UNEP POPs LABORATORY DATABANK

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Abstract
A Databank on POPs Laboratories has been developed and made available through the UNEP/GEF project "Assessment of Existing Capacity and Capacity Building Needs to Analyse POPs in Developing Countries". The Databank contains information on existing laboratories world-wide as to their infrastructure, capacity, experience or services provided with respect to POPs analysis. First evaluation show that typically , laboratories do not analyze all 12 POPs and not all matrices. The structure of the databank has been developed to assist clients in their needs for the implementation of the Stockholm Convention on POPs. The information contained in the Databank and its features have been field tested and improved through a feasibility study with nine laboratories in seven countries.

Introduction
UNEP is executing the medium-sized GEF-funded Project "Assessment of Existing Capacity and Capacity Building Needs to Analyse POPs in Developing Countries" (for further information, see http://www.chem.unep.ch/pops/laboratory/default.htm). Besides the Global Environment Facility (GEF), the governments of Canada, Germany, and Japan contribute financially to this project. This project addresses country needs for laboratory analysis of POPs and conditions necessary to conduct such analysis in a sustainable manner. The project focuses on the analysis of the 12 POPs listed in Annexes A, B, and C of the Stockholm Convention. The features and first results have been presented at Dioxin'2006[1]. During 2006/2007 some more information has been obtained and more details as to the convention-driven needs have become available. At the Third Meeting of the Conference of the Parties to the Stockholm Convention in April/May 2007, draft guidelines have been adopted or were recommended for use with respect to the Global Monitoring of POPs (GMP) [2] under the effectiveness evaluation (Article 16), the performance levels associated with best available techniques (BAT) [3], and the definition of the "low POP content" according to the Technical Guidelines on POPs as Waste as adopted by the Eighth Meeting of the Conference of the Parties of the Basel Convention in November 2006[4]. The provisional definition for the "low POP content" in waste is as follows (Table 1).

Table 1: Provisional definition of low POP content according to Basel Convention Technical Guidelines

Low POP Content	POP
50 mg/kg	for each: aldrin, chlordane, dieldrin, DDT, endrin, heptachlor, HCB, mirex, toxaphene
50 mg/kg	PCB
15 µg TEQ/kg	PCDD/PCDF

The performance levels relate to PCDD/PCDF only and are those concentrations in stack emissions for certain source categories listed in Annex C of the Stockholm Convention that have implemented BAT measures. The performance levels associated with BAT range from <0.1 ng TEQ/Nm³ to 0.4 ng TEQ/Nm³ [3]. For the first effectiveness evaluation concentrations for all POPs is being collected for three core matrices, namely mother's milk, human blood, and ambient air.
The information contained in the Databank and the experiences gained during the feasibility study of the project with nine laboratories in seven countries provide a useful tool as to the capacity to implement the provisions of the Stockholm Convention with respect to analytical needs. Experiences and results from training sessions and intercalibration exercises are presented by de Boer *et al.* [5]

Materials and Methods
The databank has been programmed in Microsoft .NET platform and the information contained was transferred manually from questionnaires submitted by the laboratories. The Databank is updated as new information comes in and will be maintained by UNEP Chemicals after the termination of the project. It is publicly accessible and searchable at http://www.chem.unep.ch/databank/Home/Welcome.aspx.

Results and Discussion

In April 2007, the databank contained 184 laboratories from 69 countries. The regional distribution of these laboratories according to the five UN regions is as shown in Table 2. It is noteworthy to mention that the coverage for the developed country region – WEOG – is still low since the project's scope is focused on developing country regions.

Table 2: Regional distribution of POPs laboratories (Status: 23 April 2007)

Region	Number of POPs Labs	Region	Number of POPs Labs
Africa	29	GRULAC*	44
Asia	38	WEOG**	18
CEE***	55		

* Group of Latin American and Caribbean countries; ** Western European and other Groups
*** Central and Eastern European countries

The coverage of POPs and matrices of these laboratories is highly variable and not all laboratories have expertise for all of the 12 POPs or all matrices. From Table 3 it can be seen that most experience exists for DDT (138 labs), chlordane (132), heptachlor (132 labs), indicator PCB (132 labs), and hexachlorobenzene (131 labs), whereas only relatively few laboratories offer to analyze PCDD/PCDF (51 labs) or dioxin-like PCB (67 labs). Among the POPs pesticides, less frequently covered are toxaphene (62 labs) and mirex (63 labs). The drins have a medium frequency (aldrin-100 labs, dieldrin-97 labs, and endrin-95 labs).

Table 3: Overview of frequency of POPs analyzed in 184 laboratories (Status: 23 April 2007)

POP	Frequently Analyzed	POP	Less Frequently Analyzed
DDT	138	PCDD/PCDF	51
Chlordane	132	Toxaphene	62
Heptachlor	132	Mirex	63
PCB	132	Dioxin-like PCB	67
HCB	131		

Among the matrices selected as core data for the effectiveness evaluation, human blood (32 labs), mothers' milk (37 labs) or ambient air (53 labs), respectively, are the least commonly analyzed ones. Instead, much more experience and interest exists for water (146 labs) or soil/sediments (135 labs). The frequency at which the matrices are analyzed are compiled in Table 4.

Table 4: Summary of frequency of matrices analyzed in 184 laboratories (Status: 23 April 2007). (Matrices for GMP core data in bold)

Matrix	Frequently Analyzed	Matrix	Less Frequently Analyzed
Water	146	**Human blood**	**32**
Soil/Sediment	135	**Mothers' milk**	**37**
Food	94	Stack emissions	50
Effluents	92	**Ambient air**	**53**
Transformer oils	88	Chemicals/products	64
Bivalves/marine mammals	85	Residues	78

From the above data it can be concluded that there are not many laboratories capable to analyze all POPs and all matrices. However, it should be noted that institutions hosting POPs laboratories have their own mandates and needs. Further, the equipment present at the laboratories also put some limits as to the spectrum of POPs and matrices analyzed.

The Guidance document for the GMP has defined the so-called instrumentation level based on commonly used methods for POPs analysis. The POPs Laboratory Databank takes this definition and applies it to its Tier

definition as follows:

Tier 1: Instrumentation capable to analyze PCDD/PCDF and dioxin-like PCB in addition to the basic POPs: Instrumentation is a high-resolution mass spectrometer in combination with a capillary column;

Tier 2: Instrumentation capable to analyze all POPs (some at high concentrations only): Instrumentation is a mass-selective detector (low resolution mass spectrometer) or a combination of two and in combination with a capillary column.;

Tier 3: Instrumentation capable to analyze all POPs without PCDD/PCDF and dl-PCB: Instrumentation is an electron capture detector in combination with a capillary column.

The Databank also includes a few laboratories that have capacity to take samples and do the extraction and clean-up but do not have instrumentation for determination.

The implications of the above can be illustrated by looking at the characteristics of the nine pilot laboratories that participated in the feasibility study of this project. They came from four UN regions: Africa-Kenya; Asia-China, Vietnam, and Fiji; CEE-Moldova; GRULAC-Ecuador and Uruguay.

The pilot laboratories included all Tier levels with the majority at Tier 3 and specialized on POPs pesticides in soil/sediment and water. However, there were also two dioxin laboratories included (at Tiers 1 and 2). The hosting organizations were either governments but of different ministries (*e.g.*, Agriculture, Health, Defense, Environment or Presidency) or academic institutions or a public institute. Private laboratories were not included in the feasibility study.

The Steering Group to the project and based on requirements recommends the following types of laboratories for the needs for POPs analysis arising from the implementation of the Stockholm Convention (Table 5):

Table 5: Recommended instrumentation (as Tiers) for analysis of combinations of POPs and matrix type

POP	Matrix	Tier
POPs pesticides:	Abiotic and Biota	Labs at Tiers 1, 2, 3
Toxaphene:	Biota (low contamination)	Labs at Tiers 1, 2
PCB	Abiotic and Biota	Labs at Tiers 1, 2, 3
	Biota (low contamination, *e.g.*, blood)	Labs at Tiers 1,2
dl-PCB	Abiotic and Biota	Labs at Tiers 1, 2
PCDD/PCDF	Abiotic (except ambient air)	Labs at Tiers 1, 2
	Abiotic - ambient air	Labs at Tier 1
	Biota	Labs at Tier 1 (2)
	Stack emissions	Labs at Tier 1

Although the needs for POPs analysis arising from the Stockholm Convention and the related guidance documents address either specific POP chemicals (sometimes mixtures of congeners as for PCDD/PCDF, PCB, toxaphene, chlordanes) or give a recommendation for analysis of transformation products (*e.g.*, DDE, DDD, β-heptachlor epoxide, *cis*- and *trans*-nonachlor, oxychlordane) that all require traditional chemical analysis with instrumentation as described above, interest in the use of bioanalytical methods has been recognized in the course of this project.

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References

1. Fiedler H. Organohalogen Compd. 2006, 68; 245-248
2. SSC. "Guidance on the Global Monitoring Plan for Persistent Organic Pollutants – Preliminary Version". 2007. For download from http://www.pops.int/documents/meetings/cop_3/meetingdocs/inf14/GMP%20Guidance%20CD/K0761293%20POPS-COP3-INF14.pdf
3. Wahlström B and Yu G. Guidelines on Best Available Techniques and Provisional Guidance on Best

Environmental Practices for the Stockholm Convention. Paper at DIOXIN'2007
and text of the BAT/BEP Guidelines for download from www.pops.int
4. SBC: General Technical Guidelines for the Environmentally Sound Management of Wastes Consisting of, Containing or Contaminated with on Persistent Organic Pollutants (POPs); 2006. For download from http://www.pops.int/documents/meetings/cop_3/meetingdocs/inf7/K0761126%20POPS-COP3-INF7.pdf
5. de Boer J, van Bavel B, Lindström G, Leslie H , van Leeuwen S, Wegener JW, Fiedler H. Paper at Dioxin'2007