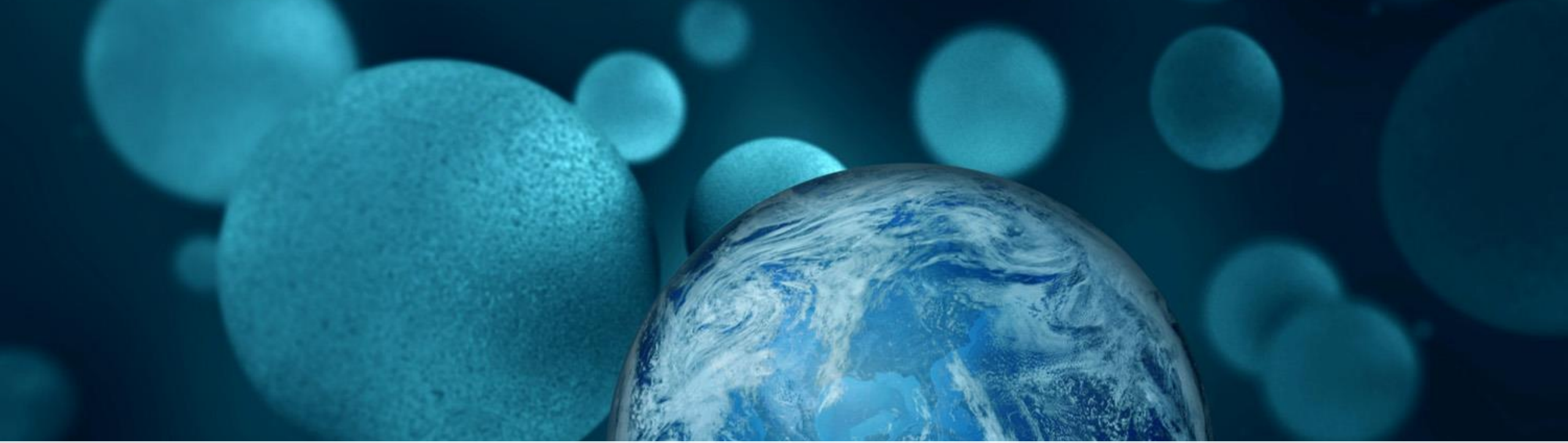

ThermoFisher SCIENTIFIC

Ion Chromatography products and applications for environmental and food safety laboratories

Roman Repas
Technical Sales Manager IC/SP, Emerging Markets
Thermo Fisher Scientific GmbH Dreieich, Germany

Agenda

Overview of IC/SP portfolio

IC systems

IC applications for environmental and food safety laboratories

2018 IC/SP Portfolio

ISQ EC MS

ASE 350

Autotrace 280

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Ion Chromatography Systems

RFIC

HPIC

Dionex Aquion

Dionex Integrion

Dionex ICS-4000

Dionex ICS-6000

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Dionex Aquion IC

- reliable IC system with straightforward operation
- for IC users in budget limited labs
- built on a compact platform
- low operating costs

Dionex Integrion HPIC

- for routine users who run an established method
- efficient IC analyses with comprehensive applications solutions
- interactive wellness features

Dionex ICS-4000 Capillary HPIC

- for high throughput labs
- reduce cost of system operation
- producing less waste

Dionex ICS-6000 HPIC

- for IC users in routine and research
- flexible, robust system
- ultimate in productivity
- modular IC configurable as a single or dual channel system
- interactive wellness
  troubleshooting knowledgebase
  consumables installation guidelines
- smart monitoring

Introducing the ICS-6000 HPIC System: What's New?

Accelerate Your Productivity

- Single or dual channel configurations
- HPIC capable up to 5000 psi
- Automated Eluent Generation (RFIC-EG)
- Always ready system operation with Capillary IC
- Tablet control of the IC system NEW
- IC Peek Viper Fittings NEW
- Consumables Device Monitor NEW

Explore the Possibilities

- Standard bore, microbore, and capillary formats
- Flexible detector options

IC – MS Enabled

Compatible with Thermo Scientific ISQ EC single quadrupole, triple quadrupole, and high-resolution accurate-mass (HRAM) Thermo Scientific™ Orbitrap™ mass analyzer mass spectrometers

Solve Complex Analysis Challenges

- 2-D ion chromatography for trace-level analysis
- Improved method reproducibility for complex carbohydrate analysis using Dual EGC control

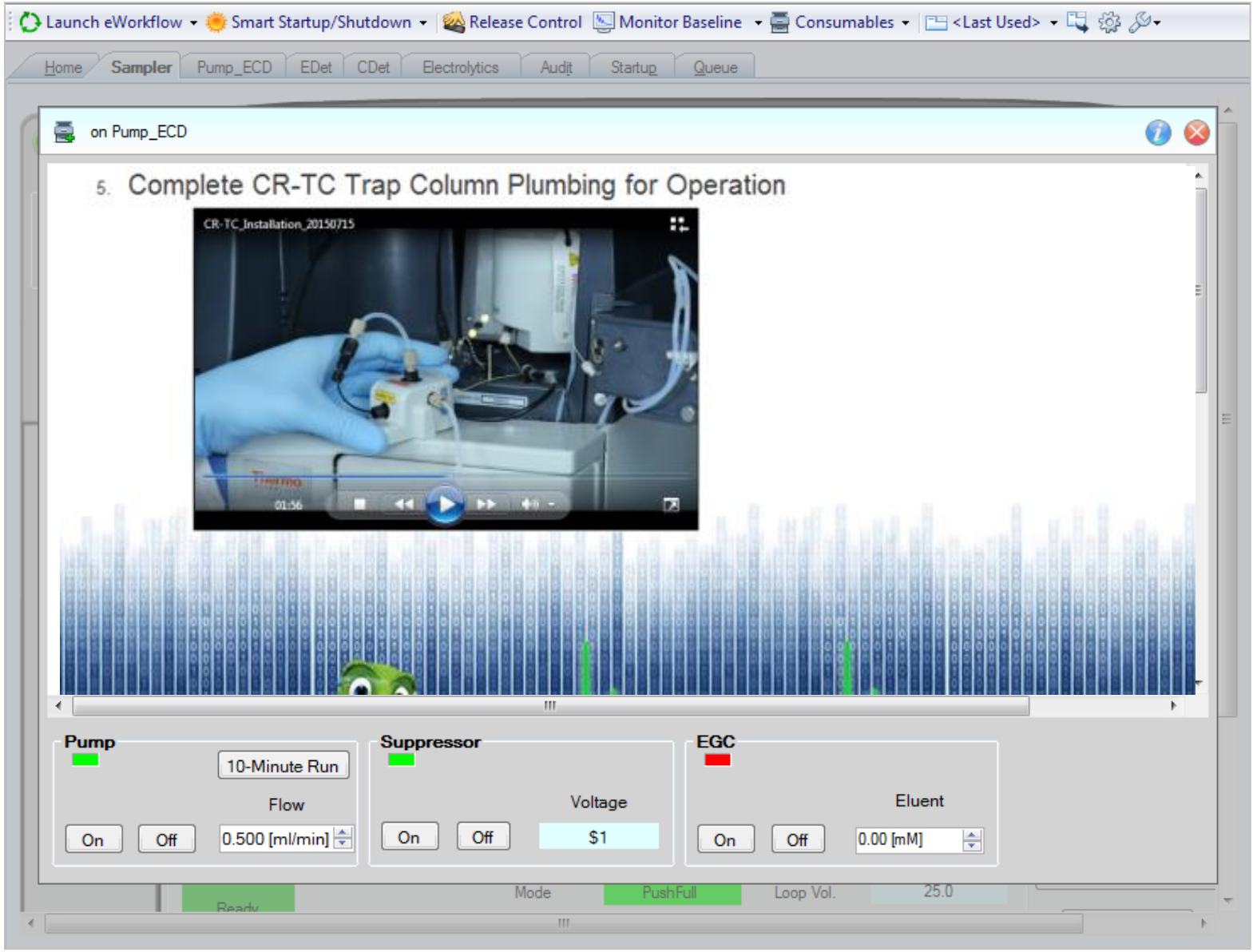
ICS-6000: Values and Advantages

Feature	Benefit	Value
Modularity	Upgradability and flexibility	Capital savings
Dual channel configuration	Run two systems in parallel with one autosampler	Capital and space savings
Proportioned Gradients (Mechanical Gradient)	Run complex gradient profiles with multiple eluent types	Labor and operational cost savings and expand capabilities
2-D Ion Chromatography	Detect low concentration analytes in complex matrices	Labor and operational cost savings and expand capabilities
Capillary IC Capability	Always ready system operation, less eluent,	Labor and operational cost savings and expand capabilities
Oligosaccharide analysis	Convenience	Labor and capital savings, expand lab capabilities
IC-MS Capabilities with One Solution Provider	Integrated support for better results	End-user confidence and improved ease-of-use

Positioning the New Features

Feature	Benefit	Value
Tablet Interface	Direct local control of system for setup, maintenance, troubleshooting, and routine monitoring.	Improved ease-of-use and convenience
Consumables Device Monitor	Track up to 16 key performance metrics on up to 25 different consumables	Automatic compliance, seamlessly manage consumables budget and increase system uptime
IC PEEK Viper Fittings	Quick and worry-free connections	Improved performance with consistent low dead-volume connections
Improved EGC Control	Quicker start-up times	Improved productivity

Consumables Installation Guides



Data Dashboard: RFID Consumable

Integrion Consumable Usage Report

Instrument Serial Number:	**123456789**
Time Range duration in Days:	**272**
Start Date:	**01-Oct-16**
End Date:	**30-Jun-17**

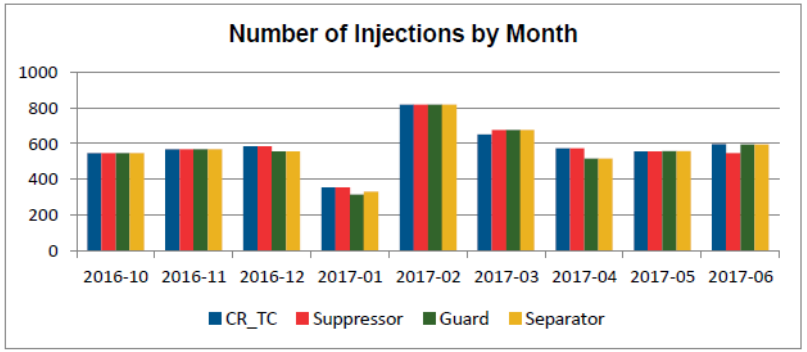
CRTC	*Last 272 days*	*Jun-17*
Total Number of Injections	5187	586
Total Eluent Volume Used (L):	96	9
Number of Different Column	2	1

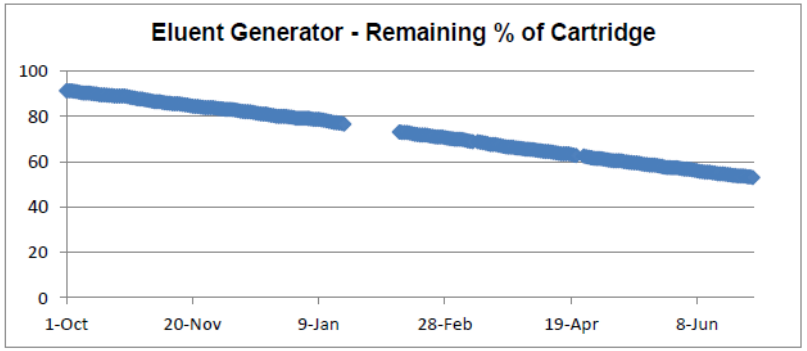
Eluent Generator	*Last 272 days*	*Jun-17*
Consumption Pace (in Days)	715	702
Consumption Pace (in Samples)	13502	14196
Number of different Generator	1	1

Suppressor	*Last 272 days*	*Jun-17*
Total Number of Injections	5162	535
Total Eluent Volume Used (L):	92	8
Number of Different Suppressor	1	1

Guard	Last 272 days	Jun-17
Total Number of Injections	5090	583
Total Eluent Volume Used (L):	92	9
Number of Different Guard	3	1

Separator	*Last 272 days*	*Jun-17*
Total Number of Injections	5099	583
Total Eluent Volume Used (L):	93	9
Number of DIfferent Separator	3	1





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Dionex ICS - 6000 IC System Detectors

Conductivity

Detection of anions and cations with suppressed conductivity detection

ICP-MS

Elemental speciation coupled with high sensitivity

Spectrophotometric

Selective determination of UV and visible absorbing compounds that allows post-column and pre-column derivatization techniques

Electrochemical

Selective and sensitive detection of electroactive compounds

Mass Spectrometry

Determine ionic and polar compounds that other techniques just can't match

ThermoFisher SCIENTIFIC

ISQ EC Mass Spectrometer – Single Quadrupole MS for IC and LC

Proven, reliable and robust

Robust, fixed source for maximum uptime and minimum cleaning

Best solution for routine IC-MS analysis, w/o solvent makeup

Fully integrated in Thermo Scientific™ Chromeleon™ 7 CDS and new Open Access UI

Best entry-level single quad MS for small molecules

Launched at **HPLC 2017**

Dionex IC Autosamplers

Thermo Scientific Dionex **AS-DV Autosampler**

Entry Level

- Carousel Type
- 50 x 5 mL PolyVials
- 50 x 0.5 mL PolyVials
- Filter Caps
- Full Loop, Concentrator
- Simultaneous Injection
- Optional 6-port/10-port Valve

Thermo Scientific Dionex **AS-HV Autosampler**

High Volume

- X0Z-Type
- 24 x 250 mL TCF
- 15 x 250 mL Bottles
- Full Loop Injection, Concentrator Loading
- Simultaneous Injection
- Peristaltic Pump for sample loading and Needle Port Rinse

Thermo Scientific Dionex **AS-AP Autosampler**

For IC, BioIC, and Cap IC

- Carousel-Type
- 81 x 10 mL Vials
- 120 x 1.5 mL or 0.3 mL Vials
- 3 x 96 Well Plates
- 3 x 384 Well Plates
- Full/Partial Loop, Limited Sample, Concentrator Loading
- Push and Pull Loop injection
- Tray Thermostat
- Optional Injection Valve
- Optional Diverter Valve
- Optional Fractionation valve
- Sequential Injection
- Simultaneous Injection
- Autodilution

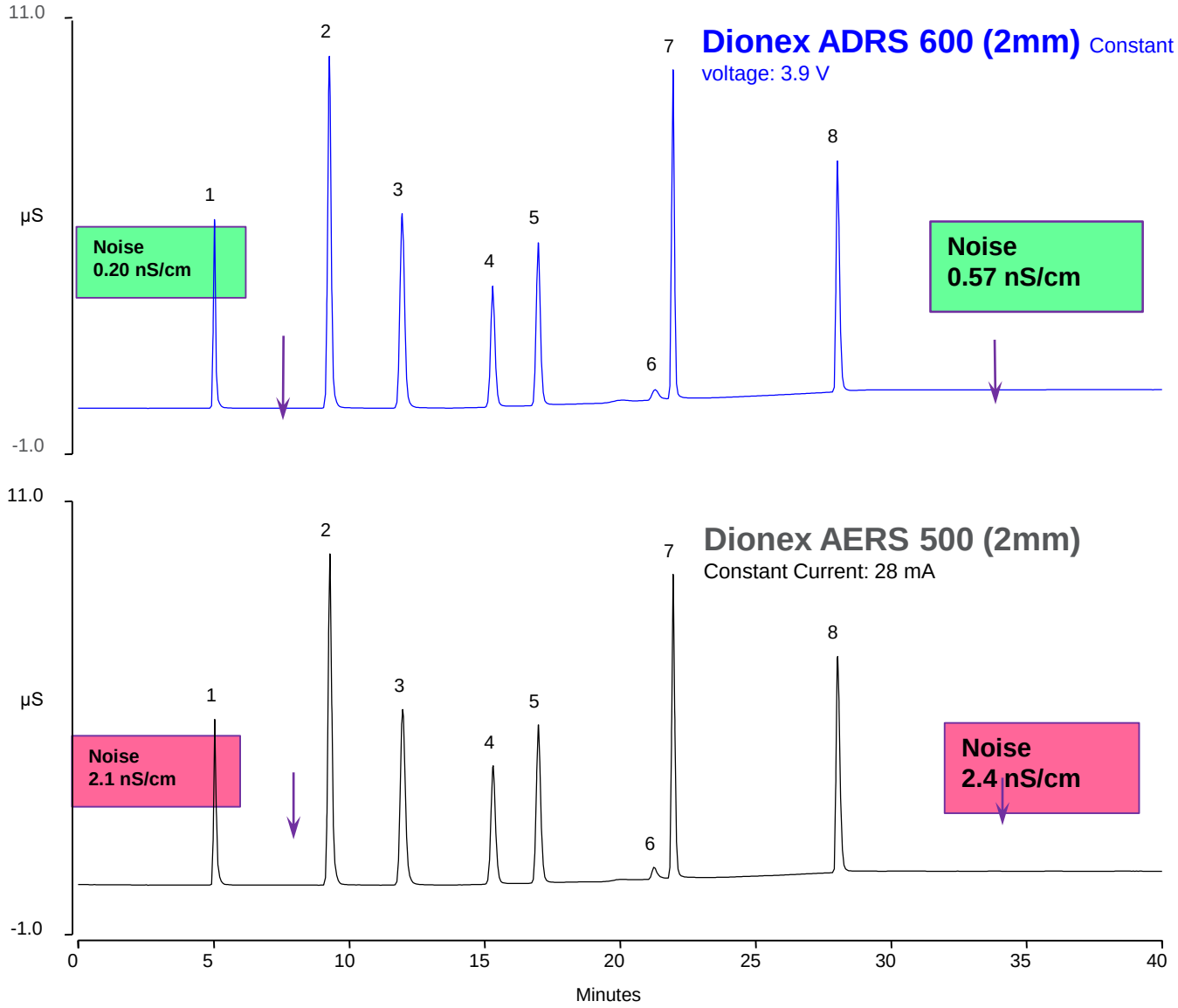
Comparing Dionex Ion Chromatography Systems

Feature	Value	Aquion	Integrion	ICS-4000	ICS-6000
High Performance Pump	Consistent, accurate results	✓	✓	✓	✓
Electrolytically Regenerated Suppressor	Saves time and money	✓	✓	✓	✓
Sample Preparation	Labor, operational, and capital savings	✓	✓	✓	✓
Eluent Generation – just add water	Increased throughput, operational savings		✓	✓	✓
Gradient Separations	Saves time and labor		✓	✓	✓
Integrated Electrochemical Cell	Capital savings, expand lab capabilities		✓	✓	✓
High Pressure IC up to 5000 psi	Increased throughput, Expanded capabilities		✓	✓	✓
Consumables Device Monitor	Maximize instrument uptime		✓		✓
Unity Remote Services	Maximize instrument uptime		✓		✓
Tablet control of system	Increased convenience		✓		✓
IC PEEK Viper Fittings	Consistent, accurate results		✓	✓	✓
Capillary IC Capability	Increased throughput, operational savings			✓	✓
Modularity	Capital savings				✓
Configurable as Independent Dual System	Capital savings				✓
Proportioned Mechanical Gradients	Expanded capabilities				✓
2-D Chromatography	Expanded capabilities				

Dionex DRS 600 Suppressor

- **Two Operational Modes**
  - Dynamic Mode (Constant Voltage)
  - Legacy Mode (Constant Current)
- **One-wire chip enabled**
  - Dionex Integrion and Dionex ICS-6000 systems will read the type of suppressor and other key parameters from the one-wire memory
- **Compatible across a wide range of applications**
  - The Dionex ADRS 600 Anion Dynamically Regenerated Suppressor allows external water mode operation and enables analyses requiring IC coupled with mass spectrometry (MS)

Dionex IonPac AS19-4µm Gradient Test: Dionex ADRS 600 vs. Dionex AERS 500 2mm



Column:	Dionex IonPac AS19-4µm, 2mm
Eluent:	10 mM KOH from 0-10 minutes 10-45 mM KOH from 10-25 minutes 45 mM KOH from 25-40 minutes
Flow Rate:	0.25 mL/min
Inj. Volume:	2.5 µL
Detection:	Suppressed conductivity
Oven Temp:	30°C

Peaks:

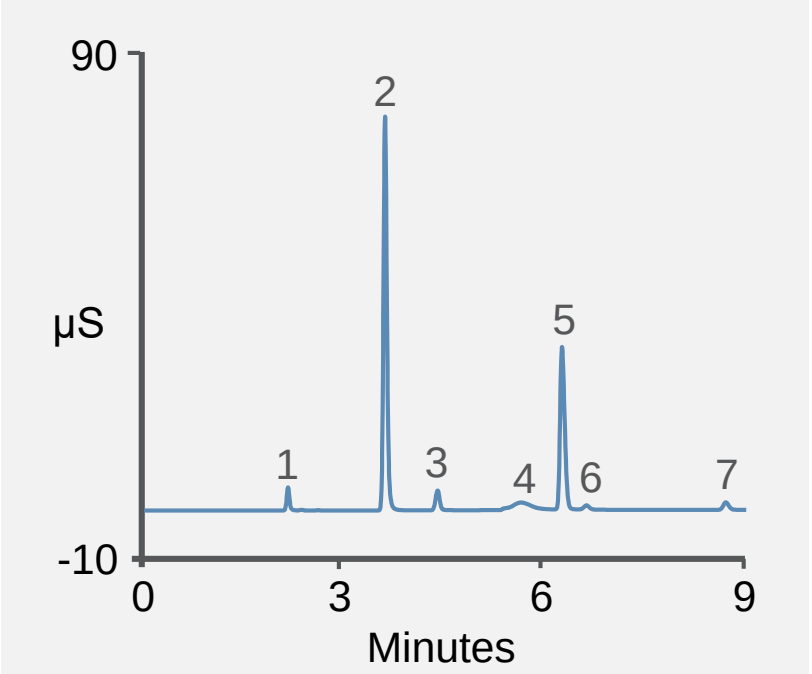
1. Fluoride
2. Chloride
3. Nitrite
4. Bromide
5. Nitrate
6. Carbonate
7. Sulfate
8. Phosphate

IC applications for environmental and food safety laboratories

AN154 and Update with Dionex IonPac AS18-4µm column

Determination of Inorganic Anions in Environmental Waters Using a Hydroxide-Selective Column

Municipal Wastewater Sample



Conditions

Columns:	Dionex IonPac AG18-Fast-4µm Dionex IonPac AS18-Fast-4µm, 4 × 150 mm
KOH Gradient:	15–44 mM (0.2 to 6 min)
Eluent Source:	Dionex EGC 500 cartridge with Dionex CR-ATC 600 trap and Dionex high pressure degasser devices
Flow Rate:	1 mL/min
Inj. Volume:	10 µL
Column Temp.:	30 °C
Detection:	Suppressed conductivity, Dionex AERS 500, 4 mm, 109 mA, recycle
Sample Prep.:	5x dilution with deionized water

Peaks:

1. Fluoride	1.0	5. Sulfate	51.8	mg/L
2. Chloride	90.6	6. Nitrate	2.6	
3. Nitrite	1.0	7. Phosphate	0.36	
4. Carbonate	--			

IC applications for environmental and food safety laboratories

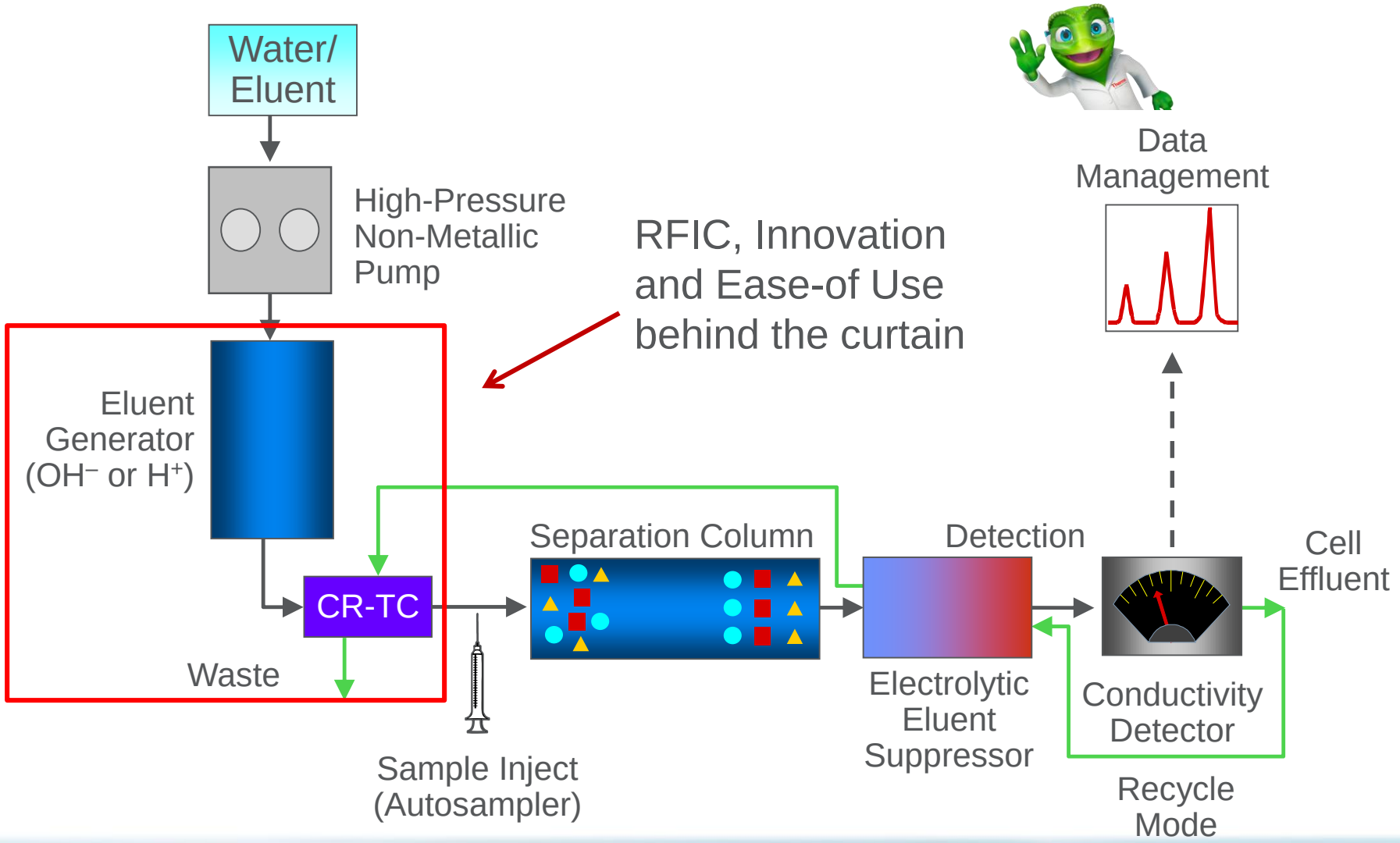
Disinfection of drinking water

- Chlorination process - generates chlorite, chlorate, halomethanes and haloacetic acids
- Ozonation process - generates bromate from bromide, and halomethanes and haloacetic acids

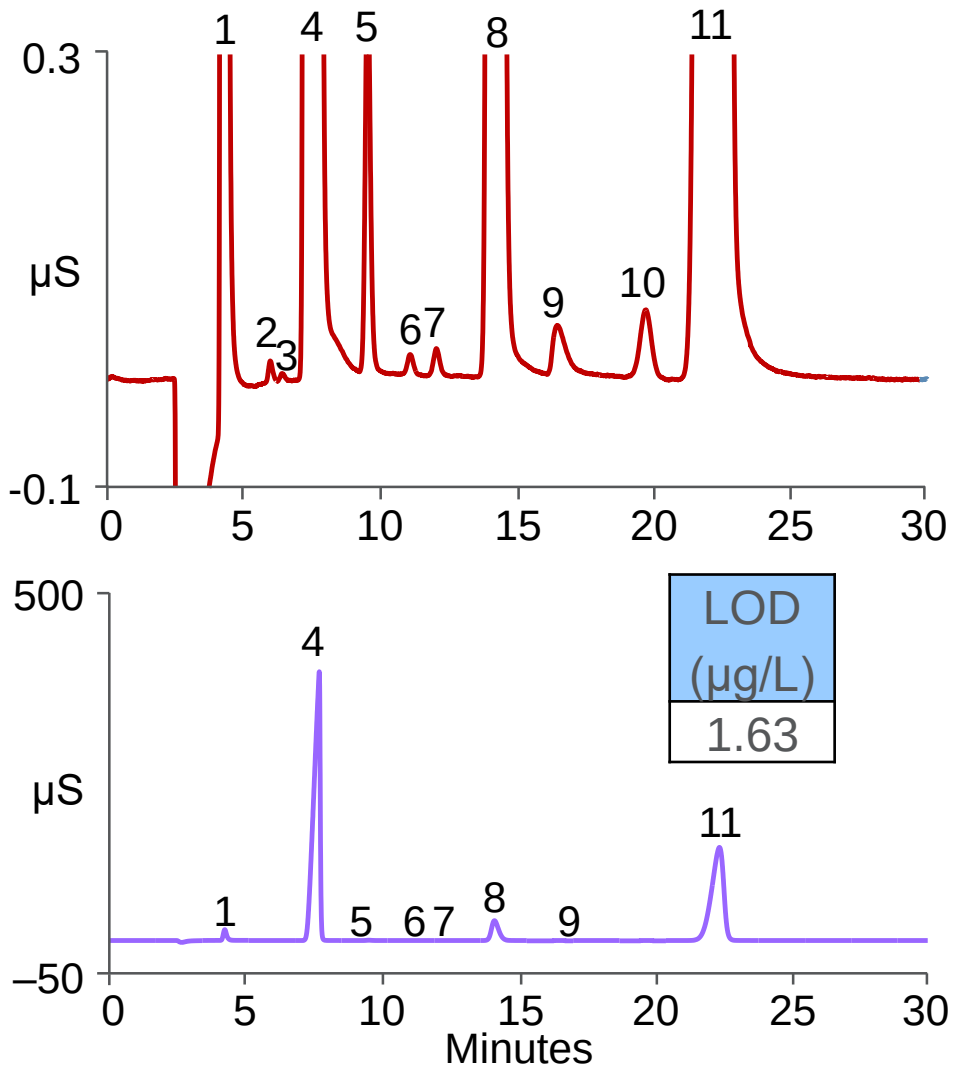
Toxic Disinfection Byproducts (DBPs)

- Highly regulated due to associated health issues
  - Chlorite: nervous system impact, affect fetal development, anemia
  - Haloacetic acids/bromate: carcinogenic
  - Chlorate: produce gastritis, a late toxic nephritis, hemolysis, methemoglobinemia, hemoglobinuria, and acute renal failure.

Reagent-Free IC System (RFIC™)



Determination of Trace Concentrations of Bromate Using Prepared Eluents (Isocratic)



Columns: Dionex IonPac AG23, AS23, 4 mm

Eluents: 4.5 mM Sodium carbonate/
0.8 mM Sodium bicarbonate

Temperature: 30 °C

Flow Rate: 1.0 mL/min

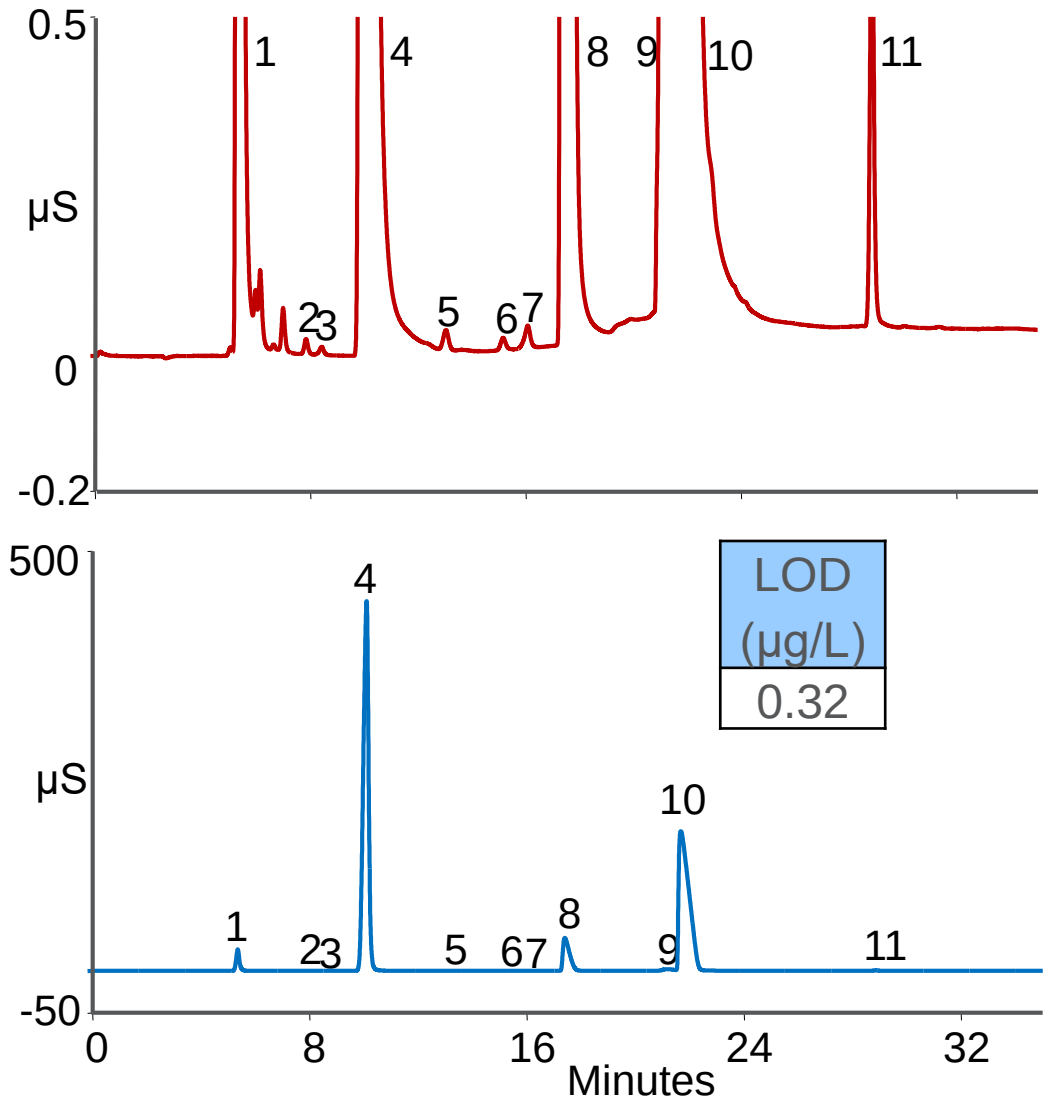
Inj. Volume: 200 µL

Detection: Suppressed conductivity, Dionex ASRS, 4 mm, AutoSuppression™, external water mode

Peaks:

1. Fluoride	1.0	mg/L (ppm)
2. Chlorite	0.01	
3. Bromate	0.005	
4. Chloride	50	
5. Nitrite	0.1	
6. Chlorate	0.01	
7. Bromide	0.01	
8. Nitrate	10	
9. Carbonate	50	
10. Phosphate	0.1	
11. Sulfate	50	

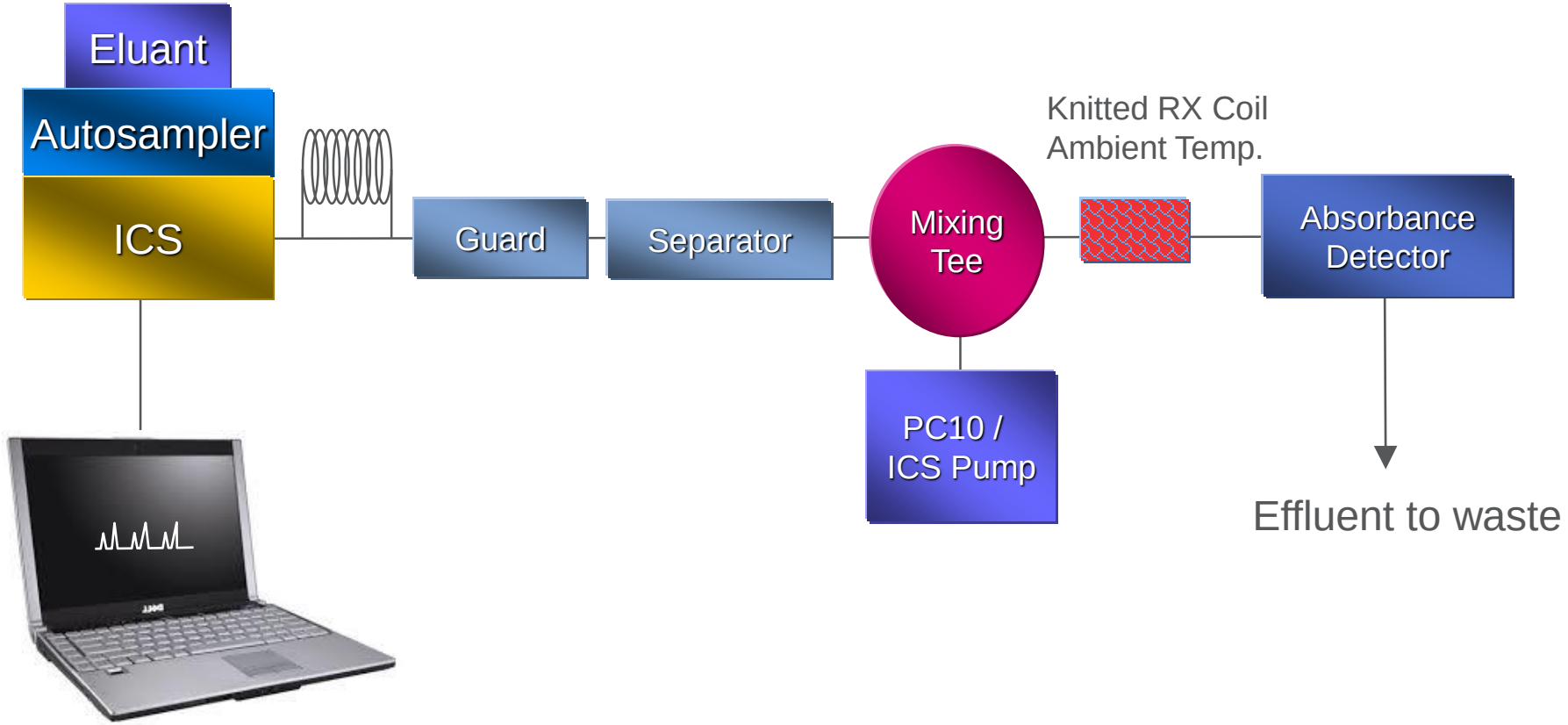
Bromate in Simulated Drinking Water



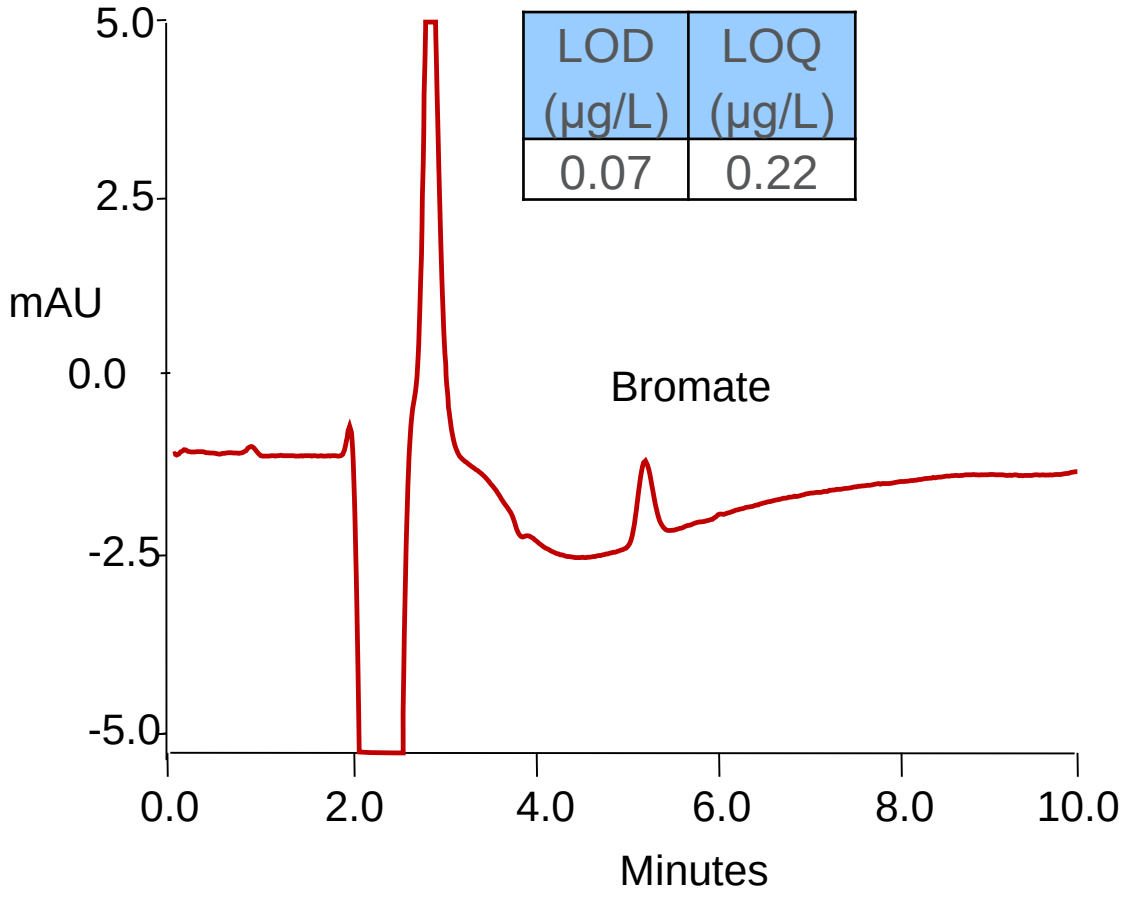
System:	Thermo Scientific™ Dionex™ ICS-5000⁺ HPIC system
Column:	Thermo Scientific™ Dionex™ IonPac™ AS19-4µm + guard (4 × 250 mm)
Eluent :	10 mM KOH from 0 to 10 min, 10–45 mM KOH from 10 to 25 min
Eluent Source:	Thermo Scientific™ Dionex™ EGC 500 KOH Cartridge
Flow Rate:	1.0 mL/min
Inj. Volume:	200 µL
Temperature:	30 ˚C
Detection:	Suppressed Conductivity, Thermo Scientific™ Dionex™ AERS™ 500 suppressor, 4 mm AutoSuppression, recycle mode
Sample:	Simulated Drinking Water

Peaks:		
1. Fluoride	1.0	mg/L
2. Chlorite	0.005	
3. Bromate	0.005	
4. Chloride	50.0	
5. Nitrite	0.005	
6. Chlorate	0.005	
7. Bromide	0.005	
8. Nitrate	10.0	
9. Carbonate	25.0	
10. Sulfate	50.0	
11. Phosphate	0.20	

System Configuration - ISO 11206



Bromate Determination with Acidic Eluent - ISO 11206

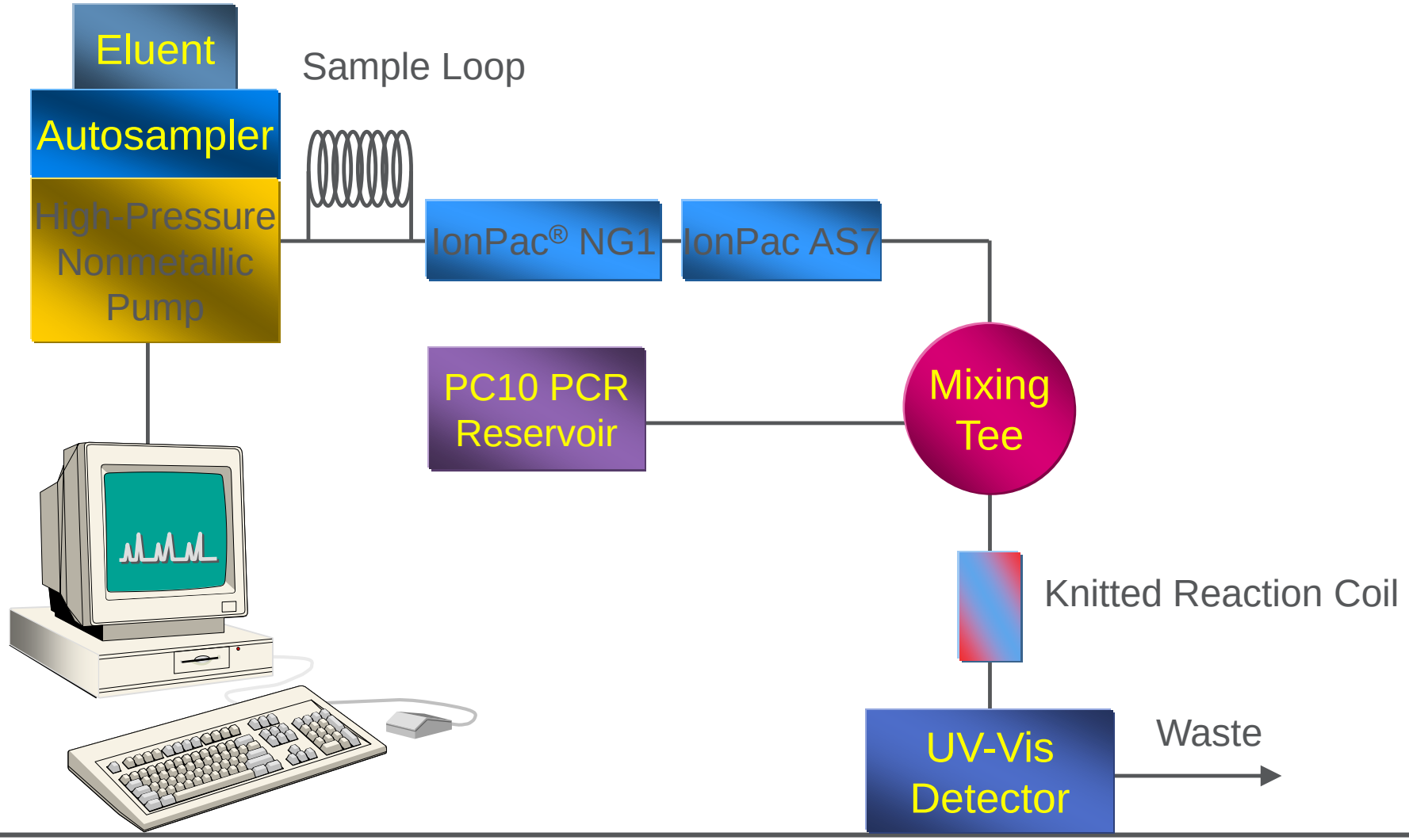


LOD (µg/L)	LOQ (µg/L)
0.07	0.22

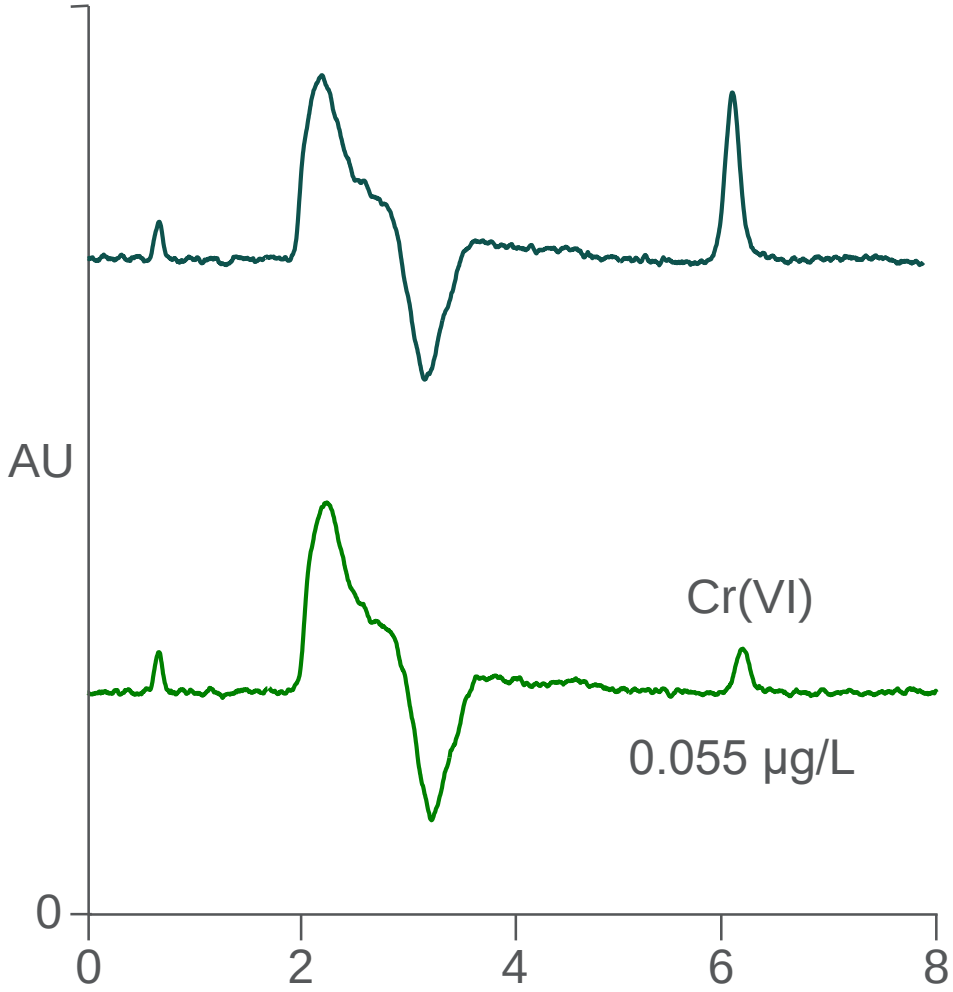
Column:	Thermo Scientific™ Dionex™ CarboPac™ PA1 (4 × 250 mm)
Eluent:	200 mmol/L MSA
Flow:	1 mL/min
Injection vol.:	500 µL
Detection:	UV 352 nm (after PCR)
Temperature:	30 °C
PCR:	
Solution A:	0.27 mol/L KI, 0.05 mmol/L $(NH_4)_6Mo_7O_{24} \cdot 4H_2O$
Flow	0.3 mL/min
Reaction coil:	375 µL
Bromate	1.2 µg/L

Reaction at Ambient Temp., and no Interferences from Chlorite
Cycle Time: 18 minutes

System Configuration for Hexavalent Chromium by EPA Method 218.6



Determination of Cr(VI) in Drinking Water Using Optimized EPA Method 218.6



Column: IonPac® NG1, AS7

Eluent: 250 mM $(NH_4)_2 SO_4$
100 mM NH_4OH

Flow: 1.0 mL/min

Inj. Volume: 1000 mL

Postcolumn Reagent: 2 mM Diphenylcarbizide
10% CH_3OH
1N H_2SO_4
0.33 mL/min

Reaction Coil: 750 mL

Detector: UV-Vis (530 nm)

Sample: Sunnyvale, CA tap water

MDL = 0.02 ppb

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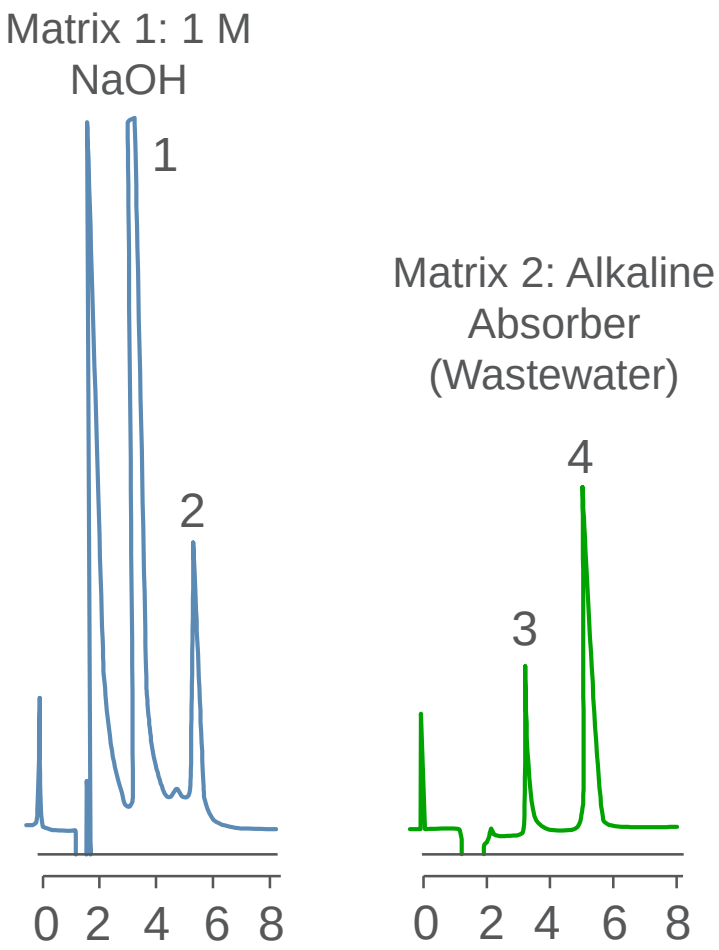
Determination of Cyanide and Sulfide in Sodium Hydroxide and Waste Water Samples Using the IonPac® AS7 Column with Amperometric Detection



Column: IonPac AS7

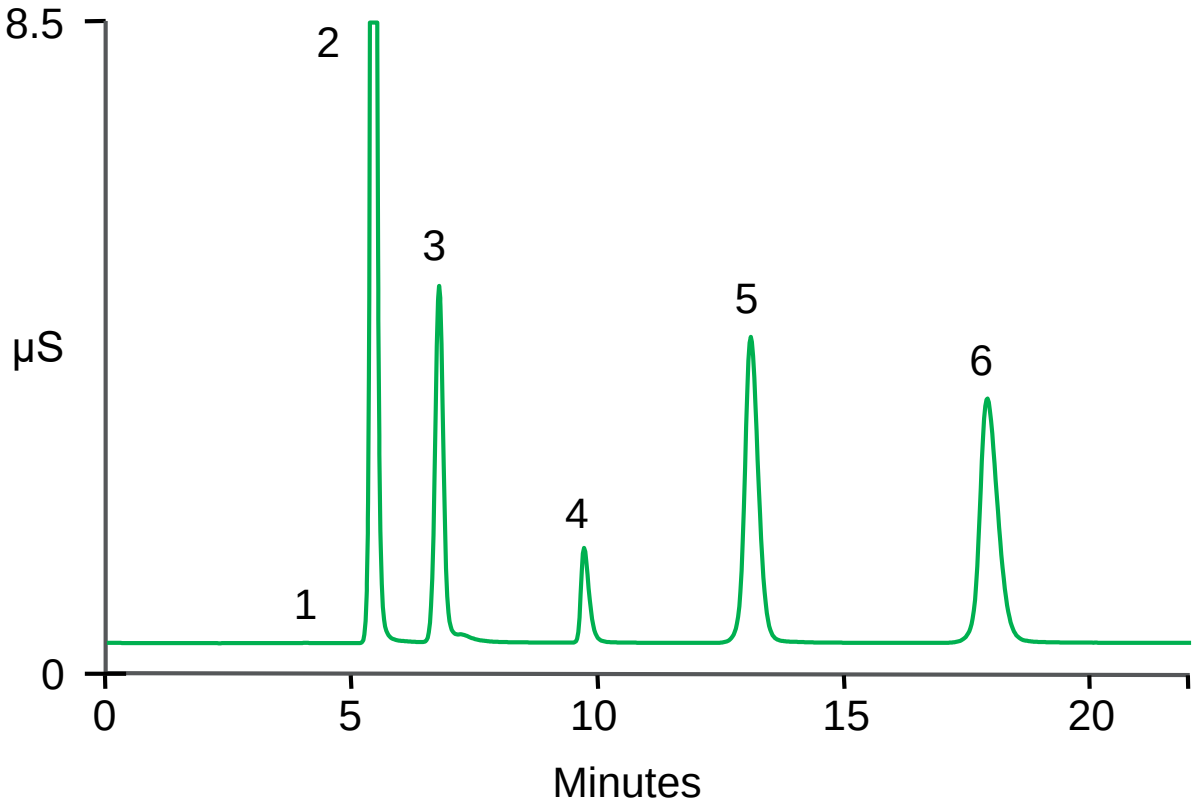
Eluent: 0.5 M Sodium acetate
0.1 M Sodium hydroxide
0.5 % (v/v) Ethylenediamine

Flow Rate: 1 mL/min

Detector: ED40, silver working electrode,
0.00 V vs. Ag/AgCl reference

Peaks:	Matrix 1	Matrix 2
	1. S^{2-} 1000 ppb	3. S^{2-} 25ppb
	2. CN^- 100 ppb	4. CN^- 125 ppb

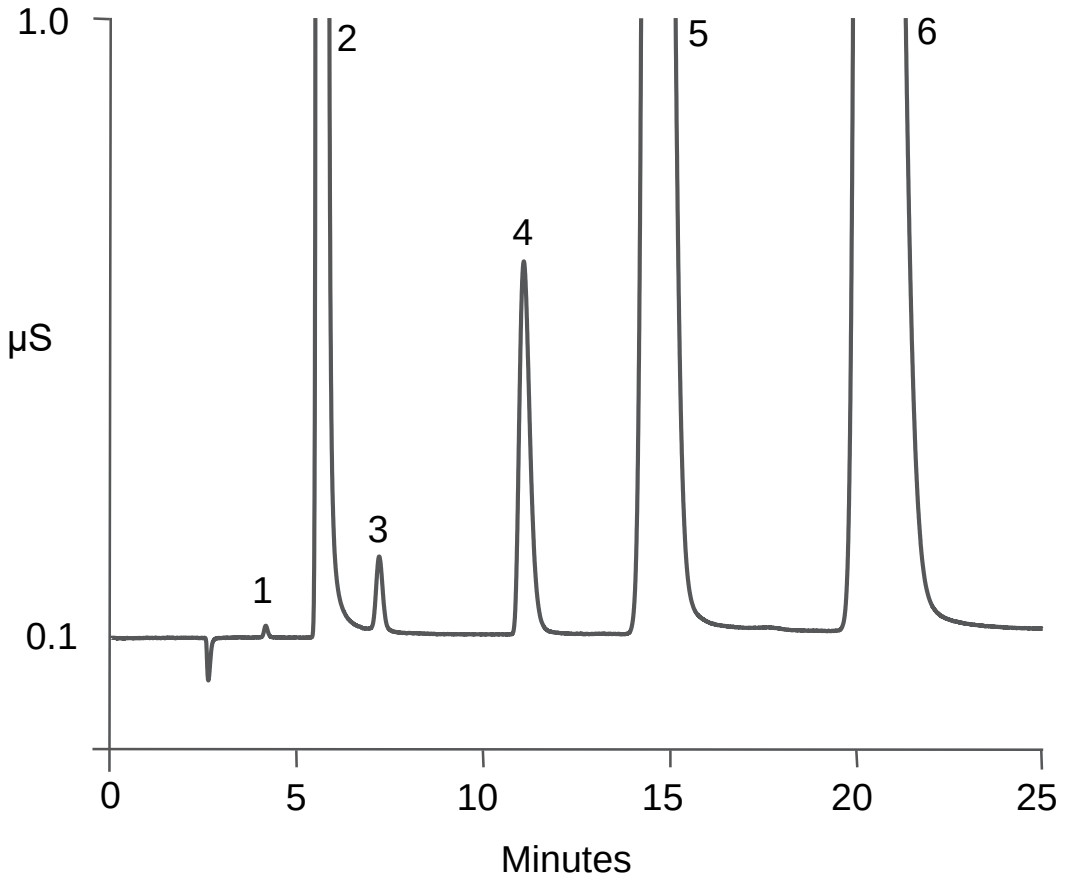
Inorganic Cations and Ammonium in Municipal Wastewater



Columns:	IonPac CG16-4µm IonPac CS16-4µm, 4 × 250 mm
Eluent:	30 mM MSA
Flow Rate:	900 µL/min
Inj. Volume:	10 µL
Column Temp.:	40 °C
Detection:	Suppressed conductivity, Thermo Scientific™ Dionex™ CERS 500, 4 mm 79 mA, recycle mode
Sample Prep.:	Filtration, 5-fold dilution with deionized water

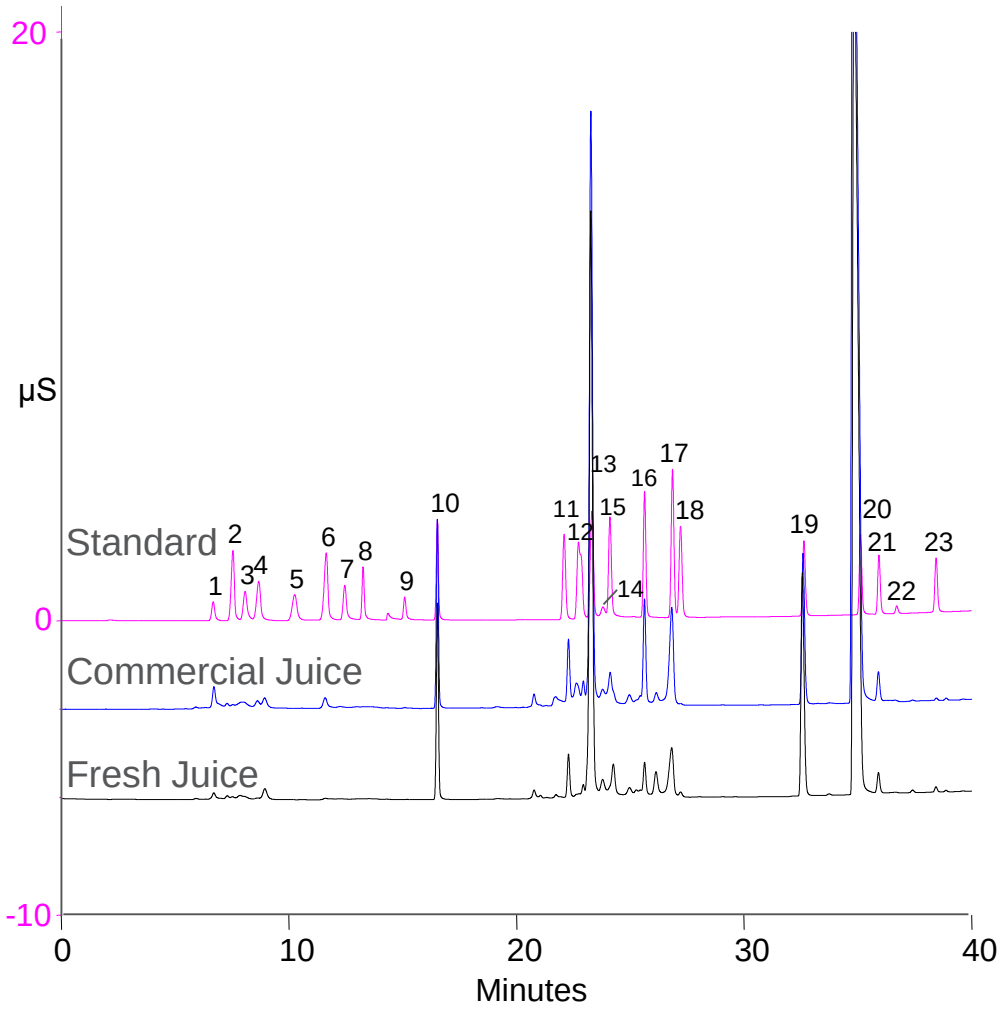
Peaks:		
1. Lithium	< 0.05	mg/L
2. Sodium	34.0	
3. Ammonium	9.6	
4. Potassium	3.6	
5. Magnesium	6.5	
6. Calcium	11.0	

Inorganic Cations and Ammonium in Drinking Water



Column:	Dionex IonPac CS16		
Dimensions:	250 mm × 5 mm i. d.		
Temperature:	40 °C		
Eluent:	30 mmol/L MSA		
Flow rate:	1 mL/min		
Inj. volume:	25 µL		
Detection:	Suppressed conductivity, AutoSuppression, recycle mode		
Peaks:	1. Lithium	0.01	mg/L
	2. Sodium	19.73	
	3. Ammonium	0.07	
	4. Potassium	0.99	
	5. Magnesium	7.21	
	6. Calcium	18.54	

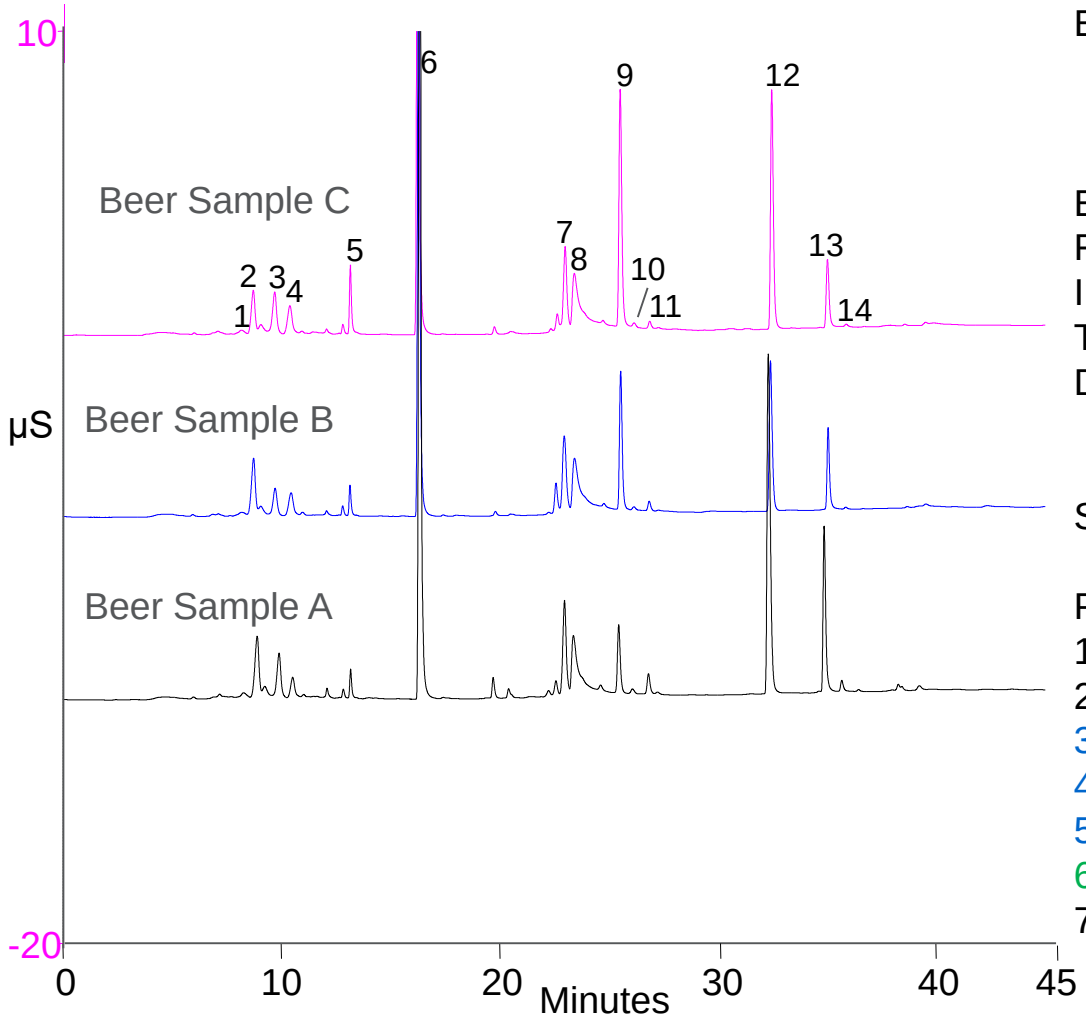
Food and Beverages Applications - Analysis of Orange Juice Samples



Column:	Dionex IonPac AS11-HC-4µm set, (4 × 250 mm)
Eluent :	1 mM KOH (8 min),1–15 mM KOH (10 min), 15–30 mM KOH (10 min), 30–60 mM KOH (10 min)
Eluent Source:	Dionex EGC 500 KOH
Flow Rate:	0.38 mL/min
Inj. Volume:	2.5 µL
Temperature:	30 ˚C
Detection:	Suppressed conductivity, Dionex ASRS 300, 2 mm, recycle mode
Sample Prep:	5-fold dilution

Peaks (Standard):	mg/L		mg/L
1. Quinate	5	12. Nitrate, Glutarate	5+5
2. Fluoride	3	13. Malate, Succinate	10+10
3. Lactate	5	14. Carbonate	10
4. Acetate	5	15. Tartrate, Malonate	10+10
5. Propionate	5	16. Sulfate	10
6. Formate	5	17. Oxalate	10
7. Butyrate	5	18. Fumarate	10
8. Pyruvate	5	19. Phosphate	15
9. Galacturonate	5	20. Citrate	15
10. Chloride	5	21. Isocitrate	15
11. Bromide	5	22. *cis*-Aconitate	--
		23. *trans*-Aconitate	15

Analysis of Beer Samples



Column:	Dionex IonPac AS11-HC-4µm set, (4 × 250 mm)
Eluent :	1 mM KOH (8 min), 1–15 mM KOH (10 min), 15–30 mM KOH (10 min), 30–60 mM KOH (10 min)
Eluent Source:	Dionex EGC 500 KOH
Flow Rate:	1.5 mL/min
Inj. Volume:	10 µL
Temperature:	30 ˚C
Detection:	Suppressed conductivity, Dionex ASRS 300, 4 mm, recycle mode
Sample Prep:	5-fold dilution

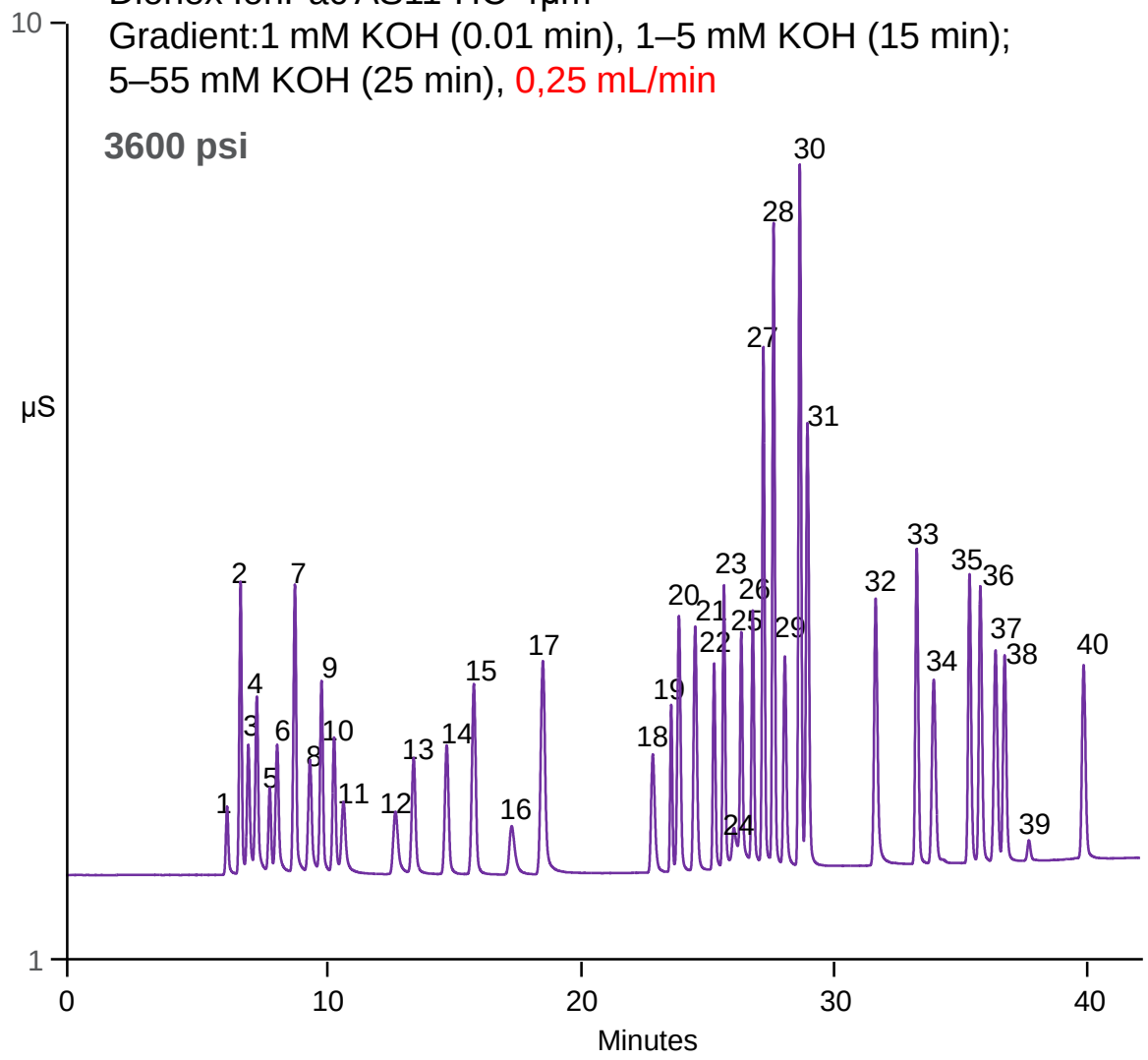
Peaks :

1. Quinate
2. Fluoride
3. Lactate
4. Acetate
5. Pyruvate
6. Chloride
7. Succinate + Malate
8. Carbonate
9. Sulfate
10. Oxalate
11. Fumarate
12. Phosphate
13. Citrate
14. Isocitrate

Gradient Separation of 40 Anions

Dionex IonPac AS11-HC-4µm
Gradient:1 mM KOH (0.01 min), 1–5 mM KOH (15 min);
5–55 mM KOH (25 min), 0,25 mL/min

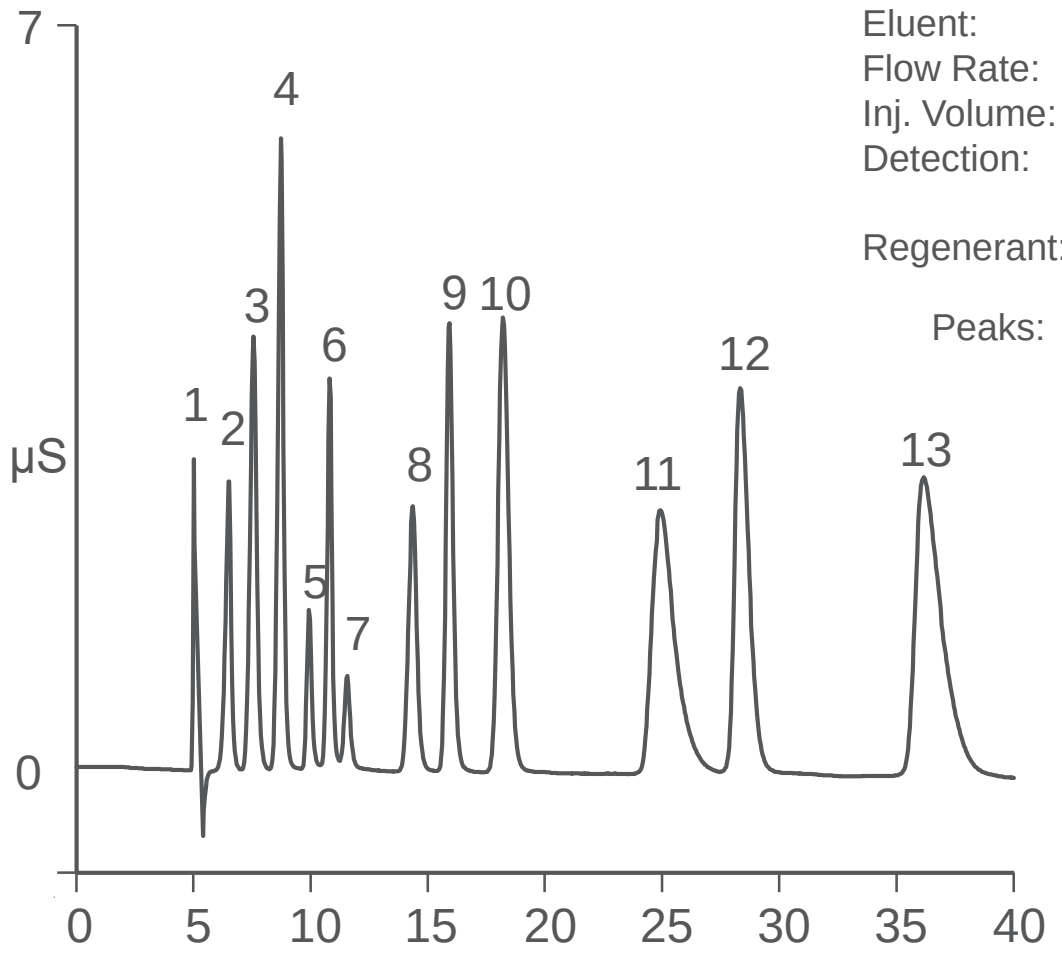
3600 psi



Peaks:

1. Quinate
2. Fluoride
3. Lactate
4. Acetate
5. 2-Hydroxy-butyrate
6. Propionate
7. Formate
8. Butyrate
9. Methylsulfonate
10. Pyruvate
11. Isovalerate
12 Valerate
13. Monochloro-acetate
14. Bromate
15. Chloride
16. 2-Oxovalerate
17. Nitrite
18. Ethylphosphate
19. Trifluoroacetate
20. Bromide
21. Nitrate
22. Citramalate
23. Malate
24. Carbonate
25. Malonate
26. Citraconitate
27. Maleate
28. Sulfate
29. α-Ketoglutarate
30. Oxalate
31. Fumarate
32. Tungstate
33. Phosphate
34. Phthalate
35. Arsenate
36. Citrate
37. Chromate
38. Isocitrate
39. *cis*-Aconitate
40. *trans*-Aconitate

Separation of Organic Acids by Ion Exclusion



Column:	Dionex IonPac ICE-AS6
Eluent:	0.4 mM Heptafluorobutyric acid
Flow Rate:	1.0 mL/min
Inj. Volume:	50 µL
Detection:	Suppressed conductivity, Thermo Scientific™ Dionex™ AMMS™-ICE
Regenerant:	5 mM Tetrabutlyammonium hydroxide

Peaks:

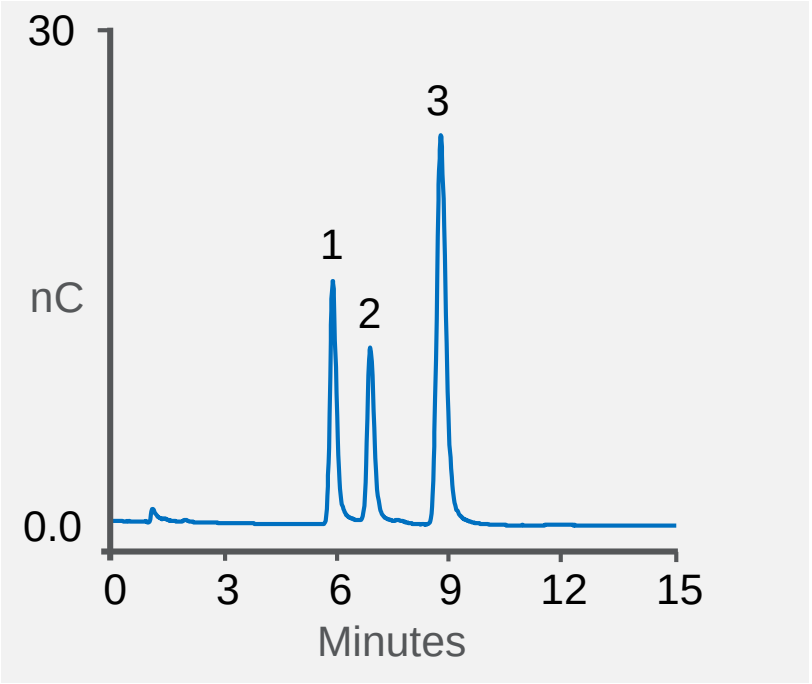
1.	Oxalic	5.0	mg/L
2.	Tartaric	10.0	
3.	Citric	15.0	
4.	Malic	20.0	
5.	Glycolic	10.0	
6.	Formic	10.0	
7.	Lactic	10.0	
8.	2-Hydroxyisobutyric acid	30.0	
9.	Acetic	25.0	
10.	Succinic	25.0	
11.	Fumaric	35.0	
12.	Propionic	50.0	
13.	Glutaric	40.0	

Food and Beverage Applications

Monosaccharides and Disaccharides

Monosaccharides and Disaccharides in a flavored rum liquor sample using a High Carbohydrate kit

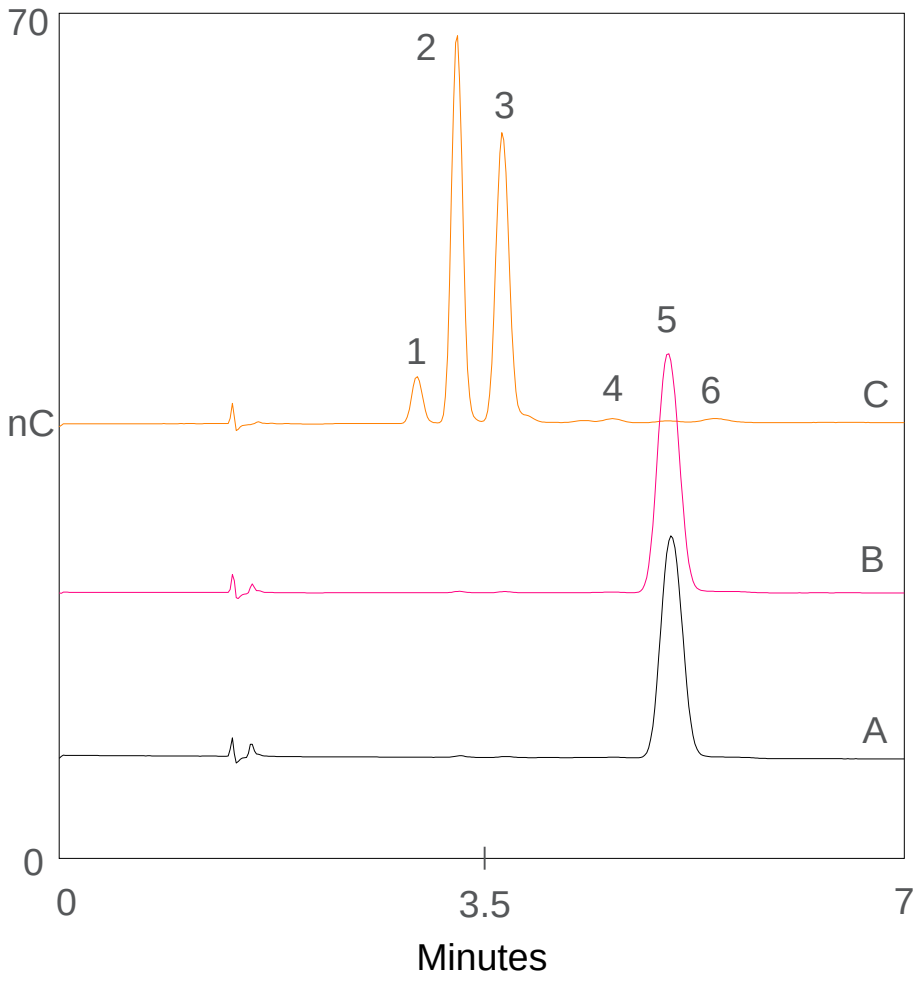
Flavored Rum Liquor Sample



Conditions

Column:	Dionex CarboPac PA20 guard, Dionex CarboPac PA20, 3 mm i.d.		
Eluent:	35 mM KOH, 100 mM KOH wash from 15 to 25 min		
Eluent Source:	Dionex EGC 500 KOH cartridge, Dionex CR-ATC 600 trap column, high pressure degasser		
Flow Rate:	0.50 mL/min		
Inj. Volume:	0.4 µL		
Column Temp.:	30 °C		
Detection:	PAD, Au on PTFE, 62 mil gasket		
Waveform:	4-Potential Carbohydrate		
Ref. Electrode:	Ag/AgCl		
Sample Prep.:	100x dilution with deionized water		
Peaks:	1. Glucose	0.30	g/L
	2. Fructose	0.28	
	3. Sucrose	1.08	

Fast Analysis of Lactose in Milk Products



TN 146, Thermo Scientific, 2013

Column: Dionex CarboPac SA10, 4 mm
Eluent Source: Dionex EGC 500 KOH
Eluent: 4 mM KOH
Flow Rate: 1.5 mL/min
Inj. Volume: 25 µL
Column Temp.: 35 °C
Detection: PAD, Au on PTFE disposable, Four-potential Carbohydrate waveform
Ref. Electrode: pH-Ag/AgCl
Sample Prep.: 1:100 diluted, prepared samples (Sample preparation as in Dionex AN248)

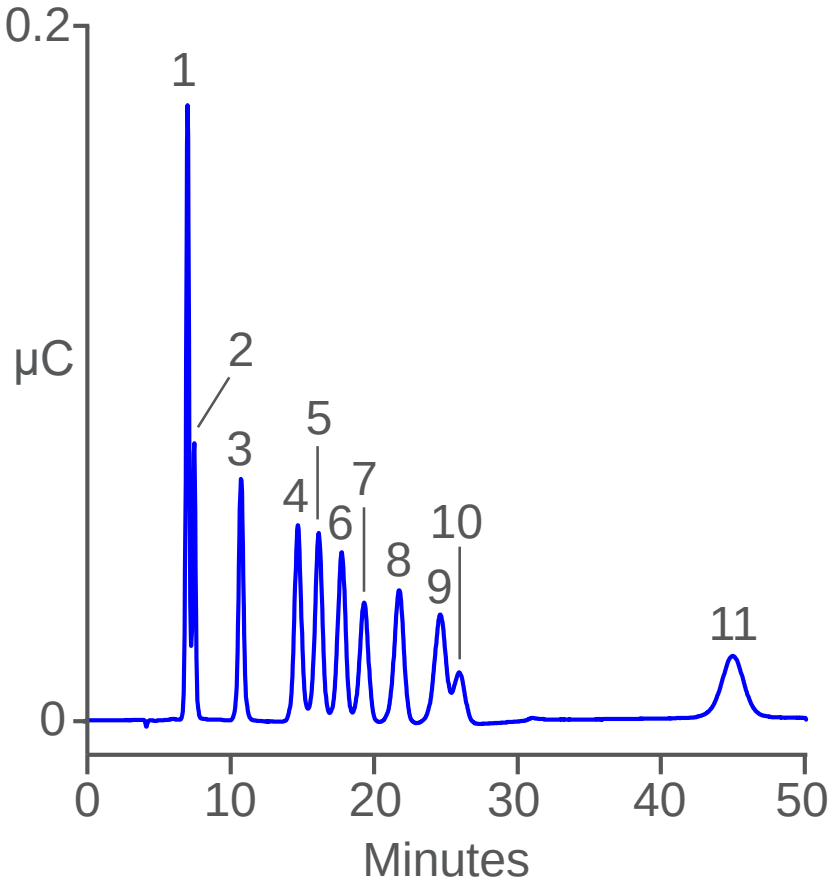
Sample:

A: Raw milk
B: Pasteurized milk
C: Lactose-free yogurt

Peaks:

1. Sucrose
2. Galactose
3. Glucose
4. Unknown
5. Lactose
6. Unknown

Reduced and Reducing Carbohydrates in Foods and Beverages



Column: CarboPac® MA1

Eluent: 480 mM Sodium hydroxide

Flow Rate: 0.4 mL/min

Detector: PED (gold)

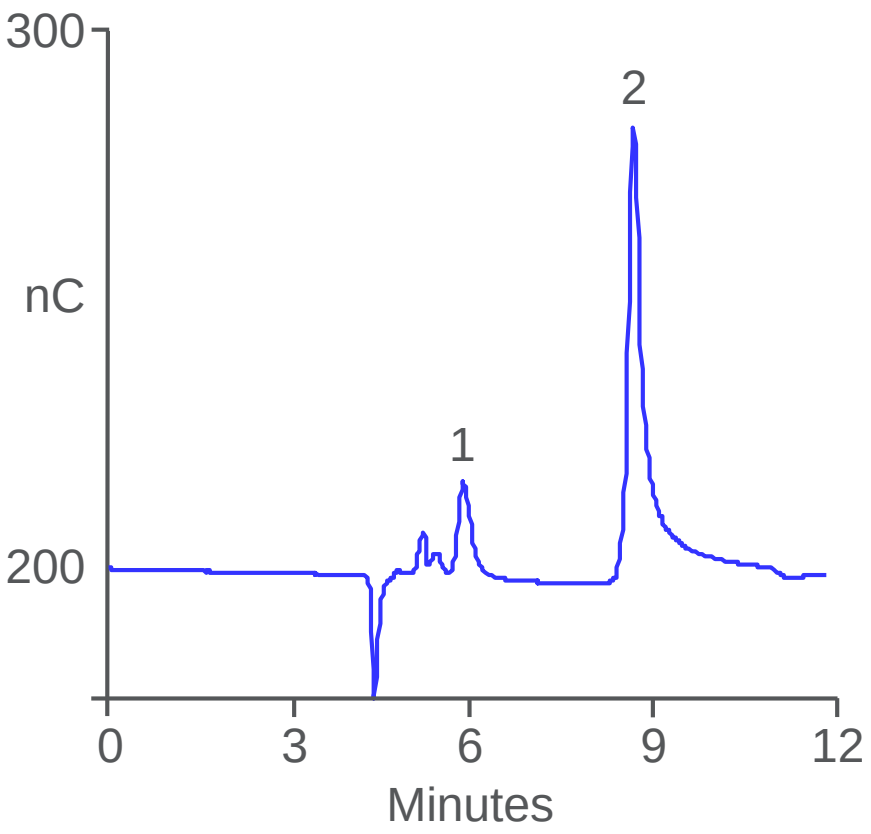
Peaks:

1.	Inositol	18 mg/L
2.	Glycerol	9
3.	Arabitol	15
4.	Sorbitol	18
5.	Dulcitol	18
6.	Mannitol	18
7.	Mannose	18
8.	Glucose	18
9.	Galactose	18
10.	Fructose	18
11.	Sucrose	34

Dionex's IC Columns for Carbohydrates Analysis

Column	Applications
CarboPac SA10, CarboPac SA10-4µm and CarboPac SA10-Fast-4 µm	***Fast*** and high capacity separation of mono and disaccharides in biofuels, foods, and beverages.
CarboPac PA210-Fast-4µm	Fast high resolution separation of mono-, di-, tri-, tetra- and pentasaccharides
CarboPac PA20	High-resolution separations of mono- and disaccharides with optimized resolution of glucosamine/galactose and glucose/mannose peak pairs.
CarboPac PA200	Fast high resolution separation of oligosaccharide structural isomers
CarboPac PA210-Fast-4µm	Fast high resolution separation of mono-, di-, tri-, tetra- and pentasaccharides
CarboPac MA1	Reduced mono- and disaccharides such as alditols and other sugar alcohols

Sulfite in Dried Apricot

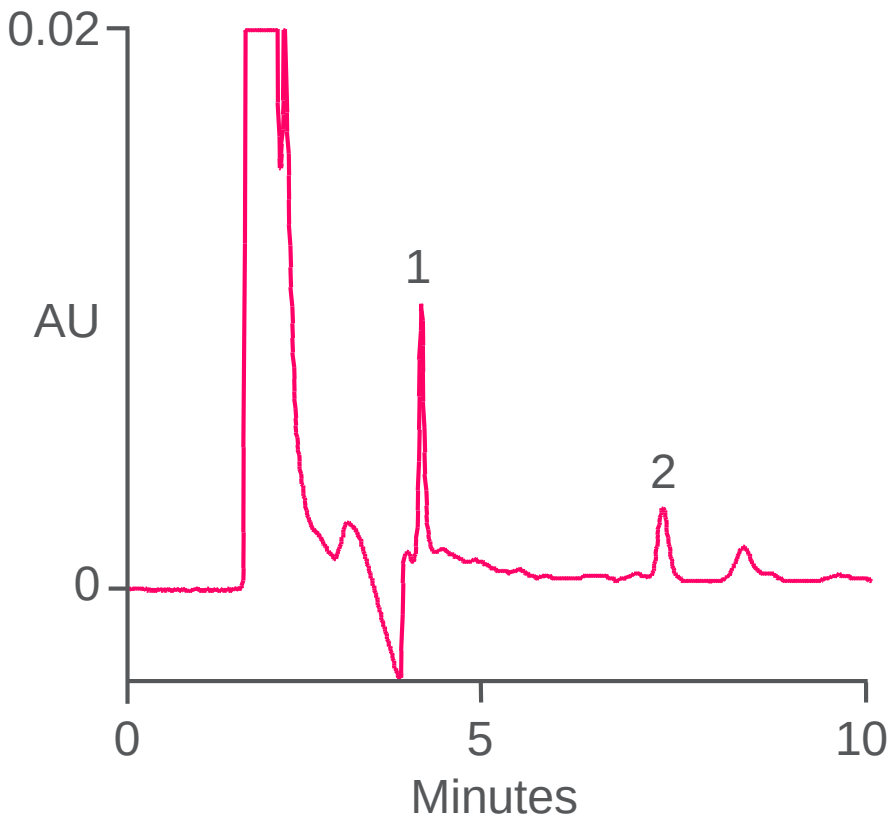


Column:	IonPac® ICE-AS1
Eluent:	20 mN sulfuric acid
Flow Rate:	1mL/min
Inj. Volume:	50 µL
Detection:	Pulsed amperometry, pt electrode

Peaks:		
	1. Mannitol	—
	2. Sulfite	2.0 mg/L

Sample Preparation: 20 g dried apricot blended in 100 mL mannitol buffer; sulfite conc. 0.8 mg/g in dried apricot sample

Nitrate and Nitrite in Ham



Column:	IonPac® AS11
Eluent:	5 mM sodium hydroxide
Flow Rate:	1mL/min
Inj. Volume:	25 µL
Detection:	UV, 225 nm
Sample Preparation:	Homogenize 10 g of sample with 100 mL of water. Heat to 75 °C for 15 min. Centrifuge. Filter through 1.2 µm filter, then 0.2 µm filter.

Peaks:	1. Nitrite	1.16 mg/L
	2. Nitrate	0.54 mg/L

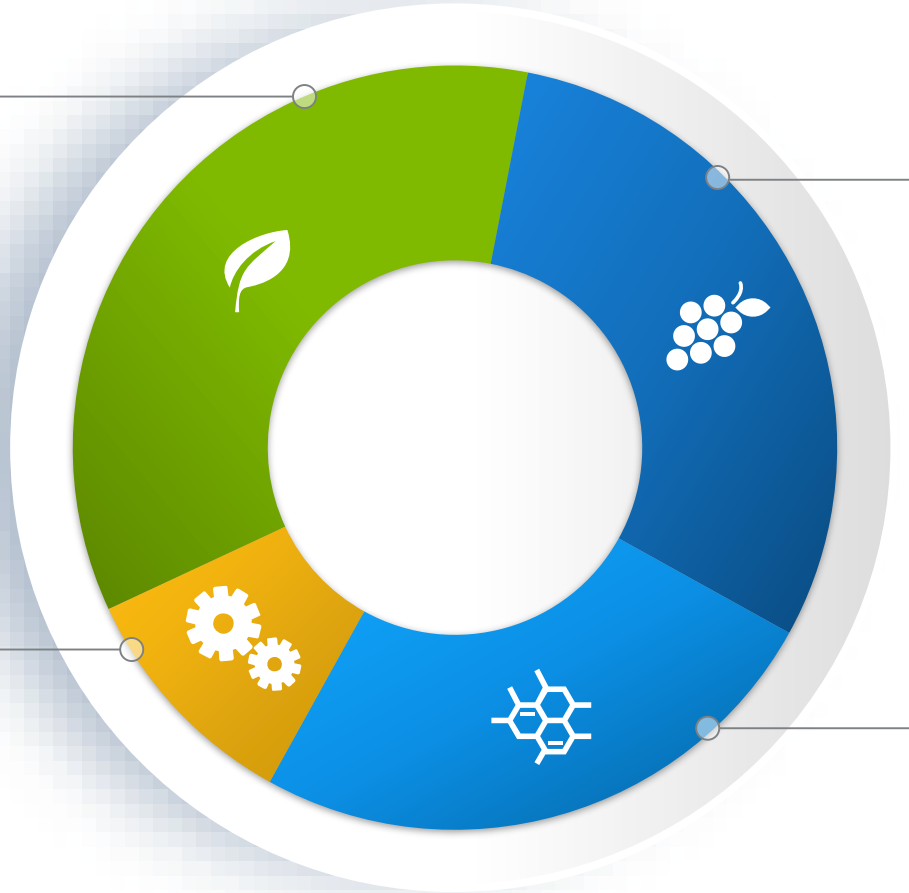
IC-MS Applications

Environmental

- Haloacetic acids in drinking water (EPA Method 557)
- Perchlorate in drinking water
- Bromate in drinking water

Industrial Manufacturing

- Corrosive anions in petrochem
- Process water
- Li-ion batteries



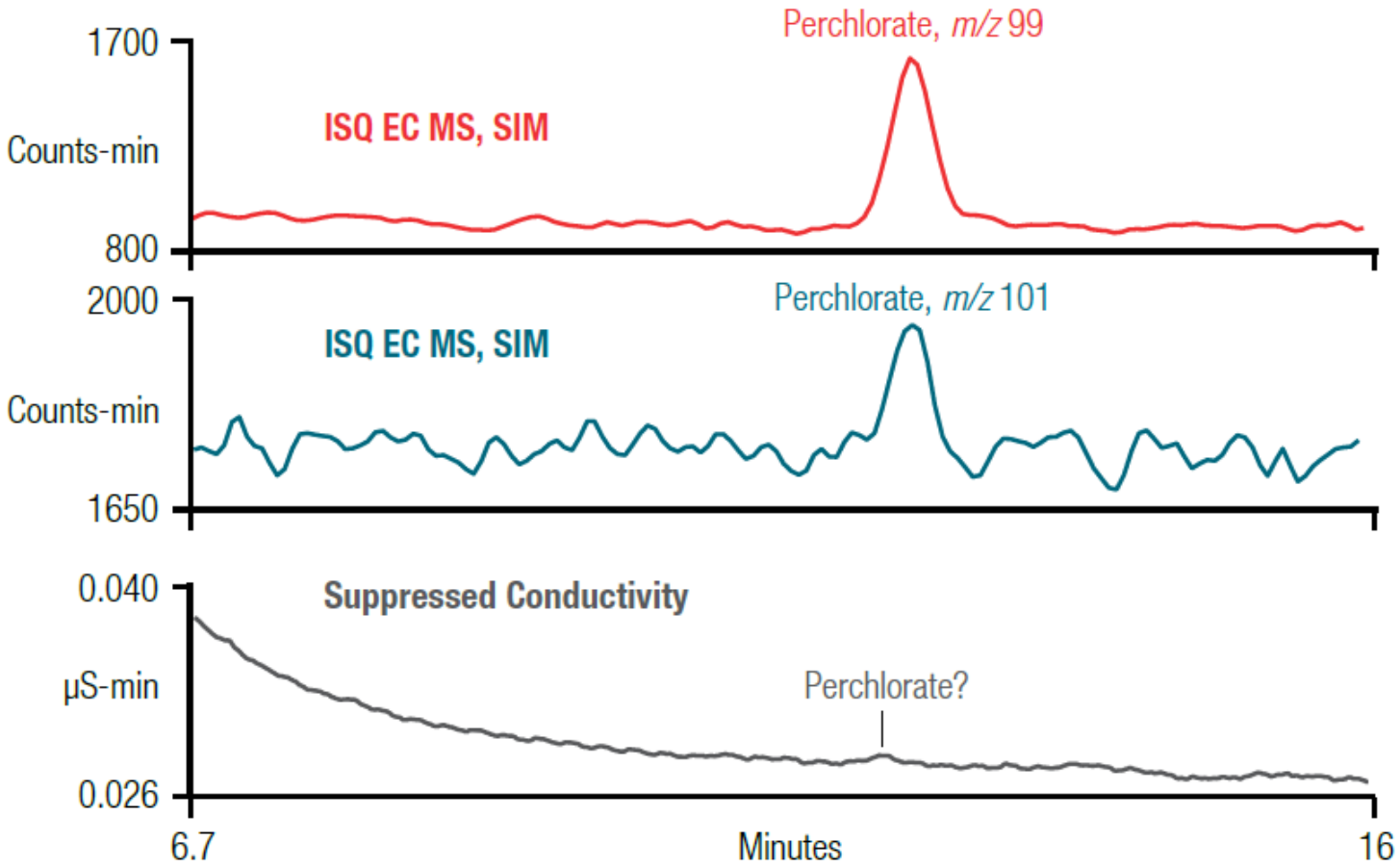
Food and Beverage

- Glyophosate, Glufosinate/AMPA (ionic pesticides)
- Perchlorate in vegetables
- Organic acids (“Food-omics”)
- Anions in brewing industry

Metabolomics

- Sugar phosphates
- Sugar amines

IC-MS: Improved Low-Mass Sensitivity in Drinking Water



Required LODs are not achievable by Conductivity Detection alone

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RAJSKI ET AL.: JOURNAL OF AOAC INTERNATIONAL VOL. 101, NO. ■■■, 2017 1

SPECIAL GUEST EDITOR SECTION

Coupling Ion Chromatography to Q-Orbitrap for the Fast and Robust Analysis of Anionic Pesticides in Fruits and Vegetables

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Ion chromatography coupled to a quadrupole Orbitrap mass analyzer was used to develop a multiresidue method for the determination of highly polar pesticides and their metabolites (chlorate, perchlorate, fosetyl-aluminum, glyphosate, aminomethylphosphonic acid (AMPA), phosphonic acid, *N*-acetyl AMPA, and *N*-acetyl glyphosate) in fruits and vegetables. After extraction with methanol, samples were diluted 5× with water. No derivatization was applied. Pesticides were separated in an anion-exchange column. Water was used as the ion chromatography mobile phase.

responsible for the retention of the analytes (2). Since the introduction of IC, column technology has improved. Current columns are characterized by higher ion-exchange capacity, higher column efficiency, reductions in column diameters, and a new chemistry of bonded functional groups (3).

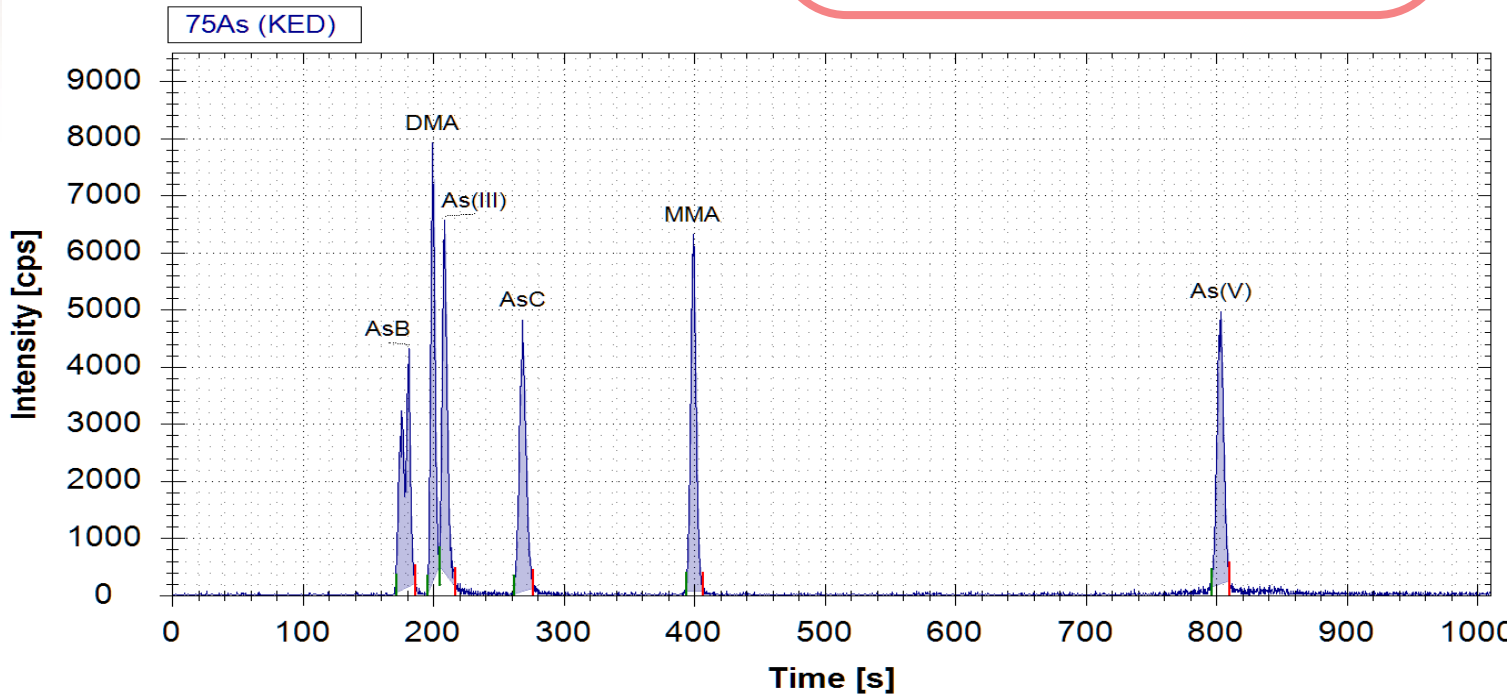
Various detectors are used with IC. Examples of the application of conductivity (4, 5), UV (6), and mass detectors (7, 8), can be found in the literature. Because of the typical high content of nonvolatile salts, an ion chromatograph cannot be connected directly to a mass spectrometer. The presence of nonvolatile salts has a negative influence on sensitivity, and salts can precipitate in the ionization source (2).

Published November 2017

IC coupled to ICP-MS

Narrow peak width enables high signal to noise, resulting in lower LODs

Improved column chemistry provides better resolution even for closely eluting peaks



BENEFITS

- Completely **metal-free** flow path
  - Less contamination
  - Lowest chemical noise
  - Better S/N
  - Lower LOD
- Narrower bore columns (2 mm ID)
  - Narrower peak shapes
  - Better S/N

Metal-free flow path ideal for metal speciation applications

Conclusion

Thermo Scientific Dionex IC systems

with suitable consumables and ready made applications

are ideal solutions for the analysis of anions, cations and carbohydrates

in environmental and food safety samples in your laboratory

Thanks for Your Attention!

ThermoFisher SCIENTIFIC

Comparing Hydroxide vs. Carbonate Eluents

Analyte	Range (µg/L)	Linearity (r^2)	Retention Time Precision (%RSD[b,c])	Peak Area Precision (%RSD)	MDL Standard (µg/L)	MDL Calculated (µg/L)
Thermo Scientific™ Dionex™ IonPac™ AS19 – Hydroxide Eluent						
Chlorite	2-50	0.9999	0.04	1.20	1.0	0.18
Bromate	1-25	0.9995	0.03	1.40	2.0	0.31
Chlorate	2-50	0.9999	0.01	0.54	1.0	0.28
Thermo Scientific™ Dionex™ IonPac™ AS23 – Carbonate/bicarbonate Eluent						
Chlorite	10-50	0.9999	0.07	2.20	5.0	1.02
Bromate	5-25	0.9998	0.07	2.63	5.0	1.63
Chlorate	10-50	0.9998	0.11	2.48	9.0	2.05

[a]See Application Note 184 for conditions; [b]RSD = relative standard deviation, *n* = 7

[c]Quality control standard contained 10 ppb each of chlorite, chlorate, and bromide and 5 ppb bromate

RFIC Technology with Hydroxide Eluents is > 5x More Sensitive