



ThermoFisher
S C I E N T I F I C

What is new in Ion Chromatography and Sample Preparation

Roman Repas
Alternate Channels Sales Manager, EMEA, IC/SP
Dreieich, Germany

The world leader in serving science

Thermo Scientific Dionex Ion Chromatography Product Line

RFIC

HPIC



Dionex Aquion



Dionex Integrion



Dionex ICS-4000

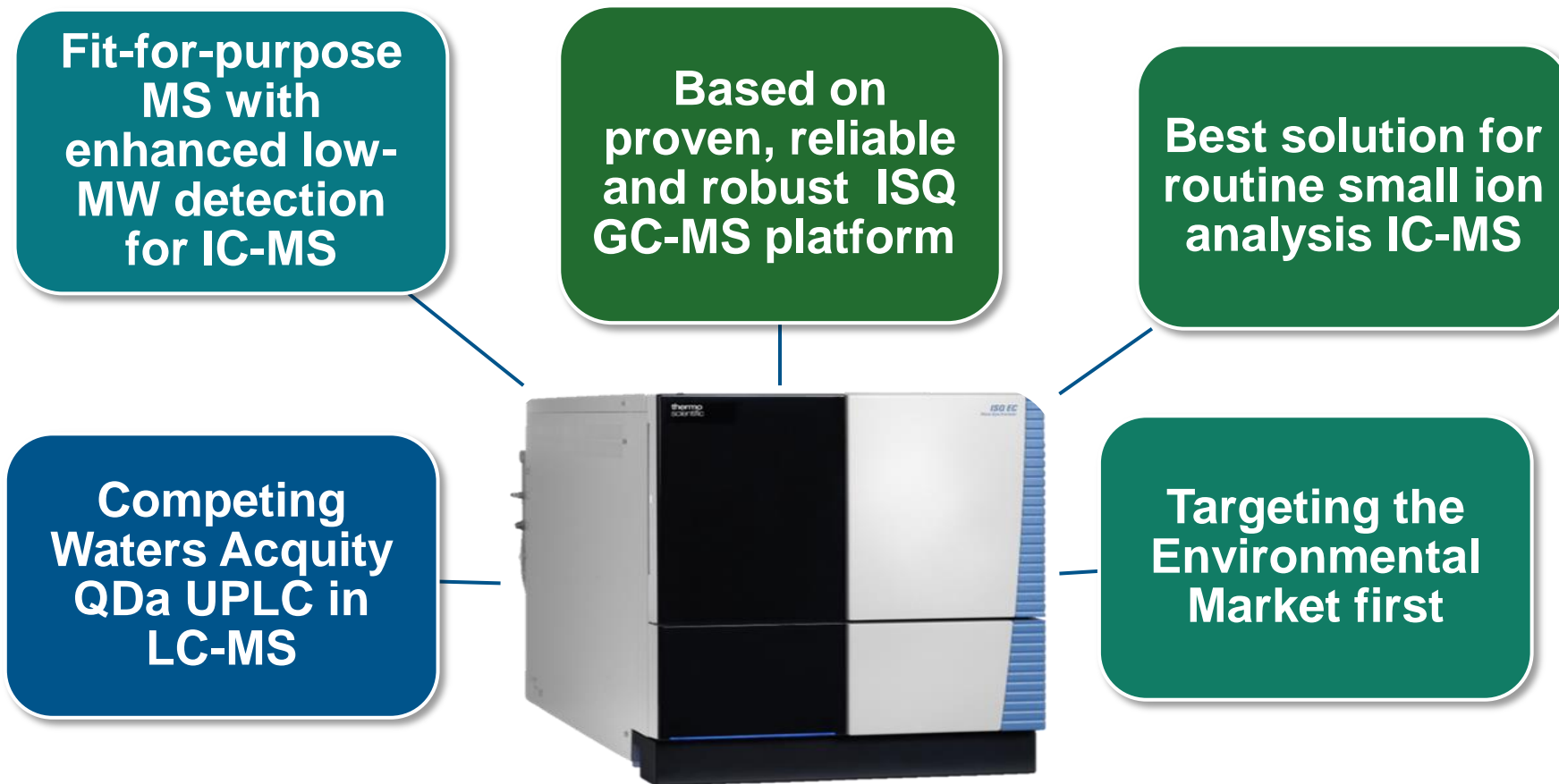


Dionex ICS-5000+



Feature / Value

| Feature | Value | Aquion | Integrion | ICS-4000 | ICS-5000+ |
|---|---|--------|-----------|----------|-----------|
| 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 | | ✓ | ✓ | ✓ |
| QD Charge Detection | Expanded capabilities | | | ✓ | |
| High Pressure IC up to 5000 psi | Increased throughput, expanded capabilities | | ✓ | ✓ | ✓ |
| Capillary IC Capability | Operational savings, expanded capabilities | | | ✓ | ✓ |
| Modularity | Capital savings | | | | ✓ |
| Configurable as Independent Dual System | Capital savings | | | | ✓ |
| Proportioned Mechanical Gradients | Expanded capabilities | | | | ✓ |
| 2-D Chromatography | Expanded capabilities | | | | ✓ |



New ISQ EC Single Quadrupole MS for IC and HPLC

At launch in June 2017:

- ESI only, no APCI
- Mass range **10** – 1250 m/z
- Requires no make-up solvent for most IC-MS (matrix dependent)
- Chromeleon 7 only (no Xcalibur)



Unique robustness and performance in a routine MS.

Stacking up ISQ EC vs MSQ Plus: Instrument Specifications

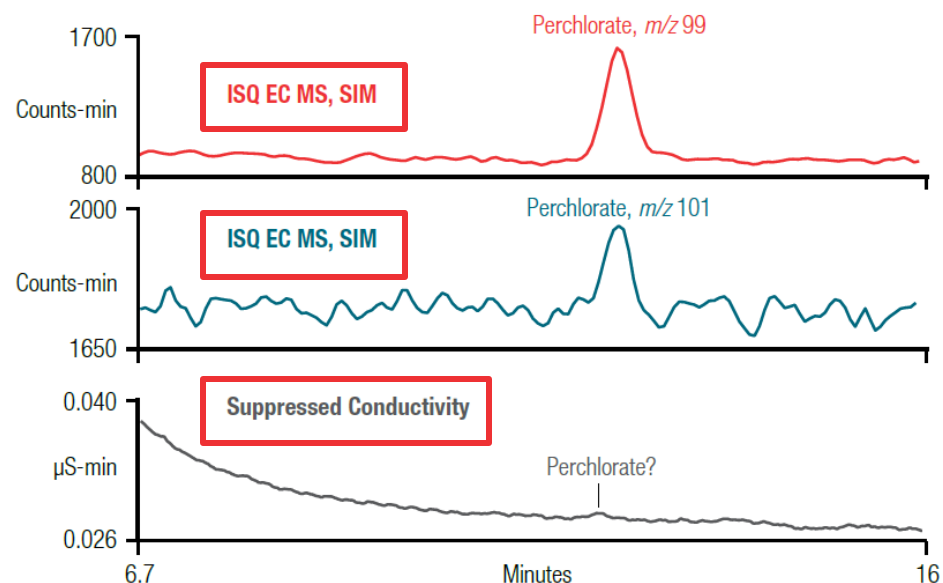
| Specification | ISQ EC | MSQ Plus |
|---------------------------|--|--|
| Mass Range (m/z) | 10–1250 | 17–2000 |
| Source Type | ESI | ESI / APCI |
| Supported Modes | Full scan / SIM | Full scan / SIM |
| ESI Max Flow Rate | 2 mL/min | 2 mL/min |
| Scan Rate, max (Da/s) | 20,000 | 12,000 |
| SIM Sensitivity (ESI+) | 10 pg Reserpine 400:1 | 50 pg erythromycin 1,000:1 |
| Polarity Switching | Yes, 25 ms | Yes, 240 ms |
| Mass Resolution | Unit (≤ 1.0 Da) | Unit (≤ 1.0 Da) |
| Mass Accuracy / Stability | $\leq \pm 0.1$ Da ≤ 0.1 Da over 24 h | $\leq \pm 0.3$ Da ≤ 0.1 Da over 24 h |
| Digital Dynamic Range | 10^7 | 10^4 |
| Roughing Pump | External oil-based rotary | External oil-based rotary |
| Power | 100-240 VAC 50/60Hz | 240 VAC 50/60 Hz |
| | ← 3x better → | |
| Reserpine MDL* (pg) | 0.3 ← 3x better → | 1.0 |
| Erythromycin MDL* (pg) | 0.08 | 0.25 |



Applications :
Environmental Labs (IC-MS)
Perchlorate, bromate, amines,
ionic pesticides

Academia and Contract Labs
(IC-MS) ca. 120 low mass analytes
in environmental matrices

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



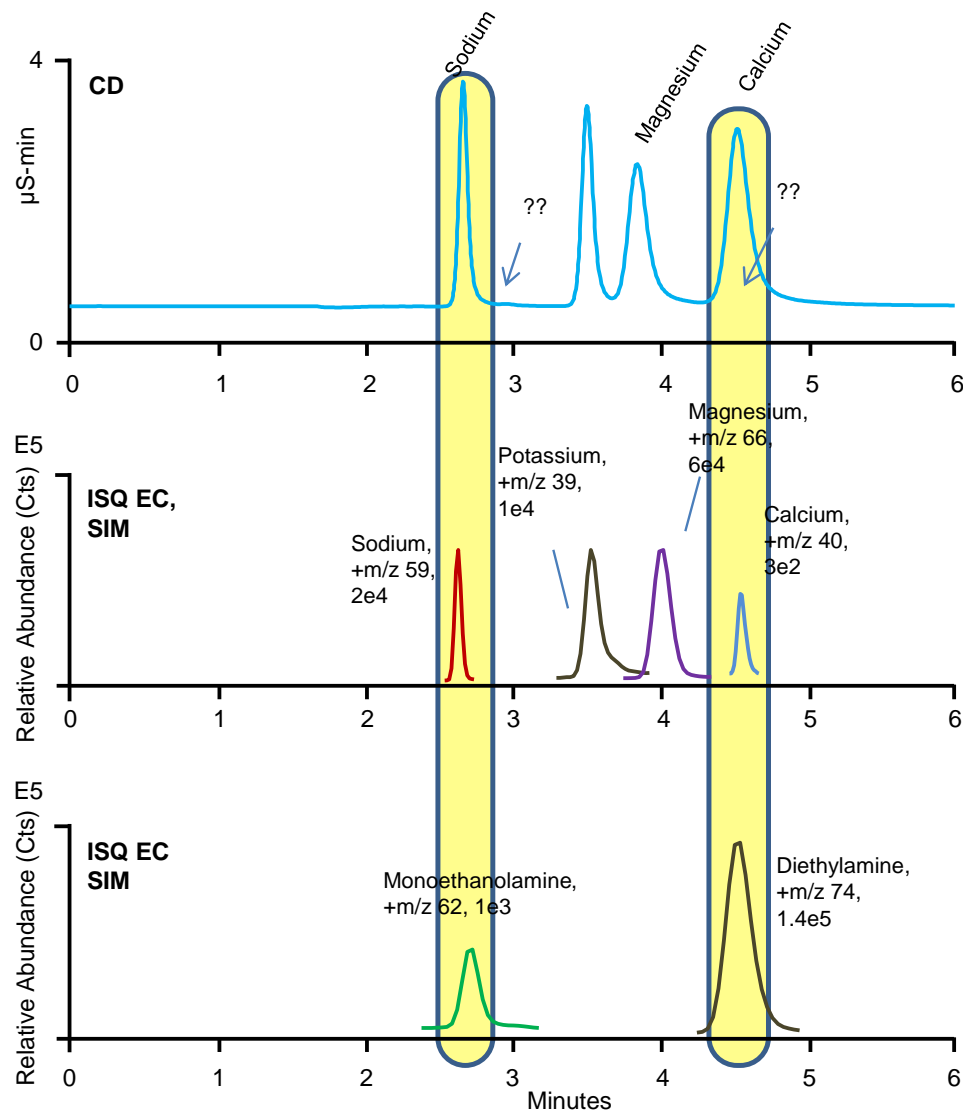
- High toxicity of perchlorate
- Necessary to quantify at very low levels
- Traditional suppressed IC systems struggle with reporting limits
- IC-MS an order of magnitude more sensitive than conductivity detection
- U.S. EPA has adopted IC-MS:
EPA Method 332.0

SIM traces 99 and 101: strong response

SIM 99: more sensitive as chloride 35 isotope more abundant, but interfering sulfate background

SIM 101: less sensitive as chloride 37 is less abundant, but no fewer interferences

Required LODs are not achievable by Conductivity Detection alone



Columns: Dionex IonPac CG12A, CS12A, 3 mm
Eluent: 33 mM Methanesulfonic Acid (MSA)
Flow rate: 0.5 mL/min
Inject volume: 100 μL
Oven temperature: 30 $^{\circ}\text{C}$
Detector 2: ISQ EC, +ESI, +3000 V source, HESI II
Scan mode: Full scan: 18-250 m/z , SIM
SIM mode from M/Z 39 to 150 as native ions or water adducts (Sodium as $\text{Na}\cdot 2\text{H}_2\text{O}$, Magnesium as $\text{Mg}_2\cdot\text{H}_2\text{O}$)

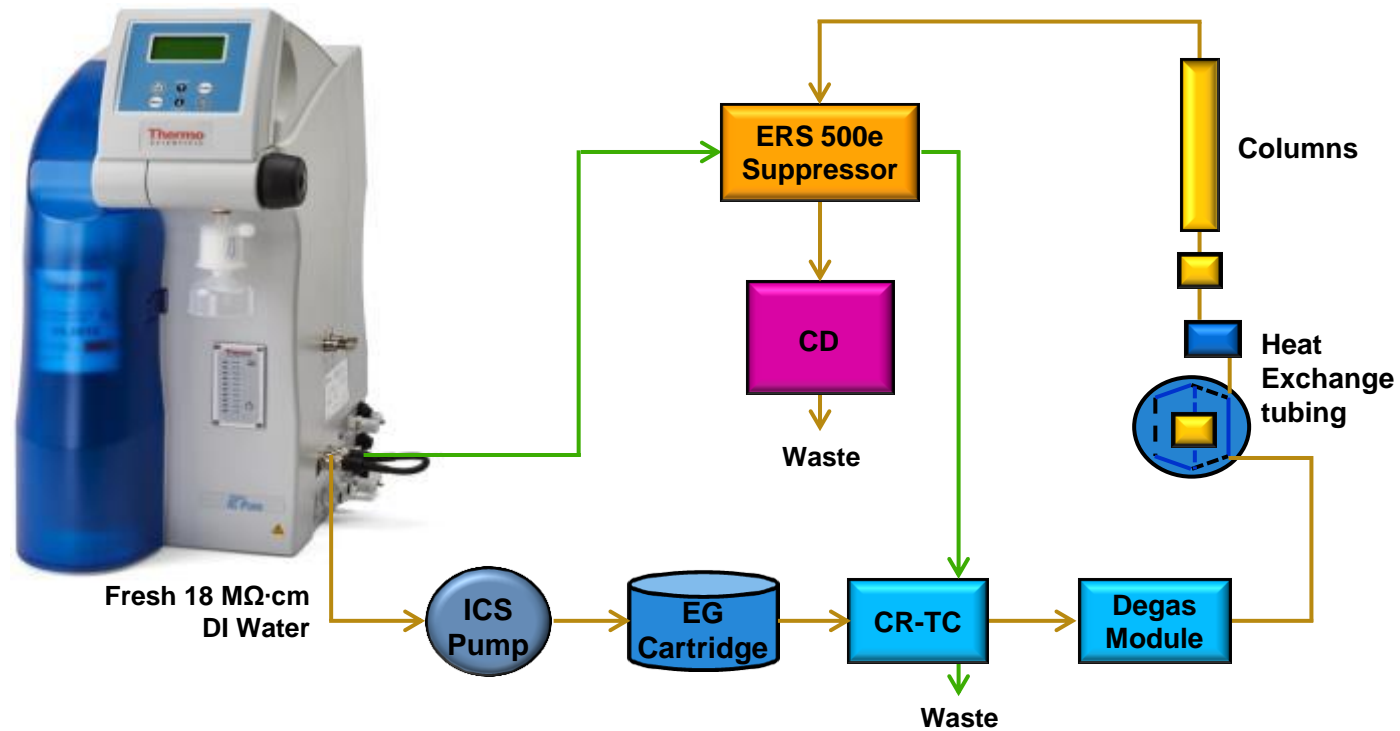
Monoethanolamine (m/z 62) and diethylamine (m/z 74) were previously undetected by suppressed conductivity

Resolve monoethanolamine and diethylamine in MS dimension

IC Pure Water Purification System



- Direct supply of ultrapure water into a Thermo Scientific™ Dionex™ Reagent-Free™ Eluent Generation (RFIC™-EG) system and Thermo Scientific™ Dionex™ ERS™ 500e suppressor
- Uses either potable or ASTM Type II water



Dionex IC Pure System Features

- In-line Connection for RFIC-EG Systems
 - 3 psi pressurized ultrapure water for electrolytic eluent generation
 - 30 psi pressurized ultrapure water for electrolytic suppressors operating in external water mode
- Multiple RFIC-EG Systems Support
 - Provides ultrapure water for one or two RFIC-EG systems or channels on one Thermo Scientific™ Dionex™ ICS-5000+ HPIC™ system



Inline connection
for RFIC-EG
systems

Superior addition to the RFIC-EG family

Dionex IC Pure System Features

- Internal 5 L Tank
 - Easy addition of pretreated water (ASTM Type II)
 - Long refill cycle requires less operator time and attention
- External 20 L Tank with Automated Refilling Station – Optional
 - Provides large reservoir of pretreated, **or potable tap water** (with the pretreatment cartridge)
 - Refills automatically

External 20 L tank with automatic filling station



Internal 5 L tank

Flexible options

Dionex IC Pure System Features

- **Ultrapure Cartridge**
 - Produces ultrapure water with maximum resistivity (18.2 MΩ·cm) and low TOC (< 5 µg/L)
 - Removes
 - Ionic contaminants with mixed-bed anion- and cation-exchange resins
 - Organic contaminants and chlorine with activated carbon resins
- **Pretreatment Cartridge – Optional**
 - Allows the use of potable water as a feed source with no pretreatment
 - Removes bacteria, colloids, inorganic and organic solids with a reverse osmosis membrane



Flexible options

Dionex IC Pure System Features

- In-line Ultrafilter
 - Removes microorganisms and particles
 - Size exclusion membrane filter (pore sizes < 10 nm)
 - Prevents plugging of valves and flow paths
- Onboard Conductivity/ TOC Meters
 - Provides readout of water quality
 - Warns when consumable change is required
 - Notifies when feed water quality is bad
- External Final 0.2 μm Filter
 - Removes particles and bacteria



Flexible options

General Information: International Water Standards

- The Thermo Scientific™ Dionex™ IC Pure™ Water Purification System meets the requirements of international water standards for ultrapure water:
 - American Society for Testing and Materials (ASTM) D1193
 - International Organization for Standardization (ISO) 3696

| Measurement (unit) | ASTM D1193 Type I Water | ISO 3696 Grade 1 Water | Typical Water Produced with Dionex IC Pure System |
|-----------------------------|--------------------------------|-------------------------------|--|
| Resistivity (MΩ·cm) | > 18 | > 10 | Up to 18.2 |
| Conductivity (μS/cm) | < 0.056 | < 0.1 | 0.055 |
| Total Organic Carbon (μg/L) | < 50 | n/a | < 5 |
| Sodium (μg/L) | < 1 | n/a | Meet ASTM Standards |
| Chloride (μg/L) | < 1 | n/a | Meet ASTM Standards |
| Total Silica (μg/L) | < 3 | < 10 | Meet ASTM Standards |
| Bacteria (CFU/mL) | < 1 | n/a | Meet ASTM Standards |

Thermo Scientific Dionex Sample Prep Product Line



Thermo Scientific™ Dionex™
TMASE™
150 and 350 Accelerated Solvent
Extractor



Thermo Scientific Dionex
AutoTrace™ 280 Solid-
Phase Extraction (SPE)
Instrument



Thermo Scientific
Dionex SolEx™ SPE
Cartridges



Genevac Rocket™
Evaporator

Novel & Innovative Solutions



40 *years of*
INNOVATION

ASE: For Solid and Semi-Solid Samples

ASE 150

- Low end system
- Ideal for low-throughput labs
- Smaller footprint that is economically priced
- Fast & efficient extraction of a single sample



ASE 350

- High end system
- Ideal for high throughput labs requiring automation
- Unattended extraction of up to 24 samples
- Mixing or selection of three different solvents for complex extractions

AutoTrace 280: For Liquid Samples

- Automated SPE instrument for large volume aqueous samples (20 mL to 4 L)
- Supports SPE cartridges or 47 mm discs
- Automatically conditions, rinses, and elutes SPE cartridges with a choice of 5 solvents or reagents
- Extracts 6 samples simultaneously with unattended operation
- All SPE parameters automatically controlled
- Offers choice of four different collection vial racks



The Rocket: For Sample Evaporation

- Five times faster than conventional evaporators
- Evaporates directly into 60 mL ASE vials
- Does not evaporate into 250 mL ASE bottles
- Evaporates directly into GC autosampler vials
- Fully automated for unattended operation



Rocket Evaporator



Rocket Evaporator



ASE Pucks



Flip Flop Vials

- Fully Automated Workflow: Fills gap not addressed by ASE or AutoTrace
- Reduces Laboratory Error: Pucks allow direct sample transfer from the ASE
- Expedites Sample Processing: Flip Flops evaporator directly into autosampler vials

Dionex Aquion

Anion and Cation capability to ppb levels

Dionex ERS Electrolytic suppressors

- No regenerant needed
- No additional peristaltic pump

Column Heater: field upgradeable option

Piston seal wash (external pump req'd)

Optional degas

Eluent shut-off valve

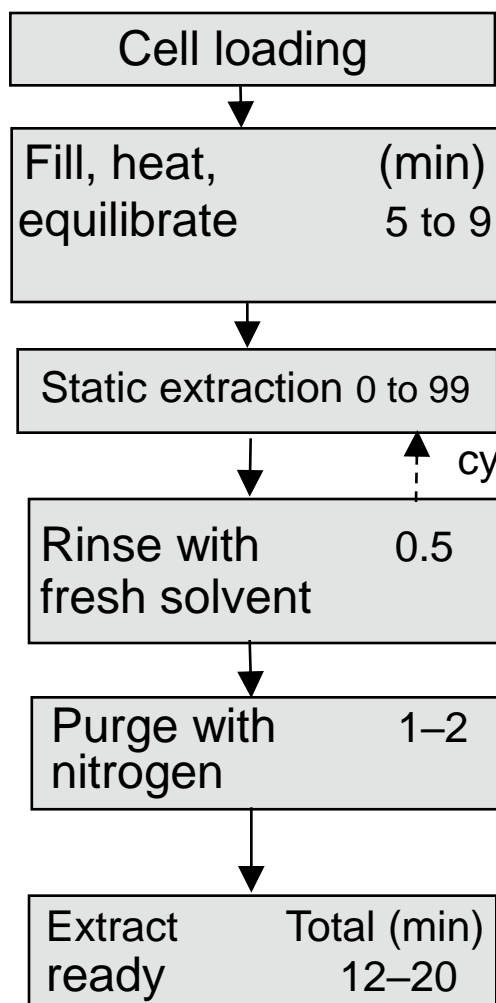
Sample prep

- AutoDilution
- Sample pre-concentration
- Matrix elimination
- In-line filtration



| | Dionex Aquion IC System | Dionex Integrion HPIC System |
|-------------------------|--|--|
| Markets | <ul style="list-style-type: none"> • Routine Water Labs • Routine Food Beverage Labs • Academia | <ul style="list-style-type: none"> • Routine water labs • Routine Food Beverage Labs • High throughput contract laboratories |
| Samples per Week | <100 | >100 |
| Features | <ul style="list-style-type: none"> • Limited upgradability (only oven) • Standard pressure (3000 psi) • No consumable tracking | <ul style="list-style-type: none"> • Modular upgradability • High pressure (5000 psi) • Viper fittings standard • Consumable tracking • Installation and troubleshooting videos |

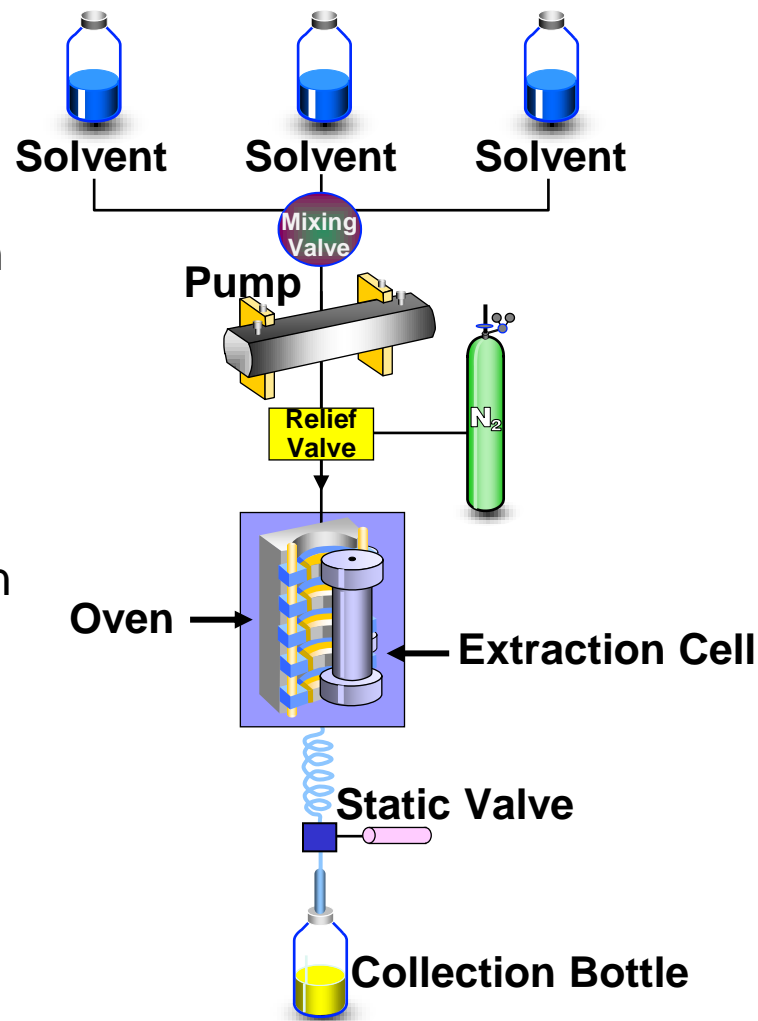
How Does Accelerated Solvent Extraction Work?



dynamic extraction

static extraction

dynamic extraction



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