

INVENTORY OF UNINTENTIONAL RELEASES OF POPS IN BELARUS: 2006 UPDATE

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Introduction

The inventory of POPs (dioxins/ furans, HCB, PCB and indicator polyaromatic hydrocarbons) emissions has been taken in Belarus since 2000 in the framework of preparation of the national emission data on pollutant releases for the Co-operative Program for Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe (EMEP)^{1,2,3}. During implementation of this task main sources of POPs emission in Belarus were revealed, certain experiments on POPs measurement in flue gases were conducted. That works allowed to elaborate emission factors on POPs emission and to estimate in general PCDD/PCDF, PCB, HCB, PAH annual emission fluxes. In the framework of the GEF project TF 053865 "Enabling activities related to the implementation of the Stockholm Convention on persistent organic pollutants (POPs) in the Republic of Belarus" the further inventory of unintentional releases of POPs was taken and the register of releases of PCB, PCDD/PCDF and HCB was elaborated. POPs releases not only to air but also to other environmental compartments – water, ground, food products, wastes and residues were identified. The year 2004 was assumed as the base year. These results were included in the NIP of the Stockholm convention of Belarus⁴. In 2007 the update of POPs inventory for 2006 was made. The paper includes the summary of the inventory methodology of this update, the procedures, results and discussion.

Methodology

The 2006 POPs (PCDD/F, HCB and PCB) releases inventory (by each group of compounds) was made in 2007 and included the following stages: update of the list of POPs release sources; collection of the statistical data on the source activity; collection of the technological data (parameters of fuels and raw materials, abatement systems etc.); development (selection) of POPs emission factors; calculation of releases and validation of results uncertainty assessment; identification of hot spots; estimation of the spatial structure of releases, identification of areas with the highest level of releases; comparison of the outcomes of the 2006 inventory with previous ones and with the POPs inventory outcomes in other countries.

To obtain the production statistics, the key ministries and agencies including the Ministry of Statistics and Analysis, main branch ministries, concerns and departments were queried.

As the source of POPs emission factors the UNEP Chemicals Standardized Toolkit⁵, EMEP/CORINAIR Atmospheric Emission Inventory Guidebook⁶ in line with other guideline documents and literature sources including those which take into account technological specificity of Belarus⁷ were used. Some HCB and PCB emission factors were obtained by own results of POPs sources testing². To specify POPs emission factors enterprises relating to the following release source categories were also queried: waste incineration; ferrous and non-ferrous metal production; minerals production; production and use of chemicals and consumer goods. For these purposes a special query form was elaborated and disseminated among more than 100 enterprises.

Emission factors applied by source sectors are shown in the table 1.

Results and Discussion

POPs releases by environment media and source sectors

In accordance with the estimates the total annual releases of PCDD/F in 2006 were 101.38 g TEQ. Into the air 26.1 g TEQ of PCDD/F were emitted, into the water – 0.5 g TEQ, to soil – 1.7 g TEQ, to products – 0.1 g TEQ and into residues – 73.0 g TEQ (Table 2).

The main sources of dioxin/furan releases to the environment of Belarus are categories Ferrous and Non-Ferrous Metal Production – 45%, Waste Incineration – 18 %, Power Generation and Heating – 18 %, Disposal/Landfill – 14 %.

Ferrous and Non-Ferrous Metal Production produce 32 % of dioxin/furan releases into the air, Power Generation and Heating processes - 25%, Waste Incineration – 17%.

Dioxins/furans releases in residues amounted 73.0 g TEQ. The considerable part of releases to residues is produced by source category Ferrous and Non-Ferrous Metal Production – 51.5%; Waste Incineration category produces 18.9 % of the total amount of releases in residues, 16.6 % of releases in residues are produced by source category Disposal/landfill.

Releases to water, to soils, and in products constituted 2.23 g TEQ, at the same time the major part of releases from all these categories is produced by sources of one subcategory (releases to water – from category Disposal/Landfill, to soils – from Uncontrolled Combustion Processes, in products – from Production of Chemicals and Consumer Goods).

Releases of HCB to air in 2006 amounted 0.60 kg; the major sources are categories Waste Incineration and Transport.

Releases of PCB to air make up 9.7 kg. Principle sources of releases to air are Ferrous and Non-Ferrous Metal Production, Waste Incineration, Power Generation and Heating. However, the amount of unintentional releases of PCB to air is insignificant if compared to releases from PCB-filled electrical equipment (which considered as emissions from stockpiles). According to preliminary estimates about 1.6 tonnes of PCBs are released annually (mostly to soils).

Identification of major point sources (hot spots) of POPs releases

In terms of contribution to the global releases, there are virtually no large point sources of POPs releases in Belarus in a 'traditional' sense; chemical plants producing herbicides, municipal waste incineration plants, sinter plants that may release up to hundreds grams of PCDD/PCDF per year^{8,9}. Given the production and technological specifics of Belarus, we have used a threshold of a plant's potential contribution to the gross releases of POPs of 1 g TEQ per year as the key criterion for classifying a plant as a major point source, 0.1 g TEQ per year for classifying a plant as a point source.

The greatest accounted point source of dioxin/furan releases in the category Ferrous and Non-Ferrous Metal Production and in Belarus on the whole is Belarusian Metallurgic Plant, with the total volume of releases about 40 g TEQ.

A few enterprises were identified as the potential major point sources of dioxins/furans releases in category Waste Incineration (mainly wood waste combustion), but this list is not stable from year to year.

The most widely used fuel at power plants of Belarus is natural gas; according to estimates in Belarus there are no power generation plants with PCDD/PCDF releases more than 0.1 g TEQ per year. Three enterprises have been classified in category Production of Mineral as point sources with annual PCDD/F emission 0.1-1 µg I TEQ. In category Miscellaneous the only source of dioxin/furan releases is cremation and the only point source in this category in Belarus is the Minsk Crematorium.

For PCB and HCB no point sources of air emission have been allocated: most of PCB hot spots are connected with places of PCB-containing equipment installations which were considered as emissions from stockpiles.

Discussion

Results of POPs inventory were compared with results of 2004 inventory and POPs inventories in other countries. EMEP database¹⁰ as most complete emission database POPs was used. As basis official data reported for 2003 was considered.

According to previous inventory⁴ 141.8 g TEQ was emitted in Belarus in 2004 (35.6 g TEQ – into air, 103.3 TEQ – into residues, 1.88 g TEQ – to water, soils and products). Reduction of emissions according to 2006 estimates are mainly due to reassessment of contribution of waste combustion sector (emissions from the combustion of the most of wood waste in boilers according to latest studies are now considered similar to emission from wood combustion). Reduction of chemical wastes combustion has taken place also.

For 2003 information on dioxin/furan emission was submitted by 26 countries. Annual PCDD/PCDF air emissions amounted in Europe 2148.3 g TEQ. Main sources of emission are Fuel combustion in Industry (together with related contact processes) – 42 % and Waste Combustion – 14.4 %. Greatest input among countries into total European emissions are of Great Britain, France and Bulgaria (common – 36.7 %); contribution of Belarus – is about 1.0 %.

Information on HCB emission was reported by 15 countries. Total emission in 2003 amounted 8372.4 kg. Main sources of HCB emission – Waste Combustion (71%), Industrial combustion (14.6%). The greatest contribution are from France – 73.4% and Spain - 21 %. Contribution of Belarus into European air emissions is less than

0.01 %. PCB emission data was reported in 2003 by 13 European countries. Total PCB emission amounted 2391.6 kg. Main sources: Industrial Processes (49.7 %) and Combustion in Industry (15 %). Greatest contributor – Great Britain (57.6 %). Contribution of Belarus into European PCB emission – 0.4 %. On the whole analysis have shown that state of POPs inventory in countries is rather different. Especially this is characteristic for PCB and HCB inventories.

Acknowledgements

Authors express their gratitude to ministries, agencies and experts for support of this work and provision of information.

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Table 1: PCDD/F, PCB and HCB Emission Factors by Source Categories

Source Category	PCDD/F releases				HCB,	PCB,
	Unit	Air	Water/Soil/ Product	Residues	µg /t	µg /t
					Air	Air
1	2	3	4	5	6	7
Municipal solid waste incineration	µg TEQ/t	30	–	107	1000	5000
Hazardous waste incineration – solid	µg TEQ/t	350	–	900	1000	5000
Hazardous waste incineration – polluted ¹	µg TEQ/t	100	–	300	2000	5000
Hazardous waste incineration – liquid	µg TEQ/t	10	–	10		3400
Medical/hospital waste incineration	µg TEQ/t	3 000	–	20	2000	19000
Waste wood/biomass incineration	µg TEQ/t	30	–	100	100	5000
Fossil fuel/waste co-fired power boilers	µg TEQ/TJ	35	–	–	30	250
Coal and peat fired power boilers	µg TEQ/TJ	10	–	–	30	250/180 ²
Heavy fuel fired power boilers	µg TEQ/TJ	2.5	–	–	–	–
Light fuel oil/natural gas fired power boilers	µg TEQ/TJ	0.5	–	–	–	–
Mixed biomass fired power boilers	µg TEQ/TJ	500	–	–	–	–
Wood fired power boilers	µg TEQ/TJ	100	–	15	30	120
Wood waste	µg TEQ/TJ	100	–	15	100	5000
Domesting heating – polluted wood/biomass	µg TEQ/TJ	1 500	–	1 000 ³	2000	5000
Domesting heating - virgin wood/biomass	µg TEQ/TJ	200	–	10 ³	100	5000

1	2	3	4	5	6	7
Domesting heating – oil	µg TEQ/TJ	10	–	–	–	–
Domesting heating – coal/peat	µg TEQ/TJ	100	–	5 000 ³	30	250/180 ²
Domesting heating - natural gas	µg TEQ/TJ	1.5	–	–	–	–
Transport - unleaded fuel without catalyst	µg TEQ/t	0.1	–	–	0.3	–
Transport - diesel engines	µg TEQ/t	0.1	–	–	200	–
Cement - wet kilns	µg TEQ/t	0.6	–	–	–	–
Cement - dry kilns	µg TEQ/t	0.05	–	–	–	–
Lime	µg TEQ/t	0.07	–	–	–	–
Brick	µg TEQ/t	0.11	–	–	–	–
Glass	µg TEQ/t	0.2	–	–	–	–
Asphalt mixing	µg TEQ/t	0.07	–	–	–	–
Iron and steel plants	µg TEQ/t	3	–	15	–	3600
Foundries	µg TEQ/t	5	–	-	–	–
Aluminum production	µg TEQ/t	0.5	–	100	–	–
Pulp and paper - wood boilers	µg TEQ/t	0.07	–	-	–	–
Pulp and paper - bark boilers	µg TEQ/t	0.2	–	50	–	–
Pulp and paper - sulfite papers	µg TEQ/t	–	0.1 ⁴	–	–	–
Recycling paper	µg TEQ/t	–	3 ⁴	–	–	–
Crematoria	µg TEQ/t	90	–	–	–	–
Cigarettes smoking	per cigarette	0.1	–	–	–	–
Sewage/sewage treatment	µg TEQ/m ³	–	0.0005 ⁵	200	–	–
Open water dumping	µg TEQ/m ³	–	0.0002 ⁵	–	–	–
PCB containing equipment	µg TEQ/t	–	–	–	–	0.3 ⁶ /2 ⁷
Forest fires	µg TEQ/t	5	–	–	–	–
Grassland and moor fires	µg TEQ/t	5	4 ⁸	–	–	–
Agricultural residue burning (in field)	µg TEQ/t	0.5	10 ⁸	–	–	–
Accidental fires in vehicles	per event	94	18 ⁷⁸	18	–	–

¹ – polluted wood waste ² - peat combustion; ³ - ng TEQ/kg ash; ⁴ - release to products; ⁵ - release to water; ⁶ - leaks from transformers (emission to soil); ⁷ - leaks from capacitors (emission to soil); ⁸ - release to soil; “–” - releases are not expected or can't be quantified.

Table 2: PCDD/F Releases on the Territory of Belarus in 2006, g TEQ

Sector	Source Category	Annual Releases				
		Air	Water	Soil	Product	Residue
1	Waste Incineration	4.35	–	–	–	13.83
2	Ferrous and Non-Ferrous Metal Production	8.41	–	–	–	37.13
3	Power Generation and Heating	9.76	–	–	–	8.44
4	Production of Mineral Products	2.38	–	–	–	–
5	Transportation	0.32	–	–	–	–
6	Uncontrolled Combustion Processes	0.45	–	1.41	–	0.01
7	Production of Chemicals and Consumer Goods	0.01	–	–	0.05	0.03
8	Miscellaneous	0.46	–	0.30	–	–
9	Disposal/Landfilling	–	0.46	–	–	13.63
Total		26.15	0.46	1.71	0.05	72.06

“–” - releases are not expected or can't be quantified.