MONITORING AND MEASURES ON POPS IN TURKEY

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Abstract. Turkey signed the Stockholm Convention on May 23, 2001, with the objective of protecting human health and environment, focusing on eliminating or reducing releases of 12 POPs, the "Dirty Dozen". Turkey has developed its National Implementation Plan (NIP) as a Party to the Stockholm Convention. The NIP sets out how the Stockholm Convention is being implemented in Turkey and outlines the next steps to be taken in the management of POPs. A number of experts, representative of the institutions, ministries, universities, Scientific and Technical Research Council of Turkey – Marmara Research Center, and non-governmental organizations took part in preparing the inventory and preparation of the NIP.

Keywords: POPs, HCB, PCBs, POPS regulation.

1. Introduction

The United Nations Environment Programme (UNEP) Stockholm Convention on POPs (http://chm.pops.int/) is a global agreement that came into effect on May 17, 2004. The objective of this Convention is to protect human health and the environment from Persistent Organic Pollutants. As a Party to the Convention, Turkey has an obligation under Article 7 to develop and implement a National Implementation Plan (NIP).

The purpose of the NIP is to inform the Conference of the Parties and the public regarding Turkey's initiatives current and projected, to meet the requirements of the Stockholm Convention. These initiatives include legislation, regulations, voluntary programs and standards, policies, programs and other related measures including action by Turkish authorities and public stipulate that the NIP for reducing unintentionally produced POPs, including dioxins and furans, hexachlorobenzene (HCB) and PCBs.

A.M. Bahadir and G. Duca (eds.), *The Role of Ecological Chemistry in Pollution Research and Sustainable Development*,

The twelve POPs defined within the Convention have been classified into in three groups in the Convention text for proposes of control measures (Table 1.1).

Table 1.1. The 12 POPs "Dirty Dozen".

Annex A: Substances Subject to Elimination	Aldrin, chlordane, dieldrin, endrin, heptachlor, hexachlorobenzene, mirex, and toxaphene Polychlorinated biphenyls (PCBs)
Annex B: Substances Subject to Restricted Use	DDT
Annex C: Unintentionally Produced Substances	Dioxins and furans (PCDDs/PCDFs) Hexachlorobenzene (HCB); and Polychlorinated biphenyls (PCBs)

2. POPs

2.1. Brief description of POPs

Persistent Organic Pollutants (POPs) are organic compounds of natural or anthropogenic origin with a particular combination of physical and chemical properties that were once released into the environment; they remain intact for exceptionally long periods of time as they resist photolytic, chemical and biological degradation. They include industrial chemicals such as PCBs, pesticides such as DDT and by-products such as dioxins and furans. They characterized by low water solubility and high lipid solubility. POPs bio-accumulate in fatty tissues of living organisms, including humans, and are found at higher concentrations at higher trophic levels in the food chain. This way, humans, wildlife and other organisms are exposed to POPs, in many cases for extended periods of time spanning generations, resulting in both acute and chronic toxic effects. In addition, they are introduced to humans through the food chain and passed on from mother to child and are known to have significant immunological, neurological and reproductive health effects and suspected for cancer.

2.2. POPs are global issue

POPS are semi-volatile chemicals, which evaporate from the regions in which they are used and are then transported over long distances in the atmosphere. They are also discharged directly or by atmospheric deposition into waterways and are transported by current of fresh and marine waters, even through the ground waters. This result shows the widespread distribution of POPs across the globe, including the regions where they have never been used, such as the inhabited and remote areas.

POPs occur at low levels in air and water, so human concerns arise from their ability to bio-accumulate in organisms rather than from direct exposure. POPs have a tendency to accumulate in fatty tissue of organisms and be transferred along terrestrial and aquatic food chains.

POPs are a global issue for the environment and human health. They can cause birth defects, various cancers, effect the immune system, cause the dysfunction and reproductive problems in mammals. In addition, the weight of evidence indicates that high levels of exposure over the long term may contribute to increasing rates of birth defects, fertility problems, greater susceptibility to disease, diminished intelligence disrupting endocrine systems and some types of cancers in humans. The major concern for human health is the effect of exposure to POPs on developing fetus. POPs have been detected in the breast milk of women throughout the world.

3. Assessment of the POPs issue in the country

On May 22–23, 2001, 125 countries including Turkey signed the Stockholm Convention, a global agreement under the United Nations Environment Programme (UNEP) that will reduce or eliminate emissions of POPs. The Convention:

- Sets out obligations for countries covering the production, use, import, export, release, and disposal of POPs.
- Requires countries to promote, and in some cases require, the use of the best available techniques (BAT) and best environmental practices (BEP) to reduce and/or eliminate emissions of unintentionally produced POPs from certain combustion and chemical processes.
- Includes provisions aimed at preventing the introduction of new POPs and for adding other POPs to the Convention in the future.

With the ratification by 50 countries, the convention entered into force on May 17, 2004. Because of the Convention includes obligations related to hazardous wastes and their transboundary movements, it is closely linked with the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (www.basel.int) and the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (www.pic.int).

The quantitative basis of the issue would typically be established by the development of inventories of the POPs covered by the Convention.

3.1. Assessment with respect to Annex A part 1 chemicals (POPs pesticides)

The authorization for the use of any pesticide is aligned with international rules. When the use of a pesticide is banned in the world, it will also be banned in Turkey. Registration Committee of Ministry of Agriculture and Rural Affairs (MARA) register agricultural pesticides after studying the chemical and physical properties, biological activity, residues, toxicological and eco-toxicological properties with internationally approved analytical methods and techniques. MARA monitors registered pesticides from their production or import to their consumption. Provincial and County Directorates of MARA responsible for market control constantly control pesticide retailers. Unsatisfactory product standards for the samples taken during market control necessitate punitive actions.

Pesticide use per hectare as active ingredient is 0.63 kg for Turkey, whereas it is 17.5 kg for Netherlands, 3.5 kg for USA, 4.4 kg for Germany and France, 7.6 kg for Italy and 6 kg for Greece. It is clear that when compared with developed countries, pesticide use levels are very low in Turkey. Thus, agricultural sector in Turkey is not an environment-polluting sector, rather affected by the pollution.

According to the reports of MARA, there is only an approximate of 2,700 tons of HCB present in the stocks.

Monitoring studies were carried out for various foodstuffs after POPs pesticides were registered and after they were banned by Plant Protection Research Institute of MARA.

3.1.1. Past, Present and Projected Future Production and Use of POPs Pesticides

According to the statistics, the total use of pesticides in Turkey was declining from 36,662 tons in 1985 to 30,792 tons in 2002. It can be observed that, over the 17-year period, use of pesticides decreased. These quantities represent the registered pesticides (Table 3.1.1.1).

Table 3.1.1.1. Annual amounts of authorized pesticides use in Turkey.

Year	Amount of pesticide use (tons)
1985	36,662
1997	33,713
1998	35,487
1999	32,230
2000	33,548
2001	29,798
2002	30,792

A total of 1231 commercial pesticides had been registered in 1995; though the picture changed in 2004 as 485 active ingredient and 3006 commercial pesticides were registered in Turkey. However, due to various reasons only 252 active ingredients containing registered pesticides are commercially available.

POPs pesticides ban was started in Turkey by 1970s, and their use, production, import, and export are prohibited by law.

Dieldrin was banned in 1971, aldrin, chlordane, heptachlor, endrin were banned in 1979 and toxaphene was banned in 1989. In addition, registrations of plant protection products containing these active ingredients were cancelled. Mirex and its formulations have never been registered in Turkey. There is no record of production of POPs pesticides in Turkey since their ban. After registration, plant protection products were being prepared by using imported active ingredients. Production of those active substances in Turkey has never been an issue. Records from Under secretariat of Foreign Trade and Under secretariat of Customs show the fact that POPs substances have not been imported or exported after they have been banned.

Starting from 1968 the use of aldrin, dieldrin, heptachlor, DDT, chlordane and toxaphene was restricted. Application of soil with aldrin and heptachlor was forbidden, but use for seed treatment was allowed.

3.1.2. Identified Obsolete Stockpiles and Wastes of POPs Pesticides

According to the official statements, there are only stocks of HCB and DDT. After POPs pesticides had been banned, as a precaution MARA collected the data of the stocks of retailers and firms. As a result, 2,700 tons of HCB (hexachlorobenzene) and 10,930 kg of DDT were found in the stocks in Turkey. Because of harmful effects on human health and environment, the Plant Protection and Agriculture Quarantine Law banned HCB in1985. The DDT stock was found in the storage of Ankara Central Service Directorate of MARA.

3.2. Assessment with respect to PCBs (Annex A, Part II Chemicals)

Polychlorinated Biphenyls (PCBs) are organic compounds, which were used in electrical machinery and equipment insulation. They have been used as insulators in transformer and in capacitors for years and some of the transformers and capacitors in start-up power stations in Turkey contain PCBs. PCBs also appear as by-products of organochlorine productions like PVC and unintentionally during waste incineration.

There are two regulations related to PCBs in Turkey:

1. “Regulation for Dangerous Chemicals”, 11.07.1993 dated, Official Gazette No: 21637
2. “Regulation for The Control of Hazardous Wastes”, 14.03.2005 dated, Official Gazette No: 25755

According to Article 41 of "Regulation for Dangerous Chemicals", products and equipments containing polyhalogenated biphenyls and terphenyls and their combination cannot be used as of January 1, 1996. According to Article 42 of the same regulation the use of such materials in

- Closed system electrical devices (transformer, resistor, inductor)
- Large densers (total weight of 1 kg and more)
- Small densers (whose chlorine content is not more than 43% and does not contain more than 3.5 penta and more chlorine biphenyl containing polychlorine biphenyl)
- Heat transfer liquids which are used in closed system heat appliances (except for processing food, medicine, feed and other veterinary products)
- Hydraulic liquids used with underground digging equipment and electrolyte aluminium production devices
- For conversion of other products as a first step or intermediate step are allowed until January 1, 1996

3.3. Assessment DDT (Annex B Chemicals)

DDT and its related products are very persistent in nature. Even after 10–15 years from its application more than 50% of them remain in the soil.

DDT has been used between 1957 and 1985. Since then, no use (import, export, use, stockpiles, etc.) of this active substance has been reported; moreover, these chemicals are sufficiently managed via a great number of legislations.

3.3.1. Past, Present and Projected Future Production and Use of DDT

According to the available data and records, there was no DDT production in Turkey in the past. Use of DDT was restricted in 1978 and banned in 1985 in Turkey. When they were registered, plant protection products were prepared using active ingredients imported from other countries.

Nationwide monitoring of organochlorine pesticide residues has been performed on agricultural products, soil, and rivers. No illegal use of DDT has been found.

3.3.2. Identified Stockpiles of DDT and DDT Waste

After the ban on POPs pesticides the stock records of retailers and firms were collected as one of the precautions taken by MARA. Turkey has 10,930 kg of DDT in the stocks. DDT stock is located in the facilities of Ankara Central Supply Directorate of MARA.

3.4. Assessment of releases from unintentional production of Annex C chemicals (PCDD/PCDF, HCB and PCBs)

This section intends to summarize the inventories of the emission of polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDDs/PCDFs), Hexachlorobenzene (HCB) and polychlorinated biphenyls (PCBs) which are unintentionally formed in a wide range of thermal and industrial chemical processes. These are the chemical substances covered by Annex C of the Stockholm Convention.

Potential sources are

- Thermal processes: waste incineration, uncontrolled waste burning, metal smelting, and refining processes, thermal power generation, cement kilns, wood and other biomass burning, and gasoline combustion.
- Industrial chemical processes: production of pulp and paper when bleaching with elemental chlorine is used.

Development of national inventory made by the Toolkit prepared by UNEP Chemicals, which is an effective methodology for identifying the relevant industrial and non-industrial processes releasing PCDD and PCDF.

A detailed database of emission factors, which provides suitable default data, was applied as representative of the class into which the processes are grouped. The main source categories for PCDDs/PCDFs emissions in the Toolkit are identified as

- Waste incineration
- Ferrous and non-ferrous metal production
- Power generation and heating
- Production of mineral products
- Transport
- Uncontrolled combustion processes
- Production of chemicals and consumer goods
- Miscellaneous
- Disposal
- Hot spots

Persistent Organic Pollutants, which may have similar effects, are found in all environmental compartments, are persistent and, being fat soluble, tend to accumulate in higher animals, including humans. Their resistance to degradation and semi-volatility means that they may be distributed over long distances and give rise to trans-national exchanges of pollutants. In addition, POPs released into the environment many years ago continue to contribute to contemporary exposure. Due to high persistence of POPs, concentrations in soils and sediments decrease very slowly, following any reduction in releases to air and water. Concentrations in air are more responsible to emission reductions, so the POPs emissions can be decreased rapidly in air than in soil or water.

It is possible to state that once released into the environment, all POPs follow a range of similar routes. In the atmosphere they exist in both the gaseous phase and bound to particles, depending upon the environmental conditions, and are deposited on soil, vegetation and water bodies by wet and dry deposition or in mist. Dioxins have been measured in areas with no local sources and it can, thus, be deduced that they are available for long-range transport over a scale of thousands of kilometres.

Table 3.4.1. Dioxin and furan emissions in Turkey.

	Source Categories	Annual Releases (g TEQ/a)				
Cat.		Air	Water	Land	Products	Residue
1	Waste Incineration	19.883	0.000	0.000	0.000	0.6
2	Ferrous and Non-Ferrous Metal Production	113.854	0.000	0.000	0.000	195.7
3	Power Generation and Heating	15.772	0.000	0.000	0.000	0.0
4	Production of Mineral Products	25.088	0.000	0.000	0.000	3.3
5	Transportation	3.063	0.000	0.000	0.000	0.0
6	Uncontrolled Combustion Processes	5.000	0.000	4.000	0.000	0.0
7	Production of Chemicals and Consumer Goods	0.000	0.000	0.000	21.589	0.0
8	Miscellaneous	0.010	0.000	0.000	0.000	0.0
9	Diposal/ Landfilling	0.000	0.000	0.000	0.001	0.0
10	Identification of Potential Hot-Spots					
1-9	Total	182.7	0.0	4.0	21.6	199.6

TEQ = international toxicity equivalencies.

The total emissions (air, water, soil, and product) of unintentionally produced POPs (dioxins and furans) in Turkey are given in Table 3.4.1. According to this table, the most important POPs producer sectors are ferrous and non-ferrous metal production, production of mineral products, waste incineration and power generation.

For PCBs emissions, Turkey has two main problems; lack of information and research on PCBs production, and insufficient laboratory facilities for PCBs analysis in different matrices, except for some governmental laboratories.

Besides being formed as unintentional by-products of manufacturing or disposal processes, PCDD/PCDF may also be introduced into processes as contaminants in raw materials. PCDD and PCDF releases arise from four types of sources.

The processes considered are as follows:

- Chemical production processes – for example the production of chlorinated phenols and the oxychlorination of mixed feeds to make certain chlorinated solvents, or the production of pulp and paper using elemental chlorine for chemical bleaching
- Thermal and combustion processes – including incineration of wastes, the combustion of solid and liquid fuels, and the thermal processing of metals
- Biogenic processes, which may form PCDD/PCDF from precursors such as pentachlorophenol. The last one is related to previous contamination
- Reservoir sources such as historic dumps of contaminated wastes and soils and sediments, which have accumulated PCDD/PCDF over extended periods

In January 2001, UNEP Chemicals within the framework of the IOMC (Inter-Organization Program for the Sound Management of Chemicals) released the "Standardized Toolkit for Identification and Quantification of Dioxin and Furan Releases" as a draft. This Toolkit is for the preparation of a release inventory for polychlorinated dibenz*o*-*p*-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF) as requested in subparagraph (a) of the Article 5 in the Stockholm Convention on Persistent Organic Pollutants. It is aimed to cover all release vectors (air, water, land, products, residues) from industrial and domestic activities by identifying the sources and quantifying the releases for two classes of unintentionally generated POPs.

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