International POPs Elimination Project

Fostering Active and Efficient Civil Society Participation in Preparation for Implementation of the Stockholm Convention

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Country Situation Report for Estonia: POPs in the environment and waste in Estonia

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About the International POPs Elimination Project

On May 1, 2004, the International POPs Elimination Network (IPEN http://www.ipen.org) began a global NGO project called the International POPs Elimination Project (IPEP) in partnership with the United Nations Industrial Development Organization (UNIDO) and the United Nations Environment Program (UNEP). The Global Environment Facility (GEF) provided core funding for the project.

IPEP has three principal objectives:

- Encourage and enable NGOs in 40 developing and transitional countries to engage in activities that provide concrete and immediate contributions to country efforts in preparing for the implementation of the Stockholm Convention;
- Enhance the skills and knowledge of NGOs to help build their capacity as effective stakeholders in the Convention implementation process;
- Help establish regional and national NGO coordination and capacity in all regions of the world in support of longer term efforts to achieve chemical safety.

IPEP will support preparation of reports on country situation, hotspots, policy briefs, and regional activities. Three principal types of activities will be supported by IPEP: participation in the National Implementation Plan, training and awareness workshops, and public information and awareness campaigns.

For more information, please see http://www.ipen.org

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1. What are POPs?

Persistent organic pollutants (POPs) are organic compounds that, to a varying degree, resist photolytic, biological and chemical degradation. POPs are often halogenated and characterized by low water solubility and high lipid solubility, leading to their bioaccumulation in fatty tissues. They are also semi-volatile, enabling them to move long distances in the atmosphere before deposition occurs (www.pops.int/documents/background/assessreport/en/ritter-e.doc).

2. Sources of POPs in Estonia

Origin of the POPs contamination in Estonia comes mainly from the different wastes of combustion (oil-shale, wood and peat). It has been suggested that lots of persistent organic contaminants in the environment (PCDD/Fs) are the products of the waste. The sources of PCDD/Fs vary in different countries (Holoubek, et al., 2000). For example, in Estonia there are power plants which use oil shale as a fuel (Inventory, 2002). It is mainly in North-east Estonia. Industry in Narva and Kohtla - Järve as well as oil shale mines in the vicinity generates a lot of waste (Mussalo-Rauhamaa and Lindström, 1995).

During the European Dioxin Project concentration of dioxins was analyzed in Baltic Thermal Power Plant in oil-shale and fly ash from electrostatic precipitators (ESP) (Dioxin Study in an oil-shale based power station. 1998.). The results are shown in the Appendices 1 and 2. (Roots, 2001 - CPS: envchem/0107003 available at: http://preprint.chemweb.com/envchem/0107003).

In Estonia, the uncontrolled burning processes are the only identified sources of the direct release of PCDD/Fs to land (Roots et al., 2004). The origin of dioxins and furans in Estonia are mainly caused by the electricity and thermal power production. The cement production factories are probably also one of the dioxin input sources to the atmosphere (Roots et al., 2002).

Estonia was one of the first countries in the Baltic Region to ban chlorinated pesticides (in 1968). In 1957, 226 tons of pesticides, mainly DDT and Lindane were used in Estonia. As pests do not reproduce in cold climates as much as in warm climates, the usage of pesticides in Estonia did not exceed 0.7-0.1 kg per ha in mid 60s (among them, 0.03-0.06 kg per ha were chlorinated pesticides) (Roots, 1996).

3. Levels of POPs found in the environment

3.1 Atmosphere

POPs levels in atmosphere in Estonia are considerably lower than in other Baltic Sea countries. In 1990 the total annual emissions of dioxin to the atmosphere in Estonia was

17,7 g (TNO report) and in 2003, 14 g (Dancee and Danish EPA projects). PCDD/PCDF release inventory for Estonia in 2000 are presented below (Table 1).

Table 1: PCDD/PCDF release inventory for Estonia, reference year 2000 (Lassen et al. 2003)

Cat.	Source Categories	Annual Releases (g TEQ/a)				
		Air	Water	Land	Product	Residue
1	Waste Incineration	0.19				0.47
2	Ferrous and non-ferrous metal production					
3	Power generation and heating	4.9				5.8
4	Production of mineral products 0.06	0.39			na	0.06 [a]
5	Transport	0.04				na
6	Uncontrolled combustion processes	8.1	na	0.12 [a]		4.4 [a]
7	Production of chemicals, consumer goods	0.004[a]	0.15		0.03	0.6 [a]
8	Miscellaneous	0.04			0.002	0.009 [a]
9	Disposal/Landfill					3.9
10	Identification of Hot Spots	na				
1-9	Total	14 [a]	0.15 [a]	0.12 [a]	0.03 [a]	15 [a]

*** only medians given; original publication lists ranges for releases to air, water and product an empty field indicates that the release route is considered to be insignificant.**
na indicates that the release route may be significant, but no emission factor was available.
[a] behind a number indicates that the number may be underestimated as some subcategories have not been quantified (UNEP Standardized Toolkit 2003)

3.2 Soil

There has been one study of dioxins in soil in the vicinity of a landfill in south-east Estonia. The PCDD/F concentrations taken in all five soil samples were at background level (0,13-0,83 pg I-TEQ WHO/g dry weight). Up to 2003 the concentrations of dioxins and furans in Estonian soil samples have not been analyzed (Roots et al., 2004).

The distribution and accumulation of polycyclic aromatic hydrocarbons (PAH) in soil as well as PAH profiles have been investigated in areas with different anthropogenic pollution such as the city of Tallinn, the towns of Pärnu and Kohtla-Järve and some rural areas in 1996. The typical PAH level in Estonian rural soil is about 100 g/kg dry weight. PAH concentrations in Tallinn, Pärnu and Kohtla-Järve soil were quite high (the mean PAH concentrations were 2240, 7665 and 12390 g/kg dry weight, respectively). The dominant PAH in soil samples were pyrene, triphenylene and fluoranthene. 3-4 ring PAH and 5-6 ring PAH ratio altered from 5:1 to 1.7:1 (Trapido, 1999).

3.3 Meteorological Synthesizing Centre-East

The information mentioned in the following paragraphs - 3.3.1 – 3.3.4 - comes from the Meteorological Synthesizing Centre-East – the information is available at: http://www.msceast.org/countries/Estonia/index.html.

3.3.1 Emission data

Emission data on PCDD/F, HCB, PCB and B[k]F transport used in calculations on the regional scale were taken from POPCYCLING-Baltic project [Pacyna et al., 1999]. For B[b]F and B[a]P, official emission data submitted to the UN ECE Secretariat were used. Total emissions of the country for 1998 (HCB, PCBs) and 2001 (PCDD/Fs, B[a]P, B[b]F, B[k]F) used for modeling are presented (Table 2).

Table 2: Total emissions of the country for 1998 (HCB, PCBs) and 2001 (PCDD/Fs, B[a]P, B[b]F, B[k]F) (Source: http://www.msceast.org/countries/Estonia/index.html)

POPs	Total emissions, t/y (for PCDD/Fs - g TEQ/y)
PCDD/Fs	12.4
HCB	$7.1 \cdot 10^{-2}$
PCBs	0.1
B[b]F	$2.0 \cdot 10^{-2}$
B[k]F	0.4
B[a]P	2.1

3.3.2 Mean annual concentrations in main environmental compartments

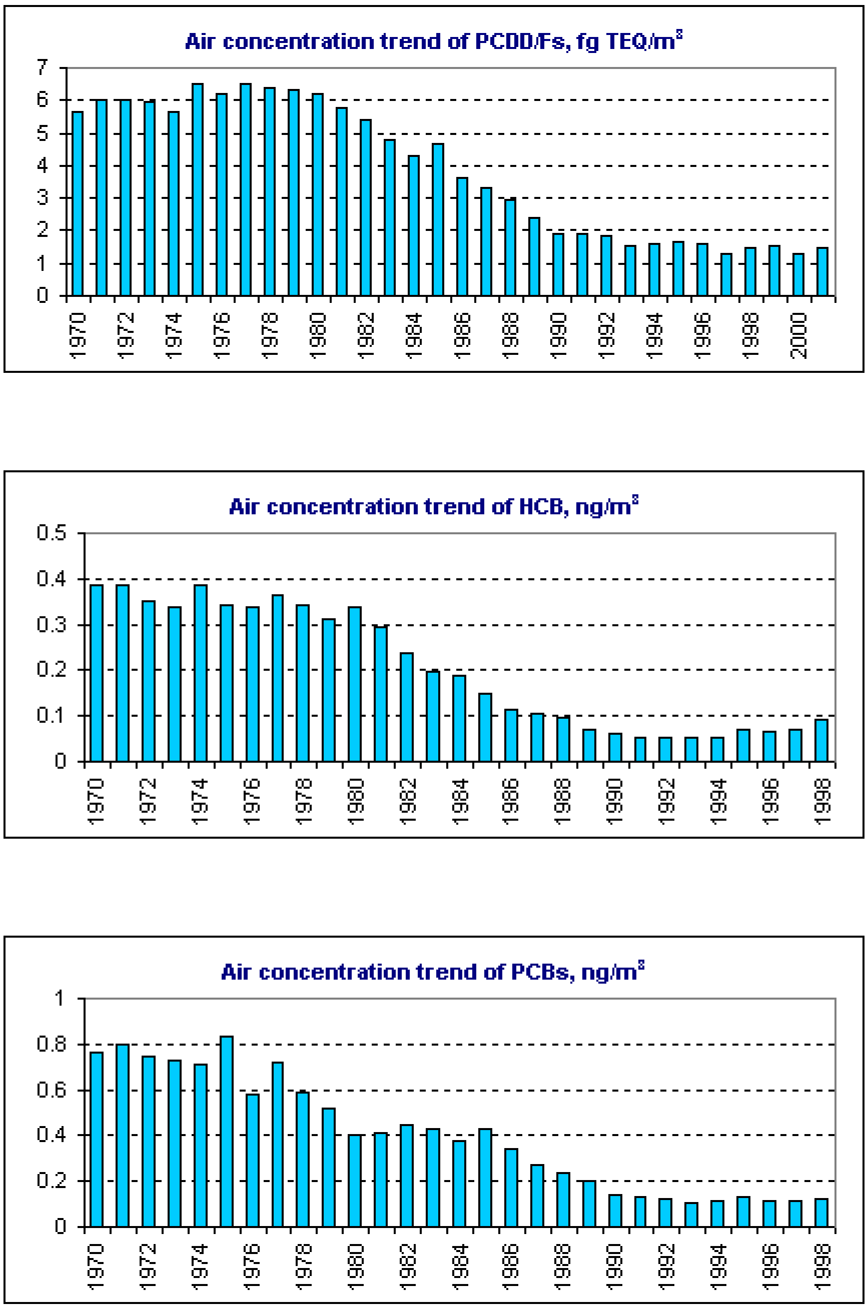
Calculated concentrations in various media including atmosphere (means over the country, minimum and maximum values in the country) are presented in the Table 3.

Table 3: Calculated concentrations in various media – air, soil and vegetation (Source: http://www.msceast.org/countries/Estonia/index.html)

POPs	Mean	Min	Max
Air concentrations, ng/m^3 (for PCDD/Fs - fg TEQ/m^3)			
PCDD/Fs	1.50	0.96	1.83
HCB	$7.05 \cdot 10^{-2}$	$5.43 \cdot 10^{-2}$	$8.09 \cdot 10^{-2}$
PCBs	0.12	$7.32 \cdot 10^{-2}$	0.18
B[b]F	0.21	0.13	0.57
B[k]F	0.24	$9.57 \cdot 10^{-2}$	0.33
B[a]P	13.49	12.14	14.12
Soil concentrations, ng/g (for PCDD/Fs - pg TEQ/g)			
PCDD/Fs	0.29	0.10	0.44
HCB	0.33	$1.40 \cdot 10^{-2}$	0.41
PCBs	8.84	0.70	14.77
B[b]F	3.41	1.00	5.49
B[k]F	3.21	0.69	4.52
Vegetation concentrations, ng/g (for PCDD/Fs - pg TEQ/g)			
PCDD/Fs	0.25	$5.03 \cdot 10^{-2}$	0.45
HCB	0.91	$5.30 \cdot 10^{-2}$	1.69
PCBs	25.28	2.20	37.00
B[b]F	36.56	6.25	76.98
B[k]F	35.70	3.83	85.03

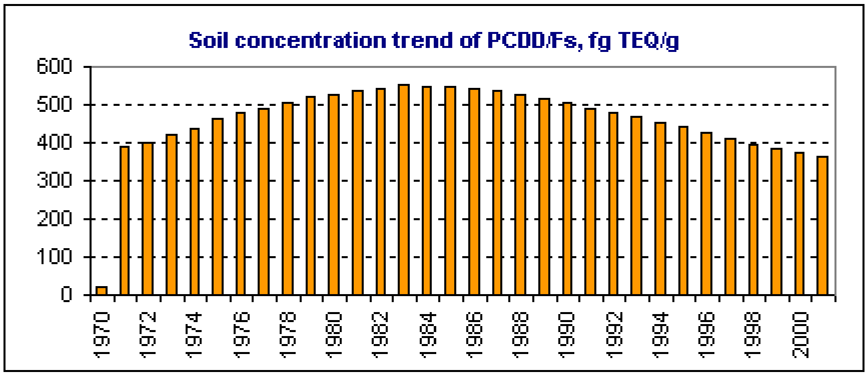
3.3.3 Trends in emissions and mean annual concentrations in main environmental compartments

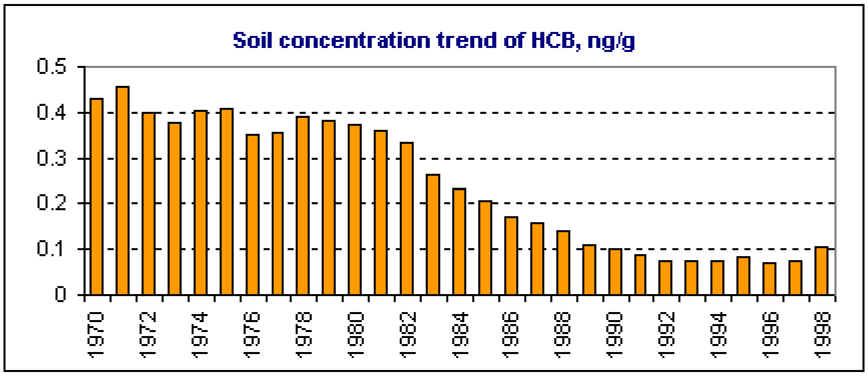
Trends in air, soil and vegetation concentrations of selected POPs, as well as trends in emission fluxes over the country are introduced - Air: Graph 1 – 3; Soil: Graph 4 – 6; Vegetation: Graph 7 – 9 and emission fluxes: Graph 10 - 12.

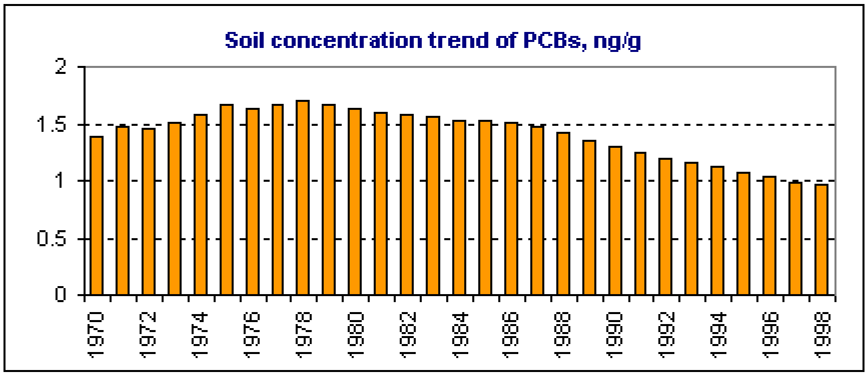


Graph 1 – 3: Air Concentration Trends of PCDD/Fs, HCB and PCBs (1970 – 1998)

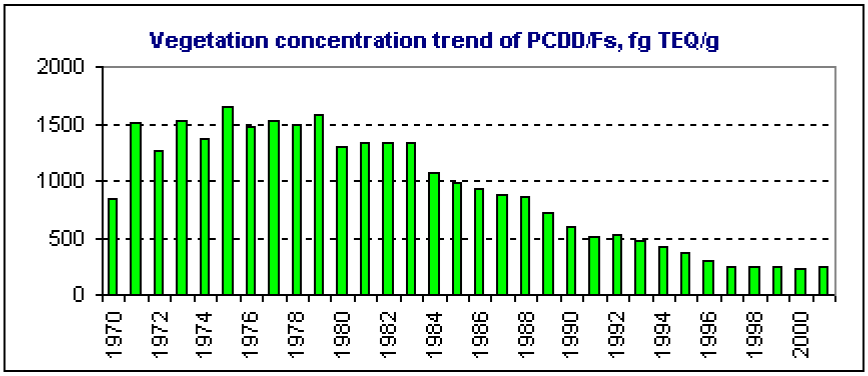
(Source: http://www.msceast.org/countries/Estonia/index.html)

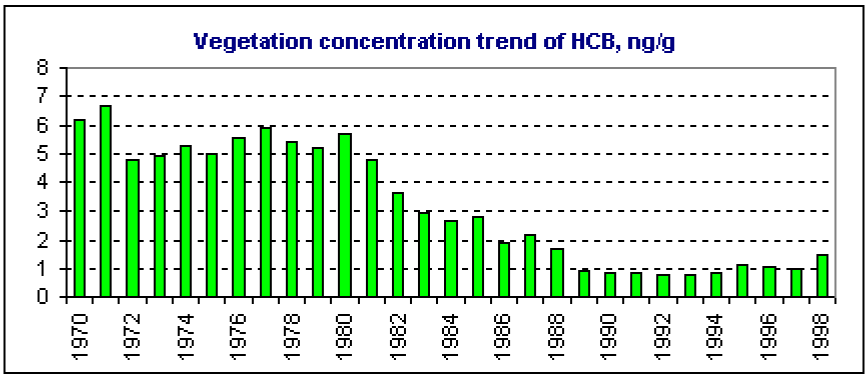


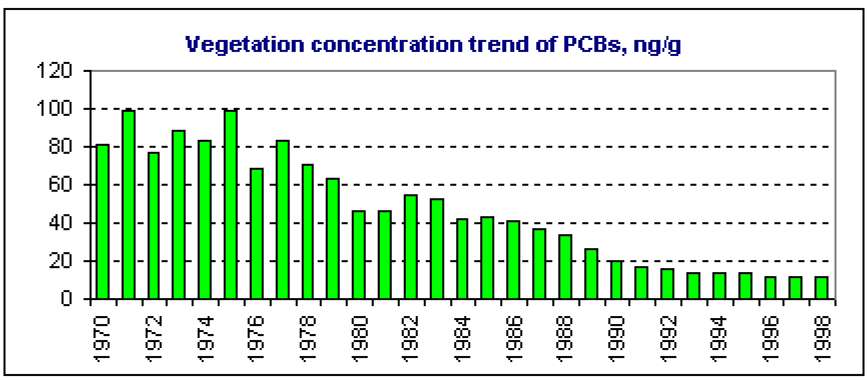




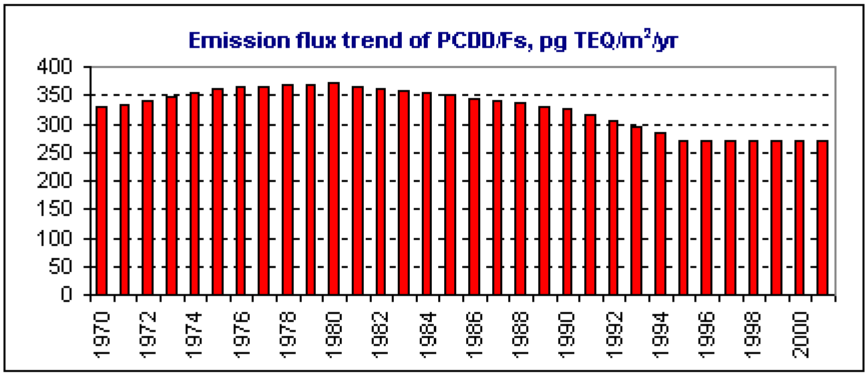
Graph 4 – 6: Soil Concentration trends of PCDD/Fs, HCB and PCBs (1970 – 1998)
(Source: http://www.msceast.org/countries/Estonia/index.html)

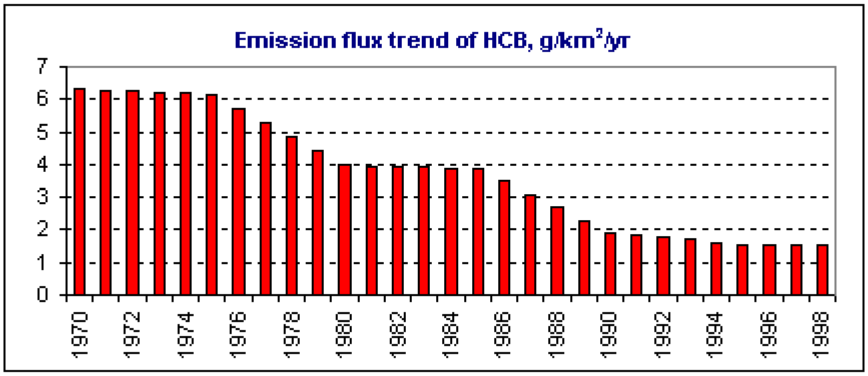


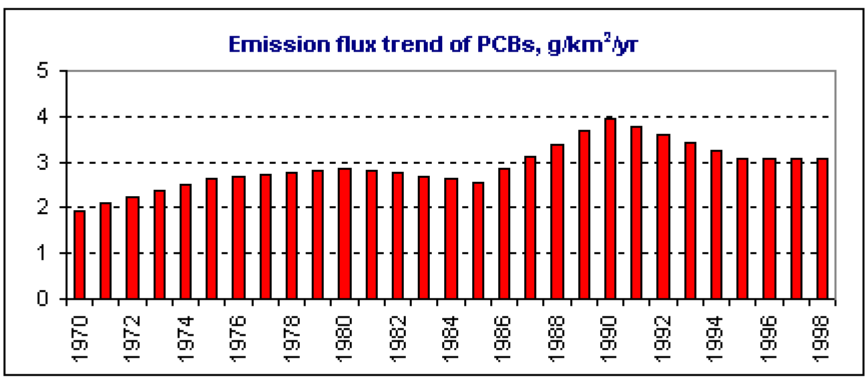




Graph 7 – 9: Vegetation trends of PCDD/Fs, HCB and PCBs (1970 – 1998 / 2000)
(Source: http://www.msceast.org/countries/Estonia/index.html)







Graph 10 – 12: Emission Flux trends of PCDD/Fs, HCB and PCBs (1970 – 1998 / 2000)
(Source: http://www.msceast.org/countries/Estonia/index.html)

3.3.4 Comparison of the modeling results with measurements

This section presents the comparison of modeling results with measurements carried out at the EMEP measurement sites, found in the literature and obtained from personal contacts with national experts - http://www.msceast.org/countries/Estonia/index.html.

Table 4 - 11: Measured and Calculated Data of PCB 105, PCB 118, PCB 153 and PCB 180 Concentration in Air, Precipitation, Fluxes
(Source: http://www.msceast.org/countries/Estonia/index.html)

PCB-105

Concentration in air, pg/m^3

Station	Year	Measured	Calculated	Meas/Calc	References
Vilsandi	1991	2.62	4.76	0.55	Pacyna et al, 1999
	1993	2.41	4.23	0.57	

PCB-118

Concentration in air, pg/m^3

Station	Year	Measured	Calculated	Meas/Calc	References
Vilsandi	1991-1993	1.500	9.83	0.15	Agrell et al, 1999
Lahhemaa		1.100	11.97	0.09	

Concentrations in precipitation, ng/L

Location	Year	Measured	Calculated	Meas/Calc	References
Vilsandi	1991-1993	0.04	0.88	0.05	Agrell et al., 2002
Lahhemaa		0.03	0.71	0.04	

Deposition fluxes, g/km^2/y

Location	Year	Measured	Calculated	Meas/Calc	References
Vilsandi	1991-1993	0.015	0.56	0.03	Agrell et al., 2002
Lahhemaa		0.011	0.71	0.02	

PCB-153

Concentration in air, pg/m^3

Station	Year	Measured	Calculated	Meas/Calc	References
Vilsandi	1991-1993	1.70	14.90	0.11	Agrell et al, 1999
Lahhemaa		1.10	11.63	0.09	

Concentrations in precipitation, ng/L

Location	Year	Measured	Calculated	Meas/Calc	References
Vilsandi	1991-1993	0.07	1.70	0.04	Agrell et al, 1999
Lahhemaa		0.07	0.89	0.08	

PCB-180

Concentration in air, pg/m^3

Station	Year	Measured	Calculated	Meas/Calc	References
Vilsandi	1991-1993	0.40	3.29	0.12	Agrell et al, 1999
Lahhemaa		0.20	2.35	0.09	

Concentrations in precipitation, ng/L

Location	Year	Measured	Calculated	Meas/Calc	References
Vilsandi	1991-1993	0.02	0.46	0.04	Agrell et al, 1999
Lahhemaa		0.01	0.30	0.03	

4. Levels of POPs found in waste and debris

4.1 Waste

There has been only one study to determine dioxin concentrations in wastes in Estonia. In the course of the European Dioxin Project, the concentration of dioxin analyzed in Baltic Thermal Power Plant in raw oil-shale dust and fly ash from electrostatic precipitators was near the lower end of the range covered by PCDD/F filter dust contents analyzed in samples taken from German hard coal and brown coal combustion plants (0,3-21 ng I-TEQ/kg). The found filter dust PCDD/F concentrations in the Estonian thermal power station correspond with flue gas concentrations of well below 0,1 ng I-TEQ/m^3 (Quass et al., 2000).

4.2 Debris

There has not been any investigation to determine POPs levels in debris.

5. Levels found in humans, food stuffs and/or animals

5.1 Human milk

POPs levels found in human milk have been observed in Estonia twice (in 1971-1974 and in 1984). In 1984 the concentration of DDT was 5-20 times lower than in 1971-1974. DDT in 1971 was 0,125 mg/kg wet weight, in 1974 0,084 mg/kg wet weight and in 1984 0,006 mg/kg wet weight. It was found that the average daily intake of total DDT and PCBs by children in Estonia did not exceed the ADI (acceptable daily intake) value of 0,005 mg/kg proposed by the WHO for DDT and for PCBs a concentration 0,07 mg/kg (Roots, 2002). In 1991 Mussalo-Rauhamaa's and Lindström's (1995) observation of the levels of PCDD/Fs levels of International Toxic Equivalents (TEQ) in human milk in Estonia was 13,5 – 21,4 pg/g on a fat weight basis. In 1993 studies the concentration of PCDD/F was 12,4 pg TEQ/g fat in rural and 14,4 pg TEQ/g fat in urban areas (WHO, 1996; Tuomisto and Hagmar, 1999).

5.2 Food staff

Polychlorinated biphenyls and organochlorine pesticides (ng/g l.w.) concentrations in Estonian butter are presented in Table 12.

Table 12: Polychlorinated biphenyls and organochlorine pesticides (ng/g l.w.) concentrations in Estonian butter (Roots, 2002).

Compound	Regions and number of samples			
	Western part of Estonia		Northern part of Estonia	
Organochlorine pesticides				
	1	**2**	**1**	**2**
Alpha-HCH	0.9	1.2	1.1	0.8
gamma-HC	0.9	2.3	0.8	1.6
HCB	5.2	5.0	4.7	3.7
p,p`DDE	3.4	3.2	3.4	2.5
p,p`DDD	0.4	0.2	0.2	0.8
p,p`DDT	4.3	2.6	1.7	1.7
sumDDT	8.5	6.4	5.7	5.4
Polychlorinated biphenyls				
IUPAC 28	2.56	2.33	2.11	0.71
IUPAC 52	0.64	0.67	0.48	0.29
IUPAC 101	0.99	0.63	0.97	0.37
IUPAC 118	1.32	1.10	0.79	0.42
IUPAC 138	0.21	1.37	0.52	0.19
IUPAC 153	2.20	1.64	0.42	2.90
IUPAC 180	0.85	0.67	0.20	0.27
SumPCB-7 isomers	8.77	8.41	5.49	5.15

5.3 POPs contamination in fish in Estonia

The comparison of concentrations of organochlorine compounds in fish of the three Baltic countries was conducted for the first time in the early 1990s (see Table 13). Samples of perch were collected at three different sites along the western coast of the Baltic countries, i.e. south of the island Hiiumaa in Estonia, the river mouth of Daugava in Latvia and Kuronian Bay in Lithuania (Blomkvist et al., 1993 according to Holoubek et al., 2000).

Table 13: Mean concentrations of organochlorines (mg/kg lipid weight) in the muscle tissue of perch (Blomkvist et al., 1993)

Area	Number of fish	Age of fish [year]	Mean lipid content [%]	p,p´-DDE	p,p´-DDD	p,p´-DDT	Sum of DDT	Sum of PCBs
Hiiumaa (Estonia)	19	1-4	0.64	0.06	0.02	0.01	0.09	0.53
Daugavgriva (Latvia)	22	2-5	0.92	0.41	0.17	0.11	0.68	1.8
Kuronian Bay (Lithuania)	25	1-4	0.6	0.47	0.25	0.04	0.76	2.1

In Estonia, dioxin content in fish has not been determined since the spring of 2002. In 2002 it was detected that the average concentration of dioxins and dibenzofurans are predominant in the Baltic herring (*Clupea harengus membras*) from the Estonian coastal waters: The 2,3,4,7,8-PeCDF congener on the average makes up 33,4% and 2,3,7,8-TCDF 22,1%. The detected dioxin content in the muscle of Baltic herring from Estonian coastal waters are all lower than the EU standard – 4 pg TEQ/g per wet weight (Table 14) (Roots and Otsa, 2002).

Table 14. Dioxin content (pg TEQ/g) in the muscles of the Baltic herring in Estonian coastal waters

Location	Sample	Age (year)	Lipids content (%)	Per lipids weight	Per wet weight
Eastern part of the Gulf of Finland	K1	5	2,1	61,0	1,3
	K2	3	1,9	33,9	0,6
Western part of the Gulf of Finland	T3	5	1,8	91,2	1,6
	T4*	3-4	2,1	90,0	1,9
Gulf of Riga	L5	4-7	2,7	64,2	1,7
	L6	2	2,0	30,9	0,6
Offshore	A7	3	1,9	44,6	0,9
	A8	7-8	2,3	115,0	2,6

*male Baltic herring

The detected dioxin concentrations in the Baltic herring are comparable to the results achieved during the second half of the 1990s. According to the data of the earlier years the average dioxins concentration in the Baltic herring is 8 – 10 pg TEQ/g per wet weight (HELCOM, 1990; 1993; Klinkhard, 2001). Then the concentrations determined after 1995 are within the limits of 1 – 3 pg TEQ/g per wet weight (Klinkhard, 2001) and 22 – 25 pg TEQ/g per lipids weight (HELCOM, 2002).

In 2004 the concentration of dioxins in Baltic herring was 1,99 pgTEQ/g wet weight, half the limit, established by the European Union. The concentration of PCBs constitutes 55,8 – 44,2% (per lipids) and 57,0 – 43,0% (per wet weight). Concentrations of PCDD/F were a bit higher in the Gulf of Riga than in the Gulf of Finland and Baltic Proper (Otsa et al., 2004).

According to international standards the Baltic herring caught from the areas of Estonian coastal waters was qualified for eating (Roots and Otsa, 2002).

The content of dioxins in the sprat (*Spratus spratus*) in Estonian coastal waters does not exceed EC limit values. However, when dioxin-like PCBs are added, the consumption of fish by people would become impossible (Simm and Roots, 2003). In 2004 the concentration of dioxins in sprat was 2,20 pgTEQ/g wet weight and the sum of the dioxin like PCBs 4,87 pgTEQ/g wet weight. The PCDD/Fs concentrations in pelagic fish (Baltic herring and sprat) in 2004 were over 4 pgTEQ/g wet weight (Otsa et al., 2004).

At the present time the contents of toxic organochlorine compounds (DDT, PCB and HCH) in perch (*Perca fluviatilis*) and flounder (*Platichtus flesus*) from the coastal waters of Estonia remain below standards established by FAO/WHO and Estonian permissible limiting standards in food, in which case the content of toxicants in the food does not cause symptoms of illness in case of people (Table 15) (Roots, 2002).

Table 15: Comparison with ADI and NOEL. Perch and flounder.

Väinameri region 1997 (Roots and Kakum, 1999**)**			
Perch (*Perca fluviatilis*)	sumDDT	3x10^{-3}	part of ADI
(n= 14)		0,3x10^{-3}	part of NOEL
Length 10,3-11,4cm	sumHCH	0,6x10^{-3}	part of ADI
	sumPCB	4x10^{-3}	part of NOEL
Väinameri region 1999			
Perch (*Perca fluviatilis*)	sumDDT	0,07x10^{-3}	part of ADI
(n= 20)		0,007x10^{-3}	part of NOEL
Length 24,5-39,0cm	sumHCH	0,9x10^{-3}	part of ADI
	sumPCB	0,3x10^{-3}	part of NOEL
Western coast of Estonia 1998Vilsandi National Park (Roots, 2001)			
Perch (*Perca fluviatilis*)	sumDDT	0,2x10^{-3}	part of ADI
(n = 10)	sumDDT	0,01x10^{-3}	part of NOEL
Length 19,2-27,2cm	sumHCH	0,1x10^{-3}	part of ADI
	sumPCB	1x10^{-3}	part of NOEL
Flounder *(Platichtys flesus)*	sumDDT	3x10^{-3}	part of ADI
(n = 10)	sumDDT	0,2x10^{-3}	part of NOEL
Length 19,1-28,8	sumHCH	0,4x10^{-3}	part of ADI
	sumPCB	0,8x10^{-3}	part of NOEL
Eastern coast of the Gulf of Finland 2000			
Perch (Perca fluviatilis) +	sumDDT	0,3x10^{-3}	part of ADI
(n = 15)	sumDDT	0,02x10^{-3}	part of NOEL
Length 23,5-270cm	sumHCH	0,6x10^{-3}	part of ADI
	sumPCB	0,8x10^{-3}	part of NOEL
Western coast of the Gulf of Finland 2001			
Perch (Perca fluviatilis) ++	sumDDT	1,3x10^{-3}	part of ADI
(n = 14)	sumDDT	0,1x10^{-3}	part of NOEL
Length 19,6-28,3	sumHCH	0,6x10^{-3}	part of ADI
	sumPCB	0,6x10^{-3}	part of NOEL

SumDDT- p,p`DDE; p,p`DDD; p,p`DDT ; sumHCH- alpha-HCH; gamma-HCH;
SumPCB- IUPAC No. 28, 31, 52, 101, 105, 118, 138, 153, 158, 163 and 180

Empty stomachs of Baltic herring and sprat at the beginning of 1990's may turn out to be one of the reasons for the decrease of PCB concentration in food, compared with the end of the 1970's and the beginning of the 1980's. One can assume that the rising number of fish with an empty stomach has contributed to the stability of organochlorine compounds content in herring organisms in the northern part of the Baltic Sea (Roots, 1998).

The concentrations of PCDD/Fs average content in flounder (*Platichtys flesus*) in 2004 was 0,42 pg/TEQ/g wet weight and in perch 0,27 pg/TEQ/g wet weight.

In 2003 the dioxin level in perch (*Percha fluviatilis*) remained well below the limits established by the EU. According to the average data (Table 16), the level of PCDD/Fs and PCB compounds, "dioxin like PCBs", is practically equal, amounting to, respectively 46.2 and 53.8 %. As it was the case with the herring and sprat, the PCDFs concentration exceeds the PCDDs content. The concentration of non-ortho-PCBs, differently from sprats and herrings, exceeds the level of monoortho-PCBs by half. The dominant isomers in the perch are PCB 126 (31.0%) and 2,3,4,7,8-PeCDF (24.9%) (Roots et al., 2004).

Table 16: Average dioxin content (avg ± SE) in samples of perch, collected in 2003

Dioxin	pg TEQ/g for wet weight	pg TEQ/g for lipids
PCDDs	0.25 ± 0.03	33.6 ± 4.6
PCDFs	0.42 ± 0.05	56.6 ± 9.2
PCDD/Fs	0.67 ± 0.08	90.2 ± 13.6
non-ortho-PCBs	0.50 ± 0.07	67.9 ± 13.1
mono-ortho-PCBs	0.27 ± 0.05	37.3 ± 9.3
PCBs	0.77 ± 0.12	105.2 ± 22.4
Sum of PCDD/Fs and PCBs	1.45 ± 0.19 195.3 ± 35.5	

The dioxin level in younger fish, aged from two to five years, is somewhat lower than that in the older fish, where the age exceeds five years. The respective average indicators have been given in Table 17.

Table 17: **Average dioxin concentration (pg TEQ/g for wet weight) in perch of different age. (Roots et al., 2004).**

Age of fish	Less than five years	More than five years
PCDDs	0.20 ± 0.02	0.30 ± 0.04
PCDFs	0.33 ± 0.02	0.51 ± 0.08
PCDD/Fs	0.54 ± 0.01	0.81 ± 0.11
non-ortho-PCBs	0.38 ± 0.01	0.62 ± 0.09
mono-ortho-PCBs	0.19 ± 0.01	0.36 ± 0.08
PCBs	0.56 ± 0.02	0.98 ± 0.16
Sum of PCDD/Fs and PCBs	1.10 ± 0.01 1.79 ± 0.26	

POPs contamination levels (DDT and PCB) in Baltic grey seal (*Halichoerus grypus*) have decreased considerably since the early 1970's. The grey seals, concentrations of DDT show a clear reduction, whereas a decrease in PCB concentrations was not confirmed (HELCOM, 1996). Comparing to the end of 1970's and the beginning of 1980's, at least the PCB concentrations obtained by food in grey seals in West-Estonian Archipelago Biosphere Reserve must have been decreased (Roots, 1998).

In 1996 the concentration for two most important PCB isomers IUPAC 138 and 153 in the blubber of 2-6 year old grey seals (*Halichoerus grypus*) varied from 2,3–4,1 mg/kg (extractable fat) and from 2,9–5,2 mg/kg (extractable fat) respectively (Roots and Talvari, 1997). The organochlorine compound content in grey seals caught in the near past from Estonian coastal areas (northern part of the Gulf of Riga and the Väinameri Sea) do not exceed 50-70 ppm, which has been considered as a limit critical to the seals reproductive ability (Helle et al., 1990).

Comparing the PCB contents in the grey seal's blubber of Estonian coastal sea–Väinameri Sea and Vilsandi, it appears that the PCB content in Vilsandi grey seal is higher but comparable or somewhat lower than in grey seals caught from the open Baltic Sea. Only individuals with a poor health status or nutrition status (thin layer of blubber and/or low content of extractable fat in blubber) had significantly higher concentrations of pollutants than other groups. The sum of the chlorobiphenyl concentrations has decreased considerably since 1980's, but the relative concentrations have not changed considerably since (Roots et al., 2005).

The contents of organochlorine compounds (polychlorinated biphenyls = PCB) and organochlorine pesticides (well-known DDT, Lindane etc.) in the biota of the Baltic Sea have been studied since the middle of the seventies. Due to the changes in analysis equipment and methods only the results gained after the nineties are comparable (Otsa and Roots, 2002)

6. Damages caused by POPs

The information in following paragraphs was obtained from Roots, 2001 - CPS: envchem/0107003 available at: http://preprint.chemweb.com/envchem/0107003.

In Estonia the use of plant protection products enlarged in the end of 50-ies. In 1957 226t of pesticides were used, mainly DDT and hexachlorane and in a less degree also seed dressing products.

Although some dangerous pesticides are not used any more, old stocks still remain in the country. Since 1996, programs have been carried out in all three Baltic countries to identify these pesticides, re-pack them and store under safe conditions. Among the identified products there are several banned substances, as DDT and HCH products (e.g. Lindane, Fentiram, Pentathiuram). Examples of existing stocks of banned pesticides in three Baltic Countries (tonnes in 2000): **Estonia** – DDT – 6 t and HCH – 3t ; Latvia – DDT – 172 t and HCH – 155 t; Lithuania – DDT – 80 t and HCH – 24 t (2nd Baltic State of the Environment Report, 2000).

7. Laws currently regulating POPs

The information in following paragraphs was obtained from Roots, 2001 - CPS: envchem/0107003 available at: http://preprint.chemweb.com/envchem/0107003.

Following are some of the regulations of Estonian Government and Minister of Environment, which regulate the use of persistent organic pollutants:

1. Government Regulation No 6, January 5, 1999 on establishing procedure for importing and exporting prohibited and strictly restricted chemicals.

According to the regulation most of the earlier mentioned 12 chemicals can not be used in Estonia. The regulation also takes account the requirements of United Nations Environment Programme UNEP, Food and Agriculture Organisation FAO and European Union on informing about chemicals export (the so-called prior informed consent PIC).

2. Government Regulation No 99, March 16, 1999 on ratifying the list of products prejudicial to environment as waste, the production, import, export and use of which is prohibited.

3. Regulation of Minister of Environment No 58, June 16, 1999 "Critical limits of hazardous substances in soil and groundwater."

- target value is content of hazardous substances in soil or groundwater; the equal or smaller value indicates good state of soil or groundwater, i.e. harmless to man and environment.

- state of soil or groundwater is satisfying if the content of hazardous substances stays between the guidance value and target value of soil or groundwater (Table 18).

Table 18: Critical limits of hazardous substances in soil and groundwater (Source: Roots, 2001 - CPS: envchem/0107003 available at: http://preprint.chemweb.com/envchem/0107003)

Hazardous substances	CAS nr	Critical limits in soil, mg/kg			Critical limits in groundwater, µg/l	
PCB	27323-18-8	0,1	5	10	0,5	1
Aldrin	309-00-2	0,1	1	5	0,01	1
Dieldrin	60-57-1	0,05	0,5	2	0,01	1
Endrin	72-20-8	0,1	1	5	0,005	0,5
DDT	50-29-3	0,1	0,5	5	0,1	1
HCH (each isomer)	-	0,05	0,2	2	0,01	1
HCB	118-74-1	2	5	25	0,5	5
Pesticides (summary)	-	0,5	5	20	0,5	5

1- Target value;
2- Guidance value in living centre;
3- Guidance value in industrial centre
4- Target value;
5- Guidance value;

4. Regulation of Minister of Environment No 71, July 19, 1999 "Procedure of managing wastes containing polychlorinated biphenyls and polychlorinated terphenyls."
(considers the EC Directive 96/59 on elimination of PCB/PCT). The location of installations and their content of PCBs will turn out after the regulation comes into force.

Some of the important points of the regulation:

- Each owner must inform Estonian Environment Information Centre about all installations that contain more than 5dm3 PCBs by July 1, 2001;
- The owner submits inventory list of each installation containing PCBs;
- Estonian Environment Information Centre keeps record of PCB containing equipment. First report on the basis of inventory sheets will come out by August 1, 2001. After that the Information Centre will be controlling and updating data of the report once a year by 1st of February;
- Owners of equipment containing PCBs must remove them from use or clear from pollution and eliminate PCBs from equipment as soon as possible but not later than 31 December 2010.

PCB containing oil may be present in the following electric equipment within the scope of the PCB/PCT directive:

- high voltage capacitors used in the power distribution network
- large low voltage capacitors used by industry, the railways and other
- large consumers of electricity transformers used in power plants and the power distribution network transformers used by industry, the railways and other large consumers of electricity power switches in the power distribution network

7.1 Medical waste

There is at least one company that deals with the hazardous hospital waste. Tartu University Hospital has a modern centre for hazardous medical waste treatment.

The ***Rotoclave***® [1] technology (autoclave) offers the opportunity for volume reduction of Municipal Solid Waste (MSW) to landfills. This unique application for ***Rotoclave***® technology reduces volume by approximately 50% without the need of grinding.

The ***Rotoclave***® technology has been installed by Tempico Company at Tartu University Hospital in Tartu, Estonia. This is the first system sold into one of the former states of the Soviet Union and is a terrific site and very well operated (http://tempico.gostrategic.com/news.php?id=4).

8. State of Stockholm Convention Ratification and the National Implementation Plan

The Estonian Parliament has not signed nor ratified the Stockholm Convention yet. Right now there are no discussions about the National Implementation Plan. Because of this

[1] The Rotoclave® system utilizes a pressure vessel with a unique rotating internal drum that accepts medical waste materials in unopened containers and subjects them to agitation, heat, and moisture. The combination of high temperature, pressure and moisture, in conjunction with the unique method of agitation ensures all materials will contact the necessary sterilizing steam. (http://tempico.gostrategic.com/index.php)

there is no co-operation between the Estonian Government and Estonian NGOs and public in this field yet.

The Estonian Ministry of the Environment is responsible for the Stockholm Convention and the National Implementation Plan in Estonia.

9. Public awareness activities

There has not been any kind of activities related to POPs and public awareness. Researchers have written articles about POPs but mostly in English. There have been few articles in Estonian language but mainly to the people who are aware of POPs.

10. Recommendations on eliminating POPs

- prevention of creating new sources of POPs (for instance construction of new waste incinerators)

- substitution of materials, which cause (or may cause) appearance of POPs during their production, usage or liquidation (for instance PVC, halogenated retardants and paraffins etc.)

- prevention of emergence of POPs by appliance of BAT – best available technologies and of processes that are the best from the environmental point of view – BEP.

- preferring technologies with the ability of complete POPs´ destruction to those which only remove POPs to other waste, environmental compounds or other products (ash, waste water, products)

- proper registration of old and newly created burdens, i.e. of places contaminated by POPs (for instance wrong way of treating ash from incinerators etc.)

- complete register of POPs´ emissions, including releases to water and to waste, eventually to soil and geological subsoil (in accordance with the Stockholm Convention).

- concrete adjustments of legislation concerning proper registers of all kinds of POPs´ emissions, prevention of their emergence and environmentally friendly cleansing of localities already polluted by POPs.

- improvement of law enforcement in the field of environmental pollution by POPs

- introduction of economic tools leading to prevention of POPs´ emergence and appliance of principle „polluters pay“ (internalization of external costs) in case of the established sources.

- mechanisms of free access to information

- informing and educating public about the effects that the POPs have on environment and health and about behaviour that is responsible in terms of preventing releases of POPs and about usage of materials which cause creation of these chemicals

- taking into consideration emergence of POPs during creation of municipal, regional and state policies (for instance of State Energy Policy and other plans and conceptions such as Plan of Waste Management etc.)

- To develop a legislative basis on POPs with regard to Estonian conditions and international requirements;
- To make an inventory (locating and registering) of sites and sources of POPs in Estonia;
- To develop a database of sources of POPs;
- To locate POPs hot spots in Estonia, evaluate the level of danger and propose solutions;
- To carry out measures concerning regulations, prohibitions and environmentally-friendly liquidations of primary and secondary sources of POPs contamination;
- To utilize POPs, POPs contaminated equipment and POPs contaminated waste with the help of environmentally-friendly methods and technologies;
- To organize a monitoring system of POPs in the environment of Estonia (POPs are included to other monitoring programs);
- To organize a monitoring system of POPs in food products and drinking water (The safety of food products and drinking water are guaranteed by general sample taking that include also POPs safety);
- To organize technical support for POPs monitoring through equipping laboratories with modern devices of analytical control and the creation of new laboratories with highly qualified personnel;
- To support scientific research on the POPs problem in Estonia for a better understanding of the problem and ways of finding solutions;
- To organize a system of preventive measures regarding the safety of the workforce during the POPs-related work and the complex of medical and biological measures during the extraordinary situations (fires, explosions, floods, etc.);
- To start an informational and educational campaign on POPs and their impact on the environment and public health for Estonian population;
- To inform the population about the process of implementation of the Stockholm Convention and National Implementation Plan Preparation

11. New POPs

11.1 BFRs – Brominated Flame Retardants

These products, basically used as additives in different applications, encompass a variety of chemical species. The most used are polybrominated diphenyl ethers (PBDEs), polybrominated biphenyls (PBBs), tetrabromobisphenol (TBBPA) and hexabromocyclododecane (HBCD).

The major source of BFRs is their evaporation from products in use. BFRs are particularly emitted to in-door environment from products where the flame retardants were / are used as additive. This is the case of computer monitors or other elements from TV sets.

The BFRs have been nominated to be included on POPs list under Stockholm Convention.

11.2 Lindane

Lindane has been nominated by Mexico to be included on POPs list under Stockholm Convention.

The Helsinki Commission (or HELCOM), which works to protect the marine environment of the Baltic Sea from all sources of pollution through intergovernmental co-operation between Denmark, Estonia, the European Community, Finland, Germany, Latvia, Lithuania, Poland, Russia and Sweden, has prepared several documents focused on the Lindane contamination in Baltic region. The results of these studies are available at their website: http://www.helcom.fi/home/en_GB/welcome/. The Lindane emissions from the year 2001 – 2003 for Estonia are shown in the Table 19.

Table 19: Annual emissions of Lindane in Estonia for 2001 - 2003.
(Source: HELCOM - http://www.helcom.fi/home/en_GB/welcome/)

year	Lindane (tonnes/year)
2001	0.003
2002	0
2003	0

Note: The officially reported data to HELCOM.

12. Resources on POPs

Websites:

A) Governments / IGOs / Institutions

1. Stockholm Convention website - http://www.pops.int/
2. UNEP Chemicals website – http://www.unep.org/
   http://www.unep.org/themes/chemicals/
3. UNDP – POPs - http://www.undp.org/gef/05/portfolio/chemicals.html#pops
4. UNIDO – POPs - http://www.unido.org/doc/46478
5. UNDP / GEF – http://www.undp.org/gef/05/
6. World Health Organisation - http://www.who.int/en/
7. Basel Convention website - http://www.basel.int/
8. EU (European Union) website – POPs -
   http://www.europa.eu.int/comm/environment/dioxin/index.htm
9. State of the Environment in Albania 1997-1998 -
   http://enrin.grida.no/htmls/albania/soe1998/eng/index.htm
10. World Bank POPs website -
    http://lnweb18.worldbank.org/ESSD/envext.nsf/50ParentDoc/PersistentOrganicPollutants?Opendocument
11. Meteorological Synthesizing Centre-East - http://www.msceast.org/about.html
12. U.S. Environmental Protection Agency - http://www.epa.gov/
13. Danish Environmental Protection Agency - http://www.mst.dk/homepage/
14. Food and Agriculture Organization of the United Nations - http://www.fao.org/
15. Protocol on Pollutant Release and Transfer Registers -
    http://www.unece.org/env/pp/prtr.htm
16. EUNECE (United Nations Economic Commission for Europe -
    http://www.unece.org/
17. European Environmental Agency - http://www.eea.eu.int/
18. OECD (Organisation for Economic Co-operation and Development) -
    http://www.oecd.org/
19. The Helsinki Commission (HELCOM) -
    http://www.helcom.fi/home/en_GB/welcome/

B) NGOs / NGOs Networks

20. IPEN (International POPs Elimination Network) website - http://ipen.ecn.cz/
21. IPEP (International POPs Elimination Project) website -
    http://www.oztoxics.org/ipepweb/
22. Greenpeace website - http://www.greenpeace.org/international_en/
23. WWF website - http://www.panda.org/
    http://www.panda.org/about_wwf/what_we_do/toxics/index.cfm
24. GAIA (Global Anti- Incinerator Alliance, Global Alliance for Incinerator Alternatives) - http://www.no-burn.org/
25. Health Care Without Harm –http://noharm.org/
26. PAN (Pesticide Action Network International) website - http://www.pan-international.org/

Databases / Magazines:

a) toxicological databases – international

1. ATSDR (Agency for Toxic Substances and Disease Registry) - http://www.atsdr.cdc.gov/
2. INCHEM (Chemical Safety Information from Intergovernmental Organizations) - http://www.inchem.org/
3. Haz-Map Occupational Exposure to Hazardous Agents - http://hazmap.nlm.nih.gov/index.html

b) Magazines

Environmental Health Perspectives - http://ehp.niehs.nih.gov/

Focal Point for IFCS - Estonia

Chemicals Notification Center
Attn: Mrs. Ethel Kalissaar, Manager
Gonsiori 29, Room 530, Tallinn 15027, Estonia
Tel: +372 62 69 968
Fax: +372 62 69 968
email: ethel.kalisaar@sm.ee

UNIDO - UNIDO does not currently maintain an Office in ESTONIA.

UNDP Small Grants Program - NO

Focal Point for the Stockholm Convention on POPs

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List of Abbreviations

ADI - Acceptable Daily Intake
BAT – Best Available Techniques
BEP – Best Environmental Practices
DDT - 4,4'-(2,2,2-trichloroethane-1,1-diyl)bis(chlorobenzene), pesticide
FAO – Food and Agriculture Organization
HCB – Hexachlorobenzene
HCH - Hexachlorocyclohexane
I-TEQ - International Toxic Equivalent
PAH - Polycyclic aromatic hydrocarbons
PCB – Polychlorinated biphenyls
PCDD/Fs – dioxin (polychlorinated dibenzo-p-dioxins and dibenzofurans)
POPs – Persistent organic pollutants
PVC - Polyvinylchloride
WHO – World Health Organization

fg - femto-gram
kg - kilogram
mg – milligram
ng - nanogram
pg – picogram
ha – hectare
yr – year
l.w. – living weight

Appendices

Appendix 1: Concentration of polychlorinated biphenyls in oil-shale (EOIL1 and EOIL1B) led to the Baltic Thermal Power Plant oven and in fly ash (EIOL2 and EOIL2B) caught by electrostatic precipitators (ESP) (Dioxin Study in an oil-shale based power station. 1998. according to Roots, 2001 - CPS: envchem/0107003 available at: http://preprint.chemweb.com/envchem/0107003).

PCB* isomers	Concentrations in µg/kg			
	EOIL1	EOIL1B	EOIL2	EOIL2B
Trichlorbiphenyl	0,49	0,52	0,20	0,06
Tetrachlorbiphenyl	2,2	2,1	0,54	0,22
Pentachlorbiphenyl	4,7	4,4	1,0	0,43
Hexachlorbiphenyl	1,2	1,1	0,41	0,25
Heptachlorbiphenyl	0,36	0,31	0,19	0,14
Oktachlorbiphenyl	n.d.	n.d.	n.d.	n.d.
Nonachlorbiphenyl	n.d.	n.d.	n.d.	n.d.
Decachlorbiphenyl	< 0,13	< 0,012	< 0,040	< 0,018
Sum:Tri+Decachlorobiphenyl	9,0	8,6	2,4	1,1
2,4,4'-Trichlorbiphenyl	0,16	0,15	0,039	0,014
2,2',5,5'-Tetrachlorbiphenyl	0,52	0,48	0,13	0,041
2,2',4,5,5'-Pentachlorbiphenyl	0,82	0,83	0,18	0,071
2,2',4,4',5,5'-Hexachlorbiphenyl	0,37	0,33	0,12	0,065
2,2',3,4,4',5'-Hexachlorbiphenyl	0,39	0,42	0,14	0,090
2,2',3,4,4',5,5'-Heptachlorbiphenyl	0,077	0,067	0,041	0,029
3,3',4,4'-Tetrachlorbiphenyl	< 0,026	< 0,019	< 0,010	< 0,010
3,3',4,4',5-Pentachlorbiphenyl	< 0,026	< 0,023	< 0,008	< 0,013
3,3',4,4',5,5'-Hexachlorbiphenyl	< 0,016	< 0,007	< 0,006	< 0,006

n.d. - not detected

* analyzed by Landesumweltamt Nordhein - Westfalen laboratory 31.3.1998

Appendix 2: Concentration of PCDD and PCDF in oil-shale (EOIL1 and EOIL1B) and in fly ash (EIOL2 and EOIL2B) caught by electrostatic precipitators (ESP) (Dioxin Study in an oil-shale based power station. 1998. according to Roots, 2001 - CPS: envchem/0107003 available at: http://preprint.chemweb.com/envchem/0107003).

PCDD and PCDF isomers*	Concentration in ng/kg			
	EOIL1	EOIL1B	EOIL2	EOIL2B
Sum TCDD	n.d.	n.d.	n.d.	n.d.
Sum PeCDD	n.d.	n.d.	n.d.	n.d.
Sum HxCDD	n.d.	n.d.	n.d.	n.d.
Sum HpCDD	3,6	3,0	13	n.d.
OCDD	< 0,89	2,0	19	< 1,6
PCDD	4,4	5,0	32	1,6
2,3,7,8-TCDD	< 0,28	< 0,33	< 0,62	< 0,28
1,2,3,7,8-PeCDD	< 0,24	< 0,46	< 0,65	< 0,51
1,2,3,4,7,8-HxCDD	< 1,0	< 1,0	< 2,3	< 2,2
1,2,3,6,7,8-HxCDD	< 0,92	< 0,86	< 2,0	< 1,9
1,2,3,7,8,9-HxCDD	< 0,86	< 0,81	< 1,9	< 1,8
1,2,3,4,6,7,8-HpCDD	1,8	1,4	6,4	< 0,66
Sum TCDF	n.d.	n.d.	n.d.	n.d.
Sum PeCDF	n.d.	n.d.	n.d.	n.d.
Sum HxCDF	1,3	1,0	3,2	n.d.
Sum HpCDF	1,0	n.d.	4,7	2,7
OCDF	< 3,4	n.d.	< 18	< 8,5
PCDF	5,7	1,0	26	11
2,3,7,8-TCDF	< 0,15	< 0,27	< 0,59	< 0,37
1,2,3,7,8/1,2,3,4,8-PeCDF	< 0,36	< 0,62	< 1,3	< 0,59
2,3,4,7,8-PeCDF	< 0,30	< 0,51	< 1,1	< 0,49
1,2,3,4,7,8/1,2,3,4,7,9-HxCDF	< 0,37	< 0,51	< 0,96	< 0,50
1,2,3,6,7,8-HxCDF	< 0,33	< 0,43	< 0,86	< 0,43
1,2,3,7,8,9-HxCDF	< 0,45	< 0,43	< 0,84	< 0,42
2,3,4,6,7,8-HxCDF	0,98	0,85	2,9	< 0,36
1,2,3,4,6,7,8-HpCDF	0,53	< 0,74	3,7	1,7
1,2,3,4,7,8,9-HpCDF	< 0,73	< 1,2	< 1,5	< 1,2
PCDD+PCDF	10	6	58	13
TE BGA excl. NWG	0,13	0,10	0,42	0,018
TE NATO/CCMS excl. NWG	0,12	0,10	0,41	0,017
TE BGA 1/2 NWG	0,49	0,54	1,30	0,60
TE NATO/CCMS 1/2 NWG	0,61	0,75	1,66	0,83
TE BGA incl. NWG	0,86	0,98	2,18	1,18
TE NATO/CCMS incl. NWG	1,11	1,40	2,92	1,64

n.d. - not detected

* analyzed by Landesumweltamt Nordhein - Westfalen laboratory 20.4.1998

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