				90 100)		1.12 1.16
HCl g/	(00 00.10 /L	Capacity (Ca 0.	y eq / L Po) 92		TABLE 6:	Capacity (versus All Ratio.	Correction kalinity to T Fac	Factor C otal Anions
70 80 90 100 120 150		1. 1. 1. 1. 1. 1.	02 10 17 23 28 37 47		0 25 50 75 99			0.95 0.97 1.00 1.03 1.05
TABLE 7 : Temperatu	Capacity versus W	Correction ater Tempo 50	Factor D erature. 99% Na		TABLE 8:0	Capacity C versus Ru (Productio	Correction I n Length on Time)	Factor E
$ \begin{array}{c} ^{\circ}C \\ 5 \\ 10 \\ 15 \\ 20 \\ 25 \\ >30 \end{array} $	0.95 0.98 1.00 1.02 1.03 1.04	$\begin{array}{c} 0.89 \\ 0.96 \\ 1.00 \\ 1.03 \\ 1.05 \\ 1.07 \end{array}$	$\begin{array}{c} 0.84 \\ 0.94 \\ 1.00 \\ 1.04 \\ 1.08 \\ 1.11 \end{array}$		Run Time (hours) 5 8 10 20 > 25	0 0.92 0.94 0.96 0.98 0.99	50 0.95 0.96 0.97 0.99 1.00	99% All 0.97 0.98 0.99 1.00 1.00

TABLE 5 : Capacity Correction Factor B

Ratio.

% Na

0

10

20

30

40

50

60 70

versus Sodium to Total Cations

Factor B

1.00

0.98

0.97

0.98

1.00 1.02

1.03

1.05 1.09 1.12 1.16

99% Alk

SAFE USE INFORMATION

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ION EXCHANGE RESINS

DUOLITE C 20

ENGINEERING DATA SHEET $(H_2SO_4 \text{ co - current regeneration})$



Duolite C 20 is strong acid Cation Exchange Resin. These data provide information to calculate the sodium leakage and operating capacity of Duolite C 20 used with co-current regeneration with Free chlorine sulphric acid. The properties of Duolite C 20 are described in the Product Data Sheet. SODIUM LEAKAGE The average sodium leakage is obtained

by multiplying the basic leakage value from Table 1 by the correction factors A & B from Tables 2, & 3

Note: Na+ leakage values are expressed as a percentage of the Equivalent Mineral Acidity(EMA)Value obtained in meq/L must be converted to mg / L as Na^+ .

TABLE 1: Basic Sodium Leakage versusH2SO4RegenerantLevel					
$H_2SO_4 g / L$	Na⁺ 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				

$Leak = Leak_0 \times A \times B$

Influent Limitations

- Nil

 TABLE 2
 : Leakage Correction Factor
 Α versus 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	0.52
40	0.66
50	0.74
60	1.00
70	1.23
80	1.58
90	1.91

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	H_2SO_4 in stepped concentrations.
Level	60 to 240 g / L
Flow rate	2 to 10 BV/h (minimum contact time 30 minutes)
Concentration	0.7 to 6% according to Ca content
Slow rinse	Minimum 2 BV at regeneration flow rate
Fast rinse	Same as service flow rate.
* 1 BV (Bed Volume) = 1 m^3 solution pe	er m ³ resin

OPERATING CAPACITY

The operating capacity of Duolite C 20 with sulphuric acid regeneration is obtained by multiplying 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 6 : Capacity Correction Factor C versus Alkalinity to Total Anions Ratio.		
% Alk	Factor C	
0	0.92	
25	0.96	
50	1.00	
75	1.04	
99	1.07	

TABLE 5 : Basic Capacity versus H2SO4regenerant level and Sodium toTotal Cations Ratio (co-currentregeneration)

$H_2SO_4 g/L$	<u>(</u>	Capacity	eq / L	<u>(Cap₀)</u>	<u>)</u>
% 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	0.69	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 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 % N	la		80% Na
0 20 40 60 80 100	0 1.00 1.11 1.22 1.33 1.44 1.55	50 99% 1.00 1. 1.09 1. 1.18 1. 1.27 1. 1.36 1. 1.45 1.	Alk 00 07 14 21 28 35	0501.001.001.051.041.111.091.161.131.221.181.271.22	99% Alk 1.00 1.03 1.07 1.10 1.14 1.17	0 1.00 1.02 1.04 1.07 1.09 1.11	5099% Alk1.001.001.021.011.041.031.051.041.071.061.091.07
TABLE 8 :	Capacity C versus Ru	orrection Fand	actor E rod.time)	TABLE 9	: Capaci versu	ty Correct s Water Te	tion Factor F
Run time	<u>^</u>			Tomporate	Iro		
	0	50	99% Alk		ure 0	50	99% Na
(hours)	0	50	99% Alk	°C 5	0.93	50 0.86	99% Na 0.79
(hours) 5	0.92	50 0.95	99% Alk 0.97	°C 5 10	0.93 0.96	50 0.86 0.93	99% Na 0.79 0.90
(hours) 5 8	0 0.92 0.94	50 0.95 0.96	99% Alk 0.97 0.98	°C 5 10 15	0.93 0.96 0.98	50 0.86 0.93 0.97	99% Na 0.79 0.90 0.96
(hours) 5 8 10	0 0.92 0.94 0.96	50 0.95 0.96 0.97	99% Alk 0.97 0.98 0.99	^o C 5 10 15 20	0.93 0.96 0.98 1.00	50 0.86 0.93 0.97 1.00	99% Na 0.79 0.90 0.96 1.00
(hours) 5 8 10 20	0 0.92 0.94 0.96 0.98	50 0.95 0.96 0.97 0.99	99% Alk 0.97 0.98 0.99 1.00	10 15 20 25	0.93 0.96 0.98 1.00 1.01	50 0.86 0.93 0.97 1.00 1.02	99% Na 0.79 0.90 0.96 1.00 1.03

SAFE USE INFORMATION

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CAUTION

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ION EXCHANGE RESINS DUOLITE C 20 ENGINEERING DATA SHEET

(SOFTENING)



Duolite C 20 is strong acid Cation Exchange Resin. These data provide information to calculate the hardness leakage and operating capacity of Duolite C -20 used for water softening with Co-flow regeneration. The properties of Duolite C-20 are described in the Product Data Sheet.

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 & 3.

Table 1 : Basic Hardness Leakage versusNaCl Regenerant Level.			
NaCl g/L	Leakage meq/L (Leak ₀)		
50	0.099		
75	0.050		
100	0.037		
125	0.027		
150	0.015		
200	0.001		
250	0.001		

Leak = $Leak_0 \times A \times B$

TABLE 2 : Leakage Correction Factor A versus Total Dissolved Solids Concentration.		
TDS meq / L	Factor A	
< 10 15 20 30 40	1.0 1.9 3.0 5.8 9.1	

TABLE 3 : Leakage Correction Factor Bversus Sodium to Total CationsRatio.			
Na %	Factor B		
< 5 10 20 30 50 70 90	1.0 1.3 1.6 1.9 2.5 3.1 3.7		

TABLE 4 : Suggested Operating Conditions

Maximum operating temperature		$120^{\circ}c$
Minimum bed depth		700 mm
Service flow rate		5 to 40 BV */ hr
Maximum line	ar velocity	50 m / hr
Regenerant		NaCl
	Level	50 to 250 g/L
Flow rate Concentration		2 to 8 BV/ hr (minimum contact time 30 minutes)
		8% to 12%
Slow rinse		Minimum 2 BV at regeneration flow rate
Fast rinse		Same as service flow rate.

OPERATING CAPACITY

The operating capacity of Duolite C 20 in water softening is obtained by multiplying the basic capacity value from Table 5 by the correction factor C to F from Tables 6 to 9.

Cap = Cap₀ \times C \times D \times E \times F

TABLE 5 : Basic capao regenerant l regeneraion NaCl g / L	city versus NaCl evel (co-current) Capacity eq / L (Cap ₀)
50	0.70
60	0.80
80	1.01
100	1.12
120	1.22
150	1.38
200	1.52
250	1.60

TABLE 6 : Capaci versus	ty Correction Factor C Sodium Concentration
Na meq / L	Factor C
< 5	1.00
10	0.98
20	0.95
30	0.92
40	0.88

SAFE HANDLING INFORMATION

A material Safety Data Sheet, Material handling & storage sheet are available for Duolite products. To obtain a copy contact Auchtel representative Ion exchange resins and polymeric adsorbants, as produced, contain manufacturing by -products. the user must determine the extent to which these by-product must be removed for any particular use and to establish methods to ensure that the appropriate level of purity is achieved for that use. The user ensure compliance with all prudent safety standards and regulatory requirements governing the application. Except where otherwise stated, Auchtel does not recommend its ion exchange resins or polymeric adsorbants as suitable or appropriately pure for any particular use. Consult your Auchtel representative for further information.

CAUTION

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TABLE	7	: Capacity Correction Factor D
		versus Hardness Concentration

TH meq/L	Factor D
< 5 10 20 30 40	1.00 0.97 0.92 0.87 0.82

TABLE 8 : Capacity Correction Factor Eversus RegenerantConcentration.		
Na Cl %	Factor E	
8	0.95	
10	0.97	
>12	1.00	

TABLE	9 : Capacity Correction Factor F		F
		versus Flow Rate in production	n.

BV/hr	Factor F
5	1.04
10	1.02
15	1.00
20	0.99
30	0.97
40	0.96