Fast and Flexible Automated Sample Extraction of PCDD/Fs and PCBs with *X-TRACTION*®

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LCTech

Content

1. Introduction

Persistent organic pollutants (POPs) are highly toxic and persistent substances, which accumulate in the environment and pose risks on health. Since 2001 they are regulated by the Stockholm Convention and monitored accordingly. By this, the analysis of POPs got increasingly important, leading to a huge growth in sample numbers and the need for standardized yet fast, automated and low-cost methods and instruments at the same time.

Additionally, today's laboratories require instruments, where global regulations and changing methods can be implemented easily into their own processes. The workflow to analyze POPs include extraction, clean-up, evaporation steps and the final analysis.

To complete our existing automated sample preparation portfolio, we have launched a new extraction system called X-Traction® by LCTech in 2021.

Pressurized Fluid Extraction (PFE) is a sample extraction method that employs liquid solvents at elevated temperatures and pressures to prepare samples for analysis. While commonly known extraction system are using high pressure (100 - 150 bar) for their process, our newly introduced extraction system works with low pressure (max. 17 bar; LPFE (Low Pressure Fluid Extraction). Working in low-pressure range is sufficient for an excellent extraction efficiency with decreased wear-and-tear of instrument parts, higher longevity and a safe handling. The ease of use is further increased by the unique extraction cell-cover-lid locking mechanism.

This system can be upgraded from 1 to 6 devices, which are able to operate either sequentially or in parallel, with a different protocol on each device.

The system features fast extraction times, easy handling, no cross-contamination and high reproducibility. It can be used for the extraction of Dioxin and PCBs acc. to US EPA method 3545A, extractions test for other POPs like PBDES, PCNs, PFOS etc. are ongoing.

In this application note the extraction for Dioxin and PCB in different food, feed, and environmental samples will be described.

2. Material and Methods

- **X-TRACTION®, LCTech GmbH**
  - Extraction cell, 75 mL (nominal volume)
  - Glass fiber filter (37 mm diameter)
  - SST Frits
  - Result vials (60 mL; 250 mL)
- **DEXTech Pure or DEXTech Heat or DEXTech 16, LCTech GmbH**
  - Acidic silica gel column
  - Alumina column
  - Carbon column
- **D-EVA, Martin Christ enhanced by LCTech GmbH**
  - Centrifuge vials
  - Temperature sensor
- **DFS HRMS, Thermo Fisher Scientific**
  - SSL-injector, HT8-PCB, 60 m, 0.25 µm film, 0.25 mm ID, Trajan
  - PTV-injector, RTX-Dioxin2, 60 m, 0.25 µm film, 0.25 mm ID, Restek
- **Standard Solutions**
  - EPA1613-LCS, ISS and CSS, Wellington Laboratories
  - EPA1613-PAR/Stock, Wellington Laboratories
  - PCB-LCS-H, ISS-H and CSS-H, Wellington Laboratories
  - PCB-Stock-A20, Wellington Laboratories
  - EDF-5526, Recovery Standard, CIL
  - EDF-5525-100x Internal Standard, CIL
- **Solvents**
  - n-Hexane, picograde
  - Cyclohexane, picograde
  - Ethanol, picograde
  - Acetone, picograde
  - Toluene picograde
  - Dichloromethane, picograde
- **Drying Agent**
  - Sodium polyacrylate (Sigma Aldrich)
- **Certified reference materials**
  - BCR 536 (European Commission, Joint Research Centre)
  - BCR 677 (European Commission, Joint Research Centre)

3. Filling of Extraction Cell

1. First put in reusable FEP O-ring into both lids:

NOTE: Ensure that the FEP O-ring is stable within the lid and does not fall out.

2. Put on the frit (SST) onto one end of the extraction cell:

NOTE: Keep sealing surfaces clean! In case of dirt or grains, use a clean brush and remove dirt carefully before putting on the frit again.

3. Put on the lid (equipped with FEP O-ring):

NOTE: Ensure that the lid has a solid magnetic connection to the extraction cell. We recommend turning the lid until you feel the magnetic force between the lid and the extraction cell.

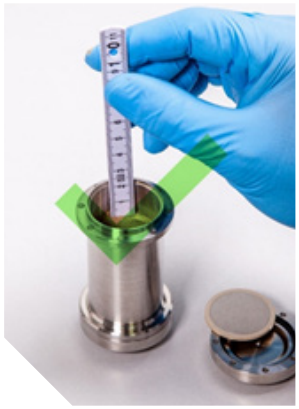
4. Turn around the extraction cell and place glass fibre filter (P/N 19281) on the upper end of the extraction cell.

5. Carefully push down the glass fibre filter to the bottom of the extraction cell. Please use the plunger (P/N 19343), for the exact placement of the filter.

NOTE: Ensure that the glass fibre filter is pushed down equally on each side and has full contact to the inner diameter of the extraction cell.

6. Fill your sample. A funnel or a weighing boat is recommended to ensure accurate filling of the cell.

NOTE: Keep sealing surfaces clean! In case of dirt or grains, use a clean brush and remove dirt carefully.



NOTE: To ensure the function of the X-TRACTION® system, it is mandatory to keep a minimum 2 cm air-gap between the upper end of the extraction cell and the upper end of the sample volume within the extraction cell. Please only use free-flowing, dry samples. If sample is wet or fluid, please use sodium polyacrylate until sample is free-flowing and dry. **Never use sodium sulfate as drying agent as it could lead to clogging of the capillaries!**

7. Put on the frit (SST) onto the upper end of the extraction cell.

NOTE: Keep sealing surfaces clean! In case of dirt or grains, use a clean brush and remove dirt carefully.

8. Put on the lid (equipped with FEP O-ring):

NOTE: Ensure that the lid has a solid magnetic connection to the extraction cell. We recommend turning the lid until you feel the magnetic force between the lid and the extraction cell.

4. Extraction of PCDD/F and PCB in Feed Samples

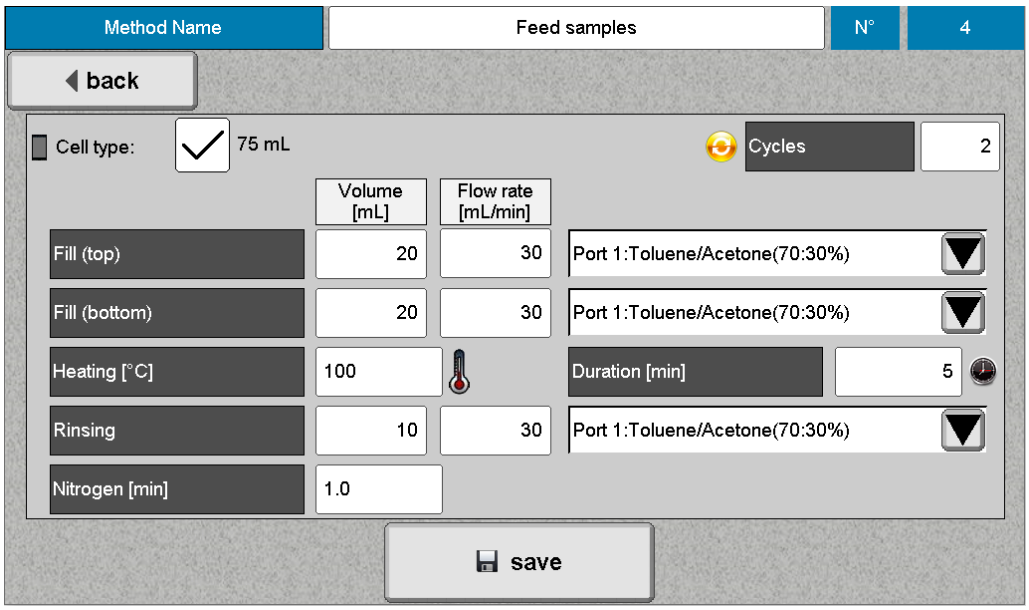
4.1 Sample Preparation

Homogenized feed samples (5 – 20 g; particle size < 1 mm) have been mixed with drying agent (sodium polyacrylate) before the extraction. The amount of the drying agent depends on the water content of the samples. The ratio between sample and drying agent was between 1:0.5 and 1:2. It is important to have a dry, free-flowing sample before the extraction. Do not use sodium sulfate as drying agent, as it may lead to clogging of the tubes!

If the sample is already dry, with a very small particles size, glass powder can be added to increase the accessibility of solvent to the matrix.

Fill your mixed sample into the extraction cell. Please keep in mind, that the extraction cell does not get filled completely. For further details, please refer to the manual.

4.2 Extraction Conditions



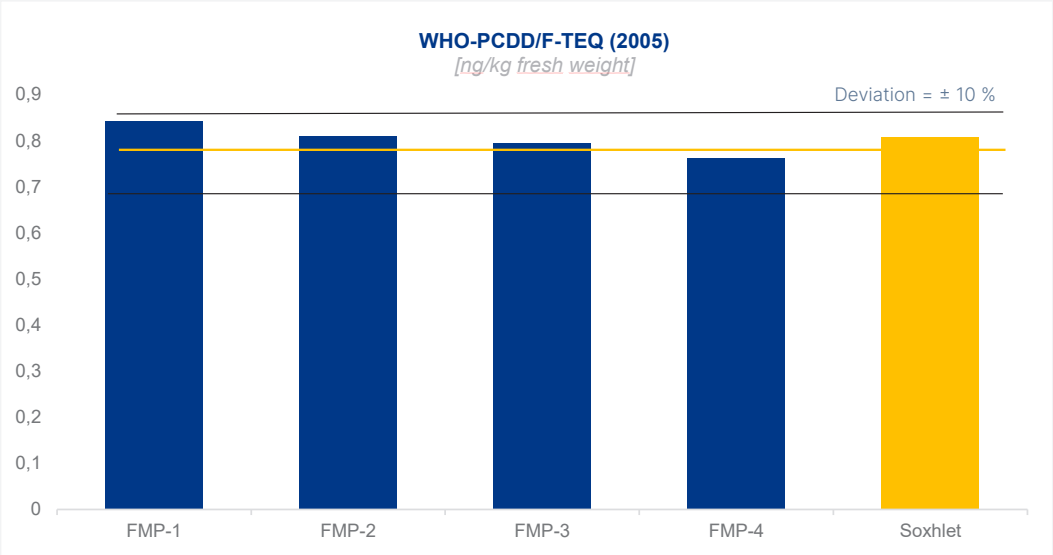
The extraction conditions for the feed samples are shown in the figure above. The parameters shown, are meant as a starting point for further method development, as results may vary depending on matrix composition. Changing the parameters, (increasing number of cycles, temperature and holding time) may lead to better extraction efficiency.

The extracted samples were further processed with a DEXTech Plus or Pure instrument, evaporated and analysed for PCDD/Fs and PCB by HR-GCMS.

4.3 Results for Feed Samples Comparison of X-TRACTION®- and Soxhlet Extraction Efficiency

Figure 1 shows the WHO-PCDD/F-TEQ results of 4 independent QC-sample extractions (FMP-1 – FMP-4) in comparison to the result of the same QC-sample extracted with Soxhlet. The 4 QC-samples show very little variation among themselves (RSD 3,6 %) as well as in comparison to the Soxhlet extraction (RSD 5,5%). All results are well in between the 10 % deviation marked with the black lines within the figure.

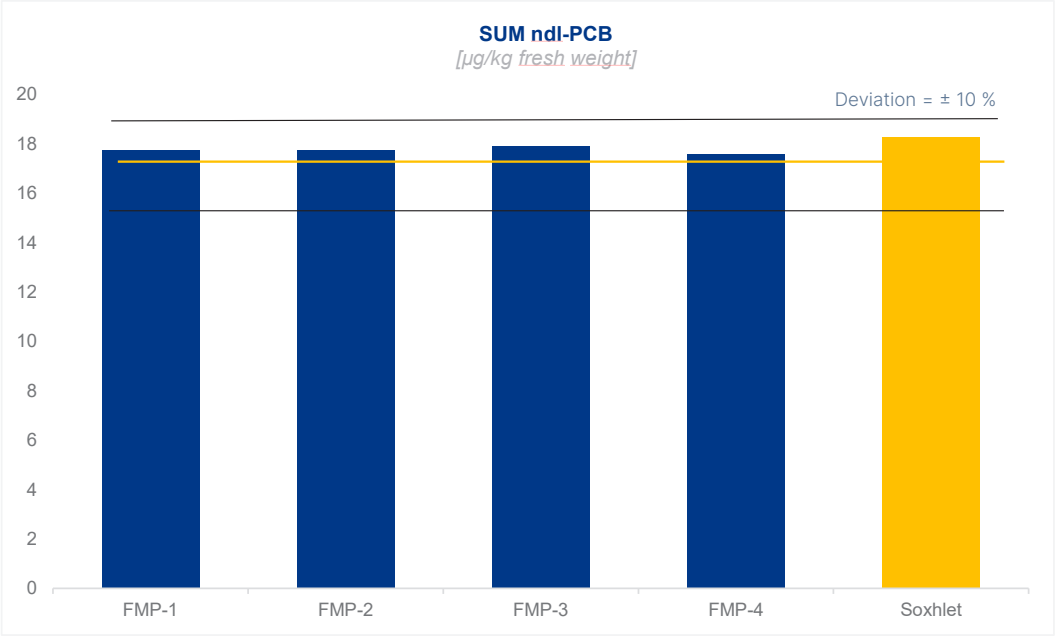
Figure 1 WHO-PCDD/F-TEQ (2005)



Data provided by Chemical and Veterinary Analytical Institute, Münsterland-Emscher-Lippe (CVUA-MEL), Muenster, Germany

Figure 2 shows the SUM ndl-PCB results of the same samples described in figure 1. Also here you can see very little variation in the SUM ndl-PCB results (RSD 0,6%) among the 4 QC-samples as well as in comparison to the Soxhlet extraction (RSD 2,6%). Numerical data of the experiments is shown in the appendix.

Figure 2 SUM ndl-PCB



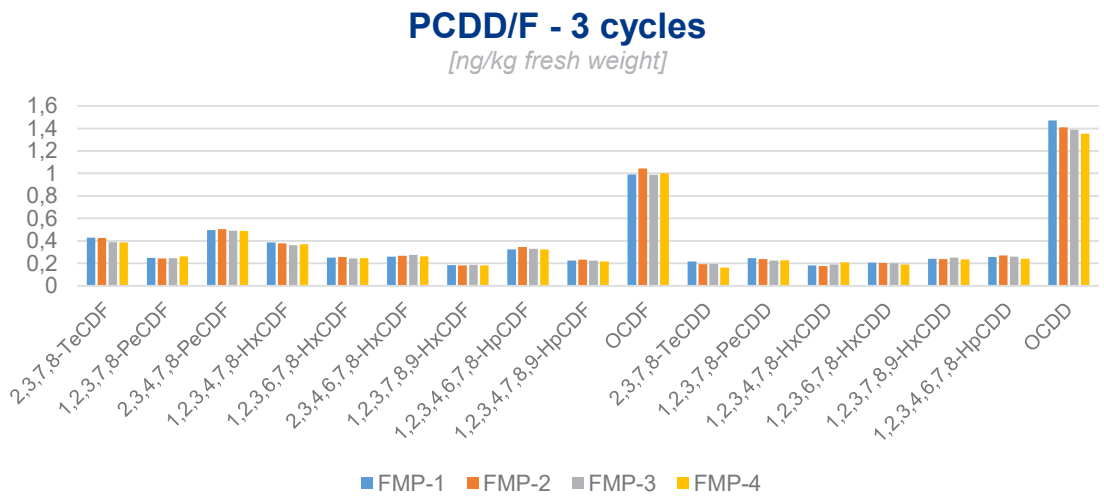
Data provided by Chemical and Veterinary Analytical Institute, Münsterland-Emscher-Lippe (CVUA-MEL), Muenster, Germany

As the results show, the efficiency and accuracy of X-TRACTION® extraction is comparable to classical Soxhlet extraction, but is much faster (45 minutes instead of several hours) and needs less solvent.

4.4 Precision of X-TRACTION® Results

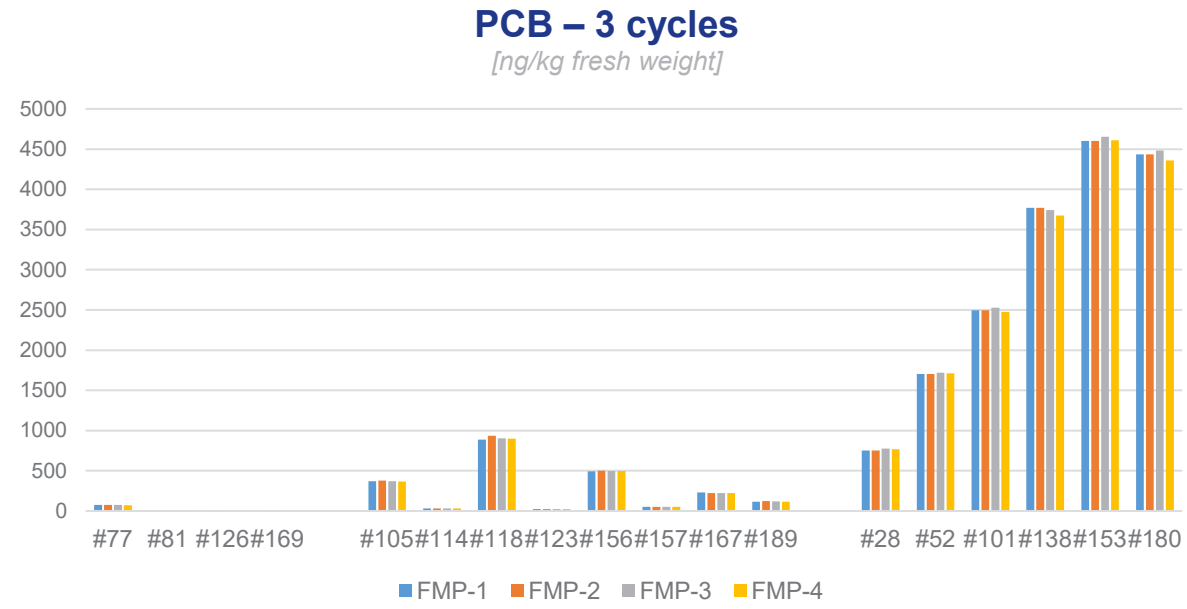
In figure 3, 4 single extractions of the QC feed samples are compared. The results are shown for each PCDD/F and PCB congenere. Numerical data of the experiments is shown in the appendix.

Figure 3 PCDD/F – 3 cycles



Data provided by Chemical and Veterinary Analytical Institute, Münsterland-Emscher-Lippe (CVUA-MEL), Muenster, Germany

Figure 4 PCB- 3 cycles



Data provided by Chemical and Veterinary Analytical Institute, Münsterland-Emscher-Lippe (CVUA-MEL), Muenster, Germany

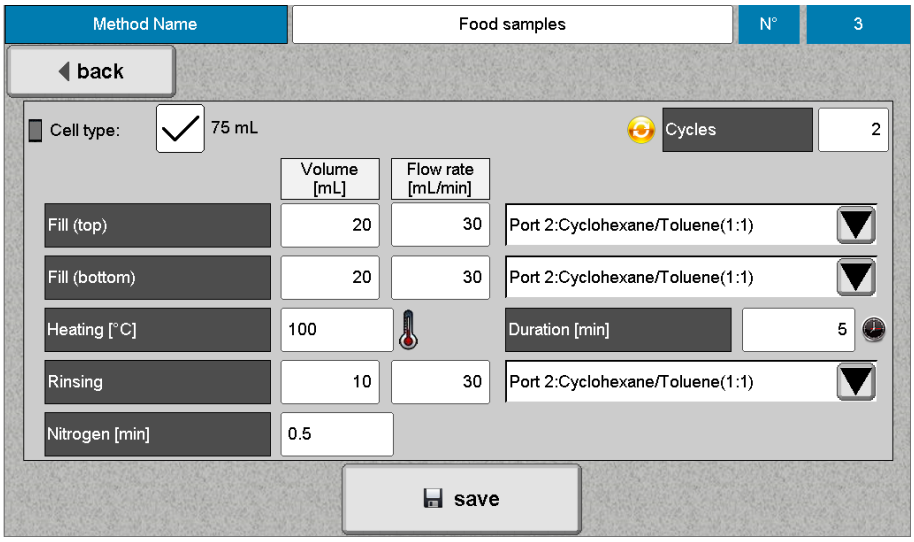
As the results show, the precision of the extraction with the X-TRACTION® system is very good with RSD values between 0.3 % and 9.8 % for the complete workflow (extraction, clean-up, evaporation and measurement).

5. Extraction of PCDD/F and PCB in Food Samples

5.1 Sample Preparation

Homogenised food samples (7 – 15 g) have been mixed with drying agent (sodium polyacrylate) before the extraction. The amount of the drying agent depends on the water content of the samples. The ratio between sample and drying agent was between 1:0.5 and 1:1. It is important to have a dry, free-flowing sample before the extraction. Don't use sodium sulfate as drying agent, as it may lead to clogging of the tubes. The mixed sample is filled into the extraction cell. For further details, please refer to the manual.

5.2 Extraction Conditions



The extraction conditions for the food samples are shown in the figure above. The parameters shown, are meant as a starting point for further method development, as results may vary depending on matrix composition. Changing the parameters (increasing number of cycles, temperature and holding time) may lead to better extraction efficiency.

The extracted samples were further processed with a DEXTech Plus or Pure instrument, evaporated and analysed for PCDD/Fs and PCB by HR-GCMS.

5.3 Results for Pure Fat Extraction of Different Food Matrices

Table 1 Fat extraction of different food matrices

	Mean % Fat	Standard Deviation	RSD%	Assigned Value % Fat	Deviation from Assigned Value %
Milk powder n=3	21.5	1.5	7.1	23.1	6.9
Beef n=4	6.3	0.3	5.1	6.5	3.1
Egg yolk powder n=2	52.8	0.8	1.5	55.8	5.4
Egg n=4	8.1	0.2	2.3	8.6	5.8
Beef liver n=3	10.1	0.4	4.0	10.8	6.5
Cod liver n=1	44.1	-	-	46.5	5.2
Halibut n=1	16	-	-	16.8	4.8

Data provided by European Union Reference Laboratory (EURL) for Halogenated POPs in Feed and Food, Freiburg, Germany

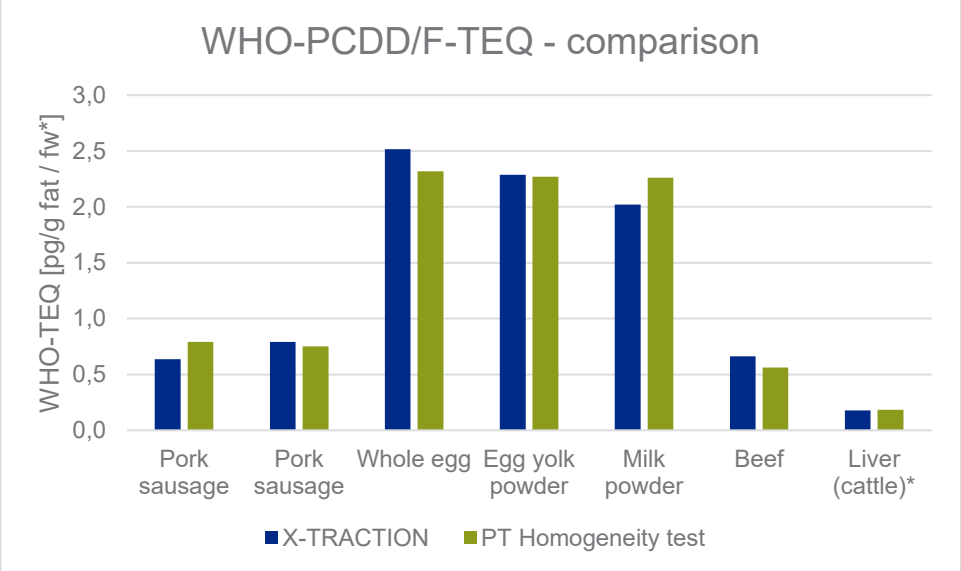
As the results show, the precision for the fat extraction of different food matrices with X-TRACTION® is very good, as can be seen by the low RSD values for each matrix.

The same is true for the accuracy, shown by the low deviation of the fat content for each extracted sample in comparison to the assigned fat value. The deviation from the assigned values are well below 10%.

5.4 Results for WHO-PCDD/F-TEQ and WHO-PCB-TEQ

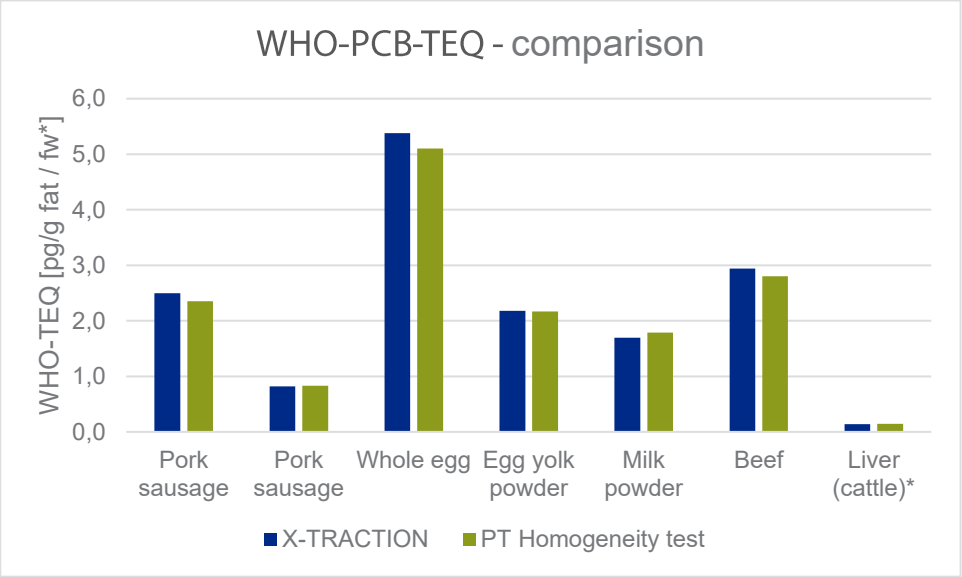
The extracted fats from chapter 2.2.2 were also analyzed for PCDD/F and PCB-TEQ. Results are shown in figure 5 and figure 6 below. Figure 5 shows a WHO-PCDD/F-TEQ comparison of samples extracted with the X-TRACTION® system (orange) and the assigned values of a PT homogenity test (green) of different food matrices. As seen in the figure, the results are well comparable to each other. The same is true for figure 6, which shows the comparison of WHO-PCB-TEQ between the X-TRACTION® system and the PT homogenity test.

Figure 5 WHO-PCDD/F-TEQ-comparison



Data provided by European Union Reference Laboratory (EURL) for Halogenated POPs in Feed and Food, Freiburg, Germany

Figure 6 WHO-PCB-TEQ-comparison



Data provided by European Union Reference Laboratory (EURL) for Halogenated POPs in Feed and Food, Freiburg, Germany

As the results show, the accuracy for the Dioxin/PCB analyses is very good, the analyzed samples are comparable to the assigned values.

6. Extraction of PCDD/F and PCB in Environmental Samples

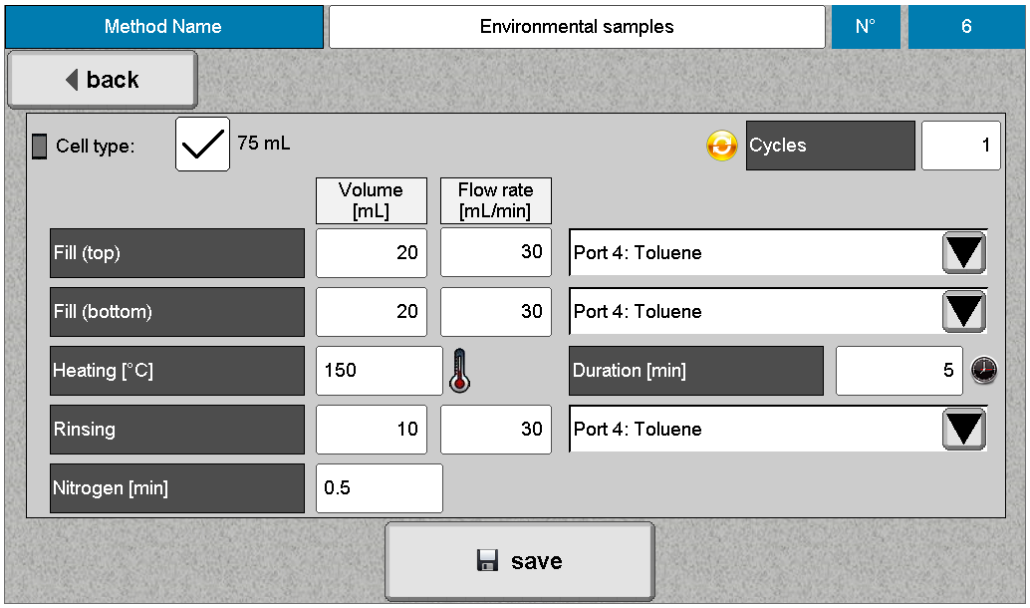
6.1 Sample Preparation

For the tests, certified reference materials (BCR 536: PCB in harbour sediment; BCR 677: PCDD/F in sewage sludge) were used and extracted according to US EPA 3545A.

Homogenised environmental samples (1 – 2 g; particle size < 1 mm) have been mixed with drying agent (sodium polyacrylate) before the extraction. The amount of the drying agent depends on the water content of the samples. The ratio between sample and drying agent was between 1:0.5 and 1:1. It is important to have a dry, free-flowing sample before the extraction. Don't use sodium sulfate as drying agent, as it may lead to clogging of the tubes.

If the sample is already dry, with a very small particles size, glass powder can be added to increase the accessibility of solvent to the matrix. The mixed sample is filled into the extraction cell. For further details, please refer to the manual.

6.2 Extraction Conditions



The extraction conditions for the environmental samples are shown in the figure above. The parameters shown, are meant as a starting point for further method development, as results may vary depending on matrix composition. Changing the parameters (increasing number of cycles, temperature and holding time) may lead to better extraction efficiency.

The extracted samples were further with a DEXTech Plus instrument, evaporated and analysed for PCDD/Fs and PCB by HR-GCMS.

6.3 Results for Environmental Samples

To show the efficiency of the X-TRACTION® several samples (certified reference material) have been extracted extracted and analyzed for PCDD/F (BCR 677) and PCB (BCR 536).

The results are shown in table 2 and table 3 below and cover the complete workflow (extraction, clean-up, evaporation and measurement).

6.3.1 BCR – 536 – PCB in harbour sediment

Table 2 shows the results of different PCB congeneres of 4 independent extractions of certified reference material (BCR 536, PCB in harbour sediment). As Table 2 shows, the accuracy for the PCB extractions is quite good, as can be seen in the recoveries that range between 85% and 113%.

Table 2 BCR – 536 – PCB in Harbour Sediment

Native [µg/kg]	Mean n=4 [µg/kg]	RDS [%]	Cert. Value [µg/kg]	Recovery [%]
PCB-#28	47.3	10.0	44.0	108
PCB-#52	42.9	16.5	38.0	113
PCB-#101	42.9	11.5	44.0	98
PCB-#118	23.0	14.9	27.5	84
PCB-#105	3.0	13.2	3.5	87
PCB-#153	53.3	12	50.0	107
PCB-#138	25.7	10.2	27.0	95
PCB-#156	2.7	11.5	3.0	90
PCB-#180	21.4	14.3	22.4	96
PCB-#128	5.3	11.5	5.4	98
PCB-#170	18.1	17.4	17.2	105
PCB-#163	13.0	11.2	13.4	97

Image 1 LCTech Laboratory, Obertaufkirchen

6.3.2 BCR – 677 - PCDD/F in Sewage Sludge

In table 3, the PCDD/F results of 5 independent extractions of certified reference material (BCR 677, PCDD/F in sewage sludge) are presented. Again the results show good recoveries between 74% and 131% indicating a good accuracy for the extracted samples.

Table 3 BCR – 677 - PCDD/F in sewage sludge

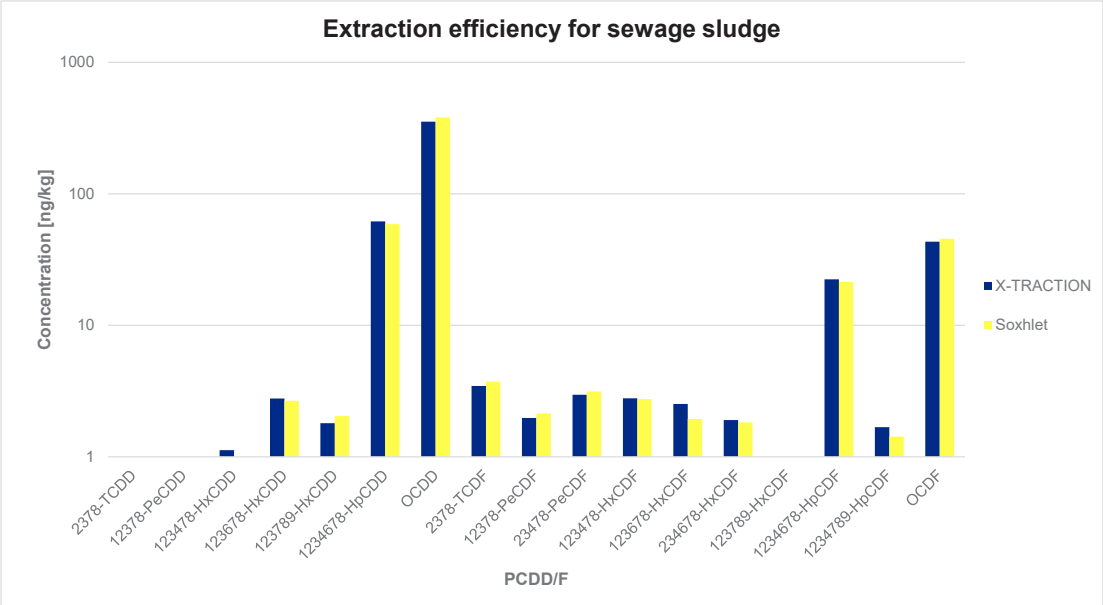
Native [pg/g]	Mean n=4 [ng/kg]	RDS [%]	Cert. Value [ng/kg]	Recovery [%]
2,3,7,8-TCDF	41	12.2	45	91
1,2,3,7,8-PeCDF	23	3.7	24.8	93
2,3,4,7,8-PeCDF	16	5.2	16.9	95
1,2,3,4,7,8-HxCDF	13	7.3	14.5	90
1,2,3,6,7,8-HxCDF	5.7	11.1	6.1	93
2,3,4,6,7,8-HxCDF	6.4	6.5	5.6	114
1,2,3,7,8,9-HxCDF	1.1	5.3	0.8	131
1,2,3,4,6,7,8-HpCDF	59.1	10.7	61.6	96
1,2,3,4,7,8,9-HpCDF	4.7	15.9	6.3	74
1,2,3,4,6,7,8,9-OCDF	158	15.2	177	89
2,3,7,8-TCDD	1.6	12.3	1.5	103
1,2,3,7,8-PeCDD	4	14.2	4.1	97
1,2,3,4,7,8-HxCDD	nd	nd	nd	nd
1,2,3,6,7,8-HxCDD	239	13.2	235	102
1,2,3,7,8,9-HxCDD	73.6	12.2	79	93
1,2,3,4,6,7,8-HpCDD	3221	14.9	3500	92
1,2,3,4,6,7,8,9-OCDD	12921	14.1	12700	102

Image 2 LCTech Laboratory, Obertaufkirchen

As shown in the figures above, the recoveries (74 – 131 %) of native PCB and Dioxins are quite good, in comparison to the assigned values of the reference materials.

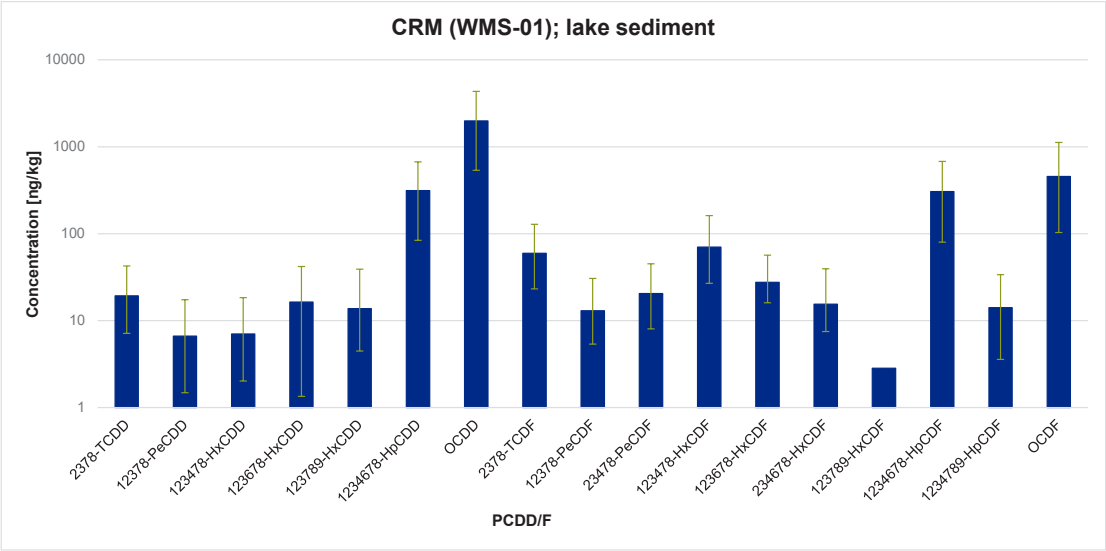
6.3.3 Exemplary Customer Data

This figure shows a comparison between the X-TRACTION® and Soxhlet extraction efficiency of real customer samples processed according to their daily routine laboratory procedure. It shows each PCDD/F in sewage sludge, after extraction, clean-up and evaporation.



As shown above, the efficiency and accuracy of X-TRACTION® extraction are completely comparable to classical Soxhlet extraction, but is much faster (45 minutes instead of several hours) and with significantly less solvent consumption.

This figure shows PCDD/F results of extractions of certified reference material (WMS-01, PCDD/F in lake sediment) are presented. The green lines show the accepted reference value limits. Also these extractions were processed from a customer according to their daily routine laboratory procedure including extraction, clean-up and evaporation.



As shown above, all reference values are obtained perfectly within the accepted reference value limits, with a method that lasts not longer than 15 minutes.

7. Conclusion

In summary, the results shown above proof that the X-TRACTION® system is a very flexible and reliable system for a variety of different samples (food, feed, environmental). The results show overall good precision and accuracy for the whole PCB and PCDD/F workflow, including extraction, clean-up, evaporation and analysis.

The handling of the X-TRACTION® system is very easy, fast and intuitive. Especially in comparison to classical extraction methods like Soxhlet, the system offers short extraction times and low solvent consumption.

8. Acknowledgements

All tests for „Extraction of PCDD/F and PCB in Feed Samples“ were done at the Chemical and Veterinary Analytical Institute, Münsterland-Emscher-Lippe (CVUA-MEL) in Münster.

All tests for „Extraction of PCDD/F and PCB in Food Samples“ were done at the European Union Reference Laboratory for halogenated POPs in Feed and Food in Freiburg.

We would like to thank both laboratories for generously providing the data for this study.

9. Appendix

Dioxin Workflow → From ***Sample*** to ***Chromatography***

2 **X-TRACTION®**
For extraction

3 **D-EVA Concentration**
For the sensor controlled evaporation of extracts

4 **DEXTech Product Family**
Sample preparation for all types of PCB and dioxin analysis

DEXTech Columns
Universal and SMART

5 **D-EVA Concentration**
For the sensor controlled evaporation to a few µL

1 Sample Preparation

- Sample intake / weigh in 5 to 10 g
- Homogenization with PAA / Hydromatrix
- Transfer into the extraction cell

2 Extraction: X-TRACTION®

- Sample intake
- Each cycle 20 min inclusive selfcleaning
- Up to 6 modules/extractions in parallel

Collection in

- 60 mL, 120 mL – bottle
- 140 mL – Centrifuge tubes for D-EVA (max. 90 mL capacity)

3 Evaporation: D-EVA

- Up to 11 × 90 mL in parallel without supervision
- Final volume approx. 1 mL
- n-hexane within approx. 40 min
- Toluene within approx. 60 min
- Manual transfer without rinsing to 15 mL Vials
- Add clean-up standard solution (n-Hex/Tol)
- Fill up to approx. 10 mL with n-hexane

4 Clean-up: DEXTech Pure / Plus and 16

- Fraction 1 in 40 mL centrifuge tubes containing PCB in 24 mL n-hexane/DCM
- Fraction 2 in 15 mL centrifuge tubes containing PCDD/F in 10 mL toluene

5 Evaporation: D-EVA

- Up to 23 x PCB or 26 x PCDD/F in parallel without supervision
- PCB within approx. 30 min to approx. 200-300 µL
- PCDD/F within approx. 40 min to 30-100 µL
- Manual transfer without rinsing to GC Vials with Insert
- Blowing down with nitrogen if necessary
- Add syringe standard solution

6 Ready for Analysis

- 6 samples in parallel
- within 5 hours
- manual handling approx. 15 min

Table 4 Comparison X-TRACTION®/Soxhlet - feed samples

	X-TRACTION®							Soxhlet		
	FMP-1	FMP-2	FMP-3	FMP-4	Mean	Deviation	RSD %	Mean	Deviation	RSD%
	3 Cycles	3 Cycles	3 Cycles	3 Cycles	n = 4			n = 9		
	Fresh weight ng/kg	Fresh weight ng/kg	Fresh weight ng/kg	Fresh weight ng/kg	Fresh weight ng/kg			Fresh weight ng/kg		
(WHO PCDD/F-TEQ 2005) upper bound	0.8429	0.8101	0.7943	0.7622	0.8024	0.0291	3.6	**0.8070**	0.0443	5.49
(WHO dl-PCB-TEQ 2005) upper bound	0.6081	0.6173	0.6095	0.591	0.6065	0.0096	1.6	**0.6660**	0.0243	3.65
(WHO-PCDD/F-PCB-TEQ 2005) upper bound	1.451	1.4274	1.4038	1.3532	1.4274	0.0193	1.3	**1.4730**	0.0401	2.72
Sum ndl-PCB upper bound	17.765	17.765	17.903	17.606	17.7598	0.1051	0.6	**18.270**	0.4682	2.56

Data provided by Chemical and Veterinary Analytical Institute, Münsterland-Emscher-Lippe (CVUA-MEL), Muenster, Germany

Table 5 Precision PCDD/F extraction - feed samples

	Extraction 1	Extraction 2	Extraction 3	Extraction 4	Mean	Deviation	RSD %
	Fresh weight ng/kg	Fresh weight ng/kg	Fresh weight ng/kg	Fresh weight ng/kg	Fresh weight ng/kg		
Polychlorinated Dibenzofurane							
2,3,7,8-TeCDF	0.4292	0.4263	0.3877	0.3862	**0.4074**	**0.0204**	**5.0**
1,2,3,7,8-PeCDF	0.2477	0.2428	0.2462	0.2615	**0.2496**	**0.0071**	**2.9**
2,3,4,7,8-PeCDF	0.4973	0.5043	0.4909	0.4892	**0.4954**	**0.0059**	**1.2**
1,2,3,4,7,8-HxCDF	0.3864	0.3791	0.3631	0.3696	**0.3746**	**0.0089**	**2.4**
1,2,3,6,7,8-HxCDF	0.2518	0.256	0.2447	0.247	**0.2499**	**0.0044**	**1.7**
2,3,4,6,7,8-HxCDF	0.2585	0.2687	0.2752	0.2619	**0.2661**	**0.0064**	**2.4**
1,2,3,7,8,9-HxCDF	0.1844	0.1819	0.1881	0.1832	**0.1844**	**0.0023**	**1.3**
1,2,3,4,6,7,8-HpCDF	0.3229	0.3448	0.3284	0.3236	**0.3299**	**0.0088**	**2.7**
1,2,3,4,7,8,9-HpCDF	0.2241	0.2323	0.2236	0.2165	**0.2241**	**0.0056**	**2.5**
OCDF Octachlordibenzofuran	0.9901	1.043	0.9885	1.001	**1.0057**	**0.0221**	**2.2**
Polychlorinated Dibenzodioxin							
2,3,7,8-TeCDD	0.2163	0.1917	0.1949	0.1634	**0.1916**	**0.0188**	**9.8**
1,2,3,7,8-PeCDD	0.247	0.2377	0.2255	0.2275	**0.2344**	**0.0086**	**3.7**
1,2,3,4,7,8-HxCDD	0.1831	0.1759	0.19	0.2084	**0.1894**	**0.0121**	**6.4**
1,2,3,6,7,8-HxCDD	0.2067	0.2032	0.2019	0.1904	**0.2006**	**0.0061**	**3.1**
1,2,3,7,8,9-HxCDD	0.2422	0.2373	0.2526	0.2351	**0.2418**	**0.0067**	**2.8**
1,2,3,4,6,7,8-HpCDD	0.2567	0.2704	0.2598	0.2401	**0.2568**	**0.0109**	**4.2**
OCDD Octachlordibenzodioxin	1.472	1.409	1.389	1.353	**1.4058**	**0.0432**	**3.1**

Table 6 Precision PCB extraction - feed samples

	Extraction 1	Extraction 2	Extraction 3	Extraction 4	Mean	STABWN	RSD %
	Fresh weight ng/kg	Fresh weight ng/kg	Fresh weight ng/kg	Fresh weight ng/kg	Fresh weight ng/kg		
non-ortho PCB							
PCB 77	74.58	77.17	77.39	73.8	**75.74**	**1.57**	**2.1**
PCB 81	6.957	7.275	6.708	6.934	**6.969**	**0.2019**	**2.9**
PCB 126	4.561	4.628	4.575	4.43	**4.549**	**0.0728**	**1.6**
PCB 169	2.542	2.546	2.516	2.405	**2.5023**	**0.0573**	**2.3**
mono-ortho PCB							
PCB 105	370.4	378.8	370.9	368.1	**372.1**	**4.0376**	**1.1**
PCB 114	33.57	33.36	33.13	31.39	**32.9**	**0.8643**	**2.6**
PCB 118	886.1	934.4	905.6	899.5	**906.4**	**17.64**	**1.9**
PCB 123	23.05	23.69	23.32	23.00	**23.3**	**0.2739**	**1.2**
PCB 156	493.1	503.8	496.7	498.8	**498.1**	**3.8710**	**0.8**
PCB 157	53.14	53.23	52.49	51.88	**52.7**	**0.5455**	**1.0**
PCB 167	229.7	224.5	224.4	223.6	**225.6**	**2.4213**	**1.1**
PCB 189	117.2	122.3	118.3	116.9	**118.7**	**2.1568**	**1.8**
ndl-PCB	µg/kg	µg/kg	µg/kg	µg/kg	**µg/kg**	**µg/kg**	
PCB 28	0.7508	0.7508	0.7764	0.7697	**0.7619**	**0.0114**	**1.5**
PCB 52	1.705	1.705	1.719	1.713	**1.7105**	**0.0059**	**0.3**
PCB 101	2.498	2.498	2.53	2.477	**2.5008**	**0.0189**	**0.8**
PCB 138	3.771	3.771	3.742	3.674	**3.7395**	**0.0396**	**1.1**
PCB 153	4.603	4.603	4.653	4.611	**4.6175**	**0.0208**	**0.4**
PCB 180	4.437	4.437	4.483	4.361	**4.4295**	**0.0438**	**1.0**

10. Ordering information

- **X-TRACTION® MAIN SYSTEM** **P/N** **20000**
- **X-TRACTION® ADD-ON-SYSTEM** **P/N** **20001**
- **EXTRACTION CELL** **P/N** **19700**
- **RACK FOR EXTRACTION CELL** **P/N** **19341**
- **FLASS FIBER FILTER (100 PCS./PCK.)** **P/N** **19281**
- **PLUNGER FOR FILTER PLACEMENT** **P/N** **19343**

For a detailed quotation and more information about D-EVA and DEXTech products please contact LCTech.

11. Related Information and References

1. Bernsmann, T., Albrecht M., Fürst, P. (2016); Organohalogen Compounds Vol. 78, 797-799
2. Calaprice C, Calvano CD, Zambonin C, Focant JF (2015); Organohalogen Compounds Vol. 77, 733-735
3. Bernsmann, T., Albrecht M., Fürst, P. (2014); Organohalogen Compounds Vol. 76, 1281-1284

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