# A Sustainable Approach to SVOC Analysis: Modernizing EPA 8270

**Session: Innovative Solutions for Reducing Methylene Chloride**

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Julian Martinez & Sarah Choyke Ph.D.

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# Emerging Tech Leads to Operational Tech

# Categorical Innovations

# Innovate or Get Left Behind

## New Technology:

- Better Sensitivity
- More Selectivity
- More Efficient

## Cost Savings:

- Smaller sample volume
- Less Solvent use (Methylene Chloride)
- Easier shipping and storage

## Cons:

- Change is scary
- NPDES Permits mandated methods/technology
- Regulations slow to adapt

# Reduce Dichloromethane use

- DCM ($MeCl_2$) is a hazardous solvent with strict handling and disposal requirements.
- Regulatory pressure from the 2024 EPA DCM Rule demands reduction.
- EPA **3510** (LLE), **3546** (Microwave), and **3550** (Ultrasonication) use DCM for EPA Methods 8081, 8082, 8141 & 8270
- Laboratories face increasing demand for sustainable, safer alternatives.


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# A Safer, Compliant Water SVOC Workflow


GC-MS/MS
GC-Triple Quad
GC- QQQ

- GC-MS/MS meets QA/QC and MDL/LOQ requirements.
- Align EPA's DCM Rule and ESG/sustainability goals.
- More sensitive & selective
- Developed in partnership with Shimadzu Scientific Instruments for GC-MS/MS method implementation.

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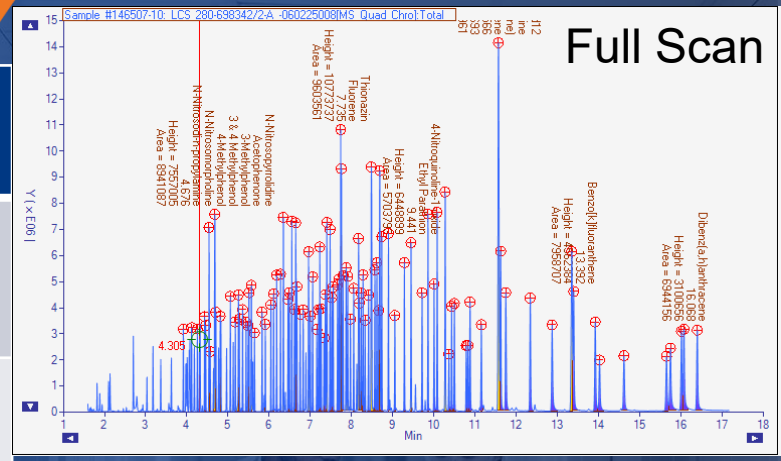
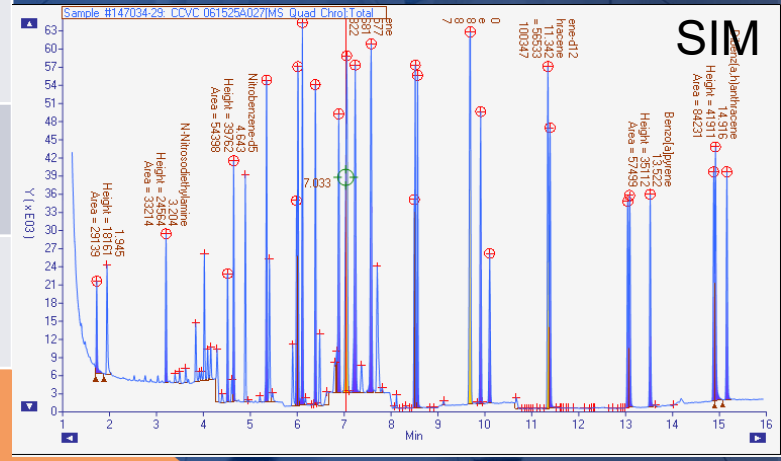
# EPA Method 3511 > Performance


- MDLs and LOQs comparable (or better)
- Less matrix
  - More passing QC
  - More stable internal standard recovery
  - Lower RPD/RSD
  - Less instrument maintenance

# Flavors of Gas-Chromatography – Mass Spectrometry

| Criteria | Full Scan | SIM |
|---|---|---|
| Description | Full mass range | Fragments for target analytes |
| Mass Range | Wide, Comprehensive | Specific ions |
| Sensitivity | Lower | Very high |
| Data output | Complete mass spectrum | Selected ions |
| Quantitation | Less robust | More robust |
| Library Search | Yes, including TIC | No |



# Flavors of Gas-Chromatography – Mass Spectrometry

| Criteria | Full Scan | SIM | MRM |
|---|---|---|---|
| Description | Full mass range | Fragments for target analytes | Full mass range & Fragments |
| Mass Range | Wide, Comprehensive | Specific ions | Wide and specific |
| Sensitivity | Lower | Very high | High |
| Data output | Complete mass spectrum | Selected ions | Selected ions for the full list |
| Quantitation | Less robust | More robust | Very robust |
| Library Search | Yes, including TIC | No | Yes, can include TICs |

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# GC-QQQ is the best of both worlds: Selectivity of SIM & Breadth of Full Scan

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## Multiple Reaction Monitoring (MRM)

- Gold Standard for selectivity and sensitivity

## High Throughput

- Fast scanning, 100s compounds in single analysis
  - SemiVolatiles
  - Organophosphorus Pesticides
  - Organochlorine Pesticides
  - PCBs

## Low Detection Limits

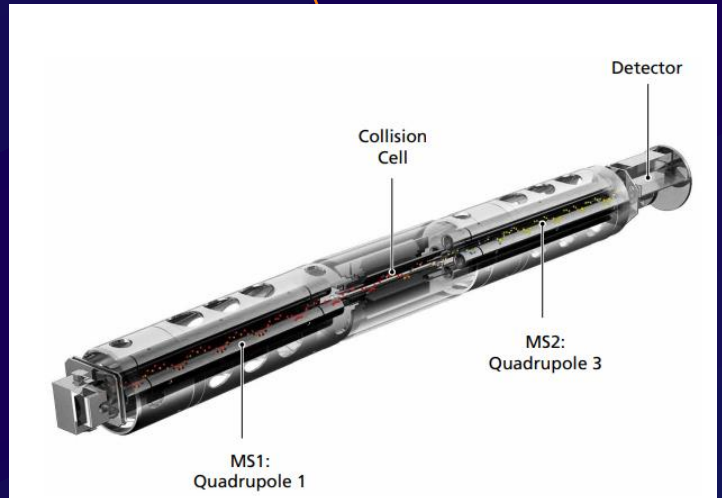
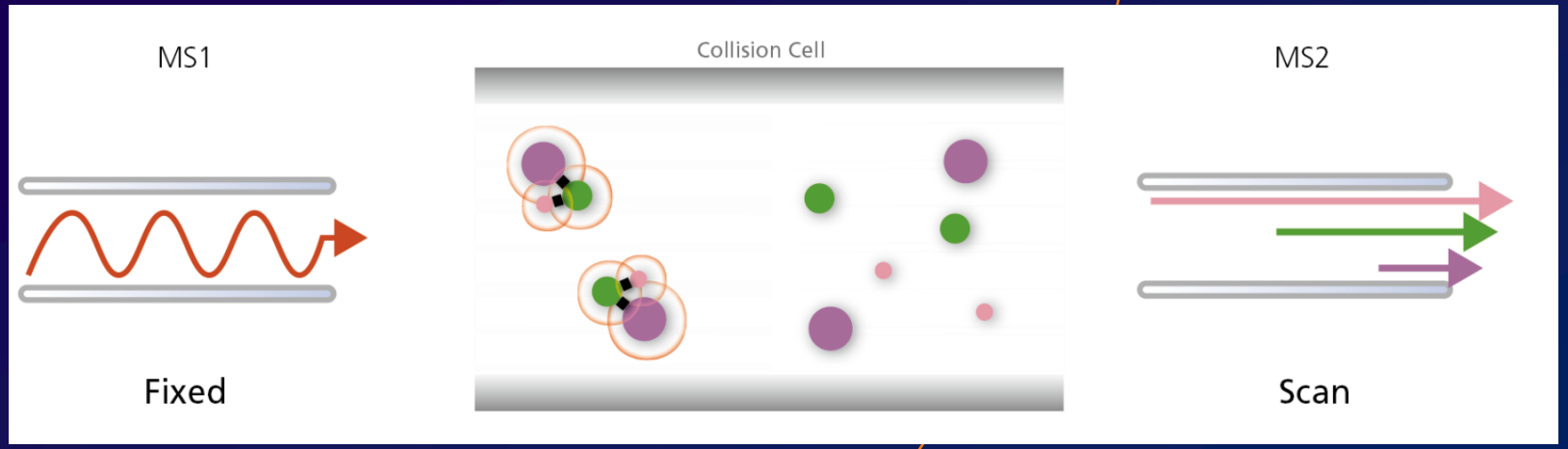
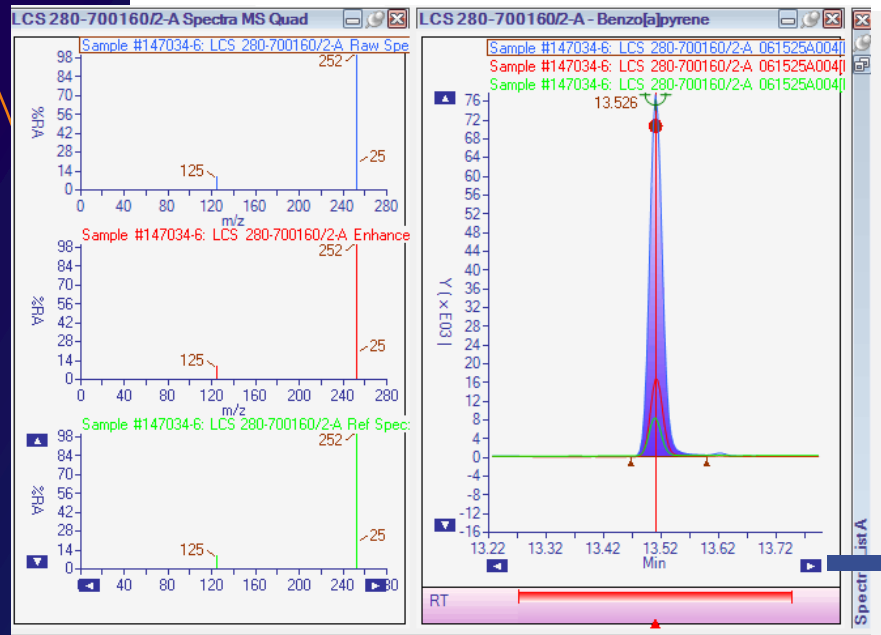


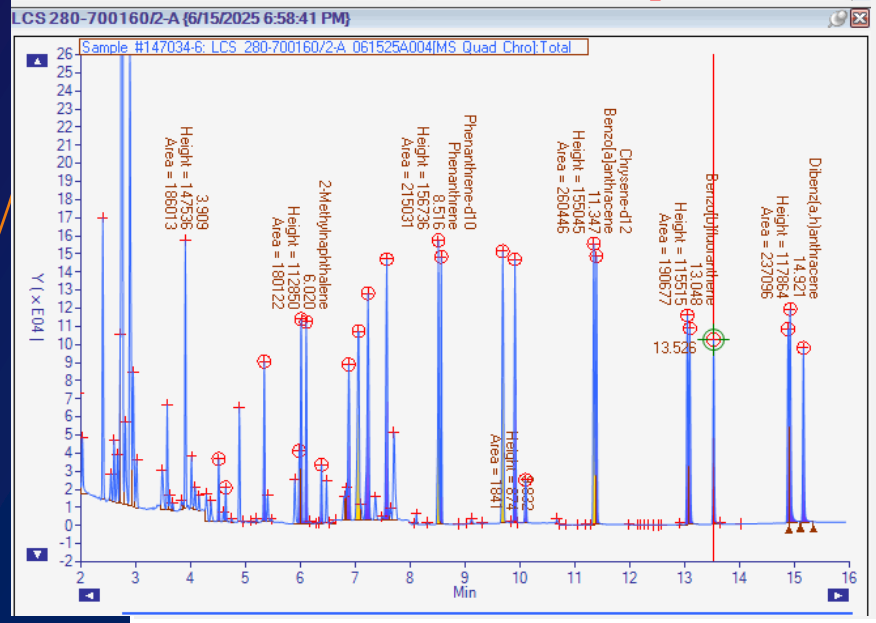
Figure 31. Instrumentation of Triple Quadrupole Mass Spectrometry (TQMS).

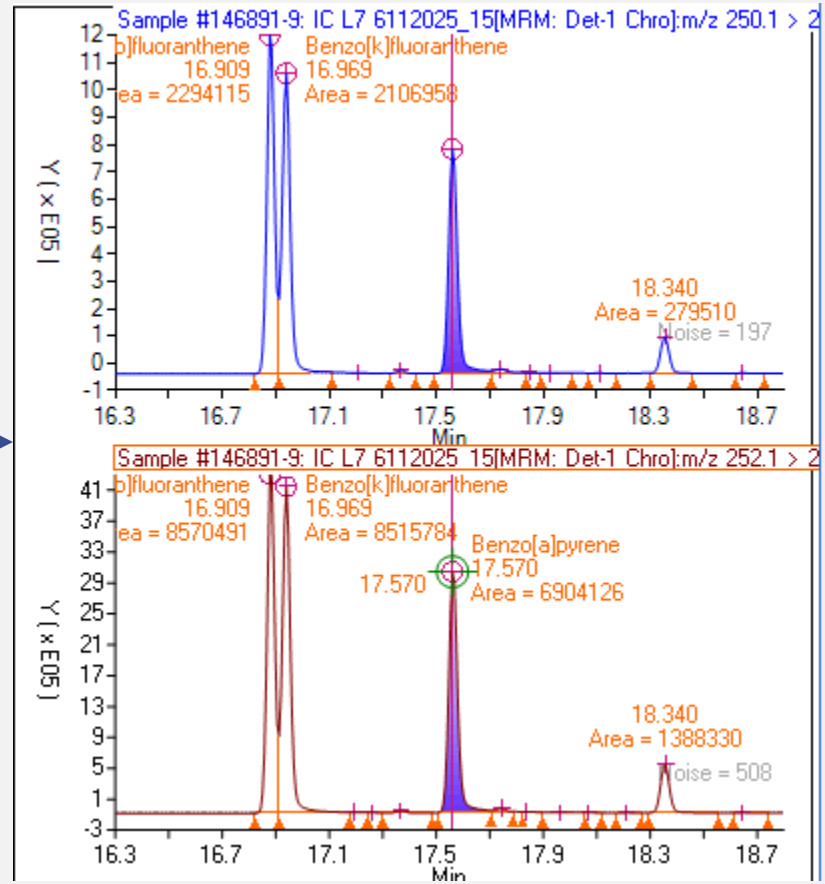


# Paradigm Shift: Reading the Tea Leaves: Benzo[a]pyrene

- **Peak Identification**
- Performance Checks
- Calibration Curve
- MDL/LOD/LOQ
- %R of LCS, MS/D



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# Instrument Performance Check

- Peak Identification
- **Performance Checks**
- Calibration Curve
- MDL/LOD/LOQ
- %R of LCS, MS/D

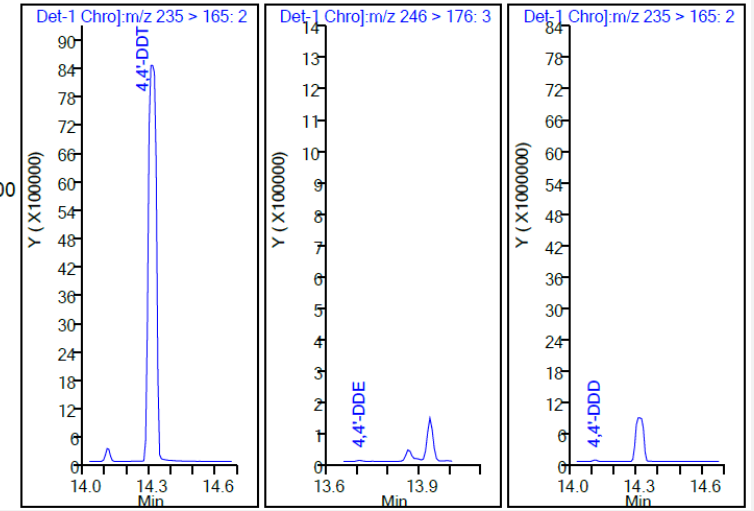
Breakdown Curve: 4,4'- DDT

SW-846 Method

%Breakdown =
(Area Breakdown Cpnds/
Total Area Breakdown Cpnds) * 100

145 4,4'-DDT, Area = 21496544
139 4,4'-DDE, Area = 5519
142 4,4'-DDD, Area = 408520

%Breakdown: 1.89%, <= 20.00%
Passed

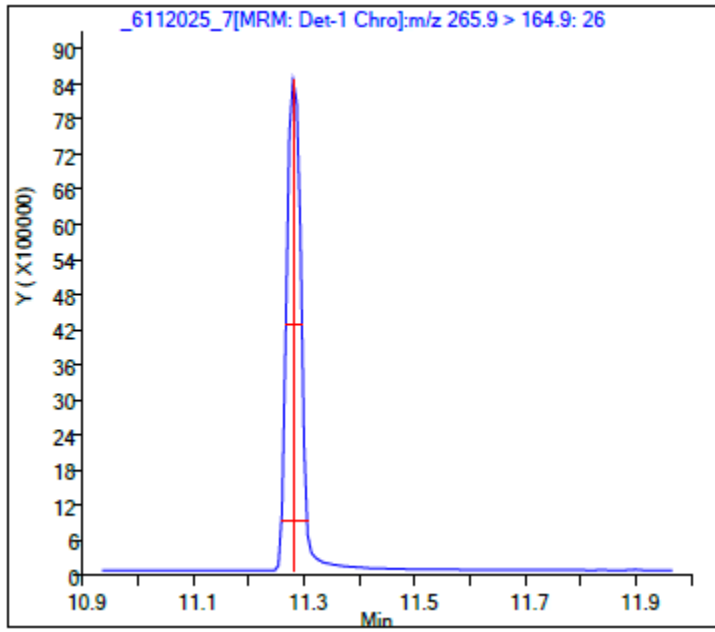



Peak Tailing Factor =
BackWidth/FrontWidth @ 10% Peak Height

Back Width = 0.026 (min.)
Front Width = 0.021 (min.)

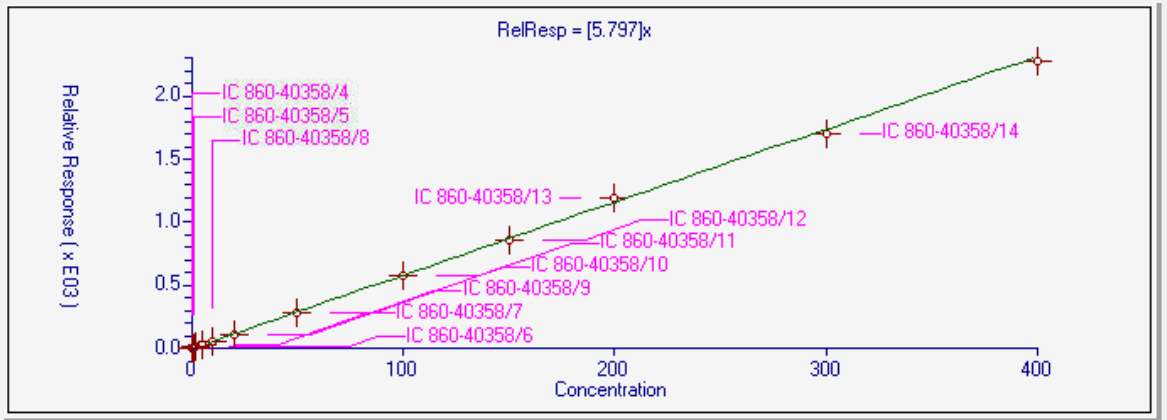
Tailing Factor = 1.24, Max. Tailing <= 2.00
Passed

Tailing Factor: Pentachlorophenol



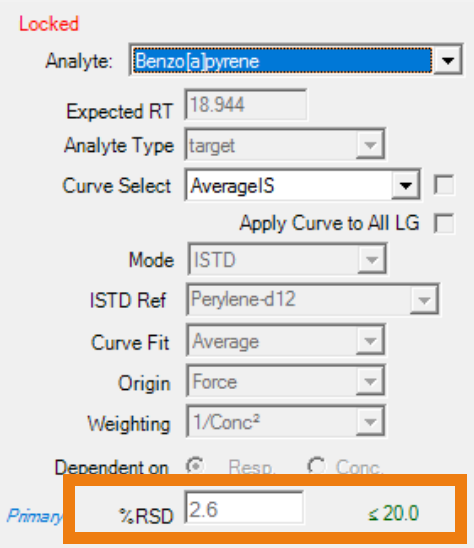
# Reading the Tea Leaves: Benzo[a]pyrene Calibration Curve

- Peak Identification
- Performance Check
- **Calibration Curve**
- MDL/LOD/LOQ
- %R of LCS, MS/D




Calibration Standard Levels

| Level | Used | Amount | Area | ISArea | %Error | ReadBackAmount | Error |
|---|---|---|---|---|---|---|---|
| IC 860-40358/4 | ☑ | 0.5 | 5988 | 49282 | 4.81 | 0.52404 | |
| IC 860-40358/5 | ☑ | 1 | 11205 | 48326 | 0.00 | 1.00001 | |
| IC 860-40358/6 | ☑ | 2 | 21444 | 47929 | 3.52 | 1.92966 | |
| IC 860-40358/7 | ☑ | 5 | 56759 | 49090 | 0.27 | 4.98671 | |
| IC 860-40358/8 | ☑ | 10 | 120072 | 49648 | 4.31 | 10.43068 | |
| IC 860-40358/9 | ☑ | 20 | 243950 | 53542 | 1.75 | 19.65075 | |
| IC 860-40358/10 | ☑ | 50 | 667491 | 58264 | 1.18 | 49.41035 | |
| IC 860-40358/11 | ☑ | 100 | 1500493 | 65381 | 1.02 | 98.98177 | |
| IC 860-40358/12 | ☑ | 150 | 2376169 | 68998 | 0.98 | 148.52981 | |
| IC 860-40358/13 | ☑ | 200 | 3226061 | 67502 | 3.06 | 206.12408 | |
| IC 860-40358/14 | ☑ | 300 | 4903310 | 71852 | 1.89 | 294.32238 | |
| IC 860-40358/15 | ☑ | 400 | 6469651 | 70877 | 1.58 | 393.6845 | |




*Tune Check is not necessary for instrument stability assessment



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- Peak Identification
- Performance Check
- Calibration Curve
- **MDL/LOD/LOQ**
- %R of LCS, MS/D

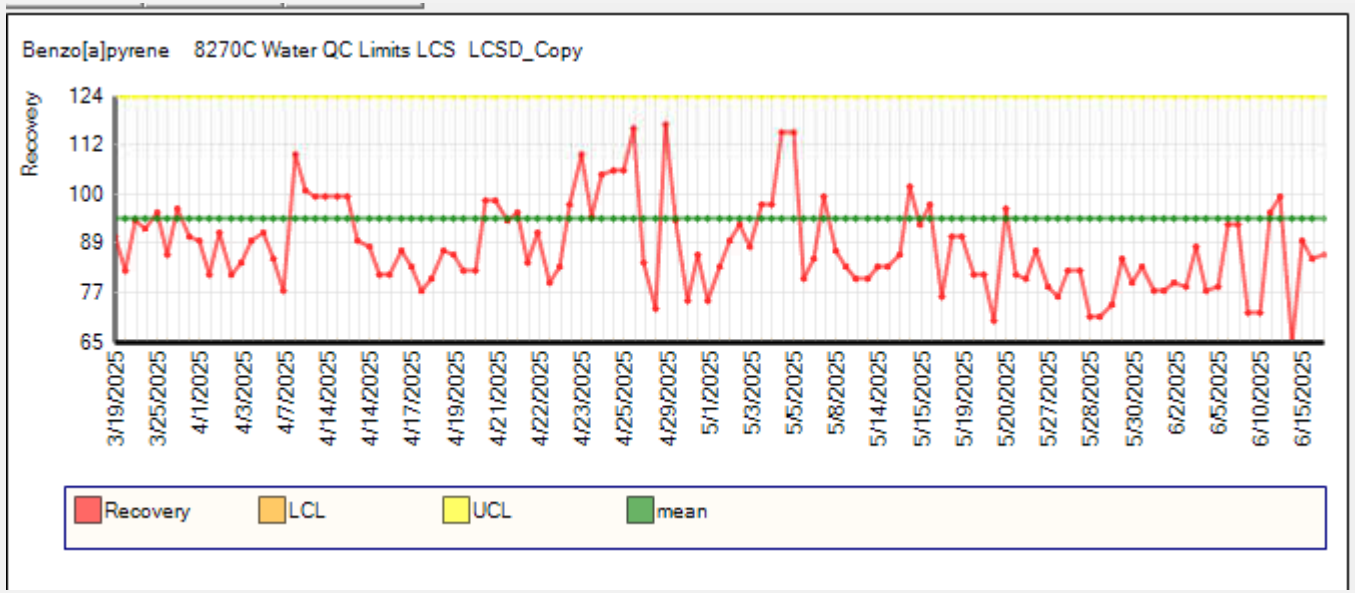
# Reading the Tea Leaves: Benzo[a]pyrene Limit of Quantitation

| Compound Class | GC-SIM LOQ | GC–QQQ LOQ | 3510/GC–MS/SIM Limitations | 3511/GC–QQQ Advantages |
|---|---|---|---|---|
| PAHs | 2-5 µg/L (Full Scan) 0.1-0.2 µg/L (SIM) | 0.2-0.5 µg/L | Matrix Interference Evaporative losses | Lower LOQs Mass separation |
| Phthalate esters | 5-10 µg/L (Full Scan) | 1 µg/L | Background contamination | Reduced background |
| Phenols (Acidic SVOC) | 10-50 µg/L | 0.5-5 µg/L | Poor chromatography, Thermal/pH degradation | Specific transitions No concentration |
| Nitrosamines | 10 µg/L | 0.5-1 µg/L | Background contamination Evaporative losses | Lower LOQs Optimized detection |

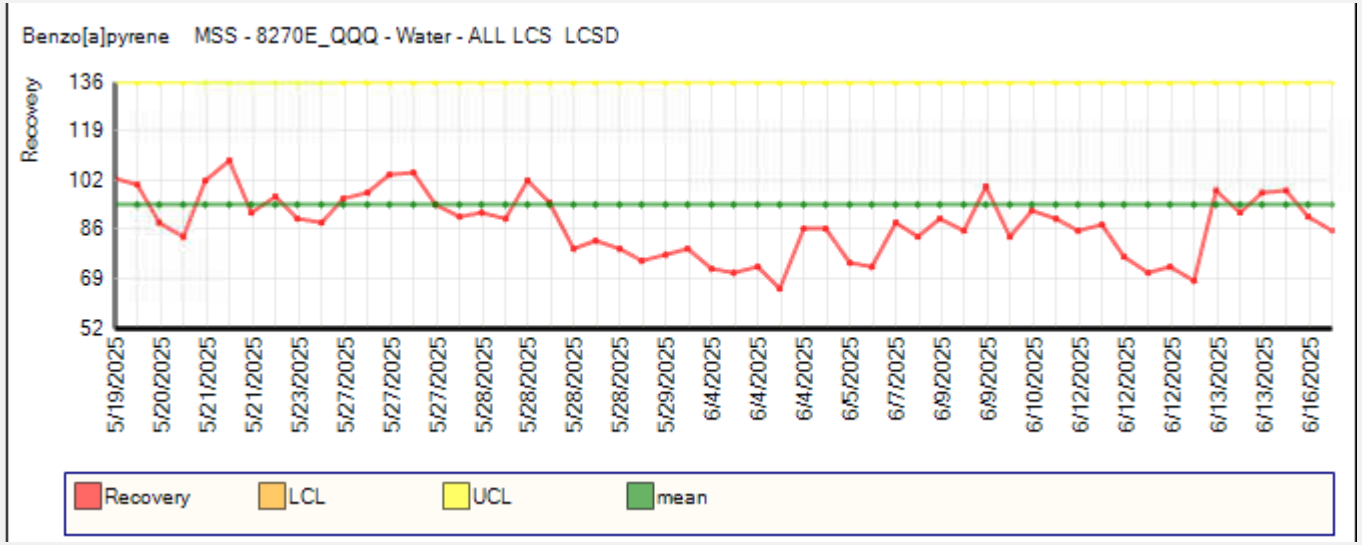
# Reading the Tea Leaves: Benzo[a]pyrene

## Control Limits: 54-128%

- Peak Identification
- Performance Check
- Calibration Curve
- MDL/LOD/LOQ
- **%R of LCS, MS/D**




LCS/LCSD
%R: 89%
%RSD: 8.0%

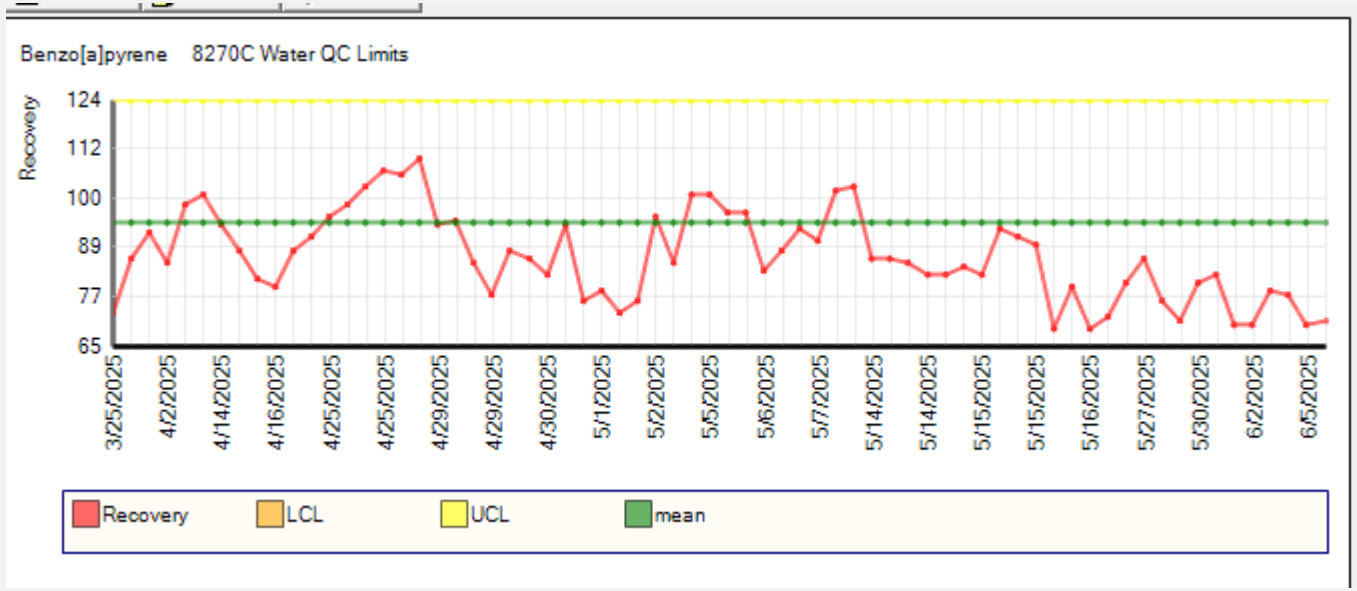



LCS/LCSD
%R: 87%
%RSD: 3.8%

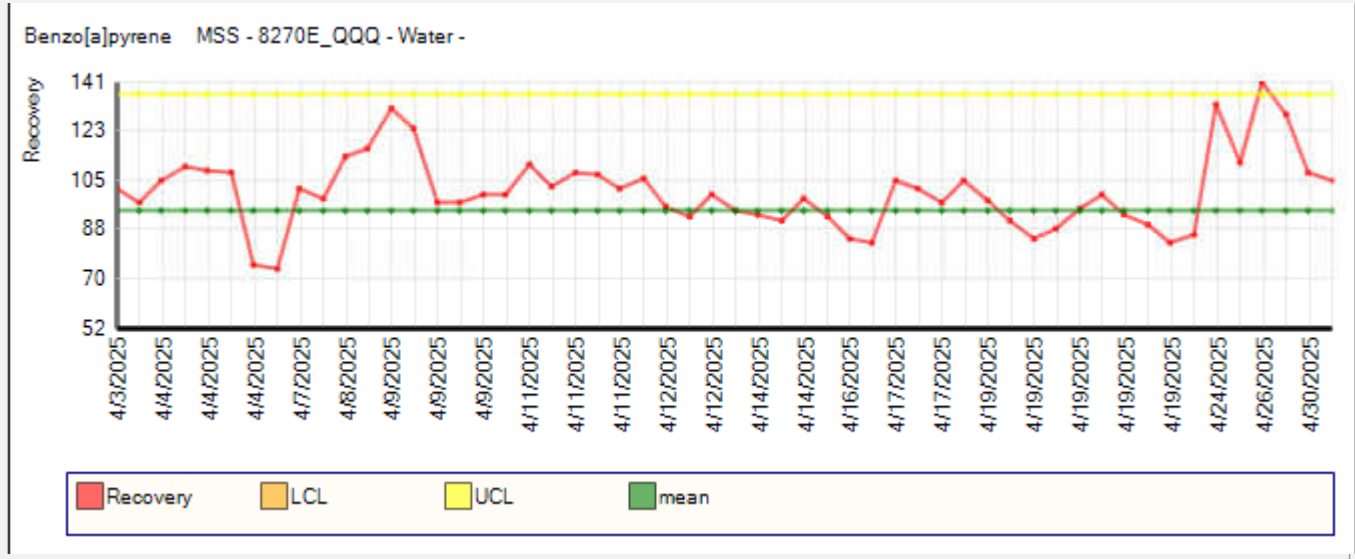
# Reading the Tea Leaves: Benzo[a]pyrene

## Control Limits: 54-128%

- Peak Identification
- Performance Check
- Calibration Curve
- MDL/LOD/LOQ
- **%R of LCS, MS/D**



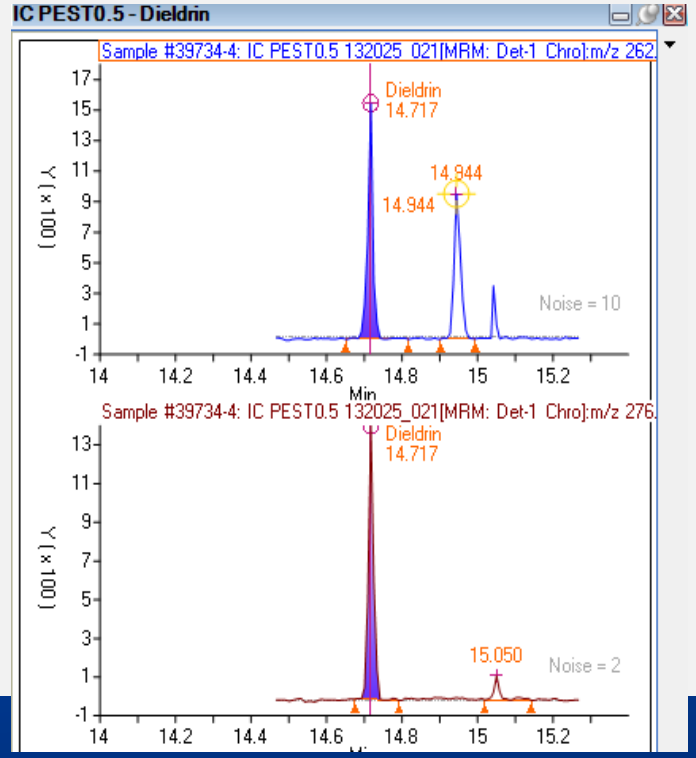

MS/MSD
%R: 86%
%RSD: 4.0%




MS/MSD
%R: 101%
%RSD: 3.3%

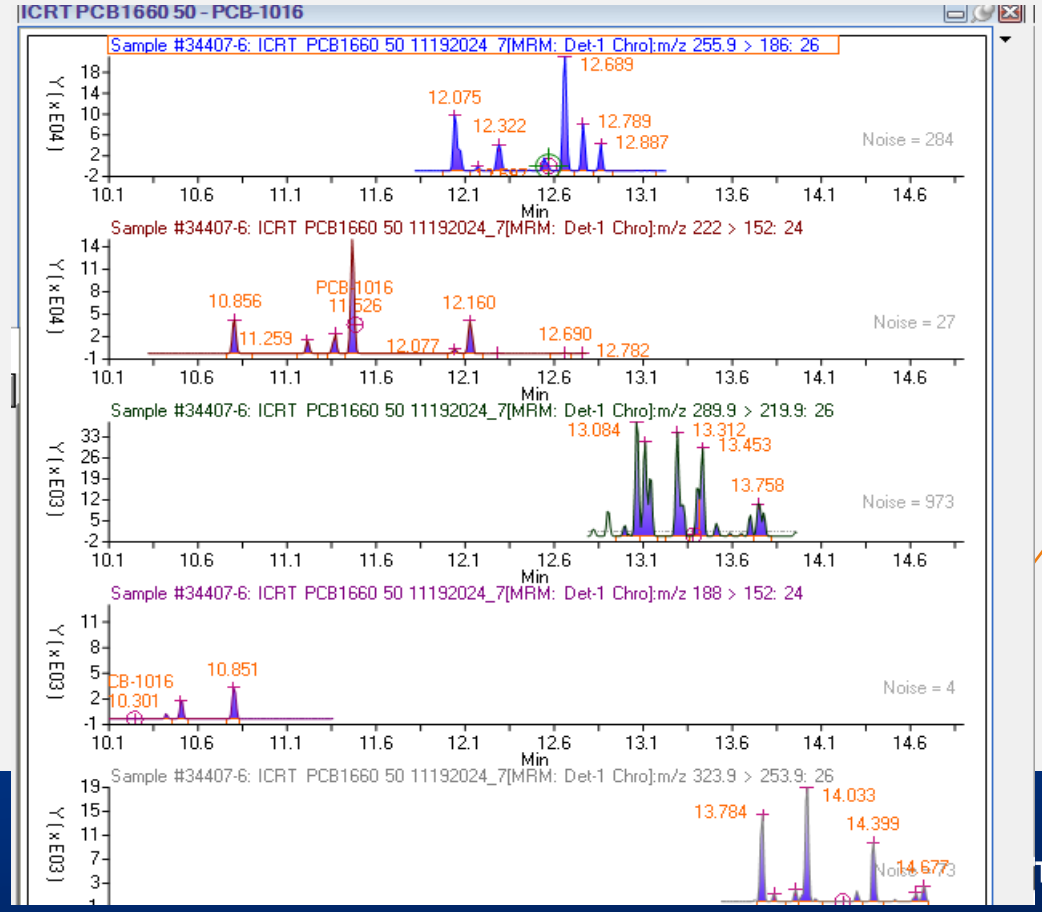
# But wait! There's MORE!

- Better resolution and lower MDLs = More analytes!
  EPA 8011, 8081, 8082, 8141




GC/MSMS (EPA Method 8081)
Dieldrin @ 0.5 PPB
Calibration range 0.5-100 ppb
%RSD 6.3

GC/MSMS (EPA Method 8082)
AR 1016 @ 50 PPB
Calibration range 1.0-1000 ppb
%RSD 6.6




Testing

# What Changes?

- Less sample volume
  - 1 L or 250 mL > 40 or 60 mL
- Less Shipping & Broken Containers
- Less matrix interference
- More robust analysis
- Expanded Analyte List for EPA 8270E
- Faster & reliable results
- Compliant with 2024 EPA DCM Rule

Julian Martinez
Eurofins Environment Testing

Julian.Martinez@ET.EurofinsUS.com

# THANK YOU

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