FIRST RESULTS OF RELEASE INVENTORIES OF PCDD/PCDF UNDER THE STOCKHOLM CONVENTION

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Introduction

The Stockholm Convention on Persistent Organic Pollutants, a global legally binding treaty requests parties to minimize or, where feasible, eliminate the releases of PCDD/PCDF. Therefore, sources of unintentionally generated POPs must be quantified and the methodology used to assess sources must be consistent in order to follow or monitor dioxin releases over time and between countries [1]. Existing PCDD/PCDF inventories are not satisfactory for these purposes. Many are incomplete, out of date or lack uniform structure. Only a few inventories address releases other than to air [2,3].

UNEP Chemicals has developed a "Standardized Toolkit for Identification and Quantification of Dioxin and Furan Releases" [4]. The "Toolkit" has been developed for use by countries that do not have their own measured PCDD/PCDF data from their sources; they will utilize the default emission factors provided in this Toolkit. However, the Toolkit is also applicable to countries that have their own measured data and would like to apply their own emission factors.

Compilation of the inventories should be consistent, time-and resource-efficient and accurate enough to identify reliably the major sources and the key data deficiencies. No testing is necessary to apply the Toolkit and to compile an inventory. The process is also designed to be adaptable.

Methods

The Toolkit consist of a "manual" and an EXCEL files to calculate the releases of PCDD/PCDF to air, water, land, in products and residues; both are available in four languages (English, Spanish, French, Russian). The basic principle is to gather "activity statistics", which describe the amount of a process (*e.g.*, tons of product produced per year), and "emission factors", which describe release of PCDD/PCDF to each medium per unit of activity (*e.g.*, µg I-TEQ/ton). Multiplying the two yields annual releases per source or source category. The Toolkit has been applied by several countries and with the assistance of UNEP Chemicals to identify their sources of PCDD/PCDF and quantify its releases.

Results and Discussion

Uruguay, a country in South America with a population of 3.3 million, estimated its total PCDD/PCDF releases to 28 g TEQ in the year 2000 (Table 1). Of these, 17.1 g TEQ/a were emitted to air with uncontrolled combustion of wastes, agricultural residues and forest fires being the major contributor with 7.7 g TEQ/a or 45 %. Hospital waste incineration contributed with 28 % and the transport sector with 8 %.

Thailand is an Asian country with a population of 60 million (Table 2). The preliminary PCDD/PCDF inventory identified releases of 1,700 g TEQ/a for the year 1999. Of these, 985 g TEQ/a were emitted to air and 705 g TEQ/a were found in residues; mainly in those from the manufacture of consumer goods and in ashes from uncontrolled burning.
The **Philippines** are an archipelago in Southeast Asia with a population of 84.5 million in 2002. The PCDD/PCDF inventory conducted for each main source category and sub-category yielded 534 g TEQ/a for a reference year of 1999 (Table 3). Emissions to air had the highest PCDD/PCDF contaminations, which totaled 328 g TEQ/a whereby 35 % were attributed to uncontrolled combustion of agricultural residues, 30 % from firewood cooking and 18 % from biomass fired boilers sub-categories. Product and land had similar PCDD/PCDF contamination at 77.64 and 46.86 g TEQ/a, respectively.
Jordan is a West Asian country with a population of about 5.2 million. The PCDD/PCDF releases were estimated inventory so far has estimated total PCDD/PCDF releases of 71.1 g TEQ/a for the year 2000 (Table 4). Of these more than 70 % were caused by uncontrolled combustion processes (49.9 g TEQ/a), second were disposal operations with major releases from wastewater treatment plants either as aqueous effluents or sludges (16.7 % of total releases or 11.4 g TEQ/a). Emissions to air accounted for 53.4 g TEQ annually and releases with residues to 16.4 g TEQ/a.
Brunei Darussalam, a country with 340,000 inhabitants on the northwest coast of Borneo Island, and recognized that many of the activities described in the Toolkit were not practiced in the country. The PCDD/PCDF inventory estimates a total of 1.4 g TEQ for the year 2001 (Table 5; note the difference in units). Of these 42 % were from medical waste incinerators and 41 % from landfilling and dumping. The major release vector is air, which accounted for 749 mg TEQ (52.9 % of total releases); 39.3 % were estimated to be concentrated in the residues (555 mg TEQ).

Overall all countries found the Toolkit to be applicable to estimate the releases of PCDD/PCDF. It is an appropriate and useful tool to assist countries in preparing inventories and to provide consistent estimation methods. Results of the national inventories will be starting points to address the issues under Article 5 of the Stockholm Convention such as priority setting and identification of activities that will need application of best available techniques (BAT) and best environmental practices (BEP) to reduce releases of PCDD/PCDF.

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Table 1: PCDD/PCDF release inventory for Uruguay, reference year 2000 [5]

Cat	Source Categories	Annual Releases (g TEQ/a)				
	Category	Air	Water	Land	Product	Residue
1	Waste incineration	4.8	0.0	0.0	0.0	0.03
2	Ferrous+non-ferrous metal production	1.25	0.0	0.0	0.0	1.60
3	Power generation and heating	1.14	0.0	0.0	0.0	0.15
4	Production of mineral products	0.91	0.0	0.0	0.0	0.12
5	Transport	1.36	0.0	0.0	0.0	0.0
6	Uncontrolled combustion processes	7.65	0.0	1.8	0.0	6.10
7	Prod. of chemicals+consumer goods	0.004	0.17	0.0	0.6	0.01
8	Miscellaneous	0.016	0.0	0.0	0.0	0.004
9	Disposal/Landfill	0.0	0.2	0.0	0.015	0.075
	Total	17.1	0.4	1.8	0.6	8.1

Table 2: Preliminary PCDD/PCDF release inventory for Thailand, reference year 1999 [6]

Cat.	Source Categories	Annual Releases (g TEQ/a)				
		Air	Water	Land	Product	Residue
1	Waste Incineration	247	0	0	0	30
2	Ferrous+non-ferrous metal production	20.4	0	0	0	1
3	Power generation and heating	40.2	0	0	0	0
4	Production of mineral products	10.0	0	0	0	0.14
5	Transport	7.3	0	0	0	0
6	Uncontrolled combustion processes	632	0	0	0	292
7	Prod. of chemicals+consumer goods	0.4	1.35	0	8.4	382
8	Miscellaneous	27.2	0	0	0	0
9	Disposal/Landfill	0	0	0	0	0
1-9	Total	985	1.4	0	8.4	705

Table 3: PCDD/PCDF release inventory for Philippines, reference year 1999 [7]

Cat	Source Category	Annual Releases (g TEQ/a)				
		Air	Water	Land	Product	Residue
1	Waste Incineration	37.8	0.0	0.0	0.0	3.72
2	Ferrous+non-ferrous metal production	8.7	0.0	0.0	0.0	1.89
3	Power generation and heating	143	0.0	0.0	0.0	14.4
4	Production of mineral products	2.5	0.0	0.0	0.0	0.04
5	Transport	0.12	0.0	0.0	0.0	0.0
6	Uncontrolled combustion processes	136	0.0	46.9	0.0	4.73
7	Prod. of chemicals+consumer goods	0.0	0.605	0.0	77.6	13.3
8	Miscellaneous	0.23	0.0	0.0	0.0	0.001
9	Disposal/Landfill	0.0	43.2	0.0	0.0	0.0
	Total	328	43.8	46.9	77.6	38.1

Table 4: PCDD/PCDF release inventory for Jordan, reference year 2000 [7]

Cat	Source Categories	Annual Release (g TEQ/a)				
		Air	Water	Land	Product	Residue
1	Waste Incineration	4.04	0.0	0.0	0.0	0.3
2	Ferrous+non-ferrous metal production	0.79	0.0	0.0	0.0	1.9
3	Power generation and heating	0.46	0.0	0.0	0.0	0.0
4	Production of mineral products	0.74	0.0	0.0	0.0	0.1
5	Transport	0.77	0.0	0.0	0.0	0.0
6	Uncontrolled combustion processes	46.8	0.0	0.0	0.0	3.1
7	Prod. of chemicals+consumer goods	0.0	0.0	0.0	0.34	0.0
8	Miscellaneous	0.001	0.0	0.0	0.0	0.0
9	Disposal/Landfill	0.014	0.64	0.0	0.0	11.2
	Total	53.6	0.64	0.1	0.3	16.5

Table 5: PCDD/PCDF release inventory for Brunei Darussalam; reference year 2001 [7]

Cat.	Source Categories	Annual Release (mg TEQ/a)				
		Air	Water	Land	Product	Residue
1	Waste Incineration	585	-	-	-	3.9
2	Ferrous+non-ferrous metal production	0.09	0.002	0	0	0
3	Power generation and heating	23.0	-	-	-	-
4	Production of mineral products	18.9	-	-	42.8	-
5	Transport	67	-	-	-	-
6	Uncontrolled combustion processes	48.5	-	30.9	-	0.8
7	Prod. of chemicals+consumer goods	0	0	0	0	0
8	Miscellaneous	6.7	-	-	-	0.01
9	Disposal/Landfill	-	23.0	-	0.05	550.8
1- 9	Total	749	23.0	30.9	42.9	555

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