MINIMIZE ANALYST INTERVENTION AND REDUCE SAMPLE VOLUMES

Performing off-line SPE and liquid-liquid extraction can be labor intensive and requires numerous vessel transfers that can increase the likelihood of analyst error. In addition, certain applications can require large sample volumes and tedious sample preparation.

UPLC with On-line SPE Technology allows cleanup, concentration, and direct injection to the analytical column, which eliminates manual intervention and reduces sample volume. Sample extracts are loaded directly into the autosampler for preparation and analysis—no additional sample transfer is required. Once samples are set up, analysts are free to focus on more important tasks.

REDUCE SAMPLE PREPARATION AND ANALYSIS TIMES BY OVER 90%

Following autosampler loading, the sample is injected onto an extraction column packed with sorbent. During the loading phase, target analytes are trapped at high flow rates on the SPE sorbent, while unretained interferences are directed to waste. Next, the sample is subjected to a mild wash, followed by elution onto a high-resolution analytical column for separation and analysis. This configuration allows the SPE extraction cartridges to be operated in parallel. Automated software tools, pre-loaded methods, and four solvent options allow cleanup of the extraction column to be easily optimized, minimizing analyst carryover and potential interferences.

With this on-line configuration, the time required for sample preparation and analysis can be reduced from up to 3 hours to as little as 15 minutes—a reduction of over 90%.

WATERS UPLC WITH ON-LINE SPE TECHNOLOGY

Automated on-line SPE with the performance of UPLC

SAMPLE PREPARATION AND ANALYSIS IN MINUTES

Waters UPLC with On-line SPE Technology dramatically improves the analyst’s ability to process water samples by providing analyte extraction, cleanup, concentration, separation, and detection in one turn-key solution. Automated sample handling, proprietary chromatographic media, and ultra-sensitive optical and mass spectrometry detection have been combined into an on-line SPE/LC/MS/MS solution that requires only a fraction of the typical sample volume. With the first UPLC-pressure enabled, analytical scale on-line SPE system, the time required for preparation and analysis, once measured in hours, has been reduced to minutes.

Key benefits for laboratory operations:

- Quality—Automated sample processing ensures reproducible results by eliminating manual variability.
- Throughput—Sample analysis and preparation times reduced by up to 90%. Accommodate more samples and run them in less time.
- Flexibility—Functions as an on-line SPE system and a stand-alone UPLC system with multiple optical and mass spectrometer detection options. Maximize laboratory asset utilization.
- Cost—the use of significantly smaller sample volumes can reduce shipping costs from remote locations.
- Productivity—Reduces sample processing time. Scientists can allocate more time to other laboratory tasks.

Eliminates Manual Interference.

INCREASE THROUGHPUT WITHOUT INCREASING COST.

Minimize labor cost without sacrificing throughput and quality. With Waters UPLC with On-line SPE Technology, analysts can achieve higher throughput with minimal equipment investment. The automated sample handling and analysis process require only a fraction of the sample volume used in off-line methods. This minimizes sample preparation costs and reduces labor time, allowing scientists to focus on other important tasks.

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On-line SPE/LC/MS/MS for the detection of:

- Endocrine disruptors
- Fungicides
- Herbicides
- Pesticides
- Personal care products
- Pharmaceuticals
- Soft drink additives
- Veterinary drug residues

Waters UPLC with On-line SPE Technology

Automated on-line SPE with the performance of UPLC

Waters Corporation
34 Maple Street
Milford, MA 01757 U.S.A.
T: 1 508 478 2000
F: 1 508 872 1990
www.waters.com

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SAMPLE PREP AND ANALYSIS TIMES

<table>
<thead>
<tr>
<th>TIME (HOURS)</th>
<th>SAMPLE PREP &amp; ANALYSIS TIMES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3</td>
<td>Off-line SPE with LC/MS/MS</td>
</tr>
<tr>
<td>0.5 0.5 0.5</td>
<td>On-line SPE with UPLC/MS/MS</td>
</tr>
</tbody>
</table>

Figure 2. Drinking water sample preparation and analysis times. On-line SPE with UPLC/MS/MS versus Off-line SPE with LC/MS/MS.

With this on-line configuration, the time required for sample preparation and analysis can be reduced from up to 3 hours to as little as 15 minutes, a reduction of over 90%.
COMpletely Integrated System

Waters UPLC with On-line SPE Technology is a completely integrated solution. Each component operates in concert to produce rapid, quality, consistent results. System components include:
- ACQUITY UPLC™ Quaternary Solvent Manager (QSM) – for injection, wash, and elution of SPE columns
- ACQUITY UPLC Binary Solvent Manager (BSM) – for injection, wash, and elution of SPE columns
- ACQUITY UPLC analytical columns
- STT Sample Manager – holds up to 16 x 2 mL samples or up to 20 single samples
- ACQUITY UPLC Detectors – Photodiode Array (PDA), fluorescence (FLR), and tandem quadrupole

Environmental Resource Associates (ERA), A WATERS COMPANY

To ensure the quality of your analytical data, ERA offers proficiency testing, certified reference materials, proficiency testing, certified analytical data, and standards.

Ultra Sensitivity – Easily Meet or Exceed Detection Requirements

Waters UPLC with On-line SPE Technology can be used with a range of Waters high-performance liquid and mass detectors – your laboratory will have the flexibility to analyze a wide variety of chemical compounds.
- ACQUITY UPLC PDA and FLR Detectors – Provide fast data acquisition capabilities for rapid analysis and the sensitivity required for trace impurity detection and quantification.
- ACQUITY TQD and Autospec TOF – The ultimate in quantitative capabilities. Designed to enable unprecedented access to superior UPLC/MS/MS performance – deliver the highest levels of sensitivity, selectivity, robustness, speed, and accuracy.
- ACQUITY TQD – A smaller, easy-to-use, tandem quadrupole mass spectrometer that provides robust performance and walk-up operation. Enables accurate, reproducible high-level quantitative analysis with reduced matrix interference.

Excellent Reproducibility and Linearity – More Confidence in Your Results

Waters UPLC with On-line SPE Technology provides excellent data reproducibility and linearity. Results from 10 concentration replicates with a density at 20 ppt show little variation in peak area or retention times, with no degradation in either the chromatograms or analysis results. A 10-point calibration curve of cyanazine demonstrates accurate and precise quantification capabilities.

Advanced Data Management

Waters UPLC with On-line SPE Technology provides advanced data management capabilities to help improve and streamline workflows.
- IntelliStart™ Technology – Automatically opens user setup and optimization screens that contain all of the necessary information to quickly produce high-quality results.
- Quanpedia™ – Rapidly creates LC/MS/MS data acquisition and processing methods and seamlessly transfers from one Waters UPLC with On-line SPE system to another.
- TargetLynx™ Application Manager – Quantiﬁes and conﬁrms contaminants while eliminating time-consuming, costly manual checks.
- MassLynx™ Mass Spectrometry Software – For comprehensive instrument control and data processing.
ANALYZE A WIDE RANGE OF COMPOUND TYPES
Waters UPLC with On-line SPE Technology is a completely integrated solution. Each component operates in concert to produce rapid, quality, consistent results. System components include:

- ACQUITY UPLC® Quaternary Solvent Manager (QSM) – For loading, washing, and reconditioning the extraction column.
- ACQUITY UPLC® Binary Solvent Manager (BSM) – For elution and separation of analytes.
- Oasis and XBridge extraction columns
- ACQUITY UPLC® Detector Module – Photodiode Array (PDA), fluorescence (FLR), and tandem quadrupole
- ACQUITY TQD – A smaller, easy-to-use, tandem quadrupole mass spectrometer
- Xevo® TQ MS and Xevo TQ-S – The ultimate in quantitative capabilities.

ADVANCED DATA MANAGEMENT
Waters UPLC with On-line SPE Technology provides advanced data management capabilities to help improve and control workflow.

ENVIROMENTAL RESOURCE ASSOCIATES (ERA), A WATERS COMPANY
To ensure the quality of your analytical data, ERA offers proficiency testing, certified reference materials, and standards.

UPLC with On-line SPE Technology can be used with a range of Waters high-performance liquid and mass detectors – your laboratory will have the flexibility to analyze a wide variety of chemical compounds.

- ACQUITY UPLC PDA and FLR detectors – Provide fast data acquisition capabilities for rapid analyses and the sensitivity required for true trace impurity detection and quantification.
- Xevo® TQ MS and Xevo TQ-S – The ultimate in quantitative capabilities. Designed to enable unparalleled access to superior UPLC/MS/MS performance – deliver the highest levels of sensitivity, selectivity, robustness, speed, and accuracy.
- ACQUITY TQD – A small, easy-to-use, tandem quadrupole mass spectrometer that provides robust performance and walk-up operation. Enables accurate, reproducible low-level quantitative analysis with reduced matrix interferences.

COMpletely Integrated System
Waters UPLC with On-line SPE Technology is an innovative integration of pumps and columns that allow for loading, washing, and separation in a pre-column that dramatically reduces analysis times.

EXCELLENT REPRODUCIBILITY AND LINEARITY – MORE CONFIDENCE IN YOUR RESULTS
Waters UPLC with On-line SPE Technology provides excellent data reproducibility and linearity. Results from 10 concentration repetitions with a pesticide at 20 ppt show little variation in peak areas or retention times, with no degradation in either the extraction or analytical column. A 10-point calibration curve of cyanazine demonstrates accurate and precise quantitative capabilities.

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**Detector Analytical Time %**

**HP Column**

- Improve recovery and reproducibility in a wide range of analytes.
- ACQUITY UPLC® FLD and FLR detection – Provide fast data acquisition capabilities for rapid analysis and the sensitivity required for trace impurity detection and quantification.
- Xevo® TQD and Xevo TQ-S – The ultimate in quantitative capabilities.
- ACQUITY UPLC PDA and FLR detectors – Provide fast data acquisition flexibility to analyze a wide variety of chemical compounds.

**ANALYZE A WIDE RANGE**

**Oasis and XBridge sample preparation columns**
- Waters UPLC with On-line SPE Technology is a completely integrated solution.
- Designed to enable uncomplicated access to superior UPLC/MS/MS performance – deliver the highest levels of sensitivity, selectivity, robustness, speed, and accuracy.
- To ensure the quality of your analytical data, ETRA offers proficiency testing, certified reference materials, and standards.

**ADVANCED DATA MANAGEMENT**
- rut**ExcITED Technology** – Automated mass spec setup and optimization ensure that all skill levels can quickly produce high quality results.
- Quanpedia**™** – Rapidly create LC/MS data acquisition and processing methods and seamlessly transfer from one UPLC with On-line SPE system to another.

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  - ACQUITY UPLC® Quaternary Solvent Manager (QSM) – To load sample, wash, and recondition the extraction column.
  - ACQUITY UPLC Bead Station Manager (BSM) – For elution and separation of the analytes.
  - Oasis and XBridge extraction columns.
  - ACQUITY UPLC analytical columns.
  - ACQUITY UPLC Six-port Sample Manager – Holds up to 64 x 2 mL samples or 8 x 20 mL samples.
  - ACQUITY UPLC Detectors – Photodiode Array (PDA), Fluorescence (FLR), and tandem quadrupole.

**Figure 1.** The UPLC with On-line SPE Technology is an innovative configuration of pumps and columns that allows for loading, wash, and recondition the extraction column.

**Figure 2.** The UPLC with On-line SPE Technology is an innovative configuration of pumps and columns that allows for loading, wash, and recondition the extraction column.

**Figure 3.** Sensitivity of UPLC with On-line SPE and Xevo TQ MS. Extracted ion chromatograms of pesticides at 10 ppt: Carbendazim (192.05 > 160.05); atrazine (216.1 > 174.0) and metolachlor (284.3 > 252.1).

**Figure 4.** Reproducibility of UPLC with On-line SPE and Xevo TQ MS. 10 overlayed extracted ion chromatograms of carbendazim (192.05 > 160.05) at 20 ppt. Percentage RSD (on area) = 1.25%.

**Figure 5.** Linearity of UPLC with On-line SPE and ACQUITY TQD. Cyanazine 12-point calibration from 10 to 5000 ppt. Percentage RSD (on area) = 0.6%.

**Figure 6.** Reproducibility of UPLC with the on-line SPE and ACQUITY TQD. Cyanazine 12 point calibration from 10 to 5000 ppt.

**Figure 7.** Sensitivity of UPLC with On-line SPE and ACQUITY TQD. Extracted ion chromatograms of cyanazine (120.8 > 99.6). Percentage RSD (on area) = 1.25%.

**Figure 8.** Sensitivity of UPLC with On-line SPE and ACQUITY TQD. Extracted ion chromatograms of cyanazine (120.8 > 99.6). Percentage RSD (on area) = 1.25%.

**Figure 9.** Sensitivity of UPLC with On-line SPE and ACQUITY TQD. Extracted ion chromatograms of cyanazine (120.8 > 99.6). Percentage RSD (on area) = 1.25%.
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T: 1 508 478 2000
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