

Levels of PCDDs and PCDFs in soil in the vicinity of the landfill

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Introduction

As landfill fires may serve as sources of dioxins, we focused on the concentrations of polychlorinated dibenzo-p-dioxins (PCDDs) and dibenzofurans (PCDFs) in soil samples taken in the vicinity of the landfill located at south-east Estonia in the course of our inventory. Concentrations of PCDDs and PCDFs were studied in soil samples taken in the vicinity of the Laguja landfill in south-east Estonia.

Materials and Methods

Concentrations of polychlorinated dibenzo-p-dioxins and dibenzofurans were studied in five soil samples taken in the vicinity of the Laguja landfill in south-east Estonia. The four soil samples were taken in southern, eastern, western and northern parts not further than 300 meters from the landfill, and one sample was taken at the distance of 3 km from the landfill.

Results and Discussion

Dioxin and furan sources have not been detected in Estonia (1). Estonia still has no waste incineration factors, which would act as substantial sources of PCDD and PCDF pollution. As uncontrolled combustion processes, including landfill fires (2), are one of the main sources of dioxin emission into the air, then we decided to focus on the determination of dioxin concentrations in soil samples taken in the vicinity of the south-east Estonian (Laguja) landfill. Up to now, the concentrations of dioxins and furans in Estonian soil samples have not been analyzed. Therefore, the data (table 1) presented in this paper should be of interest to the general public.

Table 1. PCDD/F concentrations and TEQ in soil samples from Laguja landfill (soil, ng/kg w. w.)

PCDD/F	No.1	No.2	No.3	No.4	No.5
Sum TCDD	1.5	0.85	0.68	1.8	1.5
Sum PeCDD	0.41	0.54	0.22	0.92	1.5
Sum HxCDD					
Sum HpCDD	0.74	0.61	0.49	0.60	2.4
OCDD	1.2	1.2	0.91	1.0	4.0
Sum TCDD to OCDD	2.1	2.0	1.7	1.6	7.3
	5.9	5.2	4.0	6.0	16.6
2,3,7,8-TCDD	n.d.	0.05	n.d.	n.d.	n.d.
1,2,3,7,8-PeCDD	n.d.	n.d.	n.d.	0.06	0.13
1,2,3,4,7,8-HxCDD	n.d.	n.d.	n.d.	n.d.	0.11
1,2,3,6,7,8-HxCDD	n.d.	n.d.	n.d.	n.d.	0.21
1,2,3,7,8,9-HxCDD	n.d.	n.d.	n.d.	n.d.	0.18
1,2,3,4,6,7,8-HpCDD	0.56	0.58	0.40	0.43	2.1
Sum TCDF	1.5	2.0	0.99	1.9	5.2
Sum PeCDF	0.33	1.1	0.61	1.2	4.3
Sum-HxCDF	0.98	1.2	0.73	1.1	3.7
Sum-HpCDF	0.80	1.1	0.70	0.74	3.0
OCDF	0.61	0.71	0.69	0.71	2.6
Sum TCDF to OCDF	4.2	6.0	3.7	5.7	18.8
2,3,7,8-TCDF	0.09	0.07	0.05	0.12	0.38
1,2,3,7,8/1,2,3,4,8-PeCDF	n.d.	n.d.	0.03	0.08	0.35
2,3,4,7,8-PeCDF	0.10	0.12	0.05	0.09	0.38
1,2,3,4,7,8/1,2,3,4,7,9-HxCDF	0.12	0.17	0.09	0.11	0.42
1,2,3,6,7,8-HxCDF	0.15	0.14	0.08	0.10	0.36
1,2,3,7,8,9-HxCDF	n.d.	n.d.	n.d.	n.d.	n.d.
2,3,4,6,7,8-HxCDF	0.22	0.14	0.08	0.17	0.37

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1,2,3,4,6,7,8- HpCDF	0.54	0.85	0.49	0.55	2.3
1,2,3,4,7,8,9- HpCDF	n.d.	0.05	0.04	n.d.	0.19
Sum PCDD/F	10.1	11.2	7.7	11.7	35.4
TE (WHO 1998, Humans)	0.12	0.18	0.07	0.17	0.59
TE incl. LOD (WHO 1998, Humans)	0.29	0.22	0.11	0.21	0.61
Sum PCDD/F (d.m.)					
TE incl. LOD (WHO 1998, Humans)	1.53	1.23	0.64	1.14	2.33

n.d. – not detected; LOD= Limit of detection;

The concentrations in soil tend to reflect the baseline contamination of a region. For example in the Netherlands, most soil samples have been taken in the neighbourhood of municipal soil waste incinerators, where concentrations up to 252 ng I-TEQ/kg d.m have been detected (3). The highest concentrations reported are shown in the last column of table 2.

Table 2. Summary of dioxin concentrations in soil from EU Member States [ng TEQ/kg d.m.](3;4).

	Other types	Forest	Pasture	Arable	Rural	Contamin.*
Austria		<1-64	1.6-14			332
Belgium	2.7-8.9				2.1-2.3	
Finland						>90,000
Germany		10-30	<1-30	<1-25	1-5	30,000
Ireland	<1-8.6	4.8	<1-13			
Luxembourg	1.8-20	6.0			1.4	
The Netherlands					2.2-16	98,000
Sweden					<1	11,446
United Kingdom	<1-87				<1-20	1,585

* maximum measured concentration at contaminated sites

Conclusion

The PCDD/F concentrations in all soil samples were at background level (0.64-2.33 ng I-TEQ WHO/kg d. m.). To maintain this situation, the administrator of the landfill must avoid landfill fires, which are one of the reasons for the generation of dioxins and furans.

Acknowledgments

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References

1. Quass U., Fermann M., and Bröker, G.(2000) The European Dioxin Emission Inventory. Stage II 1, 10.
2. Lassen C., Hansen E., Jensen A., Olendrynski K., Kolsut W., Zurek J., Kargulewicz I., Debski B., Skoskiewicz J., Holtzer M., Grochowalski A., Brante E., Poltimae H., Kallaste T and Kapturauskas, J. (2003) Extended Summary. ESPR 10, 1, 49.
3. Europe Regional Report. Regionally Based Assessment of Persistent Toxic Substances. UNEP Chemicals, (2003) 3, 142.
4. Fiedler H., Golder D., Coleman P., King K and Petersen A. (1999) Organohalogen compounds 43, 151.