Environmental Release and Management of Unintentionally Produced Persistent Organic Pollutants in India

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Abstract :

The environmental release of unintentionally produced persistent organic pollutants (UpPOPs) dioxins and furans have been assessed at the country level as a part of the preparation of National Implementation Plan (NIP). During the NIP preparation the ground level situation of environmental release of intentional POPs and UpPOPs have been assessed through proper inventorisation , sample collection , analysis and interpretation. In the present paper the environmental release of UpPOPs , polychlorinated dibenzo-p-dioxins/ dibenzofurans have been elaborated.

Introduction :

Persistent organic pollutants (POPs) are drawing the attention of environmentalists over the last two decades because of their very high toxicity to human beings. Pesticides, polychlorinated-bi-phenyls (PCBs), dioxins and furans (D&F) and few of the industrial chemicals are some such POPs restricted by the Stockholm Convention (SC). Convention has established the measures for 28 POPs, which are used either as pesticides or in commercial manufacturing processes or unintentionally produced in the industries or high temperature-based processes. Government of India (GoI) Ministry of Environment and Forest (MoEF) has submitted the National Implementation Plan (NIP) to SC for 12 POPs in March 2011. The submission of India's NIP on POPs has fulfilled the commitments set out by the convention and also indirectly helped in India's own chemical management.

During the NIP preparations the environmental releases of intentional and unintentionally produced POPs (UpPOPs) have been evaluated by proper inventorisation, sampling, analysis and interpretation.

Work :

The National Inventory on environmental release of UpPOPs with chemicals identified as polychlorinated dibenzo-p-dioxins (PCDD) and polychlorinated dibenzofurans (PCDF) have been discussed below.

The intensive agriculture, polluting industry and unplanned urbanisation have caused enormous disturbance to the environment of the specific country and as well as across the globe, Emerging technologies have been responsible for releasing many unknown pollutants and causing great public concern all over the world. Extensive community and regulatory agencies are on to maintain a healthy environment and to provide better life to the people of the world. The Stockholm and Rotterdam Conventions have targeted some of the emerging pollutants viz. persistent organic pollutants (POPs) and UpPOPs, pesticides and other hazardous chemicals.

These man made organic contaminants can be broadly classified into the following four very broad categories.

- Hydrocarbons
- Pesticides
- Herbicides
- Industrial Solvents

Persistent organic pollutants (POPs)

There are 28 POPs covered by the Stockholm Convention so far. POPs can always be transported across different countries through ocean, atmosphere and migratory species. They have a tendency to bioaccumulate in human bodies and other animals. Some of the POPs are banned, but some countries still produce and use such chemicals. For example DDT is used in vector management for disease control. Stockpile of unwanted POPs exists in many parts of the world, including India. All these could be mitigated and controlled by multilateral approach and adequate addressing of the problem.

The Stockholm Convention

This convention (SC) held in Stockholm on 22 May 2001 on POPs was signed by 90 countries at a diplomatic conference. The Convention entered into force on 17 May 2004. The first meeting of the Conference of the Parties was held in Punta del Este, Uruguay during 2-6 May 2005. The meeting was held in Geneva, Switzerland on 8 May 2008 in which 152 countries, including India, had signed the Convention and 128 countries had ratified it.

In June 2017 the Stockholm Convention declared the control measures for 28 POPs. These are either used as pesticides or in commercial manufacture processes or are unintentionally produced in industries. These chemicals are listed in three Annexures A, B and C in the category of: To be eliminated, restricted use and UpPOPs to the Convention.

All these chemicals have been classified for international action based on their persistence, bioaccumulation, dispersion and toxicity. Three broad areas covered are:

- Pesticides: intentional chemicals
- Dioxins, furans, dioxin-like PCBs: UpPOPs
- POPs in stockpiles and waste, e.g. pesticides, PCBs

Regulations on Chemicals

In India comprehensive legislation is available for various chemicals at different stages of life cycles. However, due to the cross-sectoral nature of chemical management it has been addressed in several parts of legislation, regulations or standards in the country. In India the industries production, chemical waste and all related industrial aspects including POP chemicals are regulated and managed under various Acts /Rules/ Notifications maintained by GOI time by time since 1962.

Environmental Contaminants in India

The country's commitment towards SC has been facilitated by MoEF, GOI in (2007-08) through the participation of various Indian institutions for the action on identified POPs. Initiatives were based on primary and secondary data collection from different activities associated to prepare the

national inventory on POPs issue. In respect to UpPOPs data have been collected from all the North, Central, East, West and South zones of the country and compiled and evaluated. This has been achieved by accessing the ground level status of UpPOPs through inventorisation, sample collection, analysis and interpretation of such releases from unintentional and intentional production and use in various sectors.

Release of Unintentional POPs (UpPOPs)

The annual releases of UpPOPs, PCDD and PCDF estimates have been calculated using UNEP Toolkit. It was estimated as 8565.55g TEQ (Toxic Equivalent Quotient). The waste incineration and ferrous and non-ferrous metal production categories have the major contribution in UpPOPs emission followed by heat and power generation (*Table 1*).

In annual releases the waste incineration has the major share of 66.75%. At the time of data collection (2009-10) nearly 4.4 mt/year of hazardous waste generation in India was reported. The second major share of 20.22% was from ferrous and non-ferrous metal production. Waste incineration and ferrous and non-ferrous metal production sectors were identified for special attention and control. To achieve the requirement under Stockholm Convention the implementation of best available technique (BAT) and best environmental practice (BEP) were suggested to undertake for the minimisation or elimination of the formation of UpPOPs release. The reported data (2009-10) on dioxin release activities in the country have not reflected the complete status because of the various reasons associated. The present inventory was considered as preliminary inventory of the period referred. The major quantity of dioxin has been released to residues and then to air. The potential categories were waste incineration and ferrous and nonferrous metal production (*Table 1*).

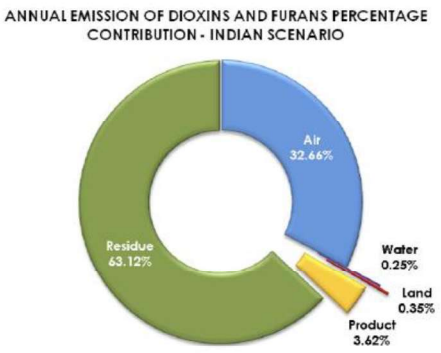
Table 1 : Environmental releases of Unintentional Persistent Organic Pollutants in India

Source	Annual Release of PCDD/Fs (gTEQ/a)						
	Air	Water	Land	Products	Residues	Total	%
Waste incineration	1812.14				3965.83	5777.97	66.75
Ferrous and non-ferrous metal production	539.68				1210.36	1750.04	20.22
Heat and power generation	308.65				195.50	504.15	5.82
Production of mineral products	141.33					141.33	1.63
Transportation	9.57					9.57	0.11
Uncontrolled combustion processes	15.19		30.29			45.48	0.53
Production and use of chemicals and consumes goods	0.174	20.27		243.51	88.51	352.46	4.07
Miscellaneous	0.566				0.16	0.73	0.01
Disposal/Landfill		1.22		70.16	3.44	74.82	0.86
TOTAL	2827.30	21.49	30.29	313.67	5463.80	8656.55	100.00
Release To Matrix (%)	32.66	0.25	0.35	3.62	63.12		100.00

* *Toxic equivalent quotient per annum*

The highest amount of PCDD and PCDF were released into residues 63.12% (5463.80gTEQ), followed by air emissions 32.66% (Fig 1) of the total releases. Waste incineration and ferrous and non-ferrous industries discharge contributed a large amount into residues. Fine fly ashes and dusts contain byproducts of PCDD and PCDF in concentrated form, hence not emitted in air.

The potential of residue to cause environmental contamination with PCDD & PCDF exposure mainly depends on how the residue is treated and disposed off. In case of not properly doing the incineration and effectively destroying the PCDD and PCDF contaminated waste from the chemical industry may result into creation of a reservoir source. Residues from one process may become raw material in another



process and if not processed for control measures, would release PCDD and PCDF in air, water or product. This needs to be given some importance because generally air releases are mostly considered by regulatory agencies. In the case of PCDD and PCDF there is a necessity that current regulatory mechanisms need to be updated to address these pollutant releases in a holistic manner.

Conclusion :

The status of environmental releases of PCDD and PCDF (2009-10) has been discussed at the country level. The annual releases calculated using UNEP Toolkit were estimated as 8656.55g TEQ. The major contribution was found from waste incineration and ferrous and non-ferrous metal productions followed by heat and Power generation sectors. Waste incineration had contributed 66.75% of the total annual releases. The copper recycling was the most leading activity under second highest source of ferrous and non-ferrous metal production for PCDD and PCDF releases. These sectors were reported to be the most important sector for controlling the environmental releases. Residue released 63.12% the highest amount of PCDD and PCDF followed by air emission with 32.66% of the total releases. The present data on environmental releases of PCDD and PCDF have been used to work out the strategies for elimination/ reductions of these UpPOPs for the chemical management of the Nation's resources in order to attend to the ultimate goal of sustainable development.

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Dr. Neeta Thacker is an Environmental Scientist and Researcher. She worked as Chief Scientist and Head at Analytical Instruments Division and Academy of Scientific and Innovative Research of CSIR-National Environmental Engineering Research Institute, Nagpur, Maharashtra, India (1977 - 2014). She has published books , papers in National and International journals and patents for the technologies on Improved Water Filter for removal of pesticides and trihalomethanes. Recipient of Hiyoshi Think of Ecology Award, Hiyoshi Corporation,Japan 2014, Best Paper Award, Hindi Science Academy Council 1997, fellow, Japanese Association of University Women, 1982, and WHO 1987, Maharashtra Academy of Sciences 2003 and Member of many learned National and International Societies. Personal Email: neetathacker9@gmail.com