Column Selection (Anions and Cations)

Separation mode		Column	Page
	Inorganic anions analysis (Suppressor method: Sodium carbonate eluent)	SI-90 4E	32
		SI-35 2B	33
	Inorganic anions and organic acids analysis (Suppressor method: Sodium carbonate eluent)	SI-50 4E	32
	Inorganic anions and oxyhalides analysis (Suppressor method: Sodium carbonate eluent)	SI-52 4E	32
IC		SI-35 4D	32
	Inorganic anions analysis (Suppressor method: Potassium hydroxide eluent)	SI-36 4D	33
		SI-37 4D	33
	Inorganic anions analysis (Non-suppressor method)	NI-424	32
		I-524A	32
Ion exclusion	Cyanide ions and cyanogen chloride analysis (Post column method)	KC-811	30

Anions

IC	Simultaneous analysis of monovalent and divalent cations (Non-suppressor / Suppressor method) Analysis of alkylamines and/or transition metals	YS-50	33
	Simultaneous analysis of monovalent and divalent cations (Non-suppressor method) Analysis of ethanolamines and/or alkylamines	YK-421	33

Cations

Ion Chromatography Columns (Anion Analysis)

https://www.shodex.de/ion-chromatography

Features

NI-424 **I-524A**	● Ideal for anion non-suppressor methods ● NI-424 provides simultaneous analysis of fluoride and phosphate ions ● I-524A fulfills USP-NF L23 requirements
SI-90 4E **SI-50 4E** **SI-52 4E**	● Suitable for anion suppressor methods with sodium carbonate eluent ● Suitable for the quantitative analysis of fluoride ion ● SI-50 4E separates target inorganic anions from organic acids ● SI-52 4E provides simultaneous analysis of oxyhalides and general inorganic ions ● Carbonate peak does not interfere with analysis
SI-35	● Rapid-analysis type columns used with suppressor and sodium carbonate eluent ● SI-35 4D provides rapid analysis of oxyhalides and general inorganic ions ● SI-35 2B provides rapid analysis of general inorganic ions
SI-36 4D **SI-37 4D** New	● Suitable for anion suppressor methods with potassium hydroxide eluent ● SI-36 4D provides good separation of sulfite and sulfate ions ● SI-37 4D provides high sensitive analysis of oxyhalides in drinking water

For non-suppressor method

● Standard columns

Product Code	Product Name	Plate Number (TP/column)	Functional Group	Particle Size (μm)	Column Size (mm) I.D. x Length	Shipping Solvent
F6995243	**IC NI-424**	≥ 5,000	Quaternary ammonium	5	**4.6 x 100**	8 mM 4-Hydroxybenzoic acid + 2.8 mM Bis-Tris + 2 mM Phenylboronic acid + 0.005 mM CyDTA aq.
F6709616	**IC NI-G**	(guard column)	Quaternary ammonium	5	**4.6 x 10**	8 mM 4-Hydroxybenzoic acid + 2.8 mM Bis-Tris + 2 mM Phenylboronic acid + 0.005 mM CyDTA aq.
F6995240	**IC I-524A**	≥ 2,000	Quaternary ammonium	12	**4.6 x 100**	2.5 mM Phthalic acid + 2.4 mM Tris(hydroxymethyl) aminomethane + 16.2 mM Boric acid aq.
F6700400	**IC IA-G**	(guard column)	Quaternary ammonium	12	**4.6 x 10**	2.5 mM Phthalic acid + 2.4 mM Tris(hydroxymethyl) aminomethane + 16.2 mM Boric acid aq.

Base Material: Polyhydroxymethacrylate
Housing Material: SUS

For suppressor method (Sodium carbonate eluent)

● Standard columns

Product Code	Product Name	Plate Number (TP/column)	Functional Group	Particle Size (μm)	Column Size (mm) I.D. x Length	Shipping Solvent
F6995244	**IC SI-90 4E**	≥ 5,000	Quaternary ammonium	9	**4.0 x 250**	1.8 mM Na_2CO_3 + 1.7 mM $NaHCO_3$ aq.
F6709620	**IC SI-90G**	(guard column)	Quaternary ammonium	9	**4.6 x 10**	1.8 mM Na_2CO_3 + 1.7 mM $NaHCO_3$ aq.
F6995245	**IC SI-50 4E**	≥ 10,000	Quaternary ammonium	5	**4.0 x 250**	3.2 mM Na_2CO_3 + 1.0 mM $NaHCO_3$ aq.
F6709625	**IC SI-50G**	(guard column)	Quaternary ammonium	5	**4.6 x 10**	3.2 mM Na_2CO_3 + 1.0 mM $NaHCO_3$ aq.

Base Material: Polyvinyl alcohol
Housing Material: PEEK

<For oxyhalides analysis>

Product Code	Product Name	Plate Number (TP/column)	Functional Group	Particle Size (μm)	Column Size (mm) I.D. x Length	Shipping Solvent
F6995260	**IC SI-52 4E**	≥ 14,000	Quaternary ammonium	5	**4.0 x 250**	3.6 mM Na_2CO_3 aq.
F6709626	**IC SI-92G**	(guard column)	Quaternary ammonium	5	**4.6 x 10**	3.6 mM Na_2CO_3 aq.

Base Material: Polyvinyl alcohol
Housing Material: PEEK

<For oxyhalides rapid analysis>

Product Code	Product Name	Plate Number (TP/column)	Functional Group	Particle Size (μm)	Column Size (mm) I.D. x Length	Shipping Solvent
F6995290	**IC SI-35 4D**	≥ 13,000	Quaternary ammonium	3.5	**4.0 x 150**	3.6 mM Na_2CO_3 aq.
F6709627	**IC SI-95G**	(guard column)	Quaternary ammonium	9	**4.6 x 10**	3.6 mM Na_2CO_3 aq.

Base Material: Polyvinyl alcohol
Housing Material: PEEK

● **Semi-micro column**

<For rapid analysis>

Product Code	Product Name	Plate Number (TP/column)	Functional Group	Particle Size (μm)	Column Size (mm) I.D. x Length	Shipping Solvent
F6995291	IC SI-35 2B	≥ 4,000	Quaternary ammonium	3.5	2.0 x 50	1.0 mM Na_2CO_3 + 2.0 mM $NaHCO_3$ aq.

Base Material: Polyvinyl alcohol
Housing Material: PEEK

● **Guard filter for IC SI-35 2B**

Product Code	Product Name	Contents
F6709720	IC SI-2GF	One holder and one filter
F6709730	IC SI-2GF filter	3 filters

Removes sample-origin insoluble components.
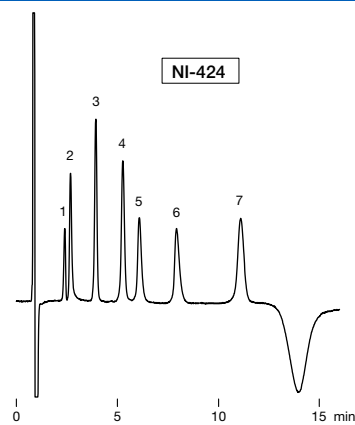
For anion suppressor method (Potassium hydroxide eluent)
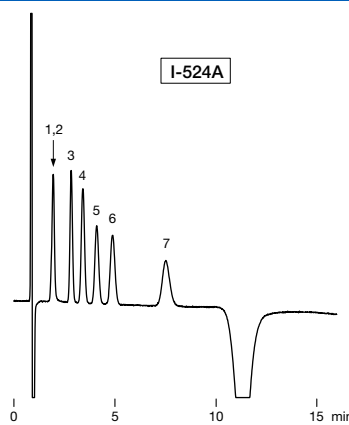
● **Standard columns**

Product Code	Product Name	Plate Number (TP/column)	Functional Group	Particle Size (μm)	Column Size (mm) I.D. x Length	Shipping Solvent
F6999361	IC SI-36 4D	≥ 8,500	Quaternary ammonium	3.5	4.0 x 150	10 mM Na_2SO_4 aq.
F6999371	IC SI-37 4D **New**	≥ 14,000	Quaternary ammonium	3.5	4.0 x 150	10 mM Na_2SO_4 aq.
F6709620	IC SI-90G	(guard column)	Quaternary ammonium	9	4.6 x 10	1.8 mM Na_2CO_3 + 1.7 mM $NaHCO_3$ aq.

Base Material: Polyvinyl alcohol
Housing Material: PEEK

Ion Chromatography Columns (Cation Analysis)

Features

YS-50
- High performance type of YK-421
- Applicable to both suppressor and non-suppressor methods
- Provides sharp peaks; more significant for divalent cation analysis
- Supports the analysis of alkylamines and transition metals
- Fulfills USP-NF L125 requirements

YK-421
- Column for cation analysis with non-suppressor method
- Simultaneous analysis of monovalent and divalent cations
- Suitable separating of alkylamines
- Fulfills USP-NF L76 requirements

For non-suppressor method/suppressor method

● **Standard columns**

Product Code	Product Name	Plate Number (TP/column)	Functional Group	Particle Size (μm)	Column Size (mm) I.D. x Length	Shipping Solvent
F7122000	IC YS-50	≥ 5,500	Carboxyl	5	4.6 x 125	10 mM Na_2SO_4 aq.
F6700530	IC YS-G	(guard column)	Carboxyl	5	4.6 x 10	10 mM Na_2SO_4 aq.

Base Material: Polyvinyl alcohol
Housing Material: SUS

For non-suppressor method

● **Standard columns**

Product Code	Product Name	Plate Number (TP/column)	Functional Group	Particle Size (μm)	Column Size (mm) I.D. x Length	Shipping Solvent
F7120012	IC YK-421	≥ 2,800	Carboxyl	5	4.6 x 125	5 mM Tartaric acid + 1 mM Dipicolinic acid + 24 mM Boric acid aq.
F6709608	IC YK-G	(guard column)	Carboxyl	5	4.6 x 10	5 mM Tartaric acid + 1 mM Dipicolinic acid + 24 mM Boric acid aq.

Base Material: Silica
Housing Material: SUS

Anion analysis using NI-424 and I-524A (non-suppressor methods)

NI-424

Sample : 20 μL
1. $H_2PO_4^-$ 10 mg/L
2. F^- 1 mg/L
3. Cl^- 1 mg/L
4. NO_2^- 5 mg/L
5. Br^- 5 mg/L
6. NO_3^- 5 mg/L
7. SO_4^{2-} 5 mg/L

I-524A

With twice increased theoretical plate number, NI-424 provides a higher performance compared to I-524A.

<Features of NI-424>
(1) Enables the separation of $H_2PO_4^-$ and F^- which were difficult to separate with I-524A.
(2) Provides sharper peaks, and resolution between all peaks are well defined. Especially, the separation of Cl^- and NO_2^- is improved.

Column	: Shodex IC NI-424
Eluent	: 8 mM 4-Hydroxybenzoic acid + 2.8 mM Bis-Tris + 2 mM Phenylboronic acid + 0.005 mM *CyDTA aq.
Flow rate	: 1.0 mL/min
Detector	: Non-suppressed conductivity
Column temp.	: 40 ℃

*CyDTA : trans-1,2-Diaminocyclohexane-N,N,N',N'-tetra acetic acid

Column	: Shodex IC I-524A
Eluent	: 2.5 mM Phthalic acid + 2.3 mM Tris(hydroxymethyl)aminomethane aq.
Flow rate	: 1.2 mL/min
Detector	: Non-suppressed conductivity
Column temp.	: 40 ℃

Anion analysis using SI-90 4E (suppressor method)

Sample : 20 μL
1. F^- 2 mg/L
2. Cl^- 3 mg/L
3. NO_2^- 5 mg/L
4. Br^- 10 mg/L
5. NO_3^- 10 mg/L
6. HCO_3^- 300 mg/L
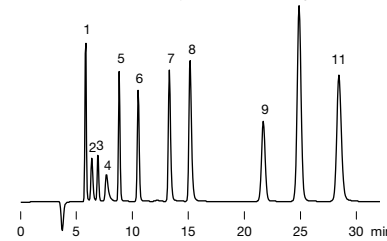7. HPO_4^{2-} 15 mg/L
8. SO_4^{2-} 15 mg/L

Column	: Shodex IC SI-90 4E
Eluent	: 1.8 mM Na_2CO_3 + 1.7 mM $NaHCO_3$ aq.
Flow rate	: 1.5 mL/min
Detector	: Suppressed conductivity
Column temp.	: Room temp. (25 ℃)

Anion analysis using SI-50 4E (suppressor method)

SI-50 4E is a high performance type of SI-90 4E. Acetic acid, formic acid, and methacrylic acid elute between F^- and Cl^-.
The carbonate system peak appears between NO_2^- and Br^- peaks.

Sample : 20 μL
1. F^- 2 mg/L
2. Acetic acid 10 mg/L
3. Formic acid 2 mg/L
4. Methacrylic acid 10 mg/L
5. Cl^- 3 mg/L
6. NO_2^- 5 mg/L
7. Br^- 10 mg/L
8. NO_3^- 10 mg/L
9. HPO_4^{2-} 15 mg/L
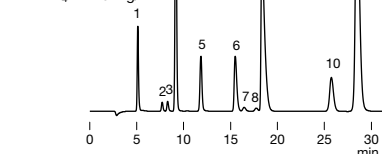10. SO_4^{2-} 15 mg/L
11. Oxalic acid 15 mg/L

Column	: Shodex IC SI-50 4E
Eluent	: 3.2 mM Na_2CO_3 + 1.0 mM $NaHCO_3$ aq.
Flow rate	: 0.7 mL/min
Detector	: Suppressed conductivity
Column temp.	: 25 ℃

Oxyhalides and anions analysis using SI-52 4E (suppressor method)

SI-52 4E is a high resolution column offering 14,000 or higher theoretical plate number. It supports simultaneous analysis of oxyhalides and inorganic anions. It is recommended to set the column temperature at 45 ℃.
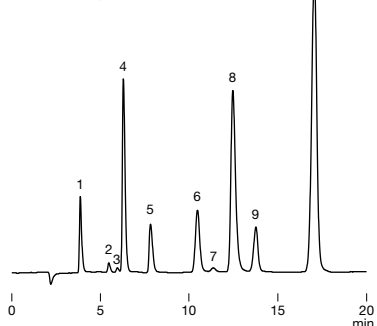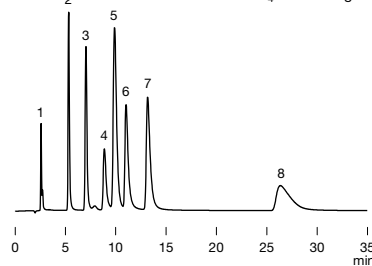
Sample : 50 μL
1. F^- 2 mg/L
2. ClO_2^- 1 mg/L
3. BrO_3^- 1 mg/L
4. Cl^- 10 mg/L
5. NO_2^- 5 mg/L
6. Br^- 10 mg/L
7. ClO_3^- 1 mg/L
8. Dichloroacetic acid 1 mg/L
9. NO_3^- 30 mg/L
10. HPO_4^{2-} 15 mg/L
11. SO_4^{2-} 40 mg/L

Column	: Shodex IC SI-52 4E
Eluent	: 3.6 mM Na_2CO_3 aq.
Flow rate	: 0.8 mL/min
Detector	: Suppressed conductivity
Column temp.	: 45 ℃

Rapid analysis of oxyhalides and anions using SI-35 4D (suppressor method)

Sample : 20 μL
1. F^- 2 mg/L
2. ClO_2^- 1 mg/L
3. BrO_3^- 1 mg/L
4. Cl^- 10 mg/L
5. NO_2^- 5 mg/L
6. Br^- 10 mg/L
7. ClO_3^- 1 mg/L
8. NO_3^- 30 mg/L
9. HPO_4^{2-} 15 mg/L
10. SO_4^{2-} 40 mg/L

Column	: Shodex IC SI-35 4D
Eluent	: 2.0 mM Na_2CO_3 + 4.5 mM $NaHCO_3$ aq.
Flow rate	: 0.6 mL/min
Detector	: Suppressed conductivity
Column temp.	: 45 ℃

Anions and sulfite ion analysis using SI-36 4D (suppressor method)

Sample : 25 μL
1. F^- 0.5 mg/L
2. Cl^- 3 mg/L
3. NO_2^- 5 mg/L
4. SO_3^{2-} 5 mg/L
5. SO_4^{2-} 10 mg/L
6. Br^- 10 mg/L
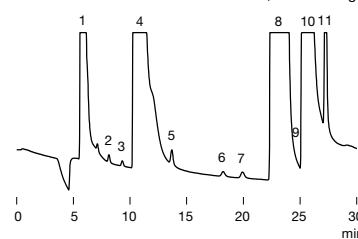7. NO_3^- 10 mg/L
8. PO_4^{3-} 15 mg/L

Column	: Shodex IC SI-36 4D
Eluent	: 25 mM KOH aq.
Flow rate	: 0.7 mL/min
Detector	: Suppressed conductivity
Column temp.	: 30 ℃

Eluent source : Dionex EGC 500 KOH

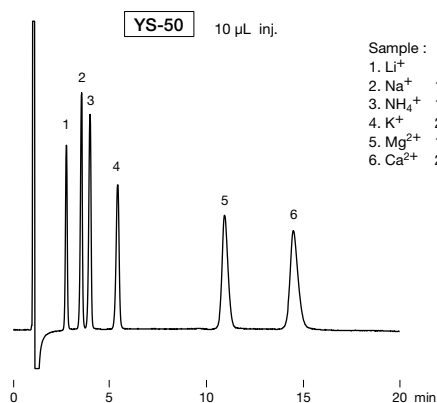## Analysis of Oxyhalides in Artificial-Drinking Water According to EPA Method 300.1 (suppressor method)

Sample : 200 μL
(simulated drinking water)
1. F^- 1 mg/L
2. ClO_2^- 5 μg/L
3. BrO_3^- 5 μg/L
4. Cl^- 50 mg/L
5. NO_2^- 5 mg/L
6. ClO_3^- 5 μg/L
7. Br^- 5 μg/L
8. NO_3^- 10 mg/L
9. CO_3^{2-} 25 mg/L
10. SO_4^{2-} 50 mg/L
11. PO_4^{3-} 0.2 mg/L

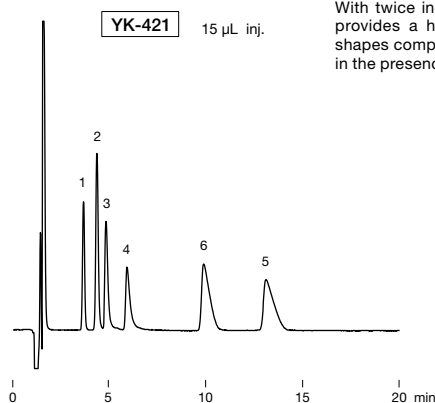|	
Column	: Shodex IC SI-37 4D
Eluent	: (Gradient) KOH aq. 10 mM (0 to 21 min), 45 mM (21.01 to 40 min)
Flow rate	: 0.5 mL/min
Detector	: Suppressed conductivity
Column temp.	: 30 ℃

Eluent source : Dionex EGC 500 KOH

Cation analysis using YS-50 and YK-421

YS-50 10 µL inj.   **YK-421** 15 µL inj.

Sample :
1. Li$^+$ 2 mg/L
2. Na$^+$ 10 mg/L
3. NH$_4^+$ 10 mg/L
4. K$^+$ 20 mg/L
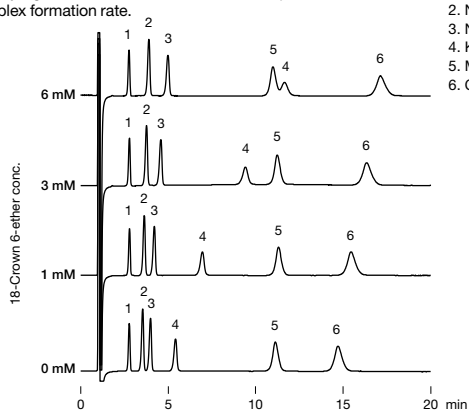5. Mg^{2+} 10 mg/L
6. Ca^{2+} 20 mg/L

With twice increased theoretical plate number, YS-50 provides a higher performance with improved peak shapes compared to YK-421. The quantitation of NH$_4^+$ in the presence of high Na$^+$ content is also improved.

TP	YS-50	YK-421
Mg^{2+}	6,900	3,000
Ca^{2+}	6,600	3,000

Resolution (Na$^+$ / NH$_4^+$)	YS-50	YK-421
	2.5	2.1

Column : Shodex IC YS-50
Eluent : 4 mM Methanesulfonic acid aq.
Flow rate : 1.0 mL/min
Detector : Non-suppressed conductivity
Column temp. : 40 ℃

Column : Shodex IC YK-421
Eluent : 5 mM Tartaric acid + 1 mM Dipicolinic acid + 24 mM Boric acid aq.
Flow rate : 1.0 mL/min
Detector : Non-suppressed conductivity
Column temp. : 40 ℃
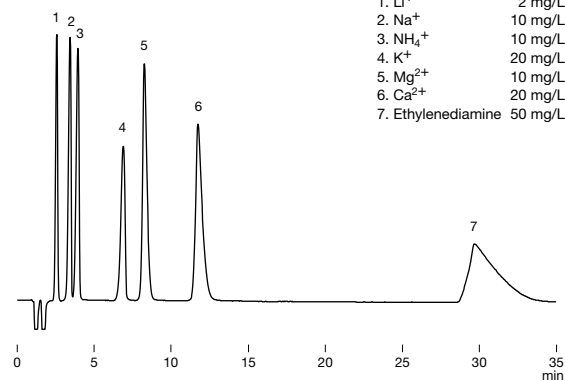
Effects of added crown ether in the eluent

The elution of cations (particularly K$^+$) can be well controlled by modifying the eluent concentration, as it provides different complex formation rate.

Sample : 10 µL
1. Li$^+$ 2 mg/L
2. Na$^+$ 10 mg/L
3. NH$_4^+$ 10 mg/L
4. K$^+$ 20 mg/L
5. Mg^{2+} 10 mg/L
6. Ca^{2+} 20 mg/L

18-Crown 6-ether conc.: 6 mM, 3 mM, 1 mM, 0 mM

Column : Shodex IC YS-50
Eluent : 4 mM Methanesulfonic acid + 18-Crown 6-ether aq.
Flow rate : 1.0 mL/min
Detector : Non-suppressed conductivity
Column temp. : 40 ℃

Simultaneous analysis of cations and ethylenediamine

Sample : 50 µL
1. Li$^+$ 2 mg/L
2. Na$^+$ 10 mg/L
3. NH$_4^+$ 10 mg/L
4. K$^+$ 20 mg/L
5. Mg^{2+} 10 mg/L
6. Ca^{2+} 20 mg/L
7. Ethylenediamine 50 mg/L

Column : Shodex IC YS-50
Eluent : 4 mM Nitric acid + 1.5 mM 18-Crown 6-ether aq. /CH$_3$CN = 90/10
Flow rate : 1.0 mL/min
Detector : Non-suppressed conductivity
Column temp. : 40 ℃

Amino alcohols

Sample : 20 µL
1. Monoethanolamine   10 µg/mL
2. Diethanolamine   20 µg/mL
3. N-Methylethanolamine   20 µg/mL
4. Triethanolamine   30 µg/mL
5. N-Methyldiethanolamine   30 µg/mL
6. N,N-Diethylethanolamine   30 µg/mL
7. N-(2-Aminoethyl)ethanolamine 30 µg/mL
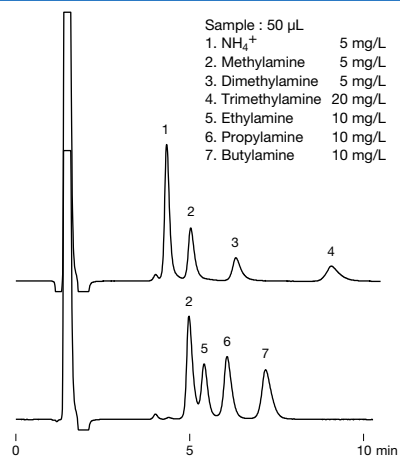
Column : Shodex IC YK-421
Eluent : 4 mM Nitric acid aq.
Flow rate : 1.0 mL/min
Detector : Non-suppressed conductivity
Column temp. : 40 ℃

Alkylamines

Sample : 50 µL
1. NH$_4^+$ 5 mg/L
2. Methylamine   5 mg/L
3. Dimethylamine   5 mg/L
4. Trimethylamine   20 mg/L
5. Ethylamine   10 mg/L
6. Propylamine   10 mg/L
7. Butylamine   10 mg/L

Column : Shodex IC YK-421
Eluent : 4 mM H$_3$PO$_4$ aq./CH$_3$CN = 90/10
Flow rate : 1.0 mL/min
Detector : Non-suppressed conductivity
Column temp. : 25 ℃