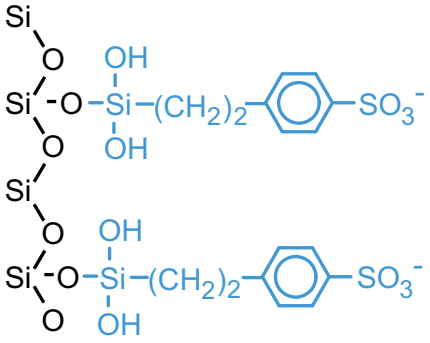
MECHANISM OF ION EXCHANGE BONDING

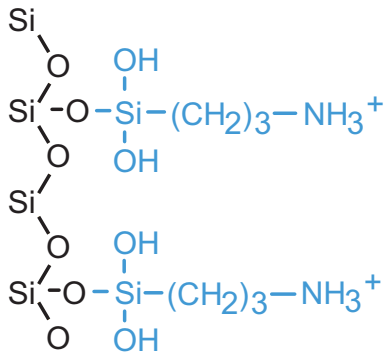
Compounds are retained on the sorbent through ionic bonds. Therefore, it is essential that the sorbent and the analyte to be extracted are charged. Generally, the number of molecules with charged cationic groups increases at pH values below the molecules pKa value. The number of molecules with charged anionic groups decreases at pH values below the molecule's pKa value. To ensure 99% or more ionization, the pH should be at least two pH units below the pKa of the cation and two pH units above the pKa of the anion. Elution occurs by using a solvent to raise the pH above the pKa of the cationic group or to lower the pH below the pKa of the anion to disrupt retention. At this point, the sorbent or compound is neutralized.

Example of a Cation Exchange Phase



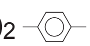
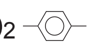
This sorbent is composed of a silica backbone bonded with carbon chains terminated by a negatively or positively charged functional group. Ion exchange interactions occur between a sorbent that carries a charge and a compound of opposite charge.

Example of a Anion Exchange Phase



This electrostatic interaction is reversible by neutralizing the sorbent and/or analyte. Ion exchange bonds can also be disrupted by the introduction of a counter ion to compete with the analyte for binding sites on the sorbent.

ION EXCHANGE SORBENTS & STRUCTURES

Sorbent	Structure	pKa
Anion Exchangers		
Aminopropyl (1° amine)	$-Si-(CH_2)_3NH_3^+$	9.8
N-2 Aminoethyl (1° & 2° amine)	$-Si-(CH_2)_3NH_2^+(CH_2)_2NH_3^+$	10.1, 10.9
Diethylamino (3° amine)	$-Si-(CH_2)_3NH^+(CH_2CH_3)_2$	10.6
Quaternary Amine Chloride	$-Si-(CH_2)_3N^+(CH_3)_3$ Cl^-	Always charged
Quaternary Amine Hydroxide	$-Si-(CH_2)3N^+(CH_3)_3$ OH	Always charged
Quaternary Amine Acetate	$-Si-(CH_2)_3N^+(CH_3)_3$ CH_3COO	Always charged
Quaternary Amine Formate	$-Si-(CH_2)_3N^+(CH_3)_3$ HCOO	Always charged
Polyimine	$-Si-(CH_2)_3-R^-$ $[NHCH_3CH_3]_x$	
Cation Exchangers		
Carboxylic Acid	$-Si-CH_2COOH$	
Propylsulfonic Acid	$-Si-(CH_2)_3SO_3H$	<1
Benzenesulfonic Acid	$-Si-(CH_2)_2$  SO_3H	Always charged
Benzenesulfonic Acid High Load	$-Si-(CH_2)_2$  SO_3H	Always charged
Triacetic Acid	$-Si-(CH_2)_3NH-(CH_2)_2N(CH_2COOH)_2$ (with CH_2COOH on NH)	

	Anion Exchange Sorbent		Cation Exchange Sorbent	
	Goal	pH	Goal	pH
WASH	To promote bonding between sorbent and analyte	> Analyte pKa or < Sorbent pKa	To promote bonding between sorbent and analyte	< Analyte pKa or > Sorbent pKa
ELUTION	To disrupt bonding between sorbent and analyte	< Analyte pKa or > Sorbent pKa	To disrupt bonding between sorbent and analyte	> Analyte pKa or < Sorbent pKa

Percent of Compound in Ionic State						
Functionality	**Ionization**	pH units away from pKa				
		2 < pKa	1 < pKa	At pKa	1 > pKa	2 > pKa
ACID	Anionic (-)	1	9	50	91	99
BASE	Cationic (+)	99	91	50	9	1

CLEAN-UP® AMINOPROPYL SORBENT

Organic Loading = 6.65%
Surface Area = 500 m^2/g
Pore Volume = 0.77 cm^3/g

Average Pore Size = 60Å
Anion Exchange = 0.28 meq/g

COLUMNS

Tube Volume (mL)	Sorbent Amount (mg)	Units per Pack	Part Number
1	50	100	CUNAX1L1
1	100	100	CUNAX111
3	200	50	CUNAX123
3	500	50	CUNAX153
6	500	50	CUNAX156
6	1000	30	CUNAX1M6
10	100	50	CUNAX11Z
10	200	50	CUNAX12Z
10	500	50	CUNAX15Z
15	2000	20	CUNAX12M15
25	5000	20	CUNAX15M25
75	10000	10	CUNAX110M75

WELL PLATES

Number of Wells	Sorbent Amount (mg)	Units per Pack	Extended Drip Tip	Part Number
48	100	1	NO	WIMNAX11
48	300	1	NO	WIMNAX13
96	50	1	NO	WSHNAX105
96	100	1	NO	WSHNAX11
96	200	1	NO	WSHNAX12
96	300	1	NO	WSHNAX13

CLEAN-UP® PRIMARY/SECONDARY AMINE SORBENT

Organic Loading = 11.1%
Surface Area = 500 m^2/g
Pore Volume = 0.77 cm^3/g

Average Pore Size = 60Å
Anion Exchange = 1.100 meq/g

COLUMNS

Tube Volume (mL)	Sorbent Amount (mg)	Units per Pack	Part Number
1	50	100	CUPSA1L1
1	100	100	CUPSA111
3	200	50	CUPSA123
3	500	50	CUPSA153
6	500	50	CUPSA156
6	1000	30	CUPSA1M6
10	100	50	CUPSA11Z
10	200	50	CUPSA12Z
15	2000	20	CUPSA12M15
75	10000	10	CUPSA110M75

WELL PLATE

Number of Wells	Sorbent Amount (mg)	Units per Pack	Extend-ed Drip Tip	Part Number
96	100	1	NO	WSHPSA11

CLEAN-UP® DIETHYLAMINO SORBENT

Organic Loading = 9.5%
Surface Area = 500 m^2/g
Pore Volume = 0.77 cm^3/g

Average Pore Size = 60Å
Anion Exchange = 0.315 meq/g

COLUMNS

Tube Volume (mL)	Sorbent Amount (mg)	Units per Pack	Part Number
1	100	100	CUDAX111
3	200	50	CUDAX123
3	500	50	CUDAX153
6	500	50	CUDAX156
6	1000	30	CUDAX1M6
10	500	50	CUDAX15Z
15	2000	20	CUDAX12M15
25	5000	20	CUDAX15M25

WELL PLATE

Number of Wells	Sorbent Amount (mg)	Units per Pack	Extended Drip Tip	Part Number
96	50	1	NO	WSHDAX105

CLEAN-UP®
QUATERNARY AMINE WITH CHLORIDE COUNTER ION SORBENT

Organic Loading = 8.40%
Surface Area = 500 m^2/g
Pore Volume = 0.77 cm^3/g

Average Pore Size = 60Å
Anion Exchange = 0.230 meq/g

COLUMNS

Tube Volume (mL)	Sorbent Amount (mg)	Units per Pack	Part Number
1	50	100	CUQAX1L1
1	100	100	CUQAX111
3	200	50	CUQAX123
3	500	50	CUQAX153
6	500	50	CUQAX156
6	1000	30	CUQAX1M6
10	100	50	CUQAX11Z
10	200	50	CUQAX12Z
15	2000	20	CUQAX12M15

WELL PLATE

Number of Wells	Sorbent Amount (mg)	Units per Pack	Extended Drip Tip	Part Number
96	100	1	YES	WSHQAX11-LD

CLEAN-UP®
QUATERNARY AMINE WITH HYDROXIDE COUNTER ION SORBENT

Organic Loading = 8.40%
Surface Area = 500 m^2/g
Pore Volume = 0.77 cm^3/g

Average Pore Size = 60Å
Anion Exchange = 0.230 meq/g

COLUMNS

Tube Volume (mL)	Sorbent Amount (mg)	Units per Pack	Part Number
1	50	100	CHQAX1L1
1	100	100	CHQAX111
3	200	50	CHQAX123
3	500	50	CHQAX153
6	500	50	CHQAX156
6	1000	30	CHQAX1M6
10	100	50	CHQAX11Z
10	200	50	CHQAX12Z
15	2000	20	CHQAX12M15

CLEAN-UP®
QUATERNARY AMINE WITH ACETATE COUNTER ION SORBENT

Organic Loading = 8.40%
Surface Area = 500 m^2/g
Pore Volume = 0.77 cm^3/g

Average Pore Size = 60Å
Anion Exchange = 0.230 meq/g

COLUMNS

Tube Volume (mL)	Sorbent Amount (mg)	Units per Pack	Part Number
1	100	100	CAQAX111
3	200	50	CAQAX123
3	500	50	CAQAX153
6	1000	30	CAQAX1M6
10	200	50	CAQAX12Z
10	500	50	CAQAX15Z
25	5000	20	CAQAX15M25

CLEAN-UP®
POLYIMINE SORBENT

Organic Loading = 14.25%
Surface Area = 500 m^2/g
Pore Volume = 0.77 cm^3/g

Average Pore Size = 60Å
Anion Exchange = 0.880 meq/g

COLUMNS

Tube Volume (mL)	Sorbent Amount (mg)	Units per Pack	Part Number
1	100	100	CUPAX111
3	200	50	CUPAX123
3	500	50	CUPAX153
6	150	50	CUPAX(150)6
6	500	50	CUPAX156
6	1000	30	CUPAX1M6

WELL PLATES

Number of Wells	Sorbent Amount (mg)	Units per Pack	Extended Drip Tip	Part Number
48	300	1	NO	WIMPAX13
96	100	1	NO	WSHPAX11
96	200	1	NO	WSHPAX12
96	300	1	NO	WSHPAX13

CLEAN-UP®
BENZENESULFONIC ACID SORBENT

Organic Loading = 10.69%
Surface Area = 500 m^2/g
Pore Volume = 0.77 cm^3/g

Average Pore Size = 60Å
Cation Exchange = 0.320 meq/g

COLUMNS			
Tube Volume (mL)	Sorbent Amount (mg)	Units per Pack	Part Number
1	50	100	CUBCX1L1
1	100	100	CUBCX111
3	200	50	CUBCX123
3	500	50	CUBCX153
6	100	50	CUBCX116
6	500	50	CUBCX156
6	1000	30	CUBCX1M6
10	100	50	CUBCX11Z
10	200	50	CUBCX12Z
10	500	50	CUBCX15Z
15	1000	30	CUBCX1M15
15	2000	30	CUBCX12M15
75	10000	10	CUBCX110M75

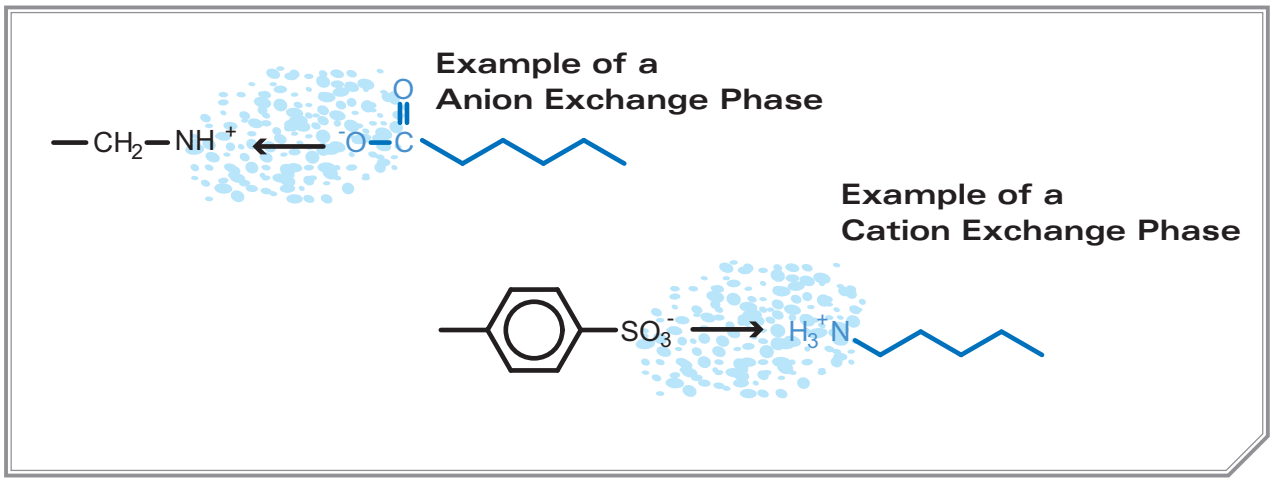
WELL PLATES				
Number of Wells	Sorbent Amount (mg)	Units per Pack	Extended Drip Tip	Part Number
48	100	1	NO	WIMBCX11
96	50	1	NO	WSHBCX105

CLEAN-UP®
BENZENESULFONIC ACID HIGH LOAD SORBENT

Organic Loading = 16.50%
Surface Area = 500 m^2/g
Pore Volume = 0.77 cm^3/g

Average Pore Size = 60Å
Cation Exchange = 0.650 meq/g

COLUMNS			
Tube Volume (mL)	Sorbent Amount (mg)	Units per Pack	Part Number
1	100	100	CUBCX1HL11
3	200	50	CUBCX1HL23
3	500	50	CUBCX1HL53
6	150	50	CUBCX1HL(150)06
6	500	50	CUBCX1HL56
6	1000	50	CUBCX1HL1M6
10	100	50	CUBCX1HL1Z
10	200	50	CUBCX1HL2Z
15	2000	20	CUBCX1HL2M15
75	10000	10	CUBCX1HL10M75



CLEAN-UP®
CARBOXYLIC ACID SORBENT

Organic Loading = 8.75%
Surface Area = 500 m^2/g
Pore Volume = 0.77 cm^3/g

Average Pore Size = 60Å
Cation Exchange = 0.043 meq/g

COLUMNS

Tube Volume (mL)	Sorbent Amount (mg)	Units per Pack	Part Number
1	50	100	CUCCX1L1
1	100	100	CUCCX111
3	200	50	CUCCX123
3	500	50	CUCCX153
6	500	50	CUCCX156
6	1000	30	CUCCX1M6
10	100	50	CUCCX11Z
10	200	50	CUCCX12Z
15	2000	20	CUCCX12M15
25	5000	20	CUCCX15M25

WELL PLATES

Number of Wells	Sorbent Amount (mg)	Units per Pack	Extended Drip Tip	Part Number
48	100	1	NO	WIMCCX11
48	300	1	NO	WIMCCX13
96	50	1	NO	WSHCCX105
96	100	1	NO	WSHCCX11
96	100	1	YES	WSHCCX11-LD

CLEAN-UP®
PROPYLSULFONIC ACID SORBENT

Organic Loading = 7.00%
Surface Area = 500 m^2/g
Pore Volume = 0.77 cm^3/g

Average Pore Size = 60Å
Cation Exchange = 0.180 meq/g

COLUMNS

Tube Volume (mL)	Sorbent Amount (mg)	Units per Pack	Part Number
1	100	100	CUPCX111
3	200	50	CUPCX123
3	500	50	CUPCX153
6	500	50	CUPCX156
6	1000	30	CUPCX1M6
10	100	50	CUPCX11Z
10	200	50	CUPCX12Z

CLEAN-UP®
TRIACETIC ACID SORBENT

Organic Loading = 7.50%
Surface Area = 500 m^2/g
Pore Volume = 0.77 cm^3/g

Average Pore Size = 60Å
Cation Exchange = 0.10 meq/g
Anion Exchange = 0.15 meq/g

COLUMNS

Tube Volume (mL)	Sorbent Amount (mg)	Units per Pack	Part Number
1	100	100	CUTAX111
3	200	50	CUTAX123
3	500	50	CUTAX153
6	300	50	CUTAX136
6	500	50	CUTAX156
6	1000	30	CUTAX1M6
10	200	50	CUTAX12Z
75	10000	10	CUTAX110M75