

LEVELS OF PCDD, PCDF AND PCBs IN DRINKING WATER IN LODZ, KRAKOW, POZNAN AND WARSAW

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Introduction

The aim of this study was to assess the drinking water concentrations of polychlorinated dibenzo-p-dioxins (PCDD), furans (PCDFs) and polychlorinated biphenyls (PCBs) in four cities Lodz, Krakow, Poznan and Warsaw (Poland), with an intense traffic. Another goal was to evaluate the use of methodology as a complementary tool to monitor the low levels of these POPs in drinking water.

Material and Methods

In 4 cities a total of 42 drinking water samples were taken by supervisory organs (sanitary inspectors) and were tested for dioxins, furans and dioxin-like PCBs.

The applied methodology follows USEPA methods 1613 and 1668. Samples were extracted using dichloromethane. Prior the extraction samples were spiked with carbon-13 isotope labeled internal standards -7 PCDD, 10 PCDF and with 12 PCBs. Extracts were evaporated to 100 microliters.

Quantification was done with a high resolution gas chromatograph (HRGC) (Hewlett-Packard/Agilent, Germany) with split/split less injection. Chromatographic column was a 60 m DB-5MS with 0.25 mm inner diameter and 25µm film thickness. The HRGC was coupled with a high resolution mass spectrometer (HRMS) (Autospec, Micromass/Waters, USA), working in the electron impact mode at 34 eV and with an average resolution of 10 000. For parent congener and corresponding labeled standards two ions each were registered. Quality assurances and quality control were done by determining laboratory blanks.

All solvents (JT Baker, The Netherland) and gas (Multax, Poland) used were ultrapure grade suitable for PCDD/F analysis.

Results

The results of the measurement are summarised in Table 1 giving the levels of PCDD and PCDF and in Table 2 giving the levels of PCBs. Additionally, these levels are compared to maximum levels, regulated in the USEPA for 2378-TCDD (30 pg/l).

In Poland there is no regulation of PCB and PCDD/PCDF level in drinking water.

Total PCDD/F I-TEQ were 0.180 (Lodz) up to 0.305 pg/l (Warsaw). The main contributor to total I-TEQ was OCDD 0.131 pg/l (Warsaw) up to 1.546 pg/l (Krakow). Congener PCB 126 was at the level <LOD in all samples.

Conclusions

Regarding the results of the study it can be concluded that drinking water in four Polish cities are contaminated only to a minor degree. The comparison to USEPA maximum level shows that the analysed levels of PCDD, PCDF and PCBs in drinking water are well below the current limit for 2378-TCDD (30 pg/l). Results showed that the used methodology is appropriate tool to monitor low levels of these POPs in drinking water.

Table 1. Levels of PCDD/PCDF determined in drinking water collected in Lodz, Krakow, Poznan and Warsaw (Poland)

Congener	TEF	L.O.D	Mean value and the range [pg/l]			
			Lodz (n=10)	Krakow (n=10)	Poznan (n=10)	Warsaw (n=12)
2378-TCDD	1	0.002	0.050 0.000÷0.144	0.040 0.017÷0.070	0.106 0.040÷0.182	0.077 0.000÷0.144
12378-PeCDD	1	0.0004	0.064 0.000÷0.326	0.000	0.069 0.000÷0.126	0.088 0.000÷0.291
123478-HxCDD	0.1	0.006	0.012 0.000÷0.066	0.104 0.000÷0.330	0.000	0.006 0.000÷0.036
123678-HxCDD	0.1	0.002	0.008 0.000÷0.050	0.060 0.020÷0.110	0.000	0.000
123789-HxCDD	0.1	0.007	0.017 0.000÷0.056	0.143 0.000÷0.330	0.078 0.000÷0.173	0.078 0.000÷0.296
1234678-HpCDD	0.01	0.006	0.007 0.000÷0.069	0.213 0.000÷0.720	0.062 0.000÷0.173	0.000
OCDD	0.0003	0.034	0.286 0.000÷0.861	1.546 0.339÷3.910	0.690 0.044÷1.406	0.131 0.000÷0.375
2378-TCDF	0.1	0.002	0.055 0.000÷0.264	0.016 0.000÷0.060	0.000	0.096 0.000÷0.291
12378-PeCDF	0.03	0.009	0.021 0.000÷0.069	0.070 0.000÷0.270	0.154 0.000÷0.228	0.073 0.000÷0.169
23478-PeCDF	0.3	0.008	0.136 0.000÷0.531	0.102 0.000÷0.300	0.103 0.061÷0.182	0.316 0.108÷0.729
123478-HxCDF	0.1	0.004	0.021 0.000÷0.118	0.101 0.000÷0.380	0.108 0.000÷0.333	0.046 0.000÷0.212
123678-HxCDF	0.1	0.003	0.027 0.000÷0.135	0.040 0.000÷0.080	0.076 0.000÷0.157	0.052 0.000÷0.145
234678-HxCDF	0.1	0.011	0.032 0.000÷0.128	0.244 0.106÷0.660	0.199 0.069÷0.327	0.067 0.000÷0.160
123789-HxCDF	0.1	0.007	0.060 0.000÷0.180	0.114 0.000÷0.220	0.154 0.064÷0.244	0.065 0.000÷0.147
1234678-HpCDF	0.01	0.011	0.026 0.000÷0.106	0.143 0.000÷0.420	0.228 0.000÷0.694	0.081 0.000÷0.272
1234789-HpCDF	0.01	0.002	0.088 0.000÷0.308	0.179 0.000÷0.660	0.097 0.000÷0.276	0.052 0.000÷0.088
OCDF	0.0003	0.01	0.210 0.017÷0.670	0.274 0.096÷0.550	0.102 0.028÷0.249	0.145 0.000÷0.410
Total [pg/l]			1.121	3.389	2.228	1.374
I-TEQ [pg/l]			0.180	0.161	0.277	0.305

Table 2 Levels of PCBs determined in drinking water collected in Lodz, Krakow, Poznan and Warsaw (Poland)

Congener	TEF	L.O.D	Mean value and the range [pg/l]			
			Lodz (n=10)	Krakow (n=10)	Poznan (n=10)	Warsaw (n=12)
PCB-77	0.0001	0.031	0.0312 0.000÷0.310	0.2090 0.000÷1.050	0.0000	0.3164 0.000÷1.900
PCB-81	0.0003	0.02	0.0298 0.000÷0.300	0.5550 0.000÷2.780	0.4596 0.000÷1.650	0.3339 0.000÷1.390
PCB-105	0.00003	0.005	0.3662 0.00÷3.050	1.1186 0.000÷2.850	0.0000	1.5741 0.000÷2.930
PCB-114	0.00003	0.005	0.4444 0.100÷1.660	1.3115 0.260÷2.590	0.2664 0.050÷0.600	1.1548 0.150÷2.260
PCB-118	0.00003	0.032	1.2377 0.00÷6.010	1.9413 0.000÷6.220	0.0000	3.3892 0.000÷7.170
PCB-123	0.00003	0.01	0.2876 0.00÷0.990	0.7526 0.000÷3.100	0.5898 0.000÷1.070	0.7139 0.180÷1.690
PCB-126	0.1	0.00004	0.0000	0.0000	0.0000	0.0000
PCB-156	0.00003	0.017	0.3828 0.00÷2.490	0.5953 0.000÷1.550	0.1261 0.000÷0.630	0.3644 0.000÷1.980
PCB-157	0.00003	0.0007	0.0067 0.000÷0.070	0.0000	0.0000	0.0000
PCB-167	0.00003	0.004	0.0829 0.000÷0.420	0.2302 0.000÷1.150	0.0000	0.0680 0.000÷0.410
PCB-169	0.03	0.0031	0.0408 0.00÷0.310	0.0000	0.0000	0.0000
PCB-189	0.00003	0.008	0.0081 0.000÷0.080	1.8465 0.000÷9.230	0.0779 0.000÷0.390	0.0000
Total [pg/l]			2.9183	8.5601	1.5197	7.9146
I-TEQ [pg/l]			0.0013	0.0004	0.0002	0.0003

Acknowledgments

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References

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2. U.S. EPA Method 1668. Revision A: Chlorinated Biphenyl Congeners in Water. Soil, Sediment and Tissue by HRGC/HRMS.