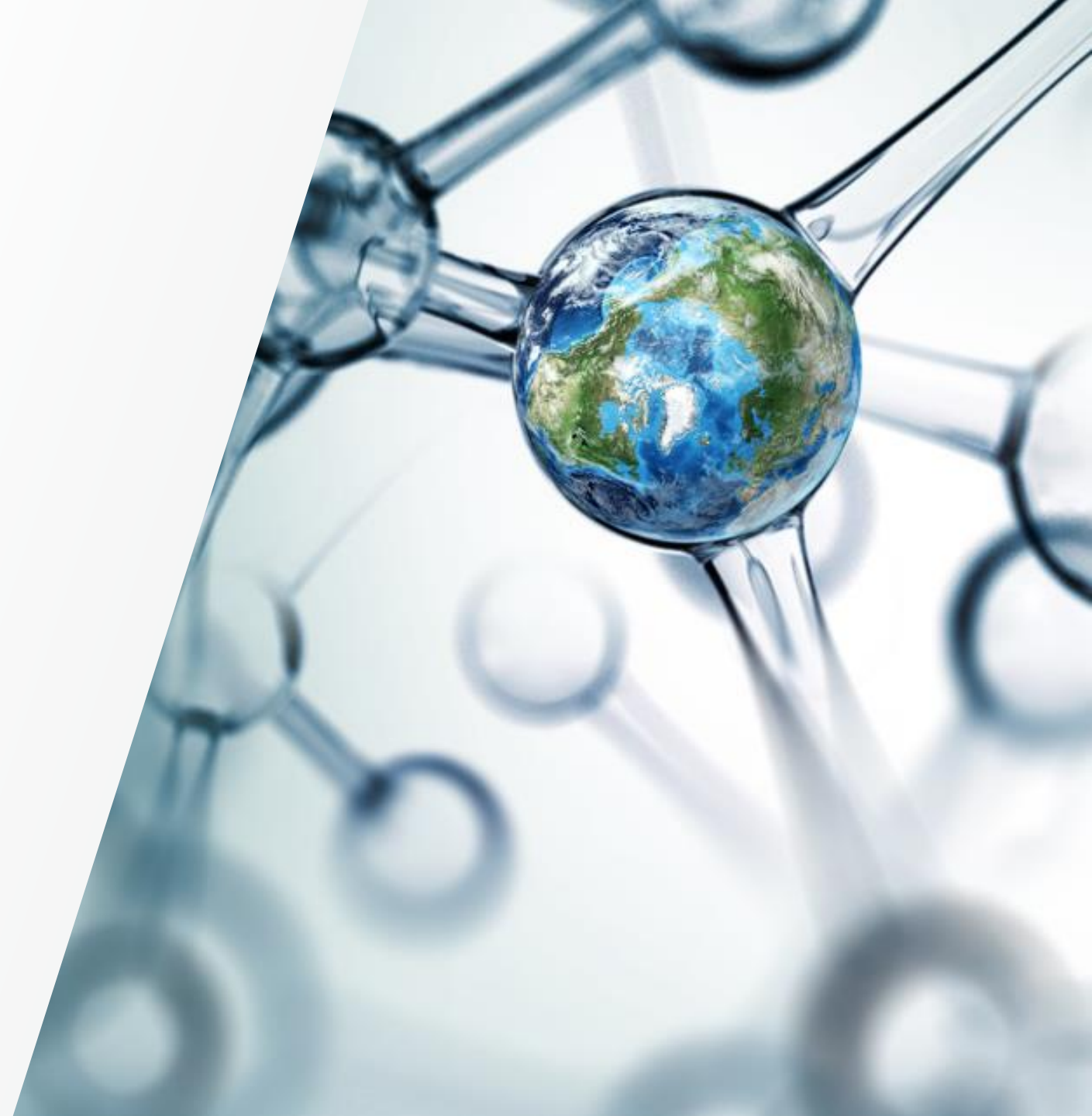


Iónová chromatografia v praxi

Ing. Roman Repáš
Technical Sales Manager IC/SP,
Indirect Channels EEMEA, CMD
Thermo Fisher Scientific GmbH Dreieich, Germany

 The world leader in serving science



The Dionex Ion Chromatography Product Line

RFIC

HPIC



Dionex Easion



Dionex Aquion



Dionex Integrion



Dionex ICS-4000



Dionex ICS-6000



Dionex Easion IC

Entry level IC system for Academic teaching and small commercial testing labs who need simple ion chromatography separations for everyday analysis, our Easion is the best in class instrument **for routine IC separations** that brings higher quality and simplicity to water testing, which fits into small laboratories' budgets



Dionex Aquion IC

For IC users in **budget limited labs** who need a **reliable IC system** with **straightforward operation**, our Dionex Aquion IC is built on a **compact** platform which provides **reliable technologies** to deliver results while maintaining **low operating costs**.



Dionex Integrion HPIC

For **routine users** who run an established method our Dionex Integrion HPIC system ensures **versatile and efficient IC analyses** with comprehensive applications solutions and **interactive wellness features** that help you adapt to changing demands while keeping your lab running seamlessly.



Dionex ICS-4000 Capillary HPIC

For **high throughput labs** who need to perform ion analysis on samples **quickly and accurately** our capillary ion chromatography (IC) systems are **always ready ion chromatographs** that enable customers to **spend more time on analyzing** sample results and **reduce cost of system operation** by producing less waste.



Dionex ICS-6000 HPIC

For IC users in **routine** and **research** who require a **flexible, robust system** and/or the **ultimate in productivity** our premiere, Dionex ICS-6000 **High Performance Ion Chromatography** system powered by the Chromeleon CDS is a **modular IC, configurable as a single or dual channel system** equipped with a modern **tablet interface and interactive wellness features** offering superior column chemistries to maximize productivity and **ease of use**.



Dionex ICS - 6000 IC System Detectors

Conductivity

Detection of anions and cations with suppressed conductivity detection



Spectrophotometric

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



ICP-MS

Elemental speciation coupled with high sensitivity



Electrochemical

Selective and sensitive detection of electroactive compounds



Mass Spectrometry

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



Auto Sampler Options

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



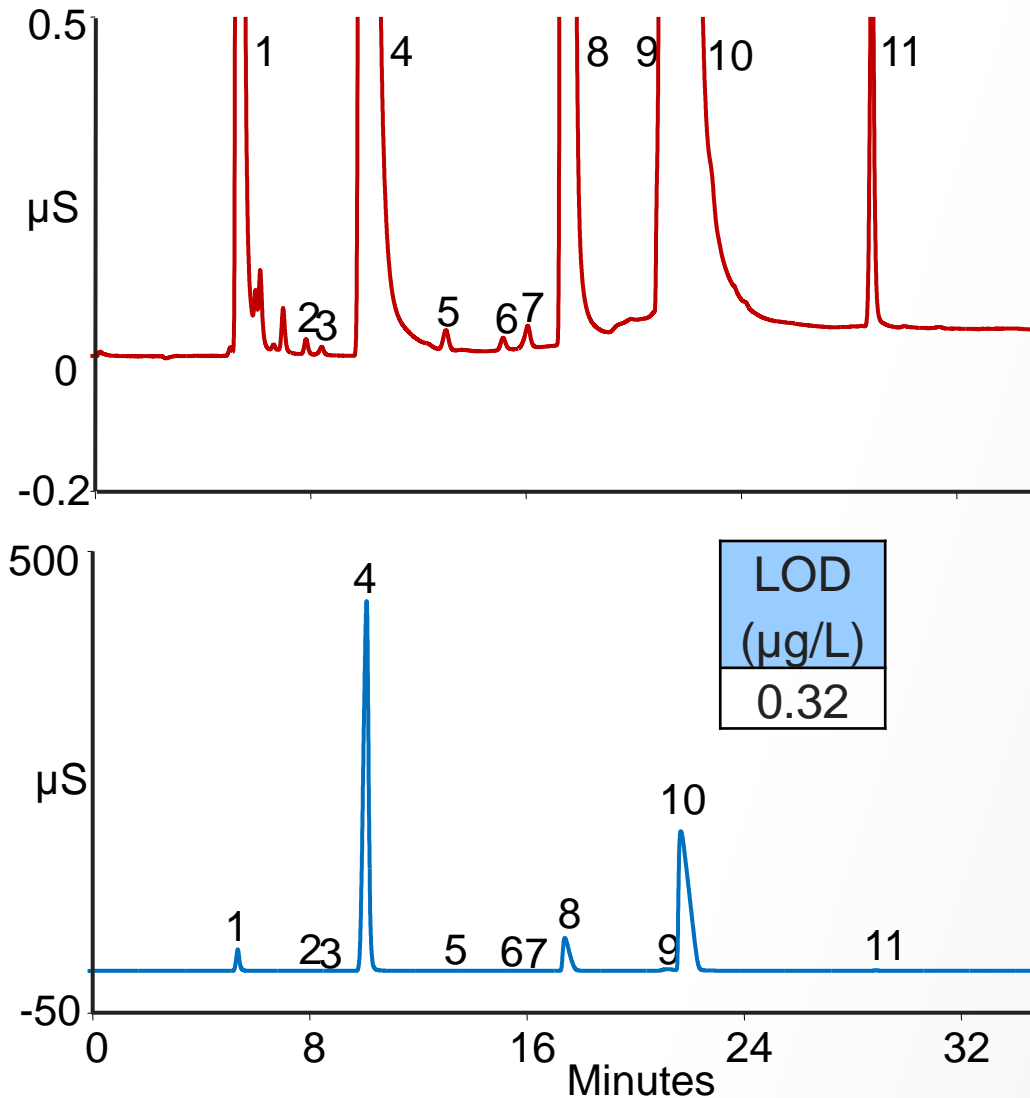
For IC, BioIC, and Cap IC

- 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

IC Supports a Wide Diversity of Application Areas

- Environmental
- Food & Beverages
- Agricultural Products
- Power & Energy Production
- Chemical & Petrochemical
- Pharmaceutical & Biotechnology
- Electronics, Semiconductors & Plating
- Personal Care & Household Products
- Forensics

Determination of Anions and Trace Bromate Using IonPac AS19-4 μ m column



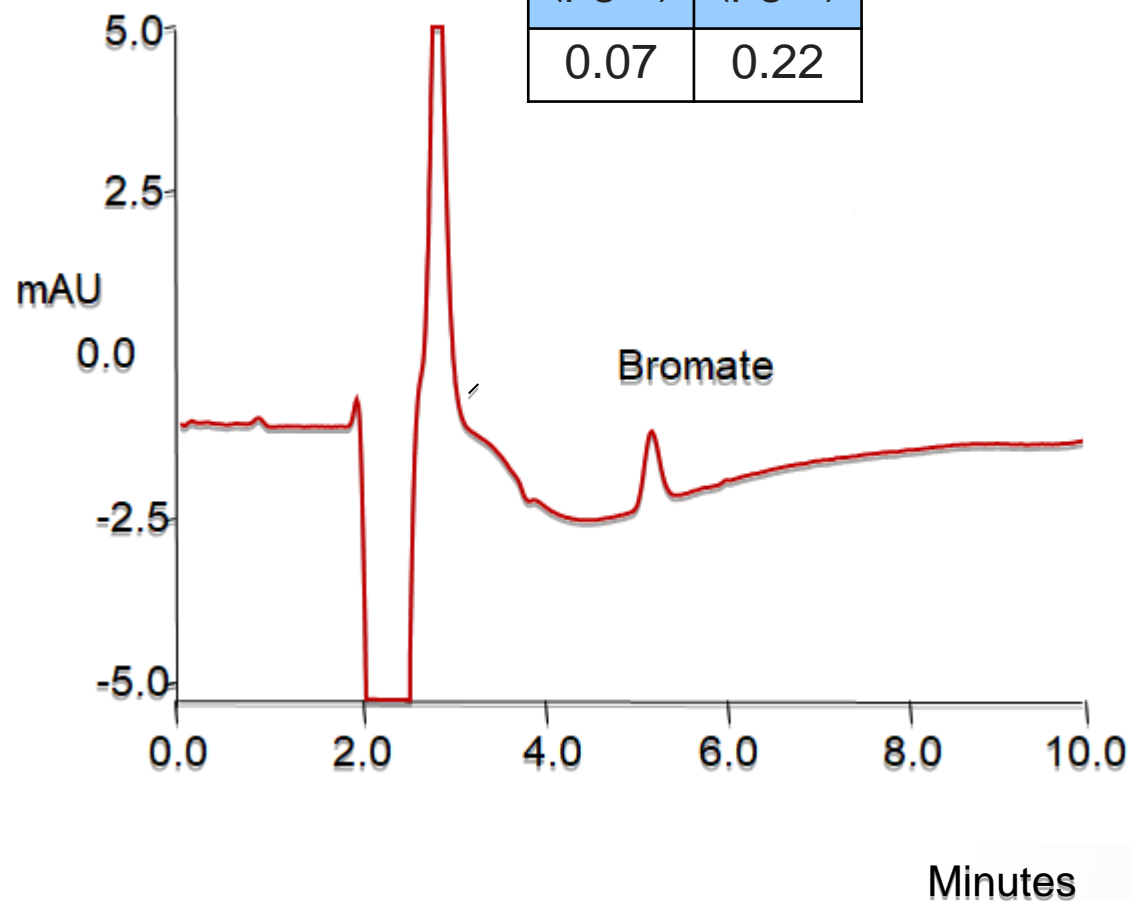
System: Thermo Scientific™ Dionex™ ICS-5000+ HPIC system
 Column: Thermo Scientific™ Dionex™ IonPac™ AS19-4 μ m + guard (4 \times 250 mm)
 Eluent : 10 mM KOH from 0 to 10 min, 10–45 mM KOH from 10 to 25 min
 Eluent Source: Thermo Scientific™ Dionex™ EGC 500 KOH Cartridge
 Flow Rate: 1.0 mL/min
 Inj. Volume: 200 μ L
 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		

Recommended hydroxide column for EPA Method 300.0 (B)

Bromate Determination by Post Column Derivatization and UV Detection

LOD ($\mu\text{g/L}$)	LOQ ($\mu\text{g/L}$)
0.07	0.22



Column: Thermo Scientific™ Dionex™
CarboPac™ PA1
(4 X 250 mm)

Eluent: 200 mmol/L MSA

Flow: 1 mL/min

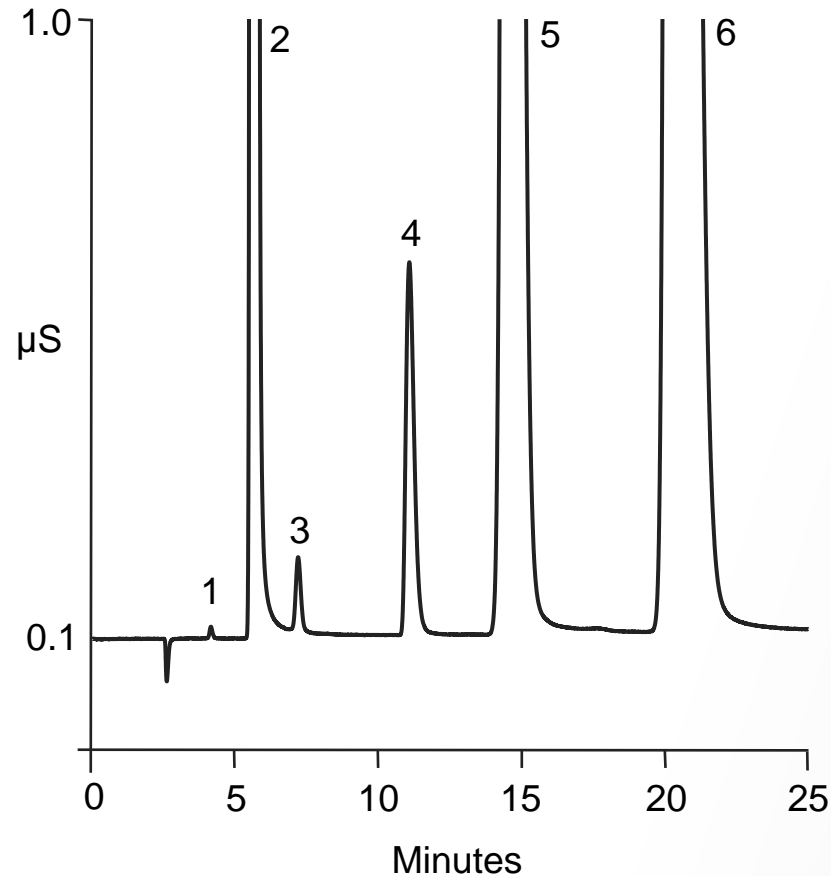
Injection vol.: 500 μL

Detection: UV 352 nm (after PCR)

Temperature: 30 °C

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

Municipal Drinking Water Analysis Utilizing a High-Capacity Cation Exchanger



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 & Beverage Components Analyzed by Ion Chromatography

- Inorganic anions
- Alkali- and alkaline-earth metals
- Organic acids
- Amines
- Carbohydrates
- Alcohols
- Amino acids

Food & Beverage Components Analyzed by Ion Chromatography

- Inorganic anions
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Dionex's IC Columns for Carbohydrates Analysis

Column	Applications
CarboPac SA10, CarboPac SA10-4 μ m and CarboPac SA10-Fast-4 μ m	Fast and high capacity separation of mono and disaccharides in biofuels, foods, and beverages.
CarboPac PA210-Fast-4 μ m	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-4 μ m	Fast high resolution separation of mono-, di-, tri-, tetra- and pentasaccharides
CarboPac MA1	Reduced mono- and disaccharides such as alditols and other sugar alcohols

Dual EGC – Ease of Use Tool for Complex Carbohydrate Analysis

Main Components of Dual EGC - For Analytical & Cap Formats



Dual EGCs – MSA& KOH



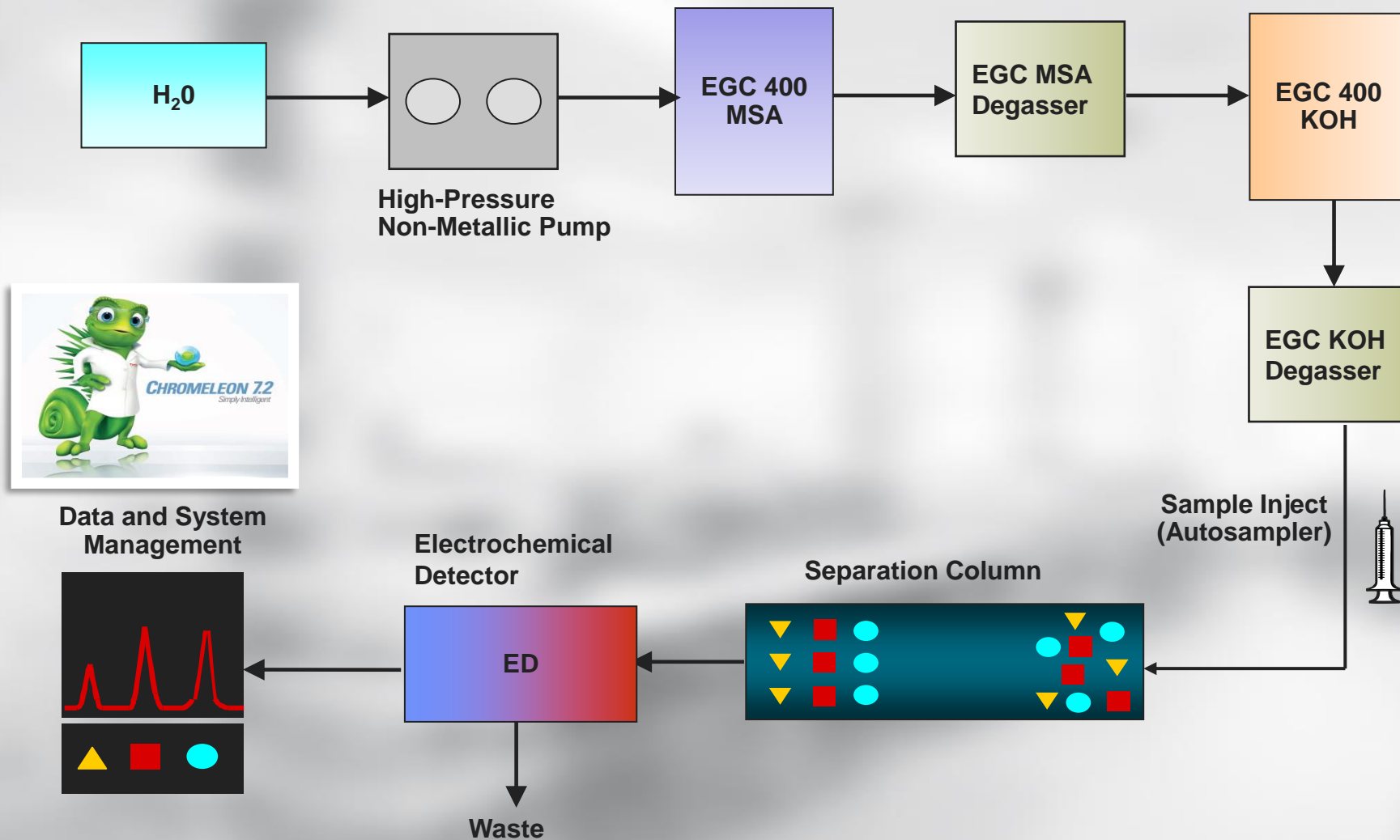
Separation + Guard columns



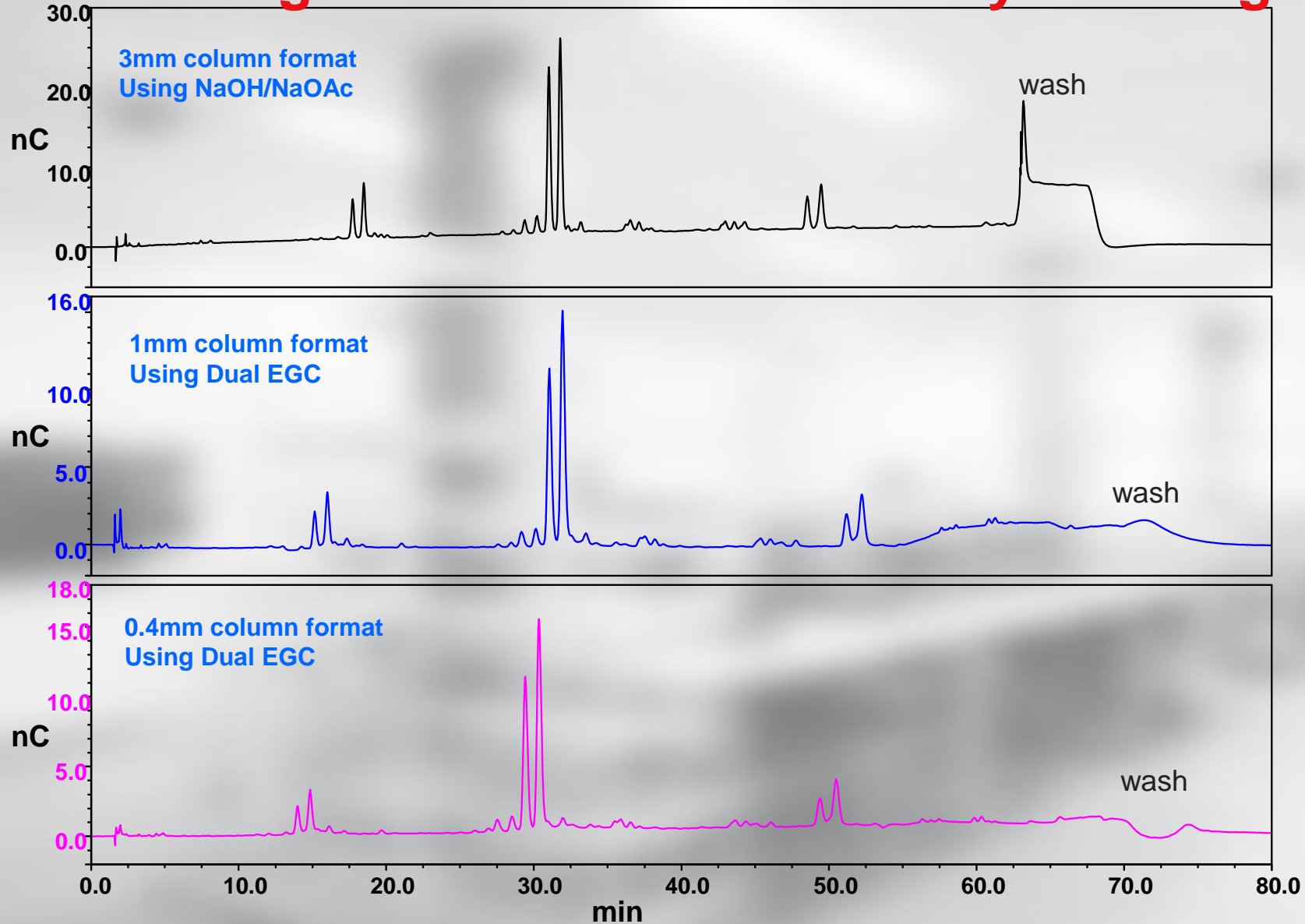
CM7 adjustments

- ✓ Leverages RFIC capabilities to electrolytically generate potassium hydroxide / potassium methanesulfonate (KOH/KMSA) eluents.
- ✓ Can replace manual NaOH/NaOAc gradients required for analyzing complex carbohydrates
- ✓ Will now allow our Cap IC systems to perform the complex carbohydrate analysis
- ✓ Available formats - capillary (0.4 mm) and analytical (1.0 mm)

ICS-6000 System Workflow under Dual EGC Mode



Fetuin Oligosaccharide Alditol Analysis using Dual EGC



Columns: CarboPac PA200, 3 mm (guard + separator)
CarboPac PA200 1-mm (guard + separator)
CarboPac PA200 0.4-mm (guard + separator)

Gradient: CarboPac PA200, 3 x 250 mm
0-60 min: 20-150 mM NaOAc in 100 mM NaOH
60-65 min: 500 mM NaOAc in 100 mM NaOH
65-80 min 20 mM NaOAc in 100 mM NaOH

CarboPac PA200, 1 x 250 mm
0-50 min: 15-64 mM KMSA in 136 mM KOH
50-60 min: 80 mM KMSA in 90 mM KOH
60-65 min: 100 mM KMSA in 100 mM KOH
65-80 min: 15 mM KMSA in 136 mM KOH

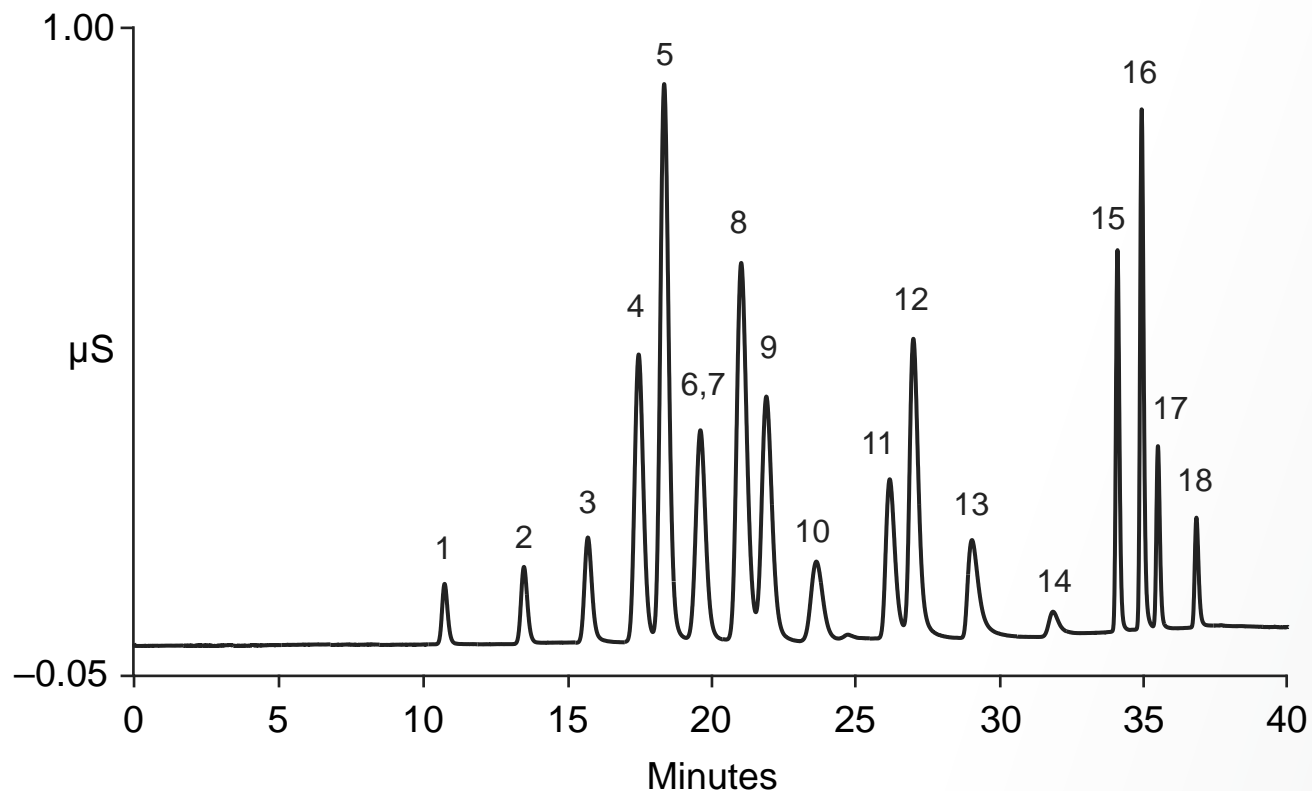
CarboPac PA200, 0.4 x 250 mm
0-50 min: 15-64 mM KMSA in 136 mM KOH
50-60 min: 80 mM KMSA in 90 mM KOH
60-65 min: 100 mM KMSA in 100 mM KOH
65-80 min: 15 mM KMSA in 136 mM KOH

Flow Rate: CarboPac PA200, 3 x 250 mm: 0.5 mL/min
CarboPac PA200, 1 x 250 mm: 0.063 mL/min
CarboPac PA200, 0.4 x 250 mm: 0.010 mL/min

Detection: CarboPac PA200, 3 x 250 mm:
PAD, Au on PTFE, 2 mil gasket, Ag/AgCl ref.
CarboPac PA200, 1 x 250 mm:
PAD, Au on PTFE, 1 mil gasket, Ag/AgCl ref.
CarboPac PA200, 0.4 x 250 mm:
PAD, Au on PTFE, 1 mil gasket, Ag/AgCl ref.

Samples: 50 µmol/L fetuin oligosaccharide alditol standard

Amines of Interest in the Petrochemical Industry



Column: Dionex IonPac CS18, 2 mm
Eluent: 0.5 mmol/L MSA (EG)
Gradient: 1 mmol/L at 20 min, to 4 mmol/L at 28 min, to 11 mmol/L at 34 min
Flow rate: 0.3 mL/min
Temperature: 50 °C
Inj. volume: 5 µL
Detection: Suppressed conductivity, Autosuppression, recycle mode

Peaks:		
1.	Lithium	0.05 mg/L
2.	Sodium	0.2
3.	Ammonium	0.25
4.	Ethanolamine	3.0
5.	Methylamine	3.6
6.	Diethanolamine	3.6
7.	Potassium	0.5
8.	Ethylamine	3.0
9.	Dimethylamine	1.4
10.	<i>N</i> -methyldiethanolamine	3.0
11.	Morpholine	3.2
12.	1-Dimethylamino-2-propanol	3.7
13.	<i>N</i> -methylmorpholine	7.5
14.	Butylamine	1.5
15.	Magnesium	0.25
16.	Calcium	0.5
17.	Strontium	0.5
18.	Barium	0.5

Ion Chromatography Analyses for Pharmaceutical Industry

- Counterions (anions, cations) analysis
- Assays analysis
- Impurity analysis
- Saccharides analysis
- Sialic acids analysis
- Glycans analysis
- Glycoproteins analysis
- Amino acids analysis

- See <https://www.thermofisher.com/sk/en/home/industrial/pharma-biopharma/pharma-biopharma-learning-center/pharmaceutical-qa-qc-information/drug-monographs-assays-ion-chromatography.html>

ASSAYS

- Sodium thiosulfate
 - Titration replaced by IC assay
 - IonPac AS12A L105 column
- Sodium thiosulfate injection
 - Wet chemistry-based identification replaced with IC assay
 - IonPac AS12A L105 column
- Sodium fluoride oral solution
 - Ion Selective Electrode (ISE) procedure replaced by IC assay
 - CarboPac PA1 L46 column
- Sodium Monofluorophosphate
 - Titration replaced with IC assay
 - IonPac AS18 L113 column

IDENTIFICATION TEST

- Choline fenofibrate
 - IonPac CS12A L106 column
- Sodium Monofluorophosphate
 - Precipitation replaced with IC assay
 - IonPac AS18 L113 column

General Chapter USP <591> Zinc Determination

- Response to request by the FDA to improve methods and thereby quality of OTC products.
- Assay of Zinc content in Zinc-containing drugs
- IonPac CS/GC5A L100 column.
 - Zinc Oxide Powder
 - Zinc Oxide
 - Zinc Oxide Neutral
 - Zinc Sulfate Ophthalmic Solution

IMPURITY

- Triptorelin Pamoate
 - IonPac AS10 L31 column with the AG10 L112 – new designation-column preceding it for a test for acetic acid
- Fludeoxyglucose F 18 Injection
 - CarboPac PA1 L46 column
- Polidocanol
 - Limit of Formic Acid and Acetic Acid IonPac ICE-AS1 L22 column
- Sodium Monofluorophosphate
 - Limit of Fluoride Ion test replaced with IC assay using IonPac AS18 L113 column

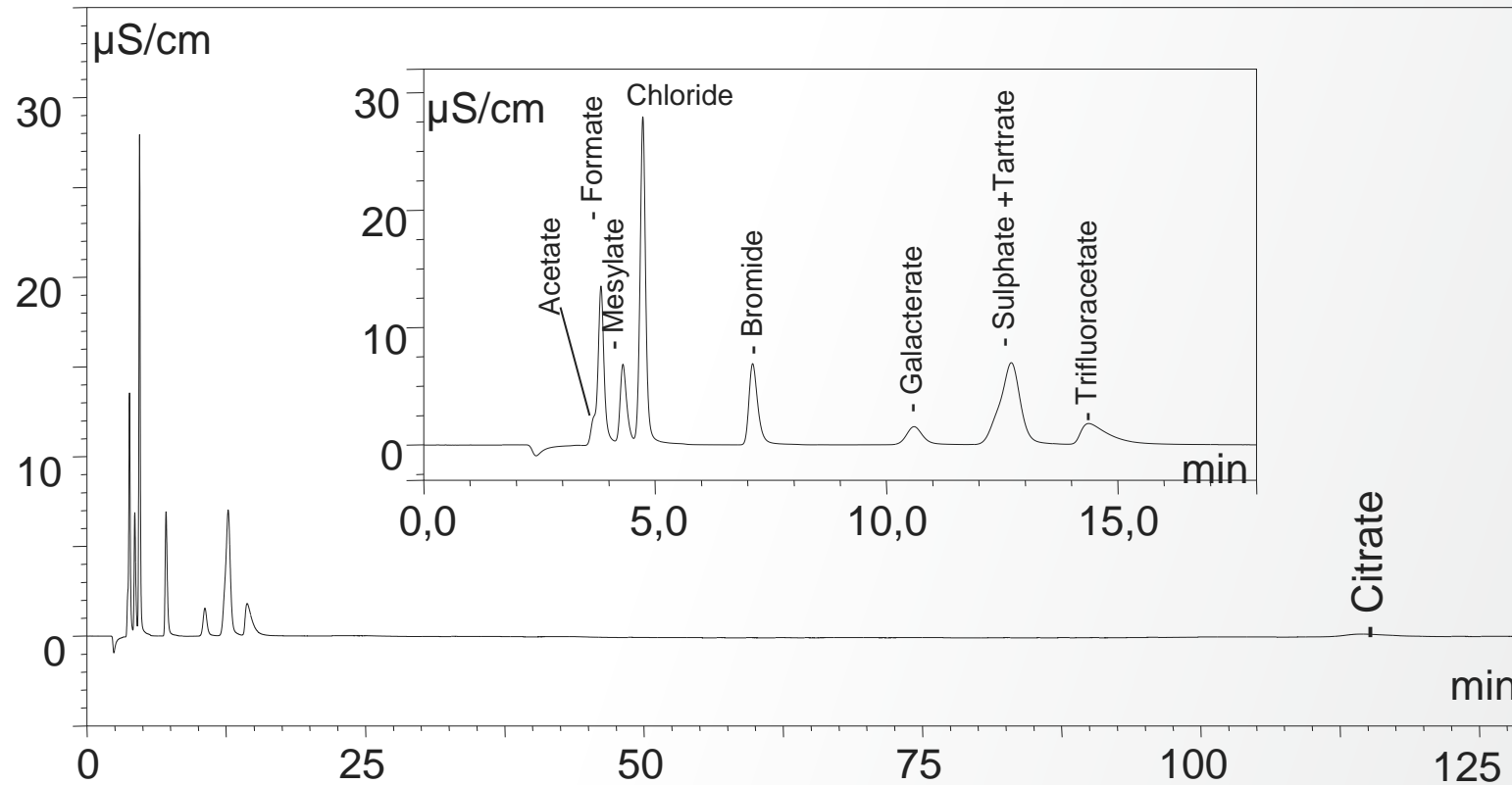
USP Modernization IC Methods

Matrix	Analyte	Test	Detector	AN
Monoclonal antibodies	Sialic acid	Assay	ED	
Sodium bicarbonate	Ammonia	Impurity	CD	AN1073
Pharmaceuticals	Citrate, phosphate	Assay	CD	AU205
Lithium carbonate	Lithium, sodium, calcium	Assay, impurity	CD	AN1090
Lithium citrate	Lithium	Assay	CD	AN1121
Lithium hydroxide	Lithium	Assay	CD	AN1144
Sodium nitrite	Nitrite, nitrate	Assay, impurity	CD	AN1148
Aminoglycosides	Sulfate, anions	Counterion, impurity	CD	
Tolterodine tartrate	Tartaric acid	Counterion	CD	AN1002
Topiramate	Sulfate, sulfamate	Assay	CD	AN238



Pharmaceutical Formulations – Isocratic Elution

Typical counter ions in pharmaceutical formulations – isocratic elution

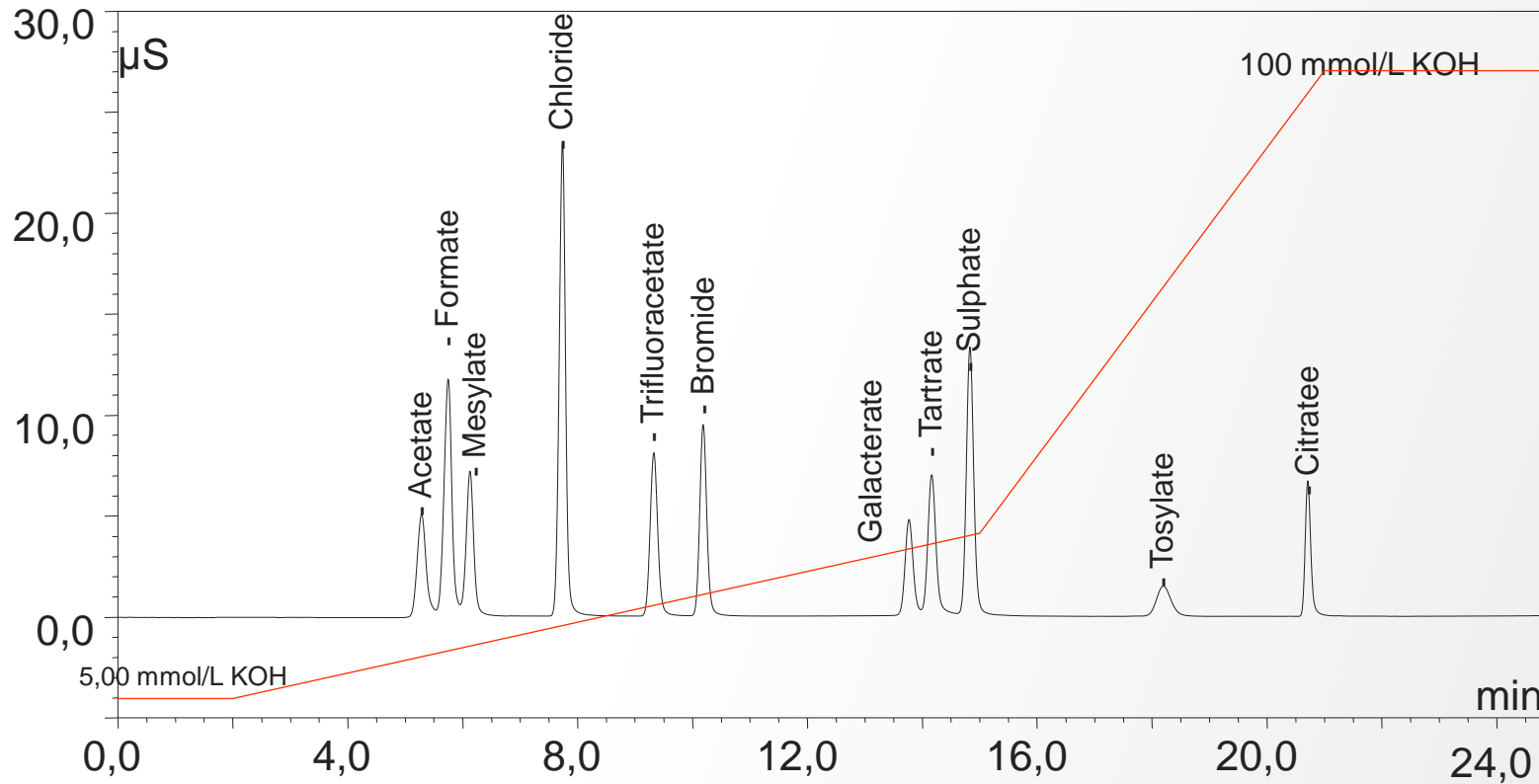


Column: Dionex IonPac AG14, AS14 (2-mm)
Eluent: 3,5 mmol/L Na_2CO_3 + 1 mmol/L NaHCO_3
Flow: 0,3 mL/min
Injection: 10 μl

Detection: Suppressed Conductivity
Suppressor: Dionex AMMS-III Anion MicroMembrane
Suppressor, 2 mm, DCR-Modus
Regenerant: 20 mmol/L H_2SO_4
Standard: 10 mg/L

Pharmaceutical Formulations – Gradient Elution

Typical counter ions in pharmaceutical formulations – gradient elution



Column: Dionex IonPac AG16, AS16 (2-mm)
Eluent: KOH-Gradient (Reagent-Free IC)
Temp.: 30 °C
Flow: 0,25 mL/min

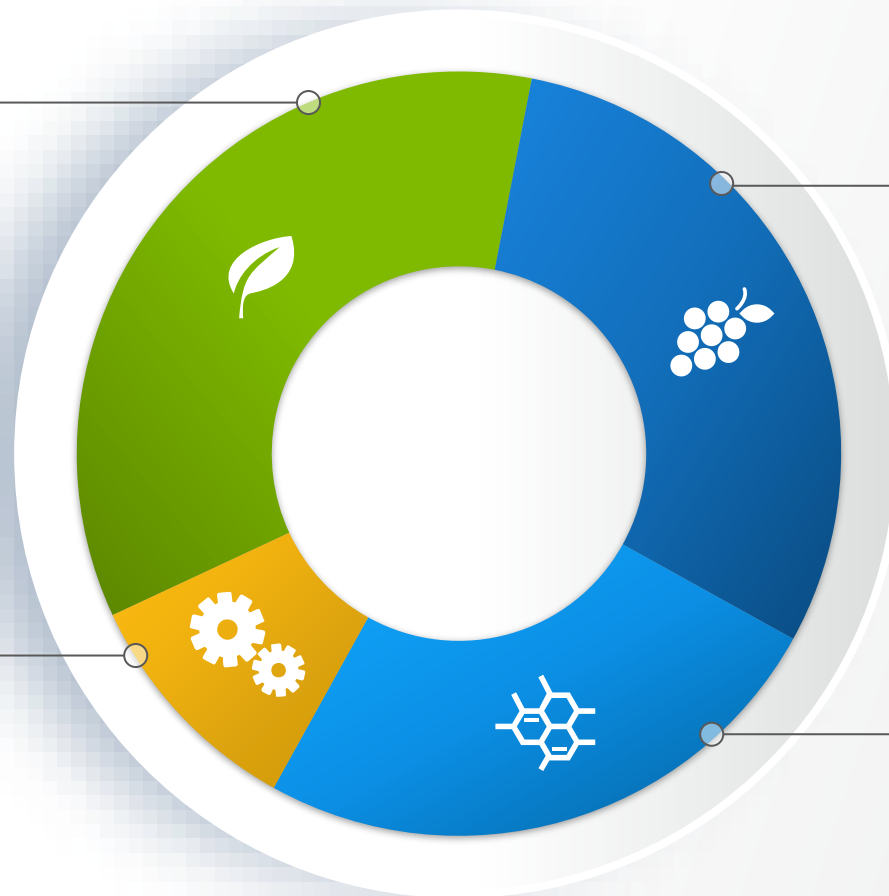
Injection: 10 µL
Detection: Suppressed Conductivity
Suppressor: Dionex ASRS-Ultra-II Anion Self-Regenerating Suppressor, 2 mm
Standard: 10 mg/L each

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

- Glyphosate, Glufosinate/AMPA (ionic pesticides)
- Perchlorate in vegetables
- Organic acids

- Anions in brewing industry

Metabolomics

- Sugar phosphates
- Sugar amines

Speciation with IC-ICP-MS

- IC-ICP-MS is the ideal choice for trace elemental speciation because:



- **Dionex IC systems are entirely metal-free (PEEK)**
- Fully integrated systems with Chromeleon plug-in for Qtegra enables seamless control of both units
- Powerful separation chemistries with a wide selection of columns also for specialized applications
- Reagent-Free Ion Chromatography (RFIC) for ease of use

The IC-ICP-MS Bundles

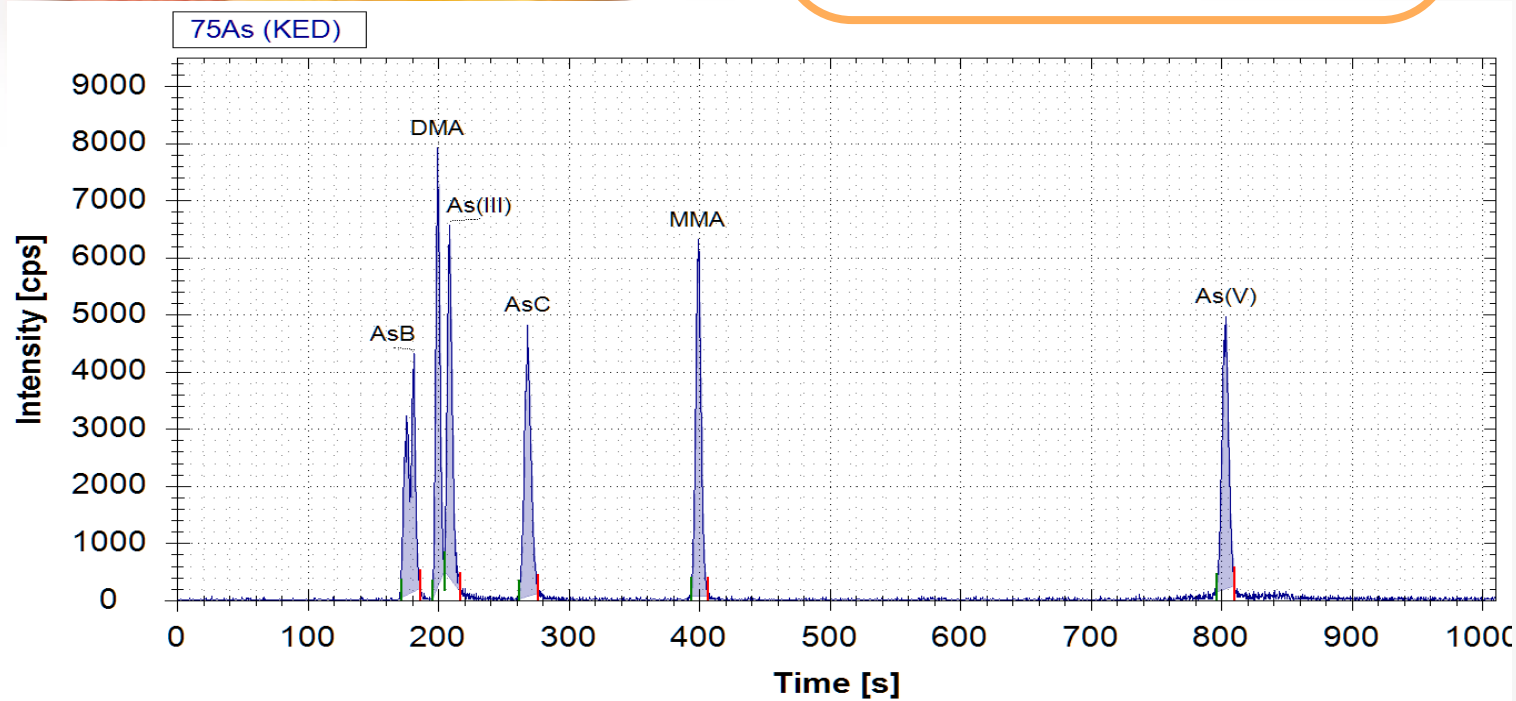
IC	Pump Channels	Autosampler	Column heater	RFIC	Elution possibilities	Applications
ICS-6000	Quaternary	AS-AP	✓	optional	Gradient - full flexibility	As, Br, Cr, Fe, Hg, I, Se, Sn

As speciation by 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

Sample Prep Systems are Key Enablers for GC and LC



Vanquish UHPLC



AutoTrace 280



ASE 350

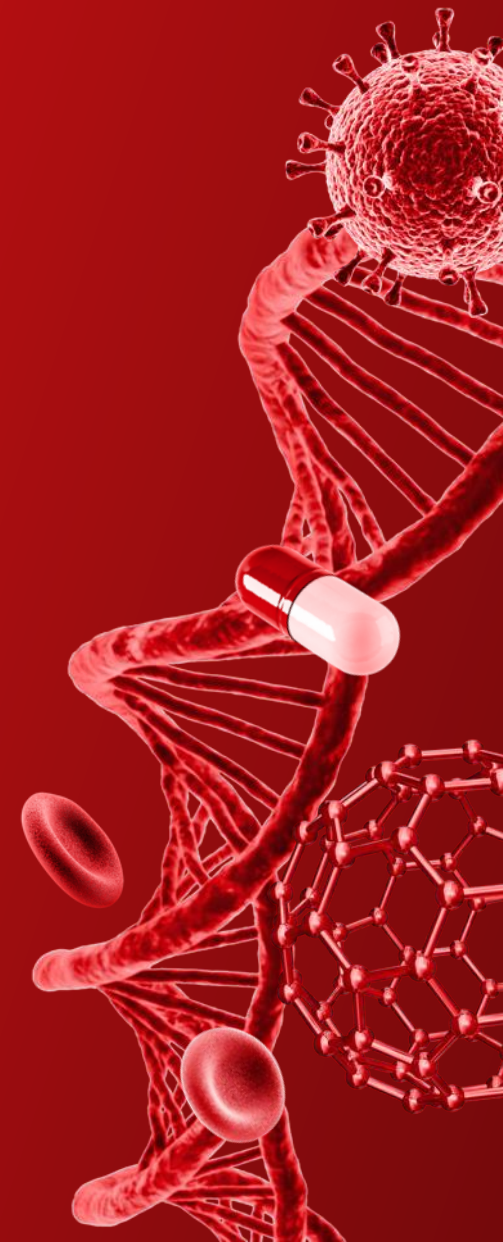


TSQ 8000 Evo

Sample Prep Systems Create Immediate Selling Opportunities

- Sample Prep is required prior to GC, GC-MS, LC, and LC-MS
- Opportunities to replace Soxhlet, sonication, and LLE
- Opens the door into labs using competitor's analytical equipment
- Enables us to position a total workflow single vendor solution

Thank you



A scenic mountain landscape with hikers on a trail, overlaid with a red geometric graphic. The background shows a dirt path winding through a lush green valley with yellow wildflowers in the foreground. Two hikers are visible on the path, one in the foreground and one further ahead. In the distance, there are majestic mountains with patches of snow under a blue sky with scattered clouds. A large, semi-transparent red graphic with a geometric pattern is overlaid on the right side of the image, framing the text.

We take pride in our Mission

We enable our customers
to make the world
**Healthier, Safer
and Cleaner**