From sample to vial in one seamless operation with EXTREVA ASE™

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The world leader in serving science

The sample preparation workflow

SP = Three Techniques

Initial Sample

Extraction

- Analytes are removed from sample
- Uses a solvent to remove analytes
- Requires energy source (e.g. heat)
- Our products: ASE and AT280

Clean Up

- Removes coextracting analytes from sample
- Ensures quality chromatography
- Uses resins or a size exclusion technique
- Our product: ASE

Evaporation

- Reduces a large sample volume for improved sensitivity
- Concentrates sample down to 1 mL or evaporates to dryness
- Our product: Rocket

Severe Processing Bottleneck

- 2/3 of processing time spent preparing samples
- >80% of all laboratory error occurs within these steps

Analysis

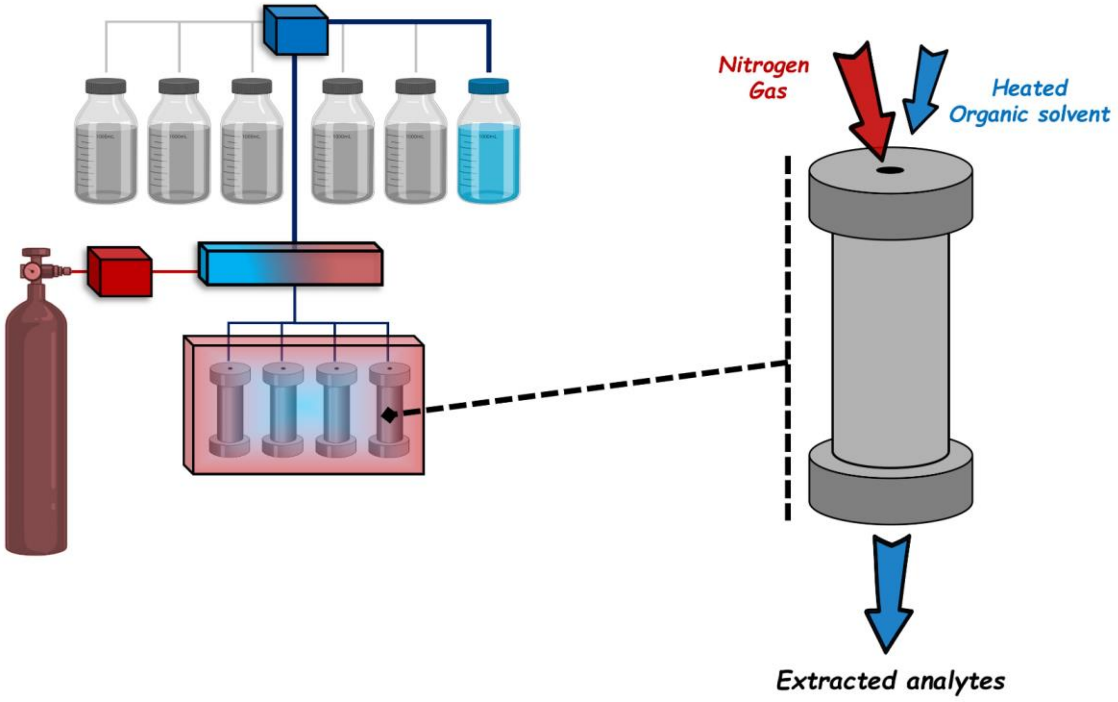
Data Recording and Reporting

Sample prep issues

The source of many problems

Not cost effective	Uses large volume of solvents and takes a long time (4 to 48 hours)	Limits sample throughput and turnaround times, solvent usage drives up cost
Error prone	A vast majority of errors in a lab occur during sample prep	Rerunning and resampling drive up costs, accreditation risk when running PT samples
Good results need good sample prep	Errors may not be realized until data processing shown as poor recoveries and high reproducibility	Rerunning and resampling drive up costs, accreditation risk when running PT samples
Inefficient use of labor	Manual processes are laborious and tedious	Personnel could be better utilized. Labs don't realize how much productivity they are losing.
Personnel management has significant costs	Technicians are not always available. Many of these labs see a high staff turnover.	Limits productivity. Training new staff greatly impacts costs.

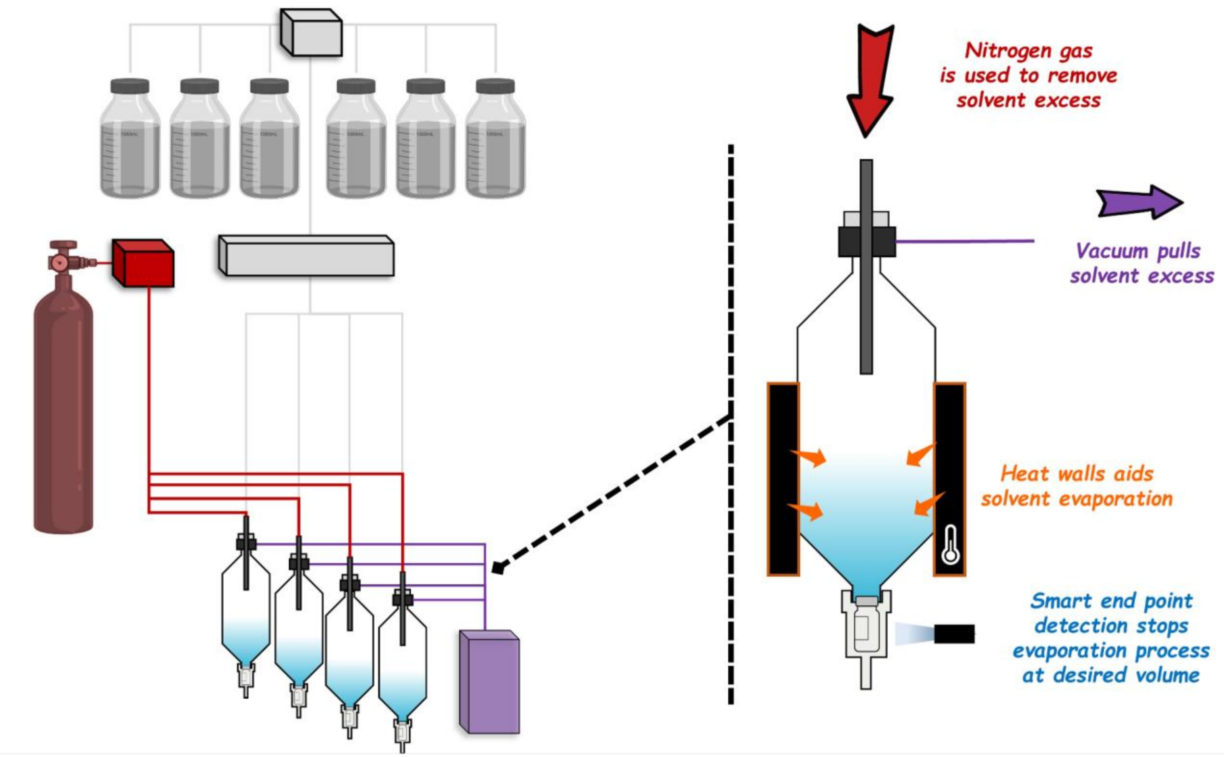
Gas assisted dynamic extraction



- Co-use of **pressurized gas** during the pressurized liquid extraction process, and the **continuous replenishment of the gas-solvent mixture**

- Solvent is added for a short period of time
- Gas follows for the second period of time
- Pressure and flow rate can be precisely controlled
- Segmented alternating flow of solvent and gas follows at a user determined flow rate
- During the entire extraction, the cell is heated and held at high pressure

Concentration with fully automated end-point detection

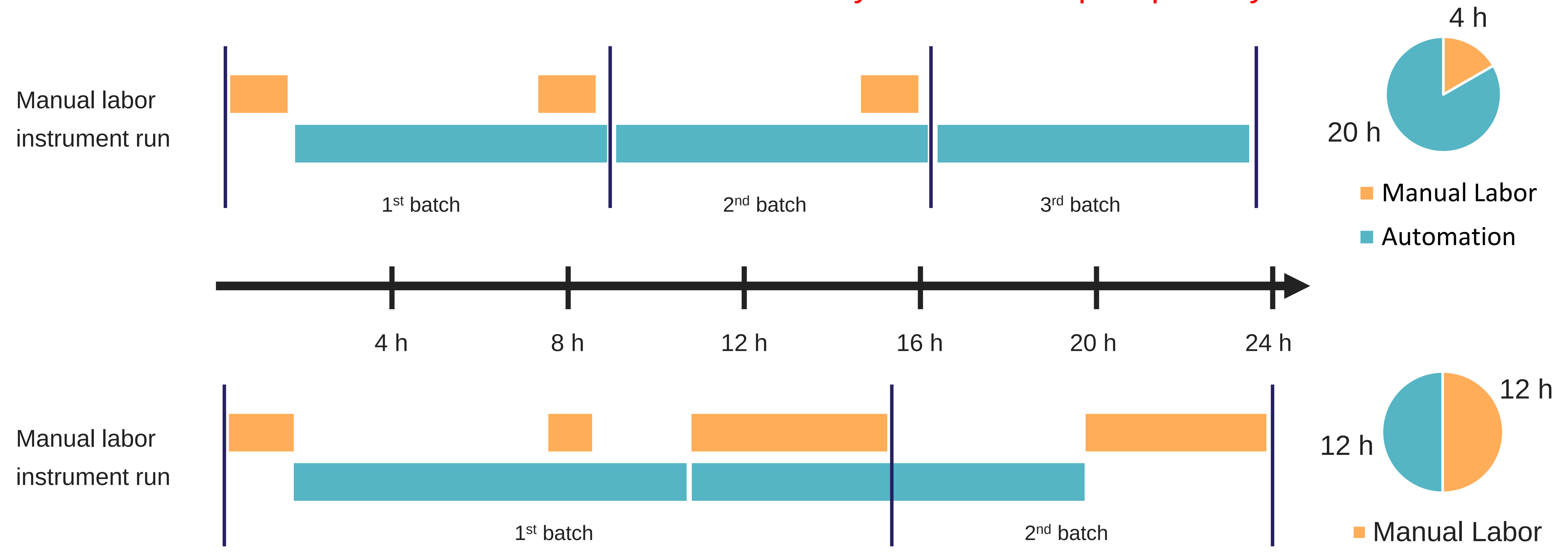


- **Automated end-point detection** using machine learning, combined with image sensor and backlighting, solves the issue of monitoring evaporation in real-time
- **Machine learning** is employed to train the instrument to stop at the desired level, ensuring precise and automated end-point detection
- Eliminates the need for constant monitoring of evaporation, enabling **true walk-away sample preparation**

New technology advantages

Based on 10 mL cell extraction

EXTREVA ASE system: 48 samples per day



ASE 350 system + Rocket Evaporator: 36 samples per day

EXTREVA ASE system - Key benefits

Streamlined sample extraction

Combines sample extraction, clean-up, and concentration

Combined footprint

Extraction and evaporation system in one platform

Increased laboratory productivity

Parallel extraction of up to 4 samples at once, reduces the cost per sample

Complete workflow from sample to vial

True walk-away technology

Increased productivity, better consistency, and cost savings

EXTREVA ASE system – How it helps you

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Sample prep pain points	How the EXTREVA ASE system solves issues
1 Complicated workflows	1 Accomplishes extraction and concentration without user interaction
2 Sample throughput	2 Extracts and concentrates 4 samples in parallel
3 Labor intensive workflows	3 Completes the entire process without the need for intervention
4 Risk of errors	4 Performs method consistently without outside distractions
5 High costs – labor and solvent usage	5 Reduces the required hands-on time and solvent used for extraction
6 Target analyte recovery and reproducibility	6 Brings a higher level of consistency and accuracy with automation compared to manual prep
7 Sample tracking	7 Records sample prep parameters by 2D barcode reading

Cost of errors - %RSD, reruns, lost samples

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Applications Data

Organochlorine pesticides (OCPs)

OCPs – EXTREVA ASE system vs ASE 350 system

EXTREVA ASE system extraction

Extraction	
Cell type	Stainless steel
Cell size	10 mL and 100 mL
Oven temperature	100 °C
Purge time	45 s (10 mL cell); 180 s (100 mL cell)
Nitrogen flow (gas assisted extraction)	10 mL/min per channel
Cell fill volume	50%
Solvent flow rate	1.1 mL/min (10 mL cell); 0.75 mL/min (100 mL cell)
Extraction solvent	Acetone-Hexane (1:1)
Extraction volume	~26 mL (10 mL cell); ~70 mL (100 mL cell)
Extraction time (four samples)	~15 min (10 mL cell); ~20 min (100 mL cell)
Rinse	Prerun, 10 mL, Acetone-Hexane (1:1)
Concentration	
Mode	Fixed volume
Collection bottle	100 mL vial assembly
Final fixed volume	1 mL
Rinse solvent	Hexane, 1.6 mL
Evaporation temperature	40 °C
Nitrogen flow rate	50 mL/min per channel
Vacuum	8 psi (414 torr/551 mbar)

ASE 350 system extraction (40 and 60 mL cells)

Extraction Conditions

Temperature:	100 °C
Pressure:	1500 psi*
Heatup Time:	5 min
Static Time:	5 min
Flush Volume:	60%
Purge Time:	100 s
Static Cycles:	1–2
Total Extraction Time:	14–18 min per sample

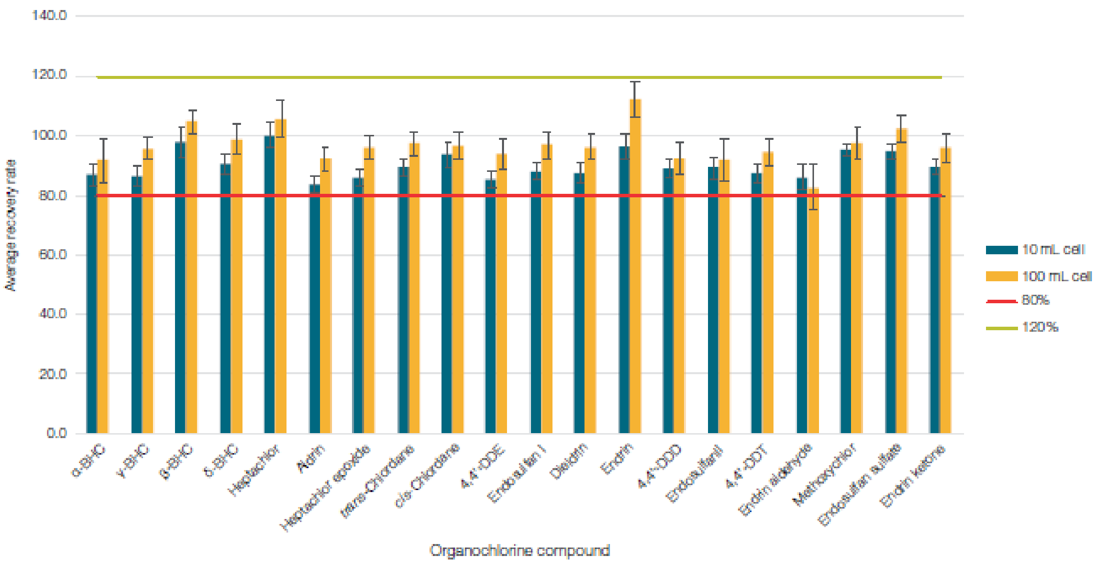
The EXTREVA ASE system extracts 4 samples in the same amount of time as a single extraction instrument

OCPs

Determination of organochlorine pesticides (OCPs) in soils using the EXTREVA ASE Accelerated Solvent Extractor and GC-ECD

Compound	Average recovery (%) (10 mL cell, n = 12)	RSD	Average recovery (%) (100 mL cell, n = 12)	RSD
α-BHC	86.7	3.7	91.7	7.6
γ-BHC	86.4	3.3	95.6	3.9
β-BHC	97.8	5.1	104.8	3.9
δ-BHC	90.6	3.5	98.9	4.8
Heptachlor	100.2	4.4	105.6	6.1
Aldrin	83.9	2.8	92.3	3.9
Heptachlor epoxide	85.8	2.8	96.0	4.1
trans-Chlordane	89.3	2.7	97.4	3.9
cis-Chlordane	93.5	4.0	96.7	4.6
4,4'-DDE	85.5	2.9	93.9	5.0
Endosulfan I	87.9	2.7	96.9	4.5
Dieldrin	87.4	3.4	96.3	4.6
Endrin	96.2	4.3	112.3	5.8
4,4'-DDD	89.1	3.2	92.3	5.1
Endosulfan II	89.3	3.5	91.7	7.2
4,4'-DDT	87.3	3.1	94.7	4.7
Endrin aldehyde	86.1	4.0	82.5	7.6
Methoxychlor	95.4	1.9	97.7	5.2
Endosulfan sulfate	94.6	2.5	102.3	4.7
Endrin ketone	89.5	2.4	95.9	5.0

Average recoveries and reproducibility show excellent performance



All %RSD <10% and recoveries 82 – 106%

(General acceptance <20% and 70 to 130%)

OCPs – Carryover and degradation tests

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EXTREVA ASE system Carry Over Test

OCP	Average recovery % (10 mL, n = 4)	RSD %	Average carryover % (10 mL, n = 4)
α-BHC	81.7	7.9	0.00
γ-BHC	83.1	6.5	0.19
β-BHC	93.9	5.7	0.07
δ-BHC	89.6	5.0	0.09
Heptachlor	90.1	7.0	0.33
Aldrin	86.9	6.9	0.00
Heptachlor epoxide	92.6	5.7	0.01
trans-Chlordane	92.9	5.0	0.00
cis-Chlordane	93.5	5.6	0.05
4,4'-DDE	86.6	5.8	0.06
Endosulfan I	90.6	5.1	0.00
Dieldrin	94.4	4.8	0.01
Endrin	102.2	4.3	0.02
4,4'-DDD	91.0	3.9	0.00
Endosulfan II	89.8	4.0	0.43
4,4'-DDT	91.7	3.8	0.02
Endrin aldehyde	83.8	5.1	0.03
Methoxychlor	98.6	4.4	0.14
Endosulfan sulfate	97.5	3.5	0.03
Endrin ketone	95.0	3.6	0.03

The EXTREVA ASE system yields very little carryover from high spike sample

EXTREVA ASE system Thermal Degradation Test

	Average breakdown (%)	
Extraction temperature	Endrin	DDT
100 °C	4.0	1.5
150 °C	3.2	1.0

- Breakdown percentages are below recommended 15%
- For endrin, 3.1% breakdown occurred in the GC inlet
- The EXTREVA ASE system has little significant effect on the breakdown

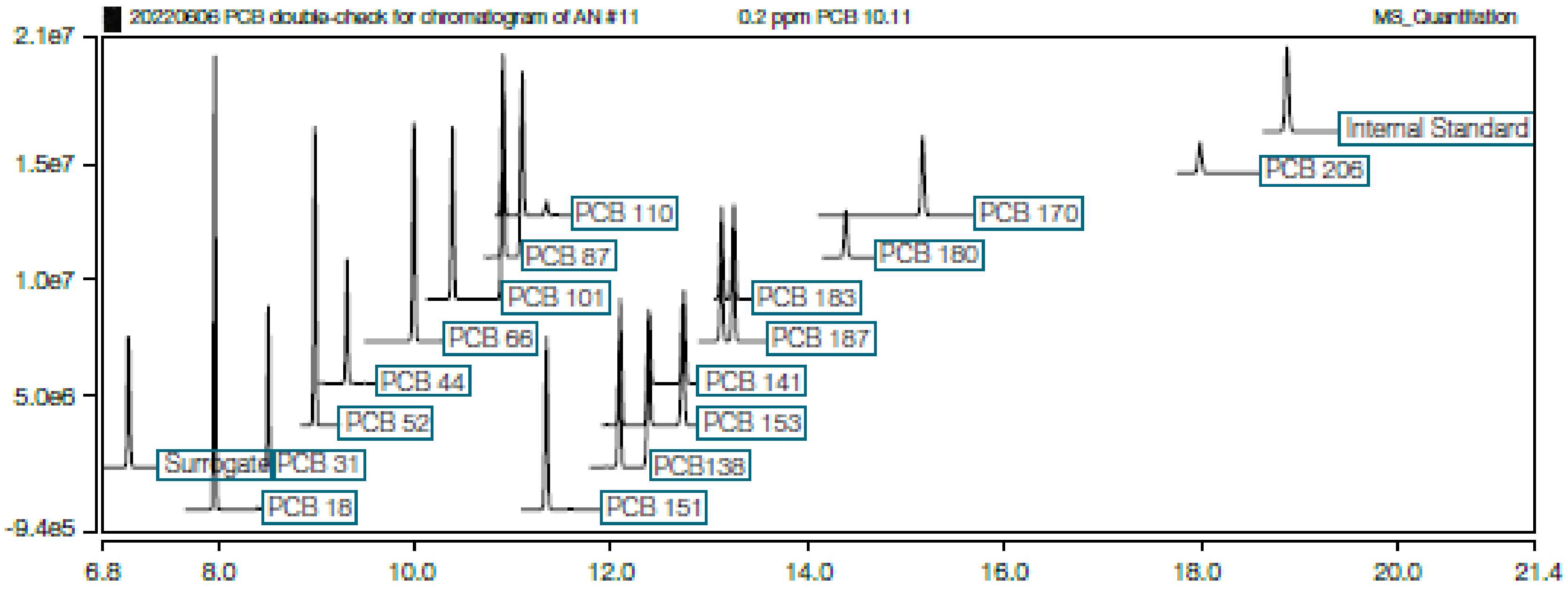
Applications Data

Polychlorinated biphenyls (PCBs)

Instrument conditions and chromatography

Extraction	
Cell type	Stainless steel
Cell size	10 mL and 100 mL
Oven temperature	100 ˚C
Purge time	45 s (10 mL cell) 180 s (100 mL cell)
Nitrogen flow (gas assisted extraction)	10 mL/min per channel
Cell fill volume	50%
Solvent flow rate	1.6 mL/min (10 mL cell) 0.35 mL/min (10 mL cell) 0.75 mL/min (100 mL cell)
Extraction solvent	Hexane
Extraction volume	–26 mL (10 mL cell, flow rate 1.6 mL/min) –15 mL (10 mL cell, flow rate 0.35 mL/min –70 mL (100 ml cell, flow rate 0.75 mL/mir
Pre-run rinse	10 mL, Hexane
Extraction time (four samples)	–10 min (10 mL cell, flow rate 1.6 mL/min) –15 min (10 mL cell, flow rate 0.35 mL/min –20 min (100 mL cell, flow rate 0.75 mL/m

Concentration	
Mode	Fixed volume
Collection bottle	100 mL vial assembly
Final fixed volume	1 mL
Rinse solvent	Hexane, 1.6 mL
Evaporation temperature	40 ˚C
Nitrogen flow rate	50 mL/min per channel
Vacuum	8 psi (414 torr/551 mbar)



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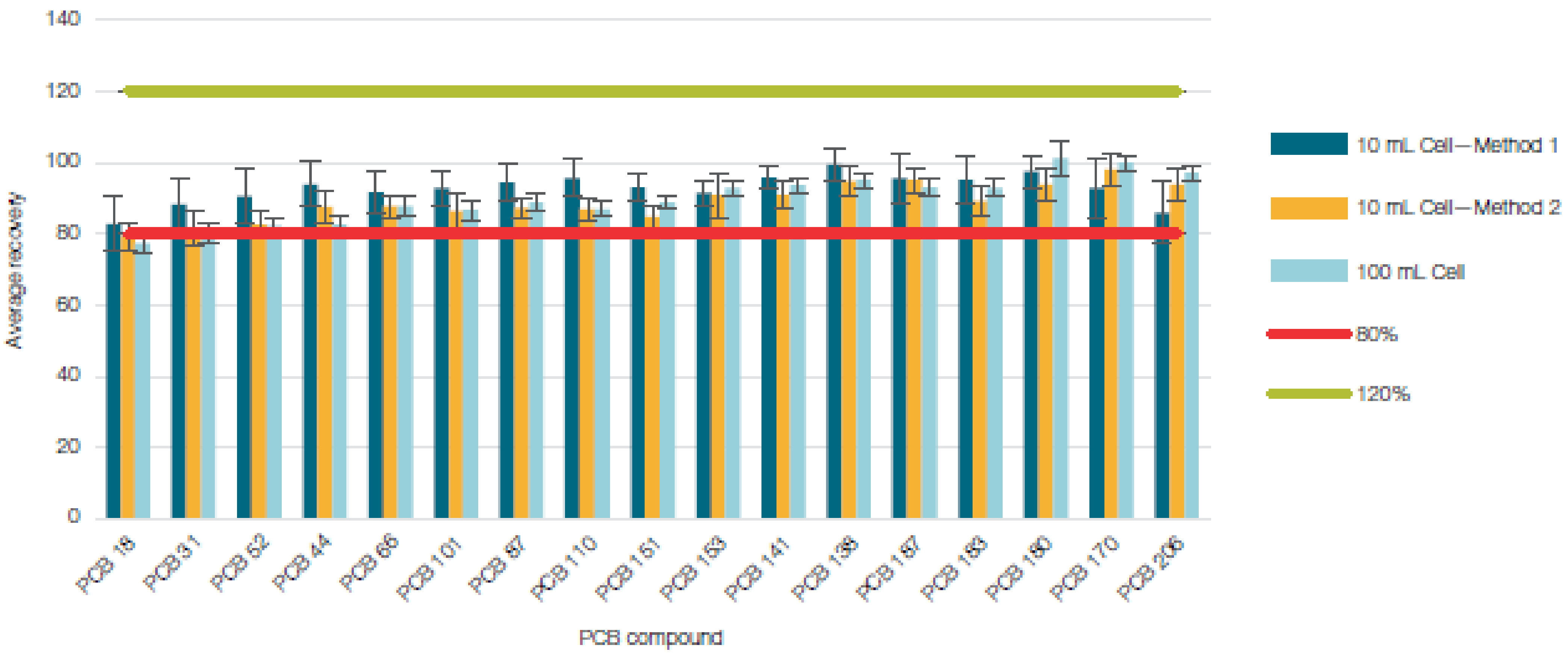
PCBs – recovery and reproducibility

2 Methods and 2 cells

	10 mL – Method 1		10 mL – Method 2		100 mL	
Compound	Average recovery % (n=12)	RSD	Average recovery % (n=12)	RSD	Average recovery % (n=12)	RSD
PCB 18	82.8	7.4	79.2	3.8	77.0	2.6
PCB 31	88.2	7.3	81.4	4.9	80.4	2.8
PCB 52	90.4	7.8	82.5	3.7	82.0	2.5
PCB 44	93.7	6.3	87.5	4.3	82.4	2.8
PCB 66	91.6	6.2	87.6	3.1	87.7	2.6
PCB 101	92.6	5.1	86.3	5.0	86.5	2.6
PCB 87	94.3	5.2	87.1	2.6	88.7	2.6
PCB 110	95.5	5.2	86.8	2.9	86.9	2.2
PCB 151	92.9	4.0	84.6	3.3	88.9	1.9
PCB 153	91.4	3.6	90.7	6.2	92.8	2.2
PCB 141	95.6	3.0	90.7	4.0	93.4	2.3
PCB 138	99.4	4.7	94.6	4.4	94.8	2.3
PCB 187	95.4	6.8	94.8	3.5	92.9	2.5
PCB 183	94.9	6.5	89.2	4.2	92.8	2.6
PCB 180	97.4	4.6	93.7	4.4	101	4.7
PCB 170	92.7	8.1	98.0	4.4	99.8	2.0
PCB 206	85.8	8.7	93.7	4.3	97.0	2.1

PCBs – recovery and reproducibility

2 Methods and 2 cells



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PCBs Carryover

Compound	Average recovery (%) (10 mL cell, n=12)	RSD	Average carryover (%) (10 mL cell, n=12)
PCB 18	77.0	10.5	0.02
PCB 31	80.5	9.2	0.05
PCB 52	84.3	8.0	0.04
PCB 44	80.4	9.2	0.06
PCB 66	90.6	5.5	0.05
PCB 101	90.0	5.4	0.05
PCB 87	91.1	5.0	0.05
PCB 110	91.3	5.1	0.06
PCB 151	95.8	3.5	0.05
PCB 153	95.9	3.8	0.04
PCB 141	97.4	3.4	0.03
PCB 138	98.0	3.5	0.04
PCB 187	99.7	3.7	0.06
PCB 183	97.7	3.6	0.07
PCB 180	94.0	4.6	0.20
PCB 170	106	5.2	0.05
PCB 206	101	3.6	0.12

PCBs – Proficiency testing samples

PT samples were purchased and run

- All 18 PCBs were detected within the PT published acceptance range
- The average of 12 sample replicates also fell within the published range and have excellent reproducibility

PCB compounds	Certified value µg/kg	Acceptance range µg/kg	Average recovery and RSD (10mL cell, n=12)	
			Avg (n=12) µg/kg	RSD (n=12)
PCB 28	64.7 ± 17.3	12.8 to 117	60.4	4.20
PCB 52	155 ± 37	45.1 to 265	136.0	3.90
PCB 101	37.3 ± 11.5	2.6 to 71.9	38.5	4.50
PCB 81	44.3 ± 8.7	18.2 to 70.4	44.9	4.30
PCB 77	115 ± 22	48.6 to 181	107.0	4.00
PCB 123	35.6 ± 6.2	16.9 to 54.3	33.7	5.10
PCB 118	120 ± 22	53.9 to 186	113.0	4.00
PCB 114	234 ± 50	85.2 to 382	227.0	3.70
PCB153	147 ± 46	8.8 to 285	158.0	4.10
PCB105	40.8 ± 8.6	14.9 to 66.7	40.1	4.70
PCB138	112 ± 32	17.2 to 207	118.0	4.50
PCB126	280 ± 61	97.5 to 462	270.0	3.60
PCB167	122 ± 25	47.9 to 197	123.0	4.40
PCB156	193 ± 38	79.5 to 307	157.0	3.70
PCB157	216 ± 50	67.7 to 365	180.0	3.50
PCB180	146 ± 40	26.9 to 266	124.0	4.60
PCB169	66.7 ± 13.3	26.8 to 107	58.3	5.20
PCB189	123 ± 24	51.3 to 195	104.2	4.20

Applications Data

Organochlorine pesticides (OCPs)

OCPs – EXTREVA ASE system vs ASE 350 system

Thermo Fisher SCIENTIFIC

EXTREVA ASE system extraction

Extraction	
Cell type	Stainless steel
Cell size	10 mL and 100 mL
Oven temperature	100 °C
Purge time	45 s (10 mL cell); 180 s (100 mL cell)
Nitrogen flow (gas assisted extraction)	10 mL/min per channel
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Extraction time (four samples)	~15 min (10 mL cell); ~20 min (100 mL cell)
Rinse	Prerun, 10 mL, Acetone-Hexane (1:1)
Concentration	
Mode	Fixed volume
Collection bottle	100 mL vial assembly
Final fixed volume	1 mL
Rinse solvent	Hexane, 1.6 mL
Evaporation temperature	40 °C
Nitrogen flow rate	50 mL/min per channel
Vacuum	8 psi (414 torr/551 mbar)

ASE 350 system extraction

Extraction Conditions

Temperature:	100 °C
Pressure:	1500 psi*
Heatup Time:	5 min
Static Time:	5 min
Flush Volume:	60%
Purge Time:	100 s
Static Cycles:	1–2
Total Extraction Time:	14–18 min per sample

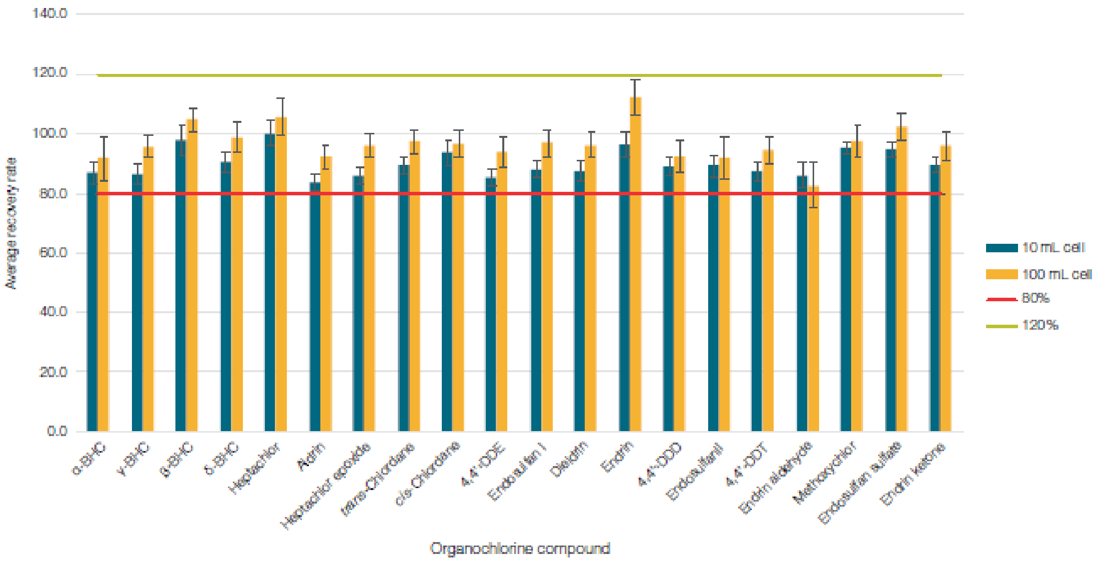
The EXTREVA ASE system extracts 4 samples in the same amount of time as a single extraction instrument

OCPs

Determination of organochlorine pesticides (OCPs) in soils using the EXTREVA ASE Accelerated Solvent Extractor and GC-ECD

Compound	Average recovery (%) (10 mL cell, n = 12)	RSD	Average recovery (%) (100 mL cell, n = 12)	RSD
α-BHC	86.7	3.7	91.7	7.6
γ-BHC	86.4	3.3	95.6	3.9
β-BHC	97.8	5.1	104.8	3.9
δ-BHC	90.6	3.5	98.9	4.8
Heptachlor	100.2	4.4	105.6	6.1
Aldrin	83.9	2.8	92.3	3.9
Heptachlor epoxide	85.8	2.8	96.0	4.1
trans-Chlordane	89.3	2.7	97.4	3.9
cis-Chlordane	93.5	4.0	96.7	4.6
4,4'-DDE	85.5	2.9	93.9	5.0
Endosulfan I	87.9	2.7	96.9	4.5
Dieldrin	87.4	3.4	96.3	4.6
Endrin	96.2	4.3	112.3	5.8
4,4'-DDD	89.1	3.2	92.3	5.1
Endosulfan II	89.3	3.5	91.7	7.2
4,4'-DDT	87.3	3.1	94.7	4.7
Endrin aldehyde	86.1	4.0	82.5	7.6
Methoxychlor	95.4	1.9	97.7	5.2
Endosulfan sulfate	94.6	2.5	102.3	4.7
Endrin ketone	89.5	2.4	95.9	5.0

Average recoveries and reproducibility show excellent performance



All %RSD <10% and recoveries 82 – 106%

OCPs – Carryover and degradation tests

OCP	Average recovery % (10 mL, n = 4)	RSD %	Average carryover % (10 mL, n = 4)
α-BHC	81.7	7.9	0.00
γ-BHC	83.1	6.5	0.19
β-BHC	93.9	5.7	0.07
δ-BHC	89.6	5.0	0.09
Heptachlor	90.1	7.0	0.33
Aldrin	86.9	6.9	0.00
Heptachlor epoxide	92.6	5.7	0.01
trans-Chlordane	92.9	5.0	0.00
cis-Chlordane	93.5	5.6	0.05
4,4'-DDE	86.6	5.8	0.06
Endosulfan I	90.6	5.1	0.00
Dieldrin	94.4	4.8	0.01
Endrin	102.2	4.3	0.02
4,4'-DDD	91.0	3.9	0.00
Endosulfan II	89.8	4.0	0.43
4,4'-DDT	91.7	3.8	0.02
Endrin aldehyde	83.8	5.1	0.03
Methoxychlor	98.6	4.4	0.14
Endosulfan sulfate	97.5	3.5	0.03
Endrin ketone	95.0	3.6	0.03

The EXTREVA ASE system yields
very little carryover from high spike sample

EXTREVA ASE system Thermal Degradation Test

	Average breakdown (%)	
Extraction temperature	Endrin	DDT
100 °C	4.0	1.5
150 °C	3.2	1.0

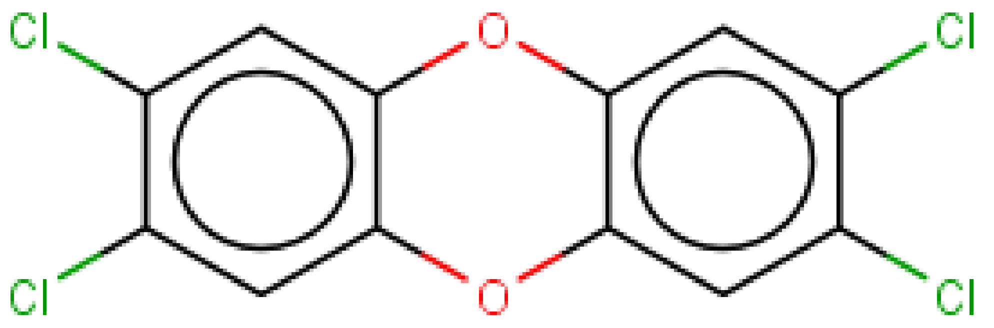
Applications Data

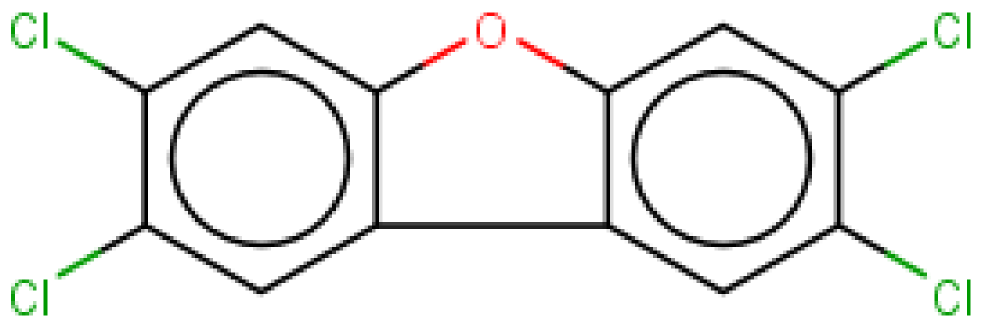
Combined dioxins and furans/PCBs

Test Summary: Dioxin/Furan; PCB → *soil*

Analysis of
- 7 dioxins
- 10 furans

2378-TCDD
12378-PeCDD
123478-HxCDD
123678-HxCDD
123789-HxCDD
1234678-HpCDD
OCDD
-
2378-TCDF
12378-PeCDF
23478-PeCDF
123478-HxCDF
123678-HxCDF
234678-HxCDF
123789-HxCDF
1234678-HpCDF
1234789-HpCDF
OCDF





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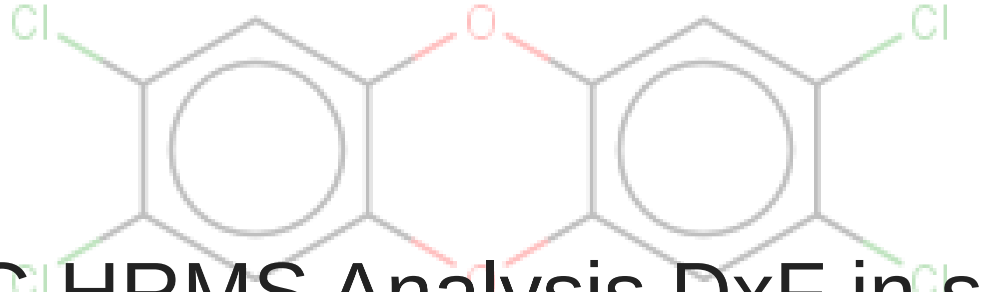
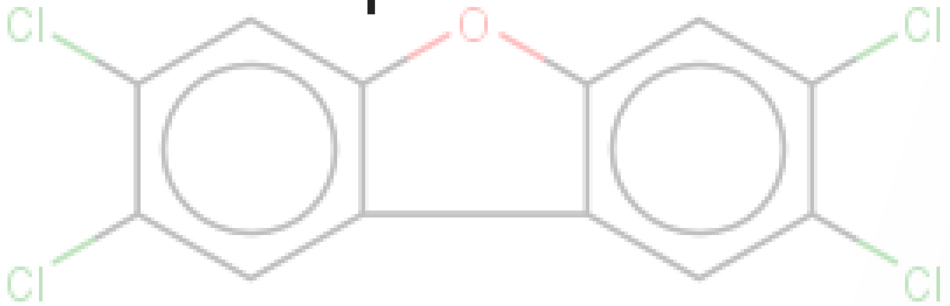
Dioxins and furans in soil – ASE 350



GC-HRMS Analysis DxF in soil

ASE 350 optimized method



Extraction time 4 samples = 2:08:00

INTERNAL STANDARDS	% REC	STDE V	RSD
2378-TCDD	50	5.57	11.2%
12378-PeCDD	68	5.32	7.8%
123478-HxCDD	72	4.55	6.3%
123678-HxCDD	105	10.02	9.6%
1234678-HpCDD	72	10.86	15.1%
OCDD	40	2.83	7.1%
2378-TCDF	44	5.44	12.4%
12378-PeCDF	51	0.82	1.6%
23478-PeCDF	60	6.45	10.8%
123478-HxCDF	68	8.29	12.2%
123678-HxCDF	95	6.90	7.2%
234678-HxCDF	94	9.00	9.5%
123789-HxCDF	86	4.03	4.7%
1234678-HpCDF	93	7.63	8.2%
1234789-HpCDF	74	8.46	11.5%

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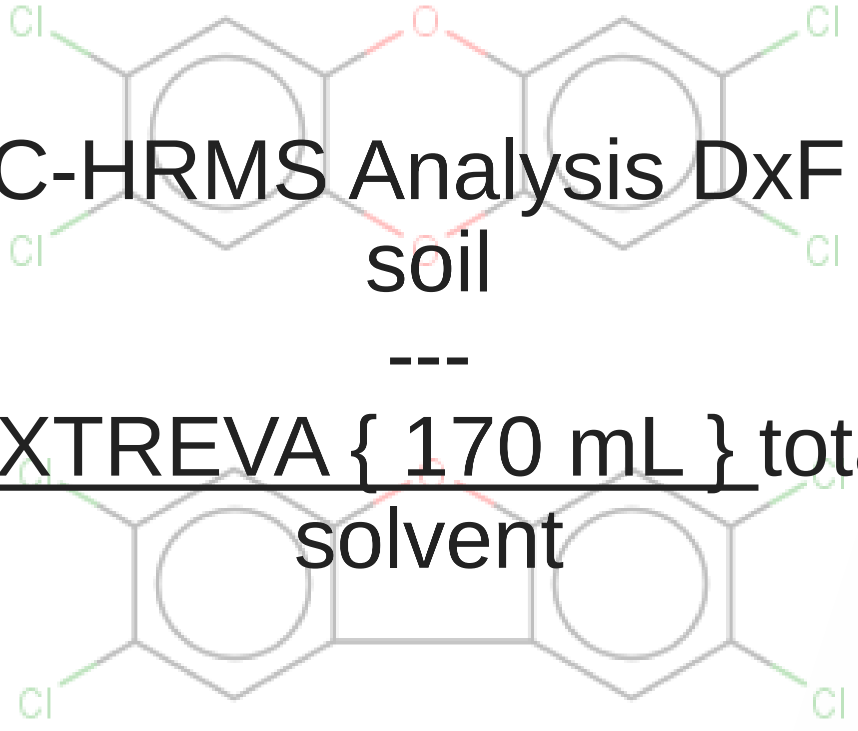
Dioxins and furans in soil – EXTREVA ASE



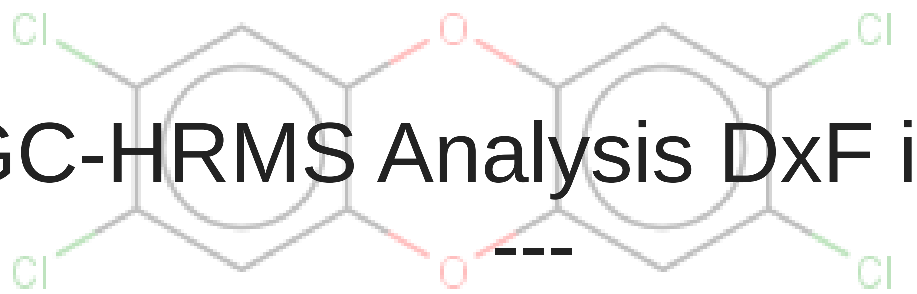
GC-HRMS Analysis DxF in soil

EXTREVA { 170 mL } total solvent

INTERNAL STANDARDS	%REC	STDEV	RSD
2378-TCDD	44	4.65	10.5%
12378-PeCDD	61	5.51	9.1%
123478-HxCDD	59	7.70	13.1%
123678-HxCDD	82	10.87	13.2%
1234678-HpCDD	57	5.97	10.4%
OCDD	35	4.65	13.5%
2378-TCDF	37	5.45	14.9%
12378-PeCDF	46	6.32	13.7%
23478-PeCDF	52	5.19	9.9%
123478-HxCDF	54	4.11	7.6%
123678-HxCDF	77	9.36	12.1%
234678-HxCDF	76	5.35	7.0%
123789-HxCDF	60	6.55	10.9%
1234678-HpCDF	72	7.27	10.1%
1234789-HpCDF	59	7.27	12.3%

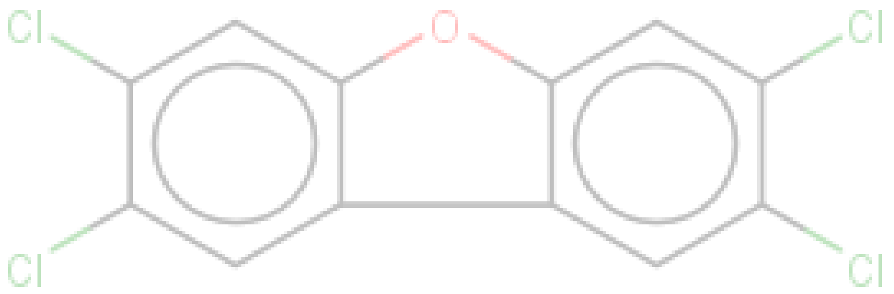
Extraction time 4 samples = 0:53:13

Dioxins and furans in soil – EXTREVA ASE



GC-HRMS Analysis DxF in soil

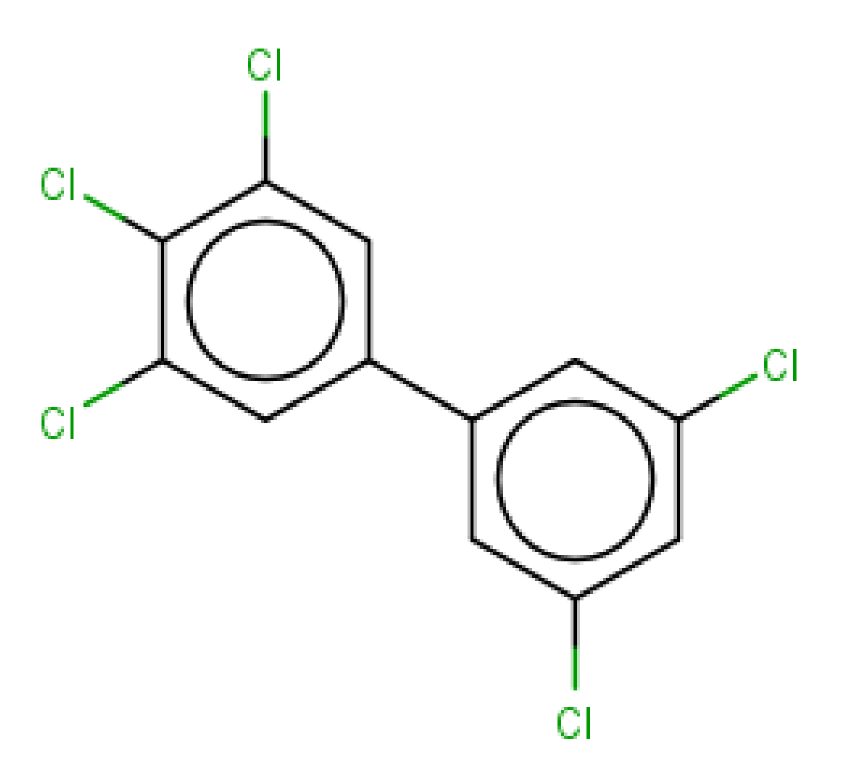
EXTREVA { 85 mL }
total solvent



Extraction time 4 samples = 0:53:13

INTERNAL STANDARDS	%REC	STDEV	RSD
2378-TCDD	30	0.5	1.7%
12378-PeCDD	38	4.65	12.1%
123478-HxCDD	41	6.85	16.8%
123678-HxCDD	54	8.54	15.9%
1234678-HpCDD	37	2.94	8.0%
OCDD	23	4.69	20.4%
2378-TCDF	26	2.52	9.9%
12378-PeCDF	31	3.10	9.9%
23478-PeCDF	37	3.20	8.7%
123478-HxCDF	38	4.55	12.0%
123678-HxCDF	51	8.54	16.7%
234678-HxCDF	49	6.35	13.1%
123789-HxCDF	44	7.18	16.4%
1234678-HpCDF	44	5.74	13.2%
1234789-HpCDF	39	3.30	8.4%

GC-HRMS Analysis of 209 PCBs in soil



GC-HRAM 209 PCBs in Soil

Old method with ASE 350

C13 INTERNAL STANDARD	%REC	RSD
PCB 1	7	33%
PCB 3	8	45%
PCB 4	13	30%
PCB 15	17	36%
PCB 19	20	25%
PCB 37	34	21%
PCB 54	27	21%
PCB 81	59	10%
PCB 77	64	10%

PCB 104	32	14%
PCB 123	62	5%
PCB 118	60	6%
PCB 114	62	4%
PCB 105	66	3%
PCB 126	77	4%
PCB 155	40	11%
PCB 167	65	3%
PCB 156	68	7%

PCB 157	70	2%
PCB 169	66	5%
PCB 188	50	3%
PCB 189	87	7%
PCB 202	55	3%
PCB 205	74	1%
PCB 208	70	8%
PCB 206	61	3%
PCB 209	60	3%

GC-HRAM 209 PCBs in soil

EXTREVA ASE Method

C13 INTERNAL STANDARD	%REC	RSD
PCB 1	7	33%
PCB 3	8	45%
PCB 4	13	30%
PCB 15	17	36%
PCB 19	20	25%
PCB 37	34	21%
PCB 54	27	21%
PCB 81	59	10%
PCB 77	64	10%

PCB 104	32	14%
PCB 123	62	5%
PCB 118	60	6%
PCB 114	62	4%
PCB 105	66	3%
PCB 126	77	4%
PCB 155	40	11%
PCB 167	65	3%
PCB 156	68	7%

PCB 157	70	2%
PCB 169	66	5%
PCB 188	50	3%
PCB 189	87	7%
PCB 202	55	3%
PCB 205	74	1%
PCB 208	70	8%
PCB 206	61	3%
PCB 209	60	3%

Questions?

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