Success Stories
Stockholm Convention
2001-2011

UNEP

Stockholm Convention

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LIST OF ACRONYMS

ALPHA-HCH	α-Hexachlorocyclohexane
AIT	Asian Institute of Technology
AMAP	Arctic Monitoring and Assessment Program
BAT	Best Available Techniques
BCRC	Basel Convention Regional Centre
BEP	Best Environmental Practices
BETA-HCH	β-Hexachlorocyclohexane
BFR	Brominated Flame Retardant
CBO	Community-Based Organization
CCO	Chemical Control Order
CEC	Commission for Environmental Cooperation
CIEN	Chemicals Information Exchange Network
COC	Code of Conduct on the Distribution and Use of Pesticides
C-OCTABDE	Commercial octabromodiphenyl ether
C-PENTABDE	Commercial pentabromodiphenyl ether
CSIC	Spanish Council for Scientific Research
DENR	Department of Environment and Natural Resources
EECA	European Electronic Component manufacturers Association
EECCA	Eastern Europe, Caucasus and Central Asia
EPR	Extended Producer Responsibility
ESEA	East and South-East Asia
ESM	Environmentally Sound Management
FAO	United Nations Food and Agricultural Organization
FFS	Farmer Field Schools
GAMMA-HCH	γ-hexachlorohexane or lindane
GAP	Good Agricultural Practices
GEF	Global Environment Facility
GMP	Global Monitoring Plan
HBB	Hexabromobiphenyl
HBCD	Hexabromocyclododecane
HCB	Hexachlorobenzene
IOMC	Inter-Organization Programme for the Sound Management of Chemicals

IPEN	International POPs Elimination Network
IPM	Integrated Pest Management
IPPC	Integrated Pollution Prevention and Control
IPPM	Integrated Production and Protection Management
IRS	Indoor Residual Spraying
ISMS	Integrated Services Management System
ITN	Insecticide Treated Net
IVM	Integrated Vector Management
JPS	Jamaica Public Service Company
LSM	Larval Source Management
MEA	Multilateral Environmental Agreement
MOU	Memorandum of Understanding
MSP	Medium-Sized Project
NGO	Non-Governmental Organization
NIP	National Implementation Plan
OCP	Organochlorine Pesticide
ODS	Ozone Depleting Substances
PAFC	Philippine National Oil Company – Alternative Fuels Corporation
PBDE	Polybrominated diphenyl ether
PCB	Polychlorinated biphenyl
PCDD	Polychlorinated dioxin
PCDF	Polychlorinated furan
PCN	Polychloronaphthalene
PCS	Polychlorostyrene
PECB	Pentaclorobenzene
PFOS	Perfluorooctane sulfonic acid
PFOSF	Perfluorooctane sulfonyl fluoride
POPRC	POPs Review Committee
POP	Persistent Organic Pollutant
PSMS	Pesticides Stock Management System
REACH	Registration, Evaluation, Authorisation and Restriction of Chemical substances
RECETOX	Research Centre for Toxic Compounds in the Environment
REC	Regional Economic Community
ROG	Regional Organization Group
SAICM	Strategic Approach to International Chemicals Management

SCCP	Short-chained chlorinated paraffins
SEMARNAT	Ministry of Environment and Natural Resources of Mexico
SINTEF	Foundation for Industrial and Scientific Research
TOT	Training of Trainers
UAB	Autonomous University of Barcelona
UBA	German Federal Environment Agency
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization
UNITAR	United Nations Institute for Training and Research
U-POP	Unintentionally-produced POP
USA	United States of America
USEPA	United States Environmental Protection Agency
WB	World Bank
WEEE	Wastes of Electronic and Electrical Equipments
WHO	World Health Organization
WSC	World Semiconductor Council

PREAMBLE

By Jim Willis, Executive Secretary

At its 10-year mark, the Stockholm Convention regulates an increasing number of persistent organic pollutants. From its adoption in 2001, when the first "dirty dozen" chemicals were listed, through COP-5 in 2011, when endosulfan was added to annex A to become the 22nd POP, the Stockholm Convention has sought to eliminate the most hazardous chemicals known to humankind. As of 2012, there were 22 chemicals listed in the Convention; 18 of these are targeted for elimination, two are restricted, and five are listed for the prevention or reduction of unintentional releases using best available techniques/best environmental practices (BAT/BEP). Three of the latter are also listed for elimination.

The numbers, however, do not tell the full story of the Convention's ambition and success.

The authors of *Success Stories: Stockholm Convention 2001-2011* bring the Convention's first decade of history to life by showcasing examples of global, regional or national successes. The 37 stories are organized around four themes: *1. Increased scientific and political engagement; 2. Increased awareness and behaviour changes; 3. Health benefits for children, women and workers; and 4. Innovative methods to introduce alternatives to POPs*. The Parties to the treaty have acted with determination, often in partnership with industry, the research community, NGOs and international organizations, to realize the promise of the Convention.

The first success highlighted in the opening chapter speaks to the strong political commitment of Governments. As of March 2012, 176 have become Parties to the Stockholm Convention.

Science has played a large role in the development of the Convention. Parties established the Persistent Organic Pollutants Review Committee (POPRC) in 2005; the POPRC reviews proposals received from its Parties to restrict or eliminate POPs and makes recommendations to the Conference of the Parties for listing such chemicals in the Convention. Among its signal achievements: no recommendation of the POPRC to the Conference of the Parties to list a chemical has failed to be agreed by the full consensus of the Parties.

The Global Monitoring Plan (GMP) for POPs was established in 2002 to collect comparable monitoring data on the presence of POPs in all regions and identify changes in levels over time. The first regional and global monitoring reports were completed in 2009, providing the baseline against which changes in levels over time will be evaluated.

Progress against POPs is also being led by Parties through their support for regional centres engaged in capacity-building at regional and national level. Stockholm has established a network of 15 Stockholm Convention Regional and Subregional Centres for Capacity-building and the Transfer of Technology.

The Stockholm Convention has served as a focal point for capacity and coalition-building within civil society around the globe, and many NGOs operate under the umbrella of the International POPs Elimination Network or IPEN. Since 2004, more than 200 projects have been implemented by more than 350 IPEN Participating Organizations in 65 countries. Without IPEN's vision and advocacy, the Stockholm Convention would not have reached the level of effectiveness it enjoys today.

Beginning in 2005, Parties to the Basel, Rotterdam and Stockholm conventions initiated a process to look for, and enhance, synergies between the three conventions. The first simultaneous extraordinary Conferences of the Parties to the conventions ever to be organized jointly by MEAs adopted agreements to further cooperation and collaboration between them, in 2010. This is considered to be a leading example of synergies between MEAs, demonstrating that it is possible to break away from "business as usual" in international environmental governance.

Success Stories concludes with four POPs case studies of innovative methods to introduce alternatives to POPs. The lesson from each is that increasing industry and public awareness due to the proposal and review of substances under the Stockholm Convention as well as regional legal activities and appropriate producer responsibility contribute to trigger industry initiatives to find safer substitutes to chemicals of concern.

On behalf of the secretariat of the Basel, Rotterdam and Stockholm conventions, I would like to thank the authors of *Success Stories* for sharing their inspiring examples of how one MEA has made –and will continue to make- a difference to the health and livelihood of our planet.

CHAPTER 1:

INCREASED SCIENTIFIC AND POLITICAL ENGAGEMENT

FIVE REASONS TO CELEBRATE THE STOCKHOLM CONVENTION

By Miriam Diamond, University of Toronto

The Stockholm Convention on Persistent Organic Pollutants (POPs) has spawned many individual successes at local and regional scales. We can also celebrate the totality of successes related to the Stockholm Convention. This synopsis lists five reasons to celebrate the successes of the Stockholm Convention.

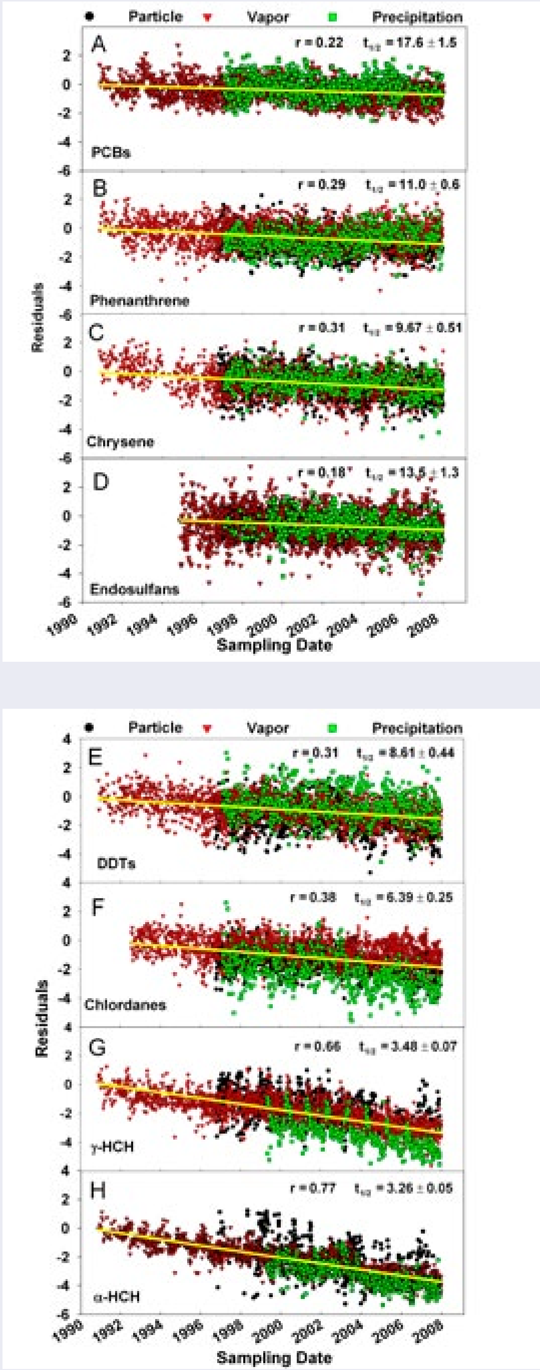
The **first success** for celebration is that global leaders came together to act on curbing POPs concentrations. The very fact that as of November 2011 we have 176 Parties to the Convention as a global legally binding instrument is a major feat unto itself. The Stockholm Convention gives legitimacy and a plan of action in response to public and scientific concerns that we are causing long-term contamination of ourselves and our environment. More than words, about USD 1 billion have been spent to implement hazardous chemical and waste cluster agreements.

Behind this success lies decades of work by innumerable members of the public, scientists and regulators. Rachel Carson, in her historic book *Silent Spring* published in 1962, was the first to draw attention to pesticides that had toxic effects beyond those intended. Underlying Carson's plea to protect birds and wildlife from pesticides was the concept of chemical persistence, whereby a chemical could cause toxicity long after its initial release. Not only was Carson a harbinger of the adverse effects of persistent organic pollutants, but she was thrown into a maelstrom of controversy and demonization by the chemical industry, the results of which were ultimately a move to control POPs.

One might consider the Stockholm Convention as a culmination of Carson's call for environmental protection from the unwitting use of toxic and persistent compounds. Between the two landmark events of Carson's *Silent Spring* and the adoption of the Stockholm Convention are numerous public campaigns, hundreds of scientific papers and discussions, and the efforts of policy makers to draft and implement a global agreement that would concretely control POPs.

The **second major success** is that the Stockholm Convention has been achieving many of its goals. Data continue to document measured reductions in POPs concentrations from widely different locations and media such as air, fish and lake sediments. There are too many examples to list so we offer only a few examples here.

PCBs and several organochlorine pesticides were among the initial "dirty dozen" substances slated for elimination under the Stockholm Convention. Many papers document the decline of these compounds stemming from early legislative controls and the Stockholm Convention in air (e.g., Hung et al. 2002, 2010, Venier and Hites 2011 *inter alia*, Schuster



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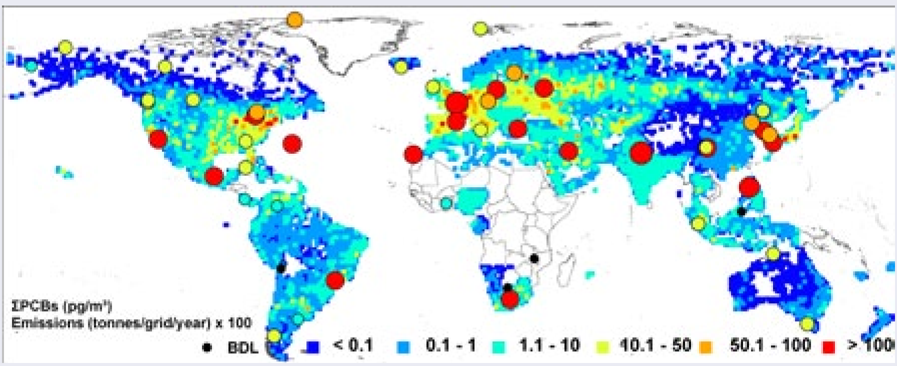
Temporal trends of PCBs, selected PAH and organochlorine pesticides in Great Lakes air sampled at the six IADN US sites. Illustrated as partial residuals of multiple regressions versus sampling date. From Venier and Hites (2011).

et al. 2010), freshwater fish (Carlson et al. 2010, Bhavsar et al. 2007), soils (Shuster et al. 2011), and Arctic biota (Riget et al. 2010). The two flame retardant mixtures penta- and octa-diphenyl ethers were listed for elimination by the Stockholm Convention in 2009, following earlier initiatives by Sweden, the European Union, United States of America (USA) and Canada. Vorkamp et al. (2011 *inter alia*) have documented decreasing PBDE concentrations in northern marine mammals and some northern marine birds populations since ~2000. However, lest we become complacent, PBDE concentrations are either stable or increasing in marine mammals from the South China Sea and the USA.

Ample evidence also documents the decrease of the "Stockholm" POPs in humans. As illustration, consider the results of Linderholm et al. (2010 *inter alia*) for POPs concentrations in adults in Guinea-Bissau and a summary of trends in other African countries. The clearest decreases in blood serum levels has been for a- and b-HCH, as well as for PCBs and DDE, the metabolite of DDT. The later decrease is evident although limited use of DDT continues to combat malaria.

The **third success** of the Stockholm Convention is the development of new scientific methods, including those developed to track changes in POPs concentrations over time. A clear example of new measurement methods that have emerged is that of passive samplers. Harner, Shoeib and co-workers introduced the idea of a very simple, inexpensive passive air sampling device with no moving parts or requirement for electricity (Harner et al. 2002). This method has been used for measuring atmospheric POPs globally, an accomplishment that would have been impossible without the simplicity of the passive sampling design (Pozo et al. 2006, 2009, Holoubek and Klánová 2008). New methods are now being explored for passive samplers of POPs in water which will facilitate global sampling efforts (Lohmann and Muir 2010). A clear benefit of the rise of popularity of passive samplers for POPs is the "democratization" of POPs sampling by enabling developing countries and conflict areas to track



Mean concentrations (pg.m3) in air for PCBs during 2005 superimposed on 2005 PCB inventory by Brevik et al. 2007. From Pozo et al. (2009)

POPs concentrations (Klánová et al. 2007). This empowerment is critical since developing countries are at risk of being POPs dumping grounds.

The **fourth success** is that monitoring and tracking efforts of the Stockholm Convention has led to a new generation of researchers and staff trained in policy implementation. Nowhere is this more important than in countries lacking scientific capacity such as sub-Saharan countries in Africa (Klanova et al. 2009). The Stockholm Convention is expanding its reach with new Regional Centres that have opened in Algeria, Kenya, India, Iran, Senegal, South Africa and the Russian Federation. This is in addition to existing Regional Centres in Beijing, Kuwait City, Brno, Sao Paulo, Mexico City, Panama City, Montevideo and Barcelona.

The **final success** is that the Stockholm Convention has served as a focal point for capacity and coalition-building within civil societies around the globe. Non-governmental, public interest groups operating in numerous countries have come together under the umbrella of the International POPs Elimination Network or IPEN. The goal of IPEN is "... achieving a world in which all chemicals are produced and used in ways that eliminate significant adverse effects on human health and the environment, and where persistent organic pollutants (POPs) and chemicals of equivalent concern no longer pollute our local and global environments, and no longer contaminate our communities, our food, our bodies, or the bodies of our children and future generations...". IPEN harnesses the public concern that has continued unabated since Carson's *Silent Spring* was published and plays the important roles of advocating to the Stockholm Convention that POPs controls should be expanded, while translating the often inaccessible language of science to citizens. Of the many examples of IPEN's success at bringing attention to POPs is their campaign to look at toxic substances in consumer products, starting with products obtained in the Philippines. Their 2011 study of brominated flame retardants found in new carpets with recycled foam backing has publicized the complex question of the fate of products and stocks of now-banned substances (DiGangi and Stakova 2011).

Praising the successes of the Stockholm Convention does not mean that most of the work is done to control POPs globally. We need to ensure that reductions in POPs stocks and concentrations in wealthy countries are not achieved at the expense of transferring these stocks to poor countries, as some recent information suggests (Goia et al. 2008, 2011, Asante et al. 2011). We need to consider how we will control the release of large stocks of now-banned POPs, especially as governments in wealthy and poor countries throughout the world grapple with intense financial constraints. At the same time, we need to be vigilant that we aren't creating new POPs. It is time to celebrate the Stockholm Convention at its 10th birthday, while soberly remembering that it will be many decades yet until we rid the world of the first "Dirty Dozen" POPs!

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THE GEF FINANCING SUCCESS FOR THE STOCKHOLM CONVENTION

By Ibrahima Sow, Anil Sookdeo and Pan Jie,
Global Environment Facility (GEF)

The Global Environment Facility (GEF) was established in 1991 to assist in the protection of the global environment and the promotion of sustainable development. The GEF's involvement in addressing POPs issues dates back to 1995, mainly through regional assessments and pilot demonstrations that covered a number of pressing POPs issues. These initial activities allowed the GEF to quickly respond to requests for supporting the Stockholm Convention negotiations. At the first Conference of the Parties (COP1), a Memorandum of Understanding (MOU) was signed between the COP and the Council of the GEF, entrusting the GEF with the operations of the financial mechanism according to Article 14 of the Convention. A guideline for POPs Enabling Activities was adopted by the GEF Council in May 2001, the same month in which the Stockholm Convention was adopted. The year after, the second GEF Assembly amended the GEF instrument, adding Persistent Organic Pollutants (POPs) as a new focal area. To date, the GEF is the largest public source of financial support for measures to reduce human and environmental exposure to POPs.

The GEF is investing in a range of programmes and projects to rid the world of POPs. Its major support and achievements are highlighted below:

- As of 30 September 2011, the GEF has committed USD 474 million to projects in the POPs focal area. This cumulative GEF POPs allocation

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GEF CEO Monique Barbut, during the 5th Conference of the Parties of the Stockholm Convention in April 2011.

has leveraged some USD 1 billion in co-financing to bring the total value of the GEF POPs portfolio to over USD 1.474 billion.

- The GEF has supported 138 countries to develop their National Implementation Plans (NIPs), through which delivery capacity of GEF Agencies and capacity at country level have been strengthened.

- Projects under implementation are expected to eliminate more than 200,000 tons of POPs chemicals, including 35,000 tons of PCB-related waste.

The GEF's success is a story of continued responsiveness to the Conference of the Parties' guidance. The GEF's intervention in the POPs focal area covers all priority POPs issues identified by the Conference of the Parties (COP) to the Stockholm Convention in its guidance to the Financial Mechanism of the Convention[1]. These include enabling activities for the preparation of NIPs, obsolete POPs disposal, demonstration of BAT/BEP, PCBs management and disposal, waste management, DDT substitution in malaria control and capacity development and institutional strengthening for a sustained implementation of the Stockholm Convention. All these activities help to mainstream Convention requirements into national development agendas, making GEF support relevant to national environmental and sustainable development priorities.

The success of the GEF's portfolio in Chemicals comes from cost effective, innovative projects that transform practices in managing chemicals and introducing technological solutions to handling the final disposal of these chemicals. The GEF also has increased the capacity at the national and regional levels to plan, develop and implement actions on chemicals. A successful GEF project ripples through communities, countries, and regions. The examples are numerous:

- A project in China for the introduction of alternatives to POPs pesticides in termite control catalyzed the Government's ban on production, sales, use, import and export of the nine POPs pesticides.

- In a project on the demonstration of sustainable alternatives to DDT for malaria control implemented in Mexico and Central America, malaria incidence was reduced at an average between 26% and 80% in each country without the use of DDT. The control strategy developed has been extensively replicated in other localities, municipalities, and countries in the region.

- A PCB management project in 16 francophone countries is expected to assist the Africa region to establish a regional facility for decontamination of 3000 tons of PCB-containing equipments.

- GEF's African Stockpile Programme sets the goal to clear all 50,000 tons of obsolete pesticide stocks from Africa and establish measures to prevent recurrence.

[1] See decisions SC-1/9, SC-2/11, SC-3/16, SC-4/27, SC-4/28, SC-5/23.

- Demonstration of BAT/BEP to reduce health-care waste to avoid environmental release of dioxins and mercury projects in seven countries, including Argentina, India, Latvia, Lebanon, Senegal, Tanzania and Vietnam aims to demonstrate and promote replication of BAT/BEP for health care facilities. Projects sharing similar objectives are underway in China, India and Tunisia.
- GEF-funded activities to support the implementation of the Global Monitoring Plan (GMP) help to build regional and national capacity for analysis and data generation of POPs level at country level and an effective monitoring system at global level for the effectiveness of the Stockholm Convention.

All these achievements are evidence to the strong prospective over the coming years for GEF POPs activities to continue to deliver stronger global benefits to protect ecosystems and human health.

In GEF-5 (2010-2014), 375 million USD have been allocated to the POPs focal area. Activities will result in the reduction of POPs releases and phasing out of POPs, in particular PCB phase-out and disposal, and removal and disposal of obsolete pesticides. The increase of resources will enable the reduction of unintentionally produced POPs (UPOPs) from industrial and non-industrial sources. With new POPs added to the Convention, the GEF will support pilot interventions on new POPs reduction activities, and eligible countries will be supported for reviewing and updating their NIPs. These activities in GEF-5 are also integrated into a larger focus on chemicals which encourages funding of multiple chemical issues to bring about synergy and enable the leveraging of additional funding.

The GEF has succeeded in providing funding for Chemicals including global action on POPs and Ozone Depleting Substances (ODS) phase-out. The GEF is broadening its engagement with the sound management of chemicals and emerging chemical issues such as mercury, e-waste, lead in paint and chemicals in products. A total of 25 million USD are allocated for mercury reduction and sound chemicals management during GEF-5. In this regard, the GEF will deepen the synergy within its Chemicals focal area and through multi-focal area projects encompassing climate change, POPs, ODS, biodiversity, land degradation, and international waters.

Although GEF's success is fully demonstrated, enormous challenges are awaiting. Developing countries are in need of new and additional resources to address existing and emerging chemicals issues recognized under SAICM. The GEF is committed to further its assistance to recipient countries and leverage additional funding from the private sector and other bilateral and multilateral agencies. It will continue to work with its partners in 182 governments, 10 agencies, NGOs and the private sector to respond to the needs of Parties and consolidate its leadership as a key innovator in paving the way for the sound management of chemicals and environmentally sustainable development.

THE IMPACT OF THE STOCKHOLM CONVENTION AND THE NIP PROCESS ON PRIORITIZATION OF CHEMICALS MANAGEMENT IN THE NATIONAL AGENDA

By Christine Wellington-Moore, United Nations Environment Programme / Global Environment Fund Scientific and Technical Advisory Panel (STAP) Secretariat

"Only within the moment of time represented by this present century has one species – man – acquired significant power to alter the nature of his world". (Rachel Louise Carson, founder of the contemporary environmental movement and author of *Silent Spring* (1962), 27 May 1907 – 14 April 1964)

Rachel Carson wore many hats, but was primarily a biologist, an advocate of nature and environmental ethics, and was the first scientist to descend from the "ivory tower" of scientific dialogue to bring the general public into the dialogue of the need for control of the way in which man-made invention is unleashed on the natural world.

Specifically, in the late 1950s, she took up the mantle of warning the public about the misuse of synthetic chemical pesticides after World War II. In doing so, she went against the prevailing view that indiscriminate removal of pests from agriculture by any means was solely beneficial, permitting advances in food security and quality of life for the human populace. She almost single-handedly fought the lack of regulation and oversight by her government at the time, as well as the chemical companies, who labelled her as alarmist and unqualified to speak on such matters. Still, with the publishing of her treatise, which was to become her legacy, and with testimony to the US Congress, her efforts were able to see a reversal on national pesticide policy (including the ban of DDT, which has since become nearly global); and indeed, the grassroots movement that sprung up around her book, ultimately led to the creation of the USEPA. But most of all: she managed to convey the message that we cannot ignore the downsides of attempting to alter nature for our sole benefit.

The battle for recognition of the need for responsible use of chemicals continues today, even as chemicals aid in development and improve the convenience of our day-to-day lives. And whilst in the developed country context, one might largely make the assumption that there is oversight on some level to ensure that whatever products we purchase, or are used around us, are safe for use, in the developing country context we cannot take for granted the existence of Protection Agencies, Pesticide and Chemical Control Boards, Consumer Protection bodies etc., without the recognition that such bodies are relatively new. Further, they are in large part overwhelmed with the pace of scientific advances and products being peddled to the manufacturing sector, and ultimately, the public. Even for developed country enforcement/monitoring bodies, staying on top of new advances is a challenge. In October 2010, Scientific American ran an article (http://www.scientificamerican.com/article.cfm?id=the-great-chemical-unknown) indicating that scientists have estimated that there are around 50,000 chemicals used in industrial and consumer products, and only 300 have been tested by the USEPA; and they point out significant regulatory and legislative shortcomings as well.

Recognizing the challenges of responsible use of chemicals in this world, one has to laud the work of the International Chemicals Treaties in promoting the notion that we, as global citizens, should take more of an interest in protecting ourselves and the rest of the natural world, as we pursue ever increasing levels of comfort and convenience in our lives. The Stockholm Convention on Persistent Organic Pollutants stands out as being particularly beneficial in raising chemicals management on the list of national priorities across the globe, particularly through its National Implementation Plan processes.

To quote the Stockholm website:

"According to the provision of the **Article 7** of the Convention, the National Implementation Plan (NIP) is not a standalone plan for the management of POPs but is a part of a national sustainable development strategy of the Party preparing and implementing such plan. Parties are required to share their plans by transmitting it to the Conference of the Parties within two years of the date on which the Convention enters into force for the Party."

More to the point it continues that "the NIP process should assist Parties in establishing inventories of new POPs and in monitoring products and articles containing new POPs. The guidance should also assist Parties in restricting and eliminating industrial POPs and to manage wastes containing these POPs in an environmentally sound manner."

But along the way, the NIP process does more than provide these outputs. First and foremost, with the incentive of the funding provided by the Global Environment Facility (GEF), the NIP provides a country with the funds to carry out comprehensive, cross-sector, public/private sector inventory of not only chemical (waste) stocks, but also legislative/regulatory and capacity-building needs for the implementation of a substantive, national chemicals management framework. It is a critical assessment of the control governments, regulatory bodies, and indeed the agricultural, industrial and manufacturing sectors have on chemicals being used within national boundaries; and often times it is one that, due to national budget restrictions, is usually deferred to the "wishful to-do list" in any government budget. The NIP process can also be the very first time some governments have undertaken a full cross-sectoral, private/public assessment of chemicals use in their country. So the novelty and innovation of the NIP cannot be underestimated.

A complaint by many countries with few human and economic resources is the fragmented approach taken by international treaties to chemicals management. This fragmentation can make the implementation of the numerous treaties difficult, resulting in non-compliance, or even non-ratification by some countries which may be overwhelmed by the various requirements. Admittedly one might see that largely for administrative and monitoring purposes, it has been easier to elaborate Conventions by category of chemical, even though on the ground in most countries, there is far more overlap required in the practical and cost-effective management of chemicals.

Although the NIP is there foremost to track POPs products, many countries take the opportunity to also take note of other hazardous substances being stockpiled alongside the POPs in their countries, and of broader chemicals management shortcomings. This is a credit to the NIP process, because of the way in which activities are structured, such that whilst the POPs are certainly addressed, there is room to simultaneously take note of other hazardous substances, without detracting from the main focus of the NIP. Also, when disposal options are being considered, and economies of scale make the cost of disposing small quantities of POPs unfeasible, the presence of other non-POPs chlorinated waste chemicals (and indeed other chemicals) can make the option more cost-effective if bulk disposal is considered. And whilst one might concede that the capacity and regulatory/legislative work for POPs can often be captured through broader chemicals management legislation and best practices, it is the NIP that acts as the key exercise in getting developing countries more in tune with the responsibilities and threats they take on board with the increased chemicals consumption inherent to national development, and the pursuit of developed country conveniences.

The dynamism and periodic review of the NIP also means that governments are given an incentive to update their thinking and to stay abreast of ever-changing developments in the world of chemicals. The addition of new POPs to Annexes A, B and C at COP 4 in May 2009 has

Old pesticides plastic bottles in Bolivia

Repackaging obsolete pesticides in salvage drums in Bolivia been attended by additional resources for the developing country Parties to update their NIPs, as well as in the provision of additional NIP guidance for the Parties, complete with a number of guidance documents to assist Parties in reviewing and updating their NIPs and the 9 new POPs. As such, Parties should be equipped with the tools to improve their inventory processes, enhance their monitoring of POPs, set them on the path to restricting and eliminating industrial POPs, and to manage wastes containing these POPs in an environmentally sound manner. It is worth noting once more, however, that much of the expertise gained in managing and eliminating POPs and POPs wastes is equally applicable to hazardous chemicals as a whole.

As such, the Stockholm Convention and its NIP process have yielded benefits far beyond the single category of chemicals that are the POPs. It is singularly one of the most effective tools to date to force governments to take a cold hard look not only at POPs but at hazardous chemicals management as a whole, in a way not matched by any of the other Chemicals Conventions. An inventory under a NIP may ultimately yield data relevant to the Vienna, Rotterdam and Basel Conventions, reflecting the unexpected reach of the NIP process.

But most of all, we should keep in mind another quote from Ms. Carson:

"The more clearly we can focus our attention on the wonders and realities of the universe about us, the less taste we shall have for destruction" (Rachel Carson, 27 May 1907 – 14 April 1964).

The Stockholm process can keep nations focused on preserving human and environment health, whilst promoting sustainable development for all. Ahead of the Rio+20 Conference in 2012, this is particularly noteworthy, and the Stockholm family should take pride in its accomplishments on its tenth anniversary!

PERSISTENT ORGANIC POLLUTANTS REVIEW COMMITTEE: THE (10-YEAR) SUCCESS STORY

By Dr. Thomas B. R. Yormah, Associate Professor, Department of Chemistry, Fourah Bay College, University of Sierra Leone, Freetown, Sierra Leone

There is now no gainsaying or denial that science and technology are key drivers of social and economic development at all fronts. It is also now clear that the division of the globe into wealthy and developed nations (mostly of the northern hemisphere) and poor and yet-to-develop nations (mostly of the southern hemisphere) is essentially a science and technology divide. One of the prime technologies that have been and continue to be in the vanguard of our present science and technology-led development are chemicals.

The deployment of chemicals at various development fronts has led to conspicuous positive achievements in all spheres of human endeavor. However, as with all technologies, such chemical development has also resulted in very negative impacts, mostly in the health and environmental arenas, as first highlighted by the author Rachel Carson in her classic "*Silent Spring*".

It is against this background that the need to regulate the production and use of chemicals was conceived.

A set of chemicals whose deployment has raised the most disturbing health and environment concerns are those that have been generically referred to as Persistent Organic Pollutants (POPs). These have been profiled based on key health and environmental indicators, namely: persistence, bioaccumulation, potential for long-range environmental transport and adverse effects such as human and environmental toxicity. Those properties are together known to have the most potent adverse impact on biotic life and the environment.

The management of those sets of chemicals falls under the purview of the Stockholm Convention on Persistent Organic Pollutants (POPs), which must ensure that chemicals that meet the characteristics of POPs are managed according to an agreed regime by all Parties to the convention.

This management regime is based on the listing of POPs chemicals in one of three annexes: Annex A – Elimination; Annex B – Restriction; Annex C – Unintentionally released POPs.

When the Stockholm Convention on POPs was first established, 12 notorious chemicals which, by their use profiles, had already established themselves as POPs were immediately listed in Annexes A, B, or C to the Convention. It was however accepted that future advancements in technology were likely to unmask other chemicals already in use and to also lead to the production and use of new chemicals that possess POPs characteristics. To address this emerging challenge, the POPs Review Committee (POPRC) was established and was charged with the responsibility of professionally characterizing and assessing new chemicals with a view to determining whether or not they possess POPs characteristics and therefore need to be managed under the prescription of the Stockholm Convention. The POPs Review Committee –popularly referred to as POPRC- was given a modus operandi spelt out in the Convention text (which in essence became its constitution) and charged to go to work to rid the world of "dirty chemicals".

At the 1st meeting of the POPRC held from 7 to 11 November 2005, there were 5 chemicals, namely, chloredecone, hexabromobiphenyl (HBB), commercial pentabromodiphenyl ether (c-pentaBDE), perfluorooctane sulfonic acid (PFOS) and lindane (γ-hexachlorohexane or γ-HCH) on the table for assessment. Lindane was nominated by Mexico, PFOS was nominated by Sweden, c-pentaBDE was nominated by Norway, and the other two were nominated by the European Union. The task of the POPRC was to collate and synthesize the scientific evidence against these chemicals and thereby establish cases for their listing under Annexes A, B or C or otherwise to "exonerate" them –as required by the Risk Profile process in the modus operandi. The associated assignment was to work out a Risk Management regime for Parties likely to be affected by the regulation of these chemicals.

At the 2nd meeting of the POPRC (6–10 November 2006), another 5 chemicals, namely, α-hexachlorocyclohexane (or alpha-HCH), β-hexachlorocyclohexane (or beta-HCH), commercial octabromodiphenyl ether (or c-octaBDE), pentachlorobenzene, and short-chained chlorinated paraffins (SCCP) were on the table for assessment. Alpha- and beta-HCH were nominated by Mexico and the other three were nominated by the European Union. The POPRC worked intensively with some Contact Groups meeting late into the night, followed by pre-plenary morning meetings. Several Plenary sessions ran late and had to be conducted in English only.

After the 3rd meeting of the POPRC (19–23 November 2007), the Committee sent recommendations to the Conference of the Parties (COP) to consider listing 9 out of the 10 chemicals mentioned above; the assessment of SCCP was carried over to POPRC4. These 9 chemicals were listed as the new POPs at COP4 (the 4th Meeting of the Conference of the Parties, 4–8 May 2009).

It can be deduced from the foregoing that the POPRC, working at break-neck pace, achieved phenomenal successes, but it was not all plain sailing.

As the first crop of POPRC members, we were essentially the trial-blazers (or guinea pigs, if you like) that tested the validity of the application of the Convention text to the chemicals' review process, and naturally we came up against a number of challenges. Our efforts to address these challenges will hopefully serve posterity in removing the pot-holes from and thereby smoothing out the review process. The following gives a highlight of the early challenges and the solutions proffered:

- Early in the deliberations it become evident that the working definitions of bio-accumulation and bio-magnification needed to be further clarified. The POPRC member from Japan, Professor Masaru Kitano, an expert in this field of research, was given the task of fine-tuning those definitions –which he did satisfactorily.

- The issue of listing isomers also posed its challenge in the assessment of lindane. In the absence of a prescribed general policy on isomers, in the case of lindane (gamma-HCH) the Committee decided to evaluate the other two hexachlorocyclohexane isomers (alpha-HCH and beta-HCH) separately. After discussions at two subsequent meetings, the Committee recommended and the Conference of the Parties agreed on a general approach for considering isomers or groups of isomers. It was noted, however, that the approach had been developed to reflect the specific situation presented by lindane and might not be appropriate in the case of other chemicals. In brief, when considering a substance, the Committee could identify any important isomers with individual commercial uses and, where appropriate, urge any Party to consider proposing the isomer or isomers for listing.

- The next challenging issue was the review of commercial pentaBDE, for which no clear guidelines on commercial mixtures were available in the Convention text. Commercial pentabromodiphenyl ether (c-pentaBDE) contains congeners that include brominated products at the 3 (tri-) to the 9 (nano-) positions; the main component being the tetra- (4) and penta- (5) brominated products. The Committee eventually decided that it is necessary to clarify such a mixture in order to reveal the identity of all constituent chemicals.

- The issue of precursors arose when reviewing PFOS (perfluorooctane sulfonic acid). Since a nominated chemical may be a result of the transformation of another chemical (the precursor) during the production stage or indeed of a naturally-occurring precursor, the Committee decided that such precursors must also be controlled. However, in the case of PFOS which has 96 known precursors, the POPRC recommended to the COP that only perfluorooctane sulfonyl fluoride (PFOSF), which is the parent compound of PFOS related substances, and perfluorooctane sulfonic acid and its salts, be listed as POPs.

- A teething challenge that was quickly apparent was the disparity in effectiveness of participation between POPRC members from the developed countries on the one hand and the developing countries on the other hand. Because of the breath-taking pace of the work of the Committee and the paucity of funds and other logistics to keep members in Geneva for longer than 6 days a year, a large chunk of the work had to be done on-line by individual members belonging to Intersessional Working Groups. This move was predicated on the erroneous assumptions of same levels of internet connectivity, electricity, and other related infrastructure in all member countries.

- The challenges related to the science and technology divide and in particular the digital divide which hampered the effective contribution of committee members from developing countries, especially those from the Africa region, was articulated in a Conference Room Paper by this writer (the POPRC member representing Sierra Leone). This produced a warm and swift response from the Chairman and the Conference Secretariat and resources were mobilized for assistance to such vulnerable Committee members on the Chemicals Information Exchange Network Platform (CIEN) of UNEP Chemicals. Other vistas of intervention included regional capacity-building workshops aimed at improving effectiveness of participation in POPRC and other chemicals management meetings as well as on global monitoring activities. That the sixth Committee meeting and thereafter were successfully conducted as paperless meetings is a plausible testimony of the success of these interventions. An associated intervention was the commissioning and production of a Handbook for Effective Participation by the Intersessional Working Group chaired by the Committee member from Mexico, Mr. Mario Yarto.

- The review of living chemicals (such as short-chain chlorinated paraffins and endosulfan) engendered a level of polemics that almost turned the decision-making stages of the plenary into battle fields, requiring several interventions of UNEP's Legal Adviser for interpretations of the small and/or invisible prints of the Convention text. This occurred in addition to the unannounced cold war between the NGOs and the industry representatives within the observer cadre of the meetings. The frequent introduction of non-empirical modelling evidence to fill in the experimental data gaps on some of these living chemicals added to the suspicion that one axis of Committee members was wagging an economic war on another axis. Even those of us who simply wanted to improve the quality of the scientific discourse by using the same fine-tooth comb to go through the Risk Profile Evaluations as we do our theses became victims of this warfare by being wrongly classified and labelled along the corridors. The review processes were, however, able to progress thanks to the tenacity, resoluteness and diplomatic dexterity of the Chairman and his secretariat and with the help of a critical clause in the Convention text that states that the "lack of full scientific certainty shall not prevent the proposal from proceeding."

The review process was further strengthened by the production (by members participating in Working Groups) of several Guidance Documents aimed at enabling and capacitating Parties to successfully implement the Convention mandate. The following Guidance Documents were produced:

- Guidance on considerations related to alternatives and substitutes for listed persistent organic pollutants and candidate chemicals - 2009 (UNEP/POPS/POPRC.5/10/Add.1);
- Guidance on alternatives to perfluorooctane sulfonic acid and its derivatives - 2011 (UNEP/POPS/POPRC.6/13/Add.3/Rev.1);
- Guidance on feasible flame-retardant alternatives to commercial pentabromodiphenyl ether - 2009 (UNEP/POPS/COP.4/INF24);
- Handbook for effective participation in the work of the POPs Review Committee under the Stockholm Convention - 2009. The associated Pocket Guide (2009) was produced and translated into the six UN languages and recommended for field work in connection with the development of National Implementation Plans for regulated chemicals.

This shows that over the past seven years since its first meeting, the POPRC has been a proactive assessment body that voluntarily took on additional mandates aimed at ensuring the wholesomeness of its operations.

One issue that remains hanging is that of persistence. Since persistence is a function of microbial activity that leads to the decomposition or otherwise of a given chemical, and given that microbial type and population are a function of moisture content, pH and temperature, it is imperative that the criteria for persistence in the Convention text be governed by specified conditions of pH, moisture content, and temperature. Such criteria could be defined by the POPRC members during the next meetings.

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Thomas Yormah at POPRC-5 (November 2009) in Geneva

UNIDO BAT/BEP ACTIVITIES: SUPPORTING WORLDWIDE ELIMINATION OF RELEASES OF UNINTENTIONALLY PRODUCED POPS

By Rami Abdel Malik, Knowledge Management Associate, United Nations Industrial Development Organization

Introduction

The United Nations Industrial Development Organization (UNIDO) focuses its resources and expertise to support developing countries and economies in transition in their efforts to achieve sustainable industrial development.

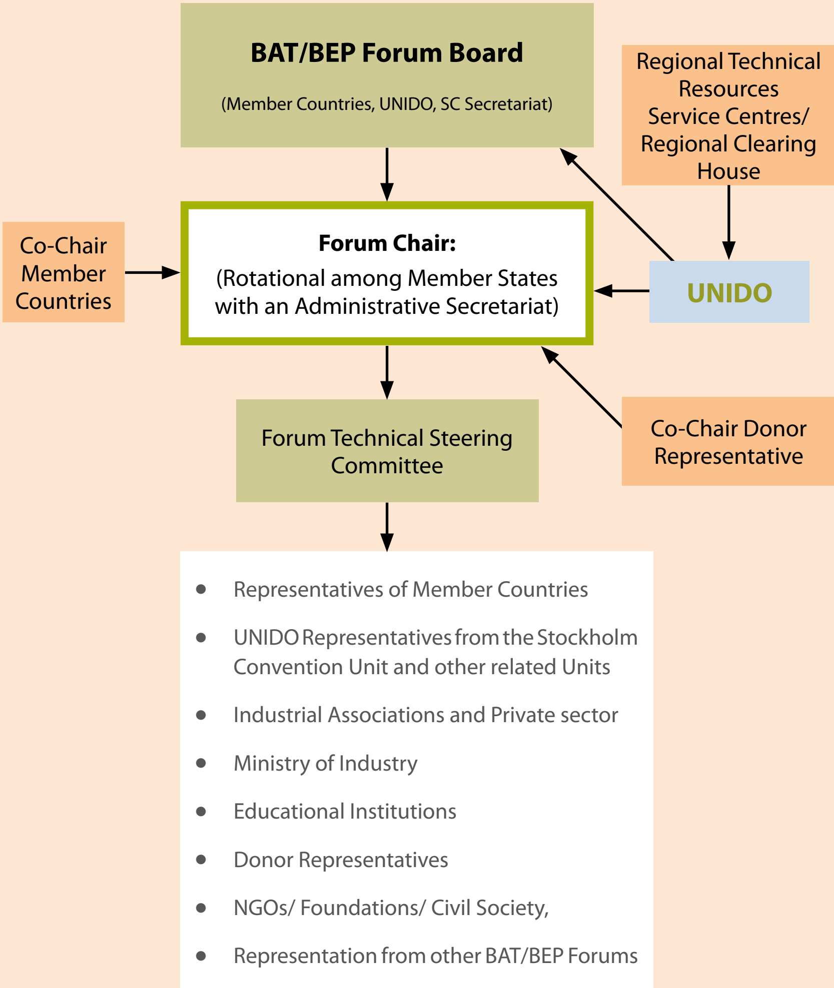
Based on the strategy and action plans outlined in the respective national implementation plans (NIPs) under the Stockholm Convention on Persistent Organic Pollutants (POPs), UNIDO assists these countries in implementing their relevant obligations under the Stockholm Convention. POPs related projects and activities are focused mainly on the following areas: (i) PCB environmental sound management and disposal, (ii) contaminated sites, (iii) pesticides, (iv) BAT/BEP projects and (v) non-combustion technology projects.

Best Available Techniques (BAT) and Best Environmental Practices (BEP) subsume the activities under the Stockholm Convention to reduce and, if feasible, ultimately eliminate the releases of unintentionally produced POPs. This goal will be achieved by implementing a harmonized framework, in co-operation with institutions and experts from developed as well as developing countries, under principles and requirements of the Stockholm Convention.

UNIDO's policy in project development and implementation strives to explore synergies and expand on the opportunities linking the multilateral environmental agreements (MEAs). As a practical example, the BAT/BEP project focusing on unintentionally produced POPs in the fossil fuel-fired utilities and industrial boilers, also explored possible options for the simultaneous reduction of dioxins and CO_2 releases in response to the requirements of both the Stockholm Convention and the Framework Convention on Climate Change.

Global BAT/BEP Forum Activities

UNIDO formally launched its first BAT/BEP Forum in East and South-East Asia (ESEA) in October 2007 during a Ministerial meeting in Bangkok, Thailand, as a means to promote and create an enabling environment for the development, diffusion, deployment and transfer of existing cost-effective and environmentally sound best available techniques and practices to mainly reduce unintentional releases of POPs from thermal processes such as industrial boilers, metallurgical sectors, and waste incineration. The ESEA BAT/BEP Forum member countries are Brunei, Cambodia, China, Indonesia, Lao PDR, Malaysia, Mongolia, Philippines, Singapore, South Korea, Thailand and Vietnam. This forum has developed a project proposal as a regionally concerted effort which culminated with the approved GEF project on the demonstration of BAT and BEP in fossil fuel-fired utilities and industrial boilers in response to the obligations under the Stockholm Convention on POPs.



General BAT/BEP Forum Management Structure

This successful approach has recently been replicated by UNIDO in other parts of the world. The Regional Forum on BAT/BEP in Central and Eastern Europe, Caucasus, and Central Asia (CEECCA) was established in Bucharest, Romania, on 5 November 2009. The member countries of the CEECCA BAT/BEP Forum are Albania, Armenia, Azerbaijan, Bosnia and Herzegovina, Croatia, Czech Republic, FYR of Macedonia, Georgia, Kyrgyzstan, Republic of Moldova, Republic of Serbia, Republic of Slovakia, Romania, Turkey and Ukraine.

The BAT/BEP Forum for Gulf Cooperation Countries (GCC) was launched in October 2010 in Kuwait and includes Bahrain, Kuwait, Oman, Qatar and the UAE as member countries.

A similar forum has been established in Africa (COMESA, ECOWAS and SADC) in September 2011.

Ongoing UNIDO BAT/BEP Projects

Introduction of BAT and BEP methodology to demonstrate reduction or elimination of unintentionally produced POPs releases from the industry in Vietnam

UNIDO helps Vietnam to apply BAT/BEP measures and complete dioxin release reduction demonstrations in selected priority sectors by 2010. The sector-wide introduction of BAT/BEP is planned to be completed by 2020. The benefits for Vietnam include enhanced efficiency in reducing, avoiding and eliminating POPs releases by cleaner production activities in the industry. The review and possible improvement of national policies and regulations is furthermore strengthened to enhance national capability for adequate monitoring of POP chemicals. The project budget amounts to USD 2.4 million over two years.

Demonstration of BAT and BEP in fossil fuel-fired utility in East and Southeast Asia (Cambodia, Lao PDR, Mongolia, Philippines, Thailand)

The regional UNIDO project aims at establishing baseline inventories for unintentional POPs in fossil fuel-fired utilities and industrial boilers, pilot demonstrations, public-private partnerships and implementation of policies and regulations. The project budget amounts to USD 4 million over four years.

Promotion of strategies to reduce unintentional production of POPs in the Red Sea and Gulf of Aden (PERSGA) coastal zone

Close cooperation on a regional level has been achieved to collectively implement BAT/ BEP measures through UNIDO assistance that enables the introduction of BAT/BEP strategies for coastal zone industries of the PERSGA region. The objective of the project is to reduce and/or eliminate the unintentional production of POPs in key sectors of industry (cement, incineration, metallurgy and pulp and paper). By achieving this goal, the project will permit countries to attain compliance with their obligations to Article 5 of the Stockholm Convention. The project includes measures to ensure public participation, targeted capacity-building, impact on human health and monitoring of socio-economic implications. The project budget amounts to USD 3 million over two years.

Environmentally Sustainable Management (ESM) of medical wastes in China

This project is determined to carry out BAT/BEP measures for the environmentally sound management of medical waste to reduce unintentional POPs releases. The UNIDO project is upgrading the incineration equipment and air pollution control system to the BAT level and replacing outdated incineration facilities with alternative, non-incineration techniques.

More than 20 medical institutions are supported by UNIDO to perform good procurement practices, waste segregation at source, waste reduction/minimization, reuse and recycling, intermediate storage, transportation, traceability and staff training. Dedicated disposal facilities keep the incineration and pyrolysis processes and unintentional POPs releases under optimal control to meet performance levels associated with BAT, while diverting a significant portion of medical waste to alternative processes such as autoclaving, microwaving, and chemical disinfections that prevent releases of unintentional POPs. The project budget amounts to a total of USD 44.7 million over five years.

UNIDO shall continuously develop projects and embark on industry-related chemicals management addressing the need through initiatives aimed at the transfer of innovative treatment processes and safe disposal technologies. In particular, UNIDO will continue to strengthen regional cooperation on POPs related issues through the establishment and promotion of BAT/BEP fora and will stay at the forefront of executing BAT/BEP projects. The support of the Global Environment Facility (GEF) and other donors, as well as of the Stockholm Convention Secretariat to these activities is crucial to their success. UNIDO values very effectively the GEF funding strategy and the programmatic approach model.

IDENTIFYING THE RESEARCH AND INFRASTRUCTURE NEEDS FOR THE GLOBAL ASSESSMENT OF HAZARDOUS CHEMICALS - A MESSAGE FROM THE LEADING SCIENTISTS

By Dr. Jana Klánová, RECETOX, Stockholm Convention Regional Centre for capacity-building and transfer of technology in Central and Eastern Europe, Brno, Czech Republic

And Dr. Kateřina Šebková, Ministry of the Environment, Czech Republic

Global efforts dealing with chemicals with an integrated and life-cycle approach have roots in Agenda 21 of the 1992 United Nations Conference on Environment and Development. It is recognized that the "sound management of chemicals is essential if we are to achieve sustainable development including the eradication of poverty and disease, the improvement of human health and the environment and the elevation and maintenance of the standard of living in countries at all levels of development". The Stockholm Convention on Persistent Organic Pollutants is a powerful instrument, however, more needs to be done in order to protect human health and the environment from hazardous chemicals.

The 10th anniversary of the adoption of the Stockholm Convention is a great occasion to reflect on achievements as well as on the challenges ahead of the Stockholm Convention. The world's leading chemicals experts participated in a workshop organized by the Stockholm Convention Regional Centre for capacity-building and transfer of technology in Central and Eastern Europe (RECETOX) in Brno, Czech Republic from 22-24 May 2011, with the aim to assess progress as well as to identify gaps, challenges and research needs associated with the global assessment of hazardous chemicals.

A declaration focusing on ten priority areas was prepared, bearing in mind the potential to maximize the benefits of the current scientific experience by transforming it into policy actions in support of reaching the implementation targets of both the Stockholm Convention and sustainable development, as follows:

Integrated measurement and modelling strategies are required to build a scientific platform to allow policy makers to assess and then undertake **cost-effective strategies** for reducing the risk for human health and the environment in the future. While the production and use of many hazardous chemicals has been banned or restricted, ongoing commitments to future source and exposure reductions are constrained by many uncertainties.

Recent evidence indicates that stockpiles, deposited wastes, and poorly controlled "recycling" of disposed products are an ongoing source of some POPs to the environment and they could become increasingly important for local and national exposure assessments. As many countries currently lack the capacity to control **sources of POPs**, it is important to ensure that compliance is not achieved by relocating banned POPs from developed countries to countries lacking capacity to manage these.

Understanding **how POPs spread** through the environment requires linking source control to knowledge on chemical and physical processes, chemical fate and transport models, and monitoring data.

Compound degradation, formation of metabolites and partial breakdown products all influence the **persistence** and hence the long-term concentrations of chemicals. Improved understanding of these processes can be achieved by linking laboratory-scale experiments with mass balance models.

Advances in **sampling and analysis** should be utilized to increase the spatial and temporal resolution of POPs concentrations and flux measurements in core media. A range of new or improved tools and techniques are needed to strengthen our ability to characterize primary and secondary emission sources of the chemicals of global concern and their fate in the environment.

The Global Monitoring Plan (GMP), a key element to the Effectiveness Evaluation of the Stockholm Convention under Article 16, is meant to be an integral part of current efforts to improve the effective management

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Workshop participants at RECETOX in Brno, Czech Republic of hazardous chemicals. While the GMP critically depends on reliable temporal trend data, the network reporting data for the GMP is currently an unsustainable, short-term 'proof of concept' project. It is envisaged that the established core international network of contributors be strengthened and further capacitated to enable the synergistic use of international joint research infrastructure together with partners from developing countries.

Development of **publicly available databases** is needed to enhance visibility of the GMP and to facilitate improved interpretation, spatial visualization, and modelling of available monitoring data. To improve the flow of relevant data to the environmental and health communities, the GMP has to be linked to available synergic instruments, especially to the **Global Earth Observation System of Systems**.

Adverse effects of pollutants on human and ecological health are particularly apparent in sensitive environments, such as the Polar Regions. Whereas the Stockholm Convention has achieved success with a chemical-by-chemical approach in the past, new approaches to minimize harm from hazardous chemicals are needed in addition to chemical screening and risk management. Chemical alternatives assessment, supported by green chemistry and preventive engineering approaches, should be promoted as a means towards ensuring the sustainable management of chemicals as the Stockholm Convention moves into the future.

To ensure the effectiveness of the Stockholm Convention and related conventions at local and global scales, knowledge and the technical ability to participate fully and meaningfully in the conventions are critical, and yet lacking in many countries. Fulfilling this need requires global collaboration between those whose capacity needs development and those who are able to assist with **capacity-building**. Such a network should address specific and urgent problems of developing countries and countries with economies in transition in the area of chemical and waste management.

The efficient environmental management requires comprehensive information on the key factors affecting the environment: data on occurrence, fate, persistence and long-range transport of various chemicals, their accumulation in biota and food chains as well as on mechanisms of their toxicity, and related ecological and human health risks. Only such complex information can provide sufficient support for decision-making and development of strategies related to the protection of the natural environment and human health. Therefore the **Stockholm Convention** on Persistent Organic Pollutants **has to be closely linked to the state-of-art science and technology** at every stage of its implementation.

The workshop was a good example of the successful engagement of the scientific community into the process of implementing the international conventions on hazardous chemicals. It triggered a fruitful dialog between 40 invited scientists from 16 countries of three UN regions and the representatives of the Stockholm Convention Secretariat, UNEP, governments and consulting companies. The conclusions that were reached and ten priorities that were identified are relevant not only for the Stockholm Convention itself, but also for other institutions dealing with chemical management and promoting capacity-building. We are convinced that the areas identified in the declaration represent pressing societal needs that should be reflected in newly developed research strategies, funding schemes and capacity-building projects for both short and long term in order to maximize benefits and improve the sound management of toxic chemicals, thereby strengthening the path towards sustainable development.

The full text of the workshop declaration, including all co-authors, can be found at www.recetox.muni.cz. It has been also published as a Viewpoint article in Environmental Science & Technology[2].

[2] Environmental Science & Technology, 2011, 45: 7617-7619.

THE ROLE OF THE STOCKHOLM CONVENTION IN INCREASED SCIENTIFIC AND POLITICAL ENGAGEMENT IN AFRICA TO PROTECT HUMAN HEALTH AND THE ENVIRONMENT FROM POPS

By Vincent Madadi, Department of Chemistry, University of Nairobi, Nairobi, Kenya

Introduction

Africa has least contributed to the production of POPs but has been worst affected by the impacts of these chemicals. Although most POPs have been produced outside the continent, POP pesticides have been widely used locally in agriculture and public health sectors, whereas industrial chemicals like PCBs have been applied in electrical power generation and distribution lines. Some POPs like dioxins and furans have been generated due to uncontrolled combustion of biomass and wastes and some industrial processes. In addition, many incineration systems do not meet the required high temperatures and therefore continue to emit unintentional POPs.

© EMPA

Uncontrolled burning of waste

Problem statement

Although massive efforts are being made to eliminate POPs from the global environment, many African countries continue to suffer from the negative effects of POPs. This is mainly due to low awareness about POPs among the general public and the governance systems. Environmental laws and regulations are also weak and in many cases only address basic chemicals pollution. There are limited research activities on POPs, but no long-term data to measure the trends and transport of these compounds in the region. Human and technical capacity to address POPs is limited; until 2008, POPs monitoring and collaborative data production activities were scanty. The efforts of the civil societies to create awareness about the negative effects of POPs are hampered by limited data. In addition, the contribution of the region to the Global Monitoring Plan (GMP) under effectiveness evaluation of the Stockholm Convention is limited, due to lack of comparability in the few available data sets.

Implementation approach

In 2007, the Stockholm Convention established an efficient strategy to implement the Global Monitoring Plan in Africa. It established regional organization groups (ROGs) to support laying the ground for implementing the POPs monitoring programme, collect existing POPs data and assess the existing capacities and capacity-building needs. The Africa region has six ROG members who support the implementation of the GMP in six sub-regions within the continent.

In 2008, a pilot project was launched to collect ambient air data from 15 countries in the continent, through collaboration between the Stockholm Convention and the Research Centre for Toxic Compounds in the Environment (RECETOX) from the Czech Republic. The programme (MONET Africa) uses polyurethane foam filters to collect POPs chemicals in air. The picture below shows one of the passive air sampling sites in the region. Concurrently human milk collection activities were initiated through the collaboration of UNEP and WHO.

Human capacity training activities were initiated in 2007, involving the participation of the local personnel in a summer school training at RECETOX in the Czech Republic. For the last five years, the Secretariat has supported the participation of 20 local personnel in the annual summer schools. In the meantime, data on existing laboratories and technical equipment is registered at the UNEP Chemical databank of laboratories analyzing persistent organic pollutants: http://212.203.125.2/databank/Home/Welcome.aspx

Important elements of capacity-building are the two GEF medium-sized projects "Supporting the Implementation of the Global Monitoring Plan of POPs" implemented with UNEP Chemicals in Eastern and Southern African countries, as well as in Western African countries.

The Secretariat organizes workshops for the Global Coordination Committee (GCC) to discuss and develop strategies for addressing POPs in the regions. These decisions are implemented at regional levels by the ROG members.

The ROG members have been trained to use the Chemical Information Exchange Network (CIEN) to strengthen coordination and information exchange in the region. The platform is also used for storage of the regional GMP data.

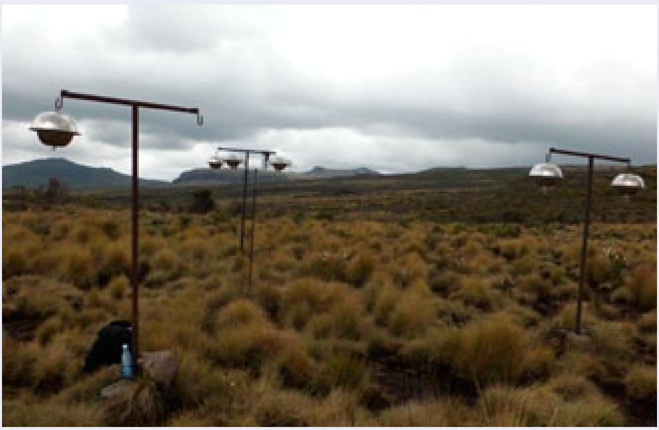
Outcomes and impacts

The GMP programme has increased the human and technical expertise to handle POPs analysis in the continent. The local scientists have been trained and are now able to perform complete analyses of basic POPs in the core media. This will enable the countries to report their POPs data to the Conference of the Parties under effectiveness evaluation.

The First Regional Monitoring Report on POPs in the African continent was published in February 2009. It shows baseline data of POPs in ambient air, human milk and other media. The report can be downloaded from the UNEP GMP website at: http://chm.pops.int/Implementation/GlobalMonitoringPlan/MonitoringReports/

The two one-year regional medium-size projects largely contributed to capacity enhancement of the existing laboratories in the region. The local personnel got opportunities to attend hands-on training activities at the backup laboratories at the Institute for Environmental Studies - Amsterdam, Netherlands, and Man-Technology-Environment - Sweden.

The activities of the Secretariat of the Stockholm Convention and UNEP Chemicals ensured improved Quality Assurance & Quality Control in local analytical laboratories through participation in trainings and international inter-laboratory proficiency testing.



Passive air sampling

Increased collaboration and data sharing has been achieved among the local scientists and the government agencies. CIEN activities have enhanced communication and data sharing through e-conferences and ROG platform, accessible at: http://www.estis.net/sites/rog/

Lessons learned

Elimination of POPs in the region can be achieved through collaborative activities involving local scientists, government agencies and international partners. The local scientists can play a significant role in supporting POPs monitoring activities in the region through data collection, analysis and interpretation. With proper coordination, networking, training and targeted capacity-building, the African countries will be able to produce comparable data suitable for the effectiveness evaluation. In addition, strengthening CIEN activities in the region will increase data sharing at national and regional levels. Long-term capacity-building activities will be required to get the regional laboratories and scientists to sustainably produce comparable POPs monitoring data.

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ROG members and other participants at a regional report drafting workshop

PIONEER ADVOCACY WORK ON PESTICIDES STOCKPILES IN RUSSIA

By Olga Speranskaya, IPEN Co-Chair

Introduction

When the Stockholm Convention on Persistent Organic Pollutants (POPs) came into force, it marked a new milestone of successful collaboration between stakeholders to address POPs contamination of the environment, food and human bodies. This serious problem, which had previously been hidden, misunderstood or ignored, became well recognized in the region. Many Eastern Europe, Caucasus and Central Asia (EECCA) civil society groups were inspired by the work of IPEN and started an unprecedented level of advocacy work on POPs, with a priority focus on stockpiles of banned and obsolete pesticides and pesticides that are POPs. Different citizens' groups began operating in countries, regions and cities of the EECCA in order to influence the development of governmental policies on POPs waste management, including stockpiles of banned and obsolete pesticides, and to strengthen public-private partnerships on issues within the environmental agenda.

Problem statement

Obsolete pesticide storage sites and illegal dumps are a tremendous problem in the EECCA region. As years passed and recognition of the extent of the problem grew, it became obvious that without the involvement of environmental and health non-governmental organizations (NGOs) it would be difficult or even impossible to obtain complete data on the storage sites and illegal dumps.

How the issues were addressed

In order to facilitate active participation of EECCA NGOs involved in national pesticide inventories, the Russian NGO Eco-Accord, working as the International POPs Elimination Network (IPEN) Hub in the EECCA, developed "Methodological Recommendations for Non-governmental Organizations on Inventories of Banned and Obsolete Pesticides". The Recommendations represented the first national and regional document of its kind, and not only described the problem of accumulation of stockpiles of obsolete pesticides, but also provided specific recommendations to members of the general public on how to participate in identifying unauthorised storage and dumps of banned and obsolete pesticides.

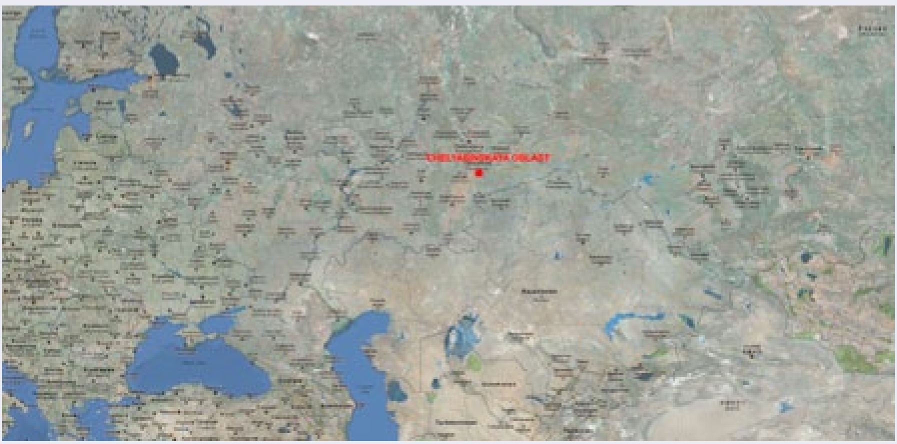
The Recommendations are intended to inform members of the general public on where to look for: storage of obsolete, banned and unusable pesticides; assessment of the quality of storage facilities; primary inventories of pesticide stockpiles in local areas; data formats for submission of the information collected and official bodies that should be approached on these matters.

The Recommendations were presented at a seminar that was held in Chelyabinsk in January 2004. The seminar was organised by Eco-Accord, jointly with the local NGO Women Network in the Urals. It began a pioneer story of advocacy work on pesticide stockpiles in Russia.

Chelyabinsk Region was selected for the seminar for a specific reason. It is among the leading regions of the Russian Federation in terms of generation and accumulation of toxic waste (including waste containing POPs). In 2004, in the course of official pesticide inventories in Chelyabinsk Region, 182,430 tons of banned and obsolete pesticides were found in the sub-stores of 70 agricultural facilities and base storage facilities in 17 administrative districts of the region.

Following the official inventory work, 3,830 tons of additional banned and obsolete pesticides were identified by NGO groups led by Women Network in the Urals in one of the region's areas. In total 67,846 tons of obsolete pesticides were additionally identified between 2003 and 2005. Using the Methodological Recommendations as their basic toolkit, NGO groups reviewed the quality of pesticide storages, and identified owners of land where storage facilities were located. They also identified derelict storage facilities located within water protection zones and close to residential areas. The results of primary inventory works by NGOs included 24 dilapidated facilities and 10 badly damaged ones; 7 dilapidated storage facilities were located within water protection zones. The pesticide storage facilities were mapped, and the map contained such information as their locations, amounts of pesticides stored and their technical quality.

A memo that described the conditions of pesticide storage facilities in Chelyabinsk Region was sent to the government of the Russian Federation. The memo contained a detailed map of these storages,



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Chelyabinskaya Oblast in Russia

as well as recommendations on how to address pesticide storage and management. The recommendations of the project team were incorporated into Chelyabinsk's regional development programme for 2006-2010.

A year later, NGOs in Chelyabinsk Region started a detailed analysis of the conditions of storage facilities located in different villages as the follow-up to the previous project. Field visits were organised for a selection of sites to be surveyed. In the course of the selection process, members of the survey team accounted for locations of pesticide storage, potential areas of contaminated land, presence of residential and other buildings within potentially contaminated areas, proximity to water bodies and individual water wells, etc. Sites for the survey were mapped and samples of environmental media were taken selectively in key places to analyse the level of POPs contamination of the water and soil.

Particularly high pesticide levels were found in samples taken at and near the sites of destroyed pesticide storage facilities. High levels of DDT and its metabolites (0.62 mg/kg) were found in the average samples, taken at a distance of 10 m from the site of the former pesticide storage in Brodokalmak village in Chelyabinsk Region at depths of 15 to 30 cm. HCCH (0.03 mg/kg) was found in soil samples taken at a distance of 30 m from the site of the former pesticide storage at depths of 15-30 cm (0.03 mg/kg) and at depths of 10-15 cm (0.0062 mg/kg). In addition, HCCH was found in soil samples at a distance of 200 m from the site, taken from the potato field of an individual farmer (0.014 mg/kg). These results suggested migration of pesticides with rainwater and meltwater and their infiltration to soil depths over 30 cm.

Based on the study results, NGOs highlighted that the methodology should be introduced to assess pesticide heath risks to local residents. Application of the methodology would help document the health status of local residents and identify routes of human intake of hazardous chemicals. In other words, the methodology would allow the design of more adequate environmental improvement plans for territories where problems concerning the safety of local residents had not been addressed for 20 years and where storage facilities containing banned and obsolete pesticides are located.

After submission of the analytical results, NGOs developed recommendations for Chelyabinsk regional executive bodies on land reclamation and rehabilitation of contaminated sites, as well as recommendations for local communities on how to monitor the implementation of the recommendations. NGO groups focused on the need to conduct research studies for identification of routes of human pesticide intake through food chains in areas where damaged and abandoned pesticide storage sites are located. Results of the research might be used to continue working on identification of priority territories for implementation of actions for repackaging and removal of pesticides for safe storage in order to ensure the environmental well-being of local residents.

Conclusion

This pioneer project on addressing obsolete pesticide stockpiles in Russia demonstrates the ability of NGOs to play crucial roles by providing data, knowledge and recommendations to other stakeholders, including governmental executive bodies working on chemical safety. Very often NGOs help to raise important issues that otherwise would not be considered. The project implemented in Chelyabinsk region started a series of similar NGO activities in different parts of Russia and in the majority of EECCA countries. Additionally, in many places NGOs empower other stakeholders to join efforts in addressing POPs contamination.

MODEL OF INDUSTRY-UNIVERSITY-RESEARCH COOPERATION: THE DIOXINS ANALYSIS LAB OF TSINGHUA UNIVERSITY

By Changmin Wu, Nana Zhao, Jun Huang and Jinhui Li, Stockholm Convention Regional Centre for Capacity-building and the Transfer of Technology in Asia and the Pacific, Tsinghua University, Beijing, China

Abstract: Located in the School of Environment (SOE), the Dioxins Analysis Lab of Tsinghua University (THU) is serving as a supporting unit for the Stockholm Convention Regional Centre for Capacity-building and the Transfer of Technology in Asia and the Pacific/Basel Convention Coordinating Centre for Asia and the Pacific (BCRC China).

As an advanced academic research institute with first-class hardware facilities and standardized management systems, the Dioxins Analysis Lab is also a model of industry-university-research cooperation, which has made brilliant achievements in POPs, especially dioxins analysis. The lab, with its CMA certificate licensed by CNAS in 2009, is qualified as a third party providing dioxins monitoring and analysis service to customers both in Tsinghua University and in the public society.

Keywords: POPs analysis; industry-university-research cooperation; Stockholm Convention implementation

Introduction

POPs monitoring capacity (especially for complicated substances like dioxins) is the premise to understanding the current status of both POPs releases from sources and POPs contamination in various environmental media, which is very important for the Parties to implement the Stockholm Convention. In 2004, the Dioxins Analysis Lab was established at SOE/THU, with the funding of the Japanese NEDO (New Energy and Industrial Technology Development Organization) and technical support of IDEA Consultants, Inc. (former Metocean Inc.). The Agilent 6890N high resolution gas chromatograph (HRGC) coupled with JEOL JMS-800D high resolution mass spectrometer (HRMS) system, which is the latest model of JEOL specifically optimized in design for the purpose of dioxins analysis, was installed. In the design and construction of the lab, we have adopted many experiences from sound international practices, especially in Japan, such as negative pressure environment, all new air without circulation, independent power supply, which enable a safe and feasible environment for dioxin analysis.

The Dioxin Lab room is more than 250m^2 in size, consisting of a preparation room, two sample pre-treatment rooms, an instrument room as well as several other assisting units. The lab is also serving as a supporting unit for the Stockholm Convention Regional Centre for Capacity-building and the Transfer of Technology in Asia and the Pacific/Basel Convention Coordinating Centre for Asia and the Pacific (BCRC China).

Problem statement

Due to the structural complexity and in many cases extremely low concentrations of dioxins as environmental contaminants, the dioxins analysis is recognized as one of the most challenging tasks in terms of environmental monitoring. To ensure the reliable performance of dioxins analysis, the following factors are essential: advanced instruments, proven methodology, professional and relatively stable technician team, and a strict quality assurance and control (QA/QC) system. As the main function of a university lab is to support teaching and research, the amount of samples are quite small but the maintaining cost is rather high. Under the current management system in China, it is nearly impossible for the laboratory to hire and maintain staff, making its effective running and therefore contribution to the Stockholm Convention's implementation in China all the more challenging. After several months of discussions, a partnership between the university, industry and research was established, which successfully solved the issue.

Implementation of the approach

In 2008, SOE/THU signed an agreement with IDEA consultants as a strategic partner to jointly operate and manage the Dioxins Analysis Lab. IDEA provides systematic trainings, including the in-lab operational skills training and theory courses in China, internships of the laboratory's staff in Japan, and appointing a Japanese expert to join the laboratory.

Outcomes and impacts

In 2009, the Dioxin Lab participated in the 'First Worldwide UNEP Intercalibration Study on POPs – Asia Region' involving more than 30 laboratories, and got a good performance. Now the Lab has become one of the leading dioxins laboratories active in China. With its CMA (China Metrology Accreditation) certificate licensed by CNCA (Certification and

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Controller of the integrated air conditioner system (2009)

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Sample preparation facilities (2009)

Accreditation Administration of the People's Republic of China), it can provide services not only to customers within the university but also to other stakeholders involved in the implementation of the Stockholm Convention in China. Annually more than 600 samples are analyzed, including flue gas, fly ash, sediment, soil and commercial chemicals. The generated data provide the university and other customers outside the campus with a solid foundation to obtain scientific understanding and guide the selection of engineering measures for POPs control.

Lessons learned

From our experience of the Lab's operation, purchasing good hardware is not enough to build capacity-building for Parties to implement the Stockholm Convention. In particular, how to use the facility effectively and efficiently constitutes a big challenge. Partnerships between industry, university and research such as the one presented here might thus provide referable experiences to solve the dilemmas that often arise during the building of analysis capacity.

HAZARDOUS CHEMICALS MANAGEMENT: A STRATEGIC COOPERATION BETWEEN SINTEF AND AIT

By Dr. Kåre Helge Karstensen, Chief Scientist, Foundation for Industrial and Scientific Research, Norway

Introduction

The Global Environment Outlook of 2008 addresses increased waste generation as one of the biggest environmental challenges in Asia. Indeed, most Asian countries have weak knowledge and awareness about this issue, dispersed institutional responsibility and capacity, inadequate legislative and regulatory frameworks, and weak enforcement procedures when it comes to waste management.

Problem statement

As a result, Asian countries face some of the largest challenges regarding POPs management. For example, China has the world's biggest emissions of dioxins, while the southern and central parts of Vietnam have the highest dioxin-contaminated areas in the world. The spreading of semi-volatile chemicals such as POPs is further enhanced by global warming: rising temperatures will also make target organisms more vulnerable and worsen the negative impacts. Currently, according to the National Population and Family Planning Commission (NPFPC) of China, every 30 seconds a baby is born with physical defects due to chemical waste pollution. Professor Pan Jianping at the Women and Child Health Research Office in Xi'an Jiaotong University has warned that the increasing rate of birth defects among Chinese infants would soon become a social problem, which "will influence economic development and the quality of life".

How the issue was addressed

The School of Environment, Resources and Development of the Asian Institute of Technology (AIT) gives comprehensive courses in the field of Environmental Engineering and Environment. The Foundation for Industrial and Scientific Research (SINTEF) is one of Scandinavia's largest independent research institutions and has wide experience in solving practical hazardous waste related problems in several Asian countries.

Both AIT and SINTEF possess unique competences and experience with "immediately" available and affordable technologies which can significantly reduce the burden of hazardous chemicals in Asia, e.g. clean-up of contaminated soil by a combination of bio- and phytoremediation, or by using existing industrial facilities, e.g. cement kilns.

AIT for example has shown that phytoremediation, which exploits the ability of some plant species to remove, extract and/or mineralize contaminants and xenobiotics, can successfully remove and/or detoxify several contaminants in the soil. Local and fast-growing plant species with deep fibrous roots, such as grasses, are particularly useful.

As for waste treatment in cement kilns, this allows for the complete recovery of energy and valuable raw material components in the wastes, thereby reducing the need for non-renewable fossil fuel and virgin raw materials and contributing to overall reduced CO2 and other greenhouse gas emissions compared to land filling, building a new incinerator or exporting the waste for treatment in another country.

A course on the "State-of-the-art of hazardous chemicals management" was developed jointly between AIT and SINTEF and has been given regularly since 2007. It provides updated and comprehensive training on hazardous chemicals management ranging throughout the whole life-cycle (from the generation of hazardous chemicals and their impact to the operation and performance verification of treatment facilities via the policy aspects). Practical examples are provided from Asian countries.

Implementation

The on-going cooperation between AIT and SINTEF on hazardous chemicals management started in October 2006. As part of this strategic cooperation, regular courses, regional seminars and technical cooperation activities were carried out in South-East Asia.

AIT courses

One of the normal course assignments for the students has been to elaborate how to avoid or minimise dioxin emissions from waste treatment plants and industry in practice. Field trips have been mandatory for the students and entailed visits to contaminated areas, hazardous waste incinerators, cement kilns co-processing wastes, etc.

A complete course description can be found on AIT's webpage: http://www.serd.ait.ac.th/karstensen

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Field trip to storage site for transformers containing PCBs in Thailand

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Field trip to hazardous waste incinerator in Bangkok, Thailand

Regional seminars

In addition to the AIT regular courses, several regional workshops on hazardous chemicals management for Asian countries were organised, in addition to other technical cooperation in the region.

Technical cooperation activities

Finally, the project has also established a platform for collaboration between the environmental authorities of Thailand and Vietnam and various industries. In this framework, a test burn with PCB was conducted in Ho Chi Minh City and another in South Vietnam.

Lessons learned / conclusion

The cooperation between AIT and SINTEF has been successful in transferring knowledge and building capacity through the regular course and regional seminars, and by carrying out applied research and technical cooperation in South-East Asian countries.

In particular, the course on hazardous chemicals management, based on real-life and practice problem-solving, will enable many master and doctoral students graduated at AIT to go to strategic positions in governmental institutions and industry in Asian countries and be future ambassadors for the importance of sound and safe hazardous chemicals management.

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Regional workshop on Hazardous Chemicals Management for Asian countries, arranged at AIT, Thailand in December 2007

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Regional workshop on Hazardous Chemicals Management for Asian countries, arranged in Ho Chi Minh City, Vietnam, in December 2008

STOCKHOLM CONVENTION ON PERSISTENT ORGANIC POLLUTANTS: A TRIGGER FOR ACCELERATED SCIENTIFIC AWARENESS AND STAKEHOLDER PARTICIPATION IN SOUND CHEMICALS MANAGEMENT IN GHANA

By Sam Adu-Kumi, Deputy Director, Pesticides, Chemicals Control and Management Centre, Environmental Protection Agency of Ghana

Introduction

The use of chemicals permeates modern life and plays an important role in sustainable development. However, in the absence of best management practices, such uses pose significant risks to human health and the environment. Human health and environmental effects could result from immediate or acute and long-term or chronic exposures (UNDP, 2006: Managing Chemicals for Sustainable Development).

Ghana is a net importer of chemicals: all sorts of chemical substances are imported and used for several purposes, including in agriculture, industry and in households. A life-cycle approach to the sound management of chemicals has long been recognised and steps have been taken since the late 1980s to regulate the use of chemicals in Ghana. This effort culminated in the promulgation of Part II of the Environmental Protection Act, 1994 (Act 490) on Pesticides Control and Management. Relevant stakeholders for the sound management of chemicals in Ghana include government ministries, departments and agencies, industry associations, research and academia, non-governmental organizations and community-based organizations. In 1996/1997 national efforts towards a sound management of chemicals were greatly enhanced when a national profile for chemicals management and a national action programme for integrated chemicals management were implemented. These projects were supported by the Inter-organization Programme for the Sound Management of Chemicals (IOMC) and led by the United Nations Institute for Training and Research (UNITAR).

Despite the giant strides taken at the national level, serious gaps existed in the process of establishing a sound chemicals management system in Ghana. These included: (1) the non-existence of a national programme to monitor POPs in the environment, food, biota and humans; and (2) the general lack of knowledge and information on the potential hazards and risks of POPs for human health and the environment.

With the entry into force of the Stockholm Convention on POPs on 17th May 2004, there has been an accelerated scientific awareness and stakeholder participation in the sound management of chemicals in general, and of POPs in particular, in Ghana. This paper provides a brief overview of the national chemicals management before and after the advent of the Stockholm Convention. Ghana ratified the Stockholm Convention on 30th May 2003.

Problem statement

A preliminary inventory on POPs was carried out in 2003 and indicated, among other issues, that: (1) there were no specific programmes to monitor the presence of POPs in the environment and biota and to assess their possible impacts on human health; and (2) best practices for the management of POPs were very often not followed due to the general lack of knowledge and information on the potential hazards and risks of POPs for human health and the environment.

This situation was mainly due to inadequate personnel and laboratory infrastructure to analyze POPs. There was an urgent need to sensitise and educate the general population, especially end-users, on the sound management of chemicals in general, and of POPs in particular. Available information showed that workers in some facilities have been exposed to polychlorinated biphenyls (PCBs) as a result of inadequate practices, such as using empty transformer oil drums as water reservoirs. PCB-contaminated oil (referred to as 'dirty oil') was thought to be used by small-scale industries for a variety of purposes (including formulation of body creams which were sold on the open markets; wielding etc.). These practices had the potential to increase exposure of the general population and aggravate subsequent health effects.

How the issue was addressed

A multi-stakeholder committee, comprising relevant chemical-related institutions, was put in place. Task teams were constituted to carry out specific assignments geared towards the sound management of POPs in Ghana. A preliminary inventory and needs assessment were carried out in 2003 to identify academic and research institutions in Ghana with the potential to monitor and assess the impacts of POPs on the general population. The overall objective was to assist identified institutions and enable them to undertake local research as well as contribute to the ongoing Global Monitoring Plan for POPs (Article 16 of the Stockholm Convention). A public awareness, education and communication campaign strategy was designed. The strategy identified government and non-governmental organizations as strategic partners. When well-executed, this strategy would effectively minimize potential adverse impacts of chemicals in general and of POPs in particular on human health and the environment. Focused training programmes were planned for identified groups who handle POPs and other chemicals.

Implementation of the approach

Several employees of a number of research institutions and academia have been trained to monitor and analyze POPs. These institutions include: the Environmental Protection Agency, Ghana Atomic Energy Commission, Food and Drugs Board, Ghana Standards Board, Water Research Institute, Food Research Institute, Cocoa Research Institute of Ghana, University of Ghana, University of Cape Coast, and the Kwame Nkrumah University of Science and Technology. Technicians of the Electricity Company of Ghana, the Volta River Authority, and major mining companies, have been trained on the safe handling of oils contained in transformers and capacitors. Awareness-raising and sensitisation workshops have been organised for decision-makers, NGOs and the general public on the issue of POPs and their effects on human health and the environment. These were made possible through a Global Environment Facility (GEF) project executed through UNEP, UNIDO, UNITAR and UNDP. Funds were complemented with in-kind contributions from the Government of Ghana.

Outcomes/impacts

Baseline information and data on POPs in ambient air, biota, soils, water, sediments and human breast milk have been generated and published in several peer-reviewed scientific publications. A comprehensive inventory of all transformers and capacitors has been carried out throughout the country. A number of environmental science programmes in universities are also currently running courses on POPs, such as the MPhil and Doctoral programme in Nuclear and Environmental Protection offered by the Graduate School of Nuclear and Allied Sciences of the University of Ghana (Atomic Campus).

Lessons learned / conclusion

Research carried out at the national level, which was primarily focused on heavy metal analysis and other inorganic compounds, has been broadened to include organic micro-pollutants. National stakeholders have become increasingly aware of the damaging effects of chemicals, particularly POPs, on human health and the environment. Many

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A local expert leading a group discussion

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International experts stressing a point during a plenary discussion stakeholders publicly confessed that before these awareness, education and training programmes, they had never heard of POPs such as PCBs. In conclusion, although there still are many challenges confronting a sound management of chemicals in Ghana, giant strides have been made since the entry into force of the Stockholm Convention on POPs. Strategies adopted in Ghana could be successfully replicated in other developing countries.

HIGH AMOUNTS OF POPS IN MINERAL MATERIAL DUMPED INTO THE EBRO RIVER, SPAIN

By Joan O. Grimalt, Institute of Environmental Assessment and Water Research (IDAEA), Spanish Council for Scientific Research (CSIC), Barcelona, Spain

A study published in 2004 by the Spanish Council for Scientific Research (CSIC) and the Autonomous University of Barcelona (UAB) showed the presence of about 350,000-500,000 tons of residues from a chlor-alkali factory in the Flix reservoir of the Ebro River. This reservoir does not have the capacity for water storage. It was constructed to act as a weir for deviation of the river water to a hydraulic power plant. Most of the residues were accumulated under the river water while a small portion was emerging above. The accumulated waste was essentially generated between 1972-1990, when the synthesis of dicalcium phosphate from phosphorite produced large amounts of mining residues, which were dumped into the river.

The retention of the river flow by the wall of the reservoir helped consolidate the dumped material around the point of discharge. These wastes had a great consistency and resistance to water erosion. In addition, they retained hydrophobic pollutants such as POPs. Some of these compounds were synthesized in the factory for commercialization when this activity was legal, e.g. polychlorobiphenyls (PCBs) or DDT. Others were by-products, e.g. hexachlorobenzene (HCB), pentaclorobenzene (PeCB), polychloronaphthalenes (PCNs) or polychlorostyrenes (PCSs). As a result, the package of residues in the reservoir contained about 8-16 tons

The Flix meander

of PCBs, 4-7 tons of HCB, 2-3 tons of PeCB, 0.3-0.5 tons of DDTs (sum of DDT and DDE), 0.2-0.4 tons of PCNs and 0.07-0.13 tons of PCSs. Moreover, the residue materials contained 10-18 tons of Hg and other heavy metals, e.g. Ni, Zn and Cd. They also contained important amounts of ^{238}U and radionuclides generated by decay of this element (^{226}Ra and ^{210}Pb among others).

The mass of residues forms a delta entering into the river from the factory side. This delta is blocking about 40% of the water passageway in this river site and therefore it is under continuous erosion by the river flow. In this situation there is the risk of eventual de-stabilization of the mud mass by the river currents, leading to potential catastrophic dragging of most of these residues downstream. There is also the effect of continuous abrasion of the waste-carrying particles and dissolved materials, which constitute a serious threat for the ecosystems located downstream, in particular the second most important natural park in Europe for its bird biodiversity, located 95 km away from this site. The river waters are also used for irrigation in agriculture and for human consumption.

The river mud accumulated in this stretch contains high concentrations of DDT, HCB, PCBs as well as Hg and Cd. This river section appears to be one of the inland water systems most contaminated by these compounds, with concentrations even higher than those found in the sediments of Lake Ontario. Furthermore, fish living in this river stretch, e.g. carps and cat fish, contain high amounts of HCB, PCBs and DDT, in addition to Hg. The concentrations of these compounds in fish muscle are too high to be suitable for human consumption according to the requirements of the European Union laws. The accumulation of POPs can also be observed in bird eggs such as the purple heron that, although a migratory species, bio-accumulates these pollutants from the Ebro River. Thus, these individuals show higher concentrations of these compounds than

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Mass of residues dumped from the factory inside the river. The wall of the reservoir is located on the left.

specimens that nest in other areas further away from these contaminated regions. On the positive side, it has also been observed that agricultural products irrigated with water whose source is downstream from the Flix reservoir do not show significant contamination levels. This is because POPs and heavy metals (Hg) are mostly associated to particles and to a much lesser extent to the dissolved water phase.

In order to devise a solution, a debate involving 70 scientists, engineers and political managers was organised. It was decided to remove the residues dumped in the Flix reservoir and dispose of them in a landfill (this decision was communicated officially on 28 December 2007). This means returning the Ebro river to its initial conditions. Having these residues under controlled storage will considerably improve the environmental quality of the area. Treatment of the residues before disposal also requires extraction of POPs and/or Hg when concentrations of these compounds are too high to allow disposal in landfills. This option matches the philosophy of the new Water Policy of the European Union and it has been undertaken by the Spanish Ministry of Environment and is now under implementation.

However, the situation remains complex. Waste has to be removed by avoiding its transport downstream. A double layer of sheet piles was chosen for isolating the residue mass from direct contact with the river water. As a secondary effect, this wall restricts free river flow. Coordination with the network of reservoirs situated upstream is needed to ensure adequate flow in the Flix reservoir in view of this restriction. Securing the strength of the shore where all residues were dumped is also needed. Taking into account the mass of dumped residues, extraction and treatment will probably take three years of work. Treatments will involve thermal extraction of POPs and Hg, which has to be done under stringent

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Total PCBs (ng/g ww) in cat fish from the Ebro River conditions to avoid emissions to air. Transport to the dumping site (situated at 6 km from the factory) will also have to be done under strict control. During the whole cleaning process, there should be a system for analysis of air and river water to prevent any unexpected contamination.

This initiative has emerged from the fruitful collaboration of scientists, civil engineers and decision-makers from the Spanish Ministry of Environment, the Ministry of Environment of the Catalan Government and the Town Hall of Flix. The project will considerably improve the chemical quality of the ecosystems in this stretch of the Ebro River and will restore the Flix reservoir to initial conditions. Important economic and technical efforts are being undertaken to address this major environmental problem.

PHILIPPINES: DESTROYING PCBS, BUILDING A HEALTHY FUTURE

By Manny C. Calonzo, EcoWaste Coalition and Global Alliance for Incinerator Alternatives (NGO partners of the UNIDO "Non-Combustion POPs Project")

The Philippines today stands at a historic juncture in its quest to protect the environment and the health of its people with the construction of a ground-breaking national treatment facility for polychlorinated biphenyls (PCBs).

While it has never manufactured PCBs, the Philippines has accumulated at least 6879 tons of PCB-containing equipment and wastes from past imports of electrical transformers, most of which are to be found in electric utility, industrial, manufacturing and commercial plants and facilities.

After years of scrupulous planning and action to get through a plethora of challenges, the first ever non-combustion facility for destroying PCBs, touted as the first of its type in a developing country in Asia and the Pacific, was built in the province of Bataan, to assist the industry, the government and the people in meeting national as well as global phase-out requirements for PCBs.

Nationally, the Chemical Control Order (CCO) for PCBs issued by the Department of Environment and Natural Resources (DENR) in 2004 bans the production, importation, sale, transfer, distribution and use of PCBs in open-ended, partially enclosed and totally enclosed applications. By 2014, or after a ten-year grace period, the use or storage for reuse of PCBs, including PCB-contaminated equipment, article, packaging and waste, will no longer be allowed.

Globally, the Stockholm Convention on POPs, which the Philippines ratified in 2004, also bans the production of PCBs, giving Parties until 2025 to phase out the use of PCB-containing equipment and until 2028 to treat and eliminate recovered PCBs (environmentally sound management).

To meet these national and global requirements on PCBs, the Philippines has embarked on a multi-stakeholder Non-Com POPs Project which began in 2008, and which has, from all indications, helped the country in dealing with limitations such as the inadequate inventories of PCBs, the absence of locally available technologies for effectively destroying POPs and the scarce financial resources for the huge costs involved in managing PCB stockpiles.

In close collaboration with private and public sector partners and with generous support from the Global Environmental Facility (GEF) and the United Nations Industrial Development Organization (UNIDO), the DENR-Environmental Management Bureau led and shepherded the project that saw the eventual establishment of a facility operated by the Philippine

National Oil Company – Alternative Fuels Corporation (PAFC) in Mariveles, Bataan.

The Non-Com POPs Project aims to ensure the environmentally sound destruction of the country's PCBs in the said facility through a closed-loop, non-incineration, sodium-based dechlorination technology.

The project integrates all essential components of a sustainable, ecological and socially-responsible approach to eliminating PCBs, such as: 1) the conduct of PCBs inventory and continuing data verification; 2) the maintenance, handling, and interim storage of PCB-containing equipment; 3) the transfer of technology, including the meticulous training of personnel; 4) public-private stakeholders' participation; and 5) public information and outreach, particularly in host communities.

The project conforms with Article 6 of the Stockholm Convention that requires Parties to manage POPs wastes, including PCBs, in a manner protective of human health and the environment. Specifically, Article 6 directs Parties to handle, collect, transport and store such wastes in an environmentally sound manner, and to dispose such wastes in a way that the POP content is destroyed or irreversibly transformed.

The technology operates in a closed-loop system, with a total destruction efficiency approaching 100%, to prevent the uncontrolled release of by-product POPs and other environmental pollutants of concern. It is commercially available and is used in Japan for managing PCBs.

© Manny Calonzo

The Philippines newly built PCBs-destruction facility

The project further takes pride in ensuring strong civil society participation in all stages of the project development and implementation, in line with Article 10 of the Stockholm Convention on "Public Information, Awareness and Education."

For instance, from 2010 to 2011, public information activities were undertaken by participating non-governmental organizations (NGOs) and other project partners to enlighten community members about the initiative, collect feedback and channel their concerns to the authorities for further action. Hundreds of local residents have participated in such activities.

Among the NGOs that have provided critical input and support for the project are the EcoWaste Coalition, Global Alliance for Incinerator Alternatives and Greenpeace Southeast Asia, along with Ban Toxics, Health Care Without Harm, Mother Earth Foundation and many other groups.

Plans are underway to strengthen the Multipartite Monitoring Team to ensure that legally-required environmental, health and social standards and requirements are duly complied by Non-Com POPs facility.

Also, to ensure sustained public awareness about PCBs and deter illegal disposal operations that can lead to the reuse and recycling of PCBs and PCB-contaminated equipment, environmental health groups led by the EcoWaste Coalition came together in March 2011 to launch the "Bantay

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PCB Eliminator as part of awareness-raising campaigns

PCBs" or PCB Watch: "The EcoWaste Coalition adopts and supports the establishment of Bantay PCBs to bring about the needed participation of various sectors toward attaining a united action to complement the government's efforts for the safe and ecological management and destruction of PCBs," the group said.

By working together, the Philippines hope to protect their people and the environment from PCBs. For more information about the Non-Com POPs Project:

http://emb.gov.ph/UNIDO-NonCom%20Web%201/index.html

HOW THE STOCKHOLM CONVENTION TRIGGERED POSITIVE CHANGES IN CHEMICALS MANAGEMENT IN THE REPUBLIC OF ARMENIA

By Anahit Aleksandryan, Head of the Hazardous Substances and Waste Policy Division, Ministry of Nature Protection, Yerevan, Armenia

The ratification of the Stockholm Convention on Persistent Organic Pollutants (POPs) by the Republic of Armenia took place on 26 November 2003. Since then, the implementation of country obligations under this environmental agreement have resulted in positive changes in the sphere of chemicals management, ranging from building capacity –in particular monitoring capacity- to developing the legal framework required, as well as reinforcing human capacity with respect to risk management, and finally raising awareness among decision-makers and the general population.

In the framework of the GEF/UNIDO project "Enabling activities to facilitate early action on the implementation of the Stockholm Convention on Persistent Organic Pollutants (POPs) in the Republic of Armenia" (2002-2004), Armenia implemented large-scale monitoring of POPs in different environmental media, foodstuffs and biomedia. Data on residues of POPs in various matrices available for the 1970s, years of intense use of organochlorine pesticides (mainly POPs), were compared with those of 1980s, i.e. 10 years after the official prohibition to use these substances in agriculture and also compared with findings of a study performed 30 years after the ban (in 2002-2004). The outcomes of such monitoring studies were presented in different national and international scientific publications, and at several conferences and symposia.

The data also provided the basis for the elaboration of a number of regulatory documents, which were approved by the government.

As the appropriate equipment and the specially equipped laboratory for analysing POPs in different environmental media and foodstuffs were lacking in Armenia, an Analytical Laboratory was established and equipped with the bench-top modern equipment GC/MS in the framework of projects implemented by the Ministry of Nature Protection.

Projects aimed at implementing country obligations under the Stockholm Convention on POPs have resulted in strengthening the analytical capacity for sound chemicals and waste management, including wastes (obsolete pesticides, PCB-containing oils and equipment, expired medicine, etc.).

Decision-making related to chemical substances and waste, including POPs, is shared by a wide circle of concerned agencies –the Ministries of Health, Agriculture and Trade and Economic Development, NGOs as well as research institutes and scientific centres under the National Academy. Another valuable output of the above-mentioned projects has been the enhancement of decision-makers' skills for risk evaluation and risk management of first-priority chemicals and waste (PCB-containing oils and equipment, obsolete pesticides, etc.), as well as raised awareness about the hazards and risks of chemicals and waste. This aim was achieved through training and workshops on risk evaluation and risk management of key chemical substances and wastes (PCB-bearing oils and equipment, outdated pesticides, polluted areas and other) that were arranged for various decision-makers and professional groups.

Further, educational and social programmes on issues related to chemical substances and wastes, their influence and consequences on human health and the environment among the population, especially for women, children and less educated persons were implemented to increase the awareness and literacy of the society in general.

Several contests and exhibitions, such as "Children against POPs", "Children against Hazards" were arranged and held in Yerevan. Their aim was to raise awareness on hazardous chemicals in the specific age group of Armenian schoolchildren. Amateur theatrical performances on environmental problems were prepared, including on how to avoid poisons and toxic chemicals, as well as drawings, posters and paintings reflecting the environmental problems and their solution in view of the growing younger generation.

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Theatrical Performance "In court: DDT is condemned". The prosecutor passes a sentence on DDT that is used against harmful pests (insects), but which is more harmful than beneficial to human health.

The theatrical performances related to environmental challenges were watched and judged by a jury of scientists and specialists in the area related to chemicals management. Children recited poems and sang songs and presented famous tales and popular cartoons' heroes in sketches adapted to current environmental problems. Contest winners were awarded diplomas.

As a result of these initiatives, we have achieved the upgrading of ecological knowledge, awareness and skills of officials and decision-makers, as well as various layers of civil society in the area of risk evaluation and management of key chemical substances and wastes, including issues related to the possible impact of POPs on human beings and the environment.

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Well-known fairy-tale "Little Red Riding Hood". The heroes of the tale condemn the use of hazardous substances, including POPs polluting the environment, threatening and destroying biodiversity. As a result, plants and animals are listed in the Red Book of endangered species (on the right hand-side of the stage).

JAMAICA PUBLIC SERVICE COMPANY LIMITED'S PCB MANAGEMENT PROGRAMME

By Jamaica Public Service Company Limited

The Jamaica Public Service Company (JPS) is the sole distributor of electricity to the public of Jamaica and is currently operating under the All-Island Electricity Licence, 2001. JPS owns and operates four fossil fuel, six hydro-electric generating plants and the electrical transmission and distribution system for the island.

In 1994, the JPS established its PCB Management Programme to facilitate the removal of equipment (transformers, capacitors, etc.) containing polychlorinated biphenyls (PCBs), on a phased basis, from its electrical transmission and distribution network. The Programme involves development of an inventory and screening of all out-of-service equipment for PCBs with the removal of any such equipment identified as containing PCBs. The company's PCB Management Programme is based on the recognition that PCBs exhibit the characteristics of persistent organic pollutants (POPs).

One of the first initiatives under the company's PCB Management Programme was an inventory of out-of-service pole mounted and substation transformers which was conducted from 1994-1996. The out-of-service pole mounted transformers which were found to contain PCBs were stored at one of the JPS Storage Facilities in Kingston. The substation transformers, which were identified to contain PCB were labelled and closely monitored for removal and disposal.

As a follow-up to the inventory, among the identified PCB-based transformers, approximately 600 metric tons were packaged and labelled in accordance with international standards and exported to a hazardous waste disposal company in France under a Bilateral Agreement between the Governments of Jamaica and France between 1995 and 1998. This Bilateral Agreement was in keeping with the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal[3].

By 2002, the company had identified and stored 5,781 transformers at its PCB storage facility in Kingston. From October 2002 to May 2003, through the contracted services of an overseas firm, JPS de-chlorinated and removed these transformers from storage at a cost of USD 2.531 million. The transformers had been de-chlorinated in such a way that their PCB concentration was 2 parts per million (ppm), significantly below the Stockholm Convention's limit for PCBs of 50 ppm. The PCB wastes were exported to a hazardous waste disposal company in France

[3] 23 January 2003: date of Accession for Jamaica to the Convention on Transboundary Movement of Hazardous Waste and their Disposal [Basel Convention] Basel, 1989.

for incineration in December 2004. The caustic waste from the de-chlorination process was exported to a hazardous waste disposal facility in Canada in 2005. This disposal exercise was done under a hazardous waste export permit issued by the Natural Resources Conservation Authority (NRCA)[4].

Under the Programme, the company packed ten containers with approximately 300 metric tons of transformers and oil containing PCBs in December 2009. These containers were exported to France and incinerated by a hazardous waste disposal company at a cost of approximately USD 600,000. This disposal operation was also done under the requisite hazardous waste export permits issued by the NRCA. To date, JPS has de-chlorinated and disposed of PCB wastes at a total cost of approximately USD 4.33 million.

JPS is currently reviewing its transformer inventory to ensure that all transformers are identified and appropriately classified for proper management. Transformers and other oil-containing equipment that are removed from the JPS generating, distribution and transmission system are screened for PCBs. Oil screening for PCBs is done using the Clor-N-Oil test. Oil samples are also tested and/or verified using Gas Chromatography when the Clor-N-Oil test is positive for PCBs. If the PCB content of the equipment is above 50 ppm, they are isolated for disposal and stored in the JPS's PCB Storage Facility. This facility is secured with restricted access. The base and walls of the facility are impervious and outfitted with the requisite safety devices (fire extinguisher, eye wash stand, etc.), spill control and containment.

[4] The Natural Resources Conservation Authority (NRCA) is Jamaica's Regulatory Environmental Authority. The National Environmental and Planning Agency (NEPA) executes the technical part and administers the NRCA.

© JPS

PCB Disposal Project 2009: PCB screening (4 February 2009)

The company has not sought to test pole-mounted transformers while they are in service/operation because of safety concerns. JPS will continue to explore options to deal with transformers and oil circuit breakers presently in service.

The ongoing JPS PCB Management Programme identifies and disposes of equipment containing PCBs every two years. The method of disposal and/or treatment will be considered based on cost and dialogue with the relevant regulatory authorities. The next disposal project under the Programme started in the last quarter of 2011, with the request for proposals for disposal. Tenders for the disposal were received and are currently being reviewed for selecting a contractor.

The company has ensured that all its activities carried out under its PCB Management Programme are in keeping with national standards and regulations, as well as the requirements under the Stockholm and Basel Conventions.

Of the original twelve POPs regulated under the Stockholm Convention, the Government of Jamaica has identified PCBs as well as Dioxins and Furans for priority attention. The JPS PCB Management Programme was spurred by Jamaica's National Implementation Plan (NIP) for POPs, which has set a target of 2020[5]

[5] *The Stockholm Convention calls for elimination of PCB oils by 2025 and PCB-based equipment by 2028.*

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PCB Disposal Project 2009: PCB Disposal – weighing of waste (2009)

© JPS

Inside the JPS PCB Storage Facility before the 2009 PCB Disposal Project (4 February 2009)

© JPS

Inside the JPS PCB Storage Facility after the 2009 PCB Disposal Project (2 December 2009)

© JPS

NEPA inspection (2 December 2009)

for the phase-out of the use of PCB-based equipment. The company will continue to phase-out all equipment containing PCBs until the Company's network is PCB-free. As such, all new oil containing equipment being procured must have a concentration of less than 2 parts per million of PCBs or be mineral oil based. The JPS PCB Management Programme will assist the Government of Jamaica in achieving its phase-out target for PCBs as outlined in its NIP, thereby safeguarding the population from exposure to PCBs.

IMPLEMENTATION OF THE STOCKHOLM CONVENTION: ROMANIA'S EXPERIENCE

By Mihaela Claudia Păun, Senior Councillor, Ministry of Environment and Forests, Bucharest, Romania

Always keeping a watch on new developments at the international level and recognizing the negative effects of persistent organic pollutants, Romania decided to take action and ratified the Stockholm Convention on Persistent Organic Pollutants on 28 October 2004, by adopting Law 261/2004.

After the ratification, the next obvious step was the development of the National Implementation Plan (NIP). In developing this document, Romania requested the financial assistance from the GEF and technical assistance from UNIDO. From 2004-2006, the National Research and Development Institute for Environment Protection–ICIM Bucharest, acting as an executing agency, went through all of the NIP's development phases and in April 2006 the NIP was sent to the Secretariat of the Stockholm Convention. It was approved by Government Decision no. 1497/2008.

The NIP established and prioritized national objectives regarding POPs problems and proposed technical, economic, institutional, and informative measures and actions for the accomplishment of the obligations foreseen in the Stockholm Convention (so called action plans). The NIP also made an estimation of the related costs to implement these actions plans.

The first of the 11 key-objectives identified (*"Eliminate pesticides stockpiles and wastes")* was achieved through the PHARE Project "Disposal of pesticides (re-packing, collection and elimination of pesticide residues on the Romanian territory)–obsolete pesticides". Developed by the Ministry of Agriculture and Rural Development from 2004 to 2006, i.e. at the same time as the NIP development process, this project enabled to collect and repack 2,516 tons of obsolete pesticides disposed in 218 locations across the entire Romanian territory, which were then transported to Germany in order to be destroyed by incineration.

The confidence in UNIDO assistance for the development of the NIP and its action plans provided the rationale to continue the PCB-related activities with a Medium-Sized Project (MSP), namely *"Disposal of PCBs waste in Romania"*. Therefore, in 2006 the Ministry of Environment and Forest obtained a GEF grant in order to consolidate ongoing and baseline activities of the government towards the implementation of its obligations for PCBs elimination. The project was meant to demonstrate the implementation of locally viable and environmentally sound PCB control measures and their incorporation into a national policy framework. Our country needed the necessary infrastructure to manage PCBs and

PCB-containing equipment in an environmentally sound manner. The project started in December 2007, with the National Research and Development Institute for Environment Protection–ICIM Bucharest and UNIDO as executing agencies and the completion was scheduled in May 2010. A new detailed PCB inventory was developed and a database of the PCB electrical equipments was set up. In addition, around 1000 tons of PCBs-containing oils were phased out at the end of the project.

During 2007-2009 Romania hosted the consultative meetings of the *"Regional Forum on Best Available Techniques and Best Environmental Practices (BAT/BEP) for Central and Eastern Europe, Caucasus and Central Asia (CEECCA)"*, organized together with UNIDO. The Forum was successfully launched on 5 November 2009 and Romania was nominated as Chair of the Forum for a two-year period, supported by two co-chairs, Armenia and Sweden. The aim of the Forum is to promote guidelines on best available techniques and best environmental practices, adopted by the Conference of Parties, through awareness raising, information dissemination and publicity at regional, sub-regional and national levels.

This launching meeting was preceded by a three-day training workshop for National Focal Points present, held by the Stockholm Convention Secretariat, dedicated to the dissemination of the information included in the BAT/BEP guidelines.

In June 2010, a new meeting of the Forum National Coordinators was held in Istanbul, Turkey, where the programme of work for 2010-2011 and two project proposals were developed, to be forwarded to the GEF for approval.

In December 2011 during the CEECCA BAT/BEP Forum Board Meeting held in Yerevan, Armenia, Romania turned over the Chairmanship of the Forum for a two-year period to the new elected country, Former Yugoslavia Republic of Macedonia.

Furthermore, up-to-date a number of activities foreseen in the NIP document were implemented, namely:

- Gradual modernization of the large combustion plants using BAT and BEP, implementation of modern systems for the control of air pollution and establishment of standard emission limit values for the incineration and co-incineration of waste;
- Introduction of legal regulations on integrated pollution prevention and control (IPPC);
- Environmental sound management of POPs stockpiles, collection, storage and decontamination and/or disposal of equipments containing PCBs;
- Improvement of the environmental performance in the energy sector by implementation and certification of the environmental management system through the allocation of a financial support from the governmental budget;

- Increasing of the energetic efficiency, essential component of the national energetic policy, through the approval of the national strategy in the field of energetic efficiency and implementation of adequate programmes to raise energetic efficiency;
- Setting up a legislative framework for management and control of PCBs, for implementation of the National Strategy on Wastes Management and the National Wastes Management Plan;
- Elaboration of PCB/PCT Decontamination Guide and PCBs environmentally sound management Guidelines;
- Introduction of fiscal incentives for using the ecological products by promoting the Green Public Procurement and elaboration of a programme for increasing the industrial products' competitiveness in order to award the eco-label for which was allocated financial support from the governmental budget;
- Encouraging the use of "cleaner" and economical vehicles by ongoing implementation of the "Rabla" project on the renewal of the national transport park and agricultural machineries;
- Setting up differential taxing of fuels and starting 2005, use of unleaded petrol;
- Elaboration of the guidelines for application of BAT/BEP in order to prevent and reduce the emissions from wastes incinerators by undertaking the BREF Documents on wastes incineration;
- Elaboration of guidelines for application of BAT/BEP in order to prevent and reduce the emissions from large combustion plants;
- Elaboration and implementation of the legislation on wastes incineration.

Transformer station where the samples were taken from on a training exercise, Buzău County, Romania

One of the main issues which were not explored enough nor dealt with in the NIP was the OPs and POPs pesticides contaminated sites. After the inclusion into the Convention of alpha-hexachlorocyclohexane, beta-hexachlorocyclohexane and lindane at the 4th meeting of the Conference of Parties (COP-4) in May 2009, the OPs and POPs contaminated sites issue became one of the global key issues and one of the major problems of Romania.

In this context Romania had to face the low awareness level of local authorities (mayors, city councils) about hazards of contaminated sites and their responsibilities and opportunities in dealing with this problem.

The Regional Project "Capacity Building on obsolete pesticides in the EECCA Region" enabled Romania to undertake the first steps towards proper awareness-raising on OPs and POPs pesticides contaminated sites, especially for those contaminated with alpha-HCH, beta-HCH and lindane, by holding a one-day workshop at the environmental protection authorities' decision-making level. During the workshop the current situation of OPs and POPs pesticides contaminated sites in Romania was presented and further actions were proposed in order to increase the country capacities to deal with this challenging problem. The project has also contributed to strengthening national capacities in dealing with OPs and POPs wastes as well as with OPs and POPs inventory and awareness-raising issues. A total of seven experts were trained on inventory development, repackaging of hazardous wastes, awareness raising and Pesticides Stock Management System (PSMS, developed by FAO).

Participants of the "Regional Forum on Best Available Techniques and Best Environmental Practices (BAT/BEP) for Central and Eastern Europe, Caucasus and Central Asia (CEECCA)" launching meeting, Bucharest, Romania

In the framework of the *micro-support project for awareness-raising* granted by the Regional Project "Capacity-Building on obsolete pesticides in the EECCA Region", the Ministry of Environment and Forests prepared an awareness-raising campaign on OPs and POPs pesticides contaminated sites in order to increase the number of applications for funding to the European Union Commission for contaminated sites remediation as an action towards the implementation of Article 6 paragraph (1) e) of the Convention.

The campaign included developing awareness-raising materials on the proposed theme as well as holding a series of eight workshops. The campaign targeted approximately 30% of the administrative and environment protection local authorities and was undertaken from September to November 2011. The awareness-raising campaign provided the local authorities with the appropriate administrative and environmental information on the human health and environment risks of OPs and POPs contaminated sites, as well as available methods to deal with this global issue, and guidance on how to get funding to solve it.

As a result, at the ministry level, the following priorities were identified in relation to the OPs and POPs contaminated soils management: adaptation and supplementation of national legislation; completion of the national inventory of soils contaminated with POPs and OPs, validated by laboratory analysis; prioritization of land to be urgently addressed, based on risk imposed on human health and the environment; intensification of awareness-raising activities aimed at local authorities and economic operators on technical and financial opportunities for tackling soils contaminated with POPs and OPs; addressing the problem of abandoned/orphan contaminated soils; increasing communication and cooperation between the authorities involved in the management of soils contaminated with POPs and OPs; and strengthening the institutional capacity necessary to manage contaminated soils.

Currently there are four ongoing projects on rehabilitation of historic and industrial contaminated sites financed under European Union structural funds, adding up to Euros 58 million.

CHAPTER 2:

INCREASED AWARENESS AND BEHAVIOUR CHANGES

THE BEST WAY TO REDUCE EXPOSURE TO POPS IS TO RAISE AWARENESS AMONG UNSUSPECTING USERS AND ASSIST THEM WITH SUBSTITUTION: AN EXAMPLE FROM NEPAL

By Ram Charitra Sah, Executive Director/Environment Scientist, Centre for Public Health and Environmental Development (CEPHED), Kathmandu, Nepal

Nepal is a developing landlocked country lying between India and China in South Asia. The Centre for Public Health and Environmental Development (CEPHED) is a non-governmental organization based in Kathmandu, Nepal. Established in October 2004, it has the aim of building bridges between people, science and technology for a healthy living and environmental safety.

Polychlorinated biphenyls (PCBs) are chemicals listed as Persistent Organic Pollutants (POPs) under the Stockholm Convention on POPs. The Dielectric fluid used in transformer oil contains PCBs. The entry of transformer oil, transformers and other electrical items have been imported and used in Nepal when the first power generation plant was established in 1911. While PCBs were discovered in 1865, industrial production only started in 1929. Therefore, PCBs may have entered Nepal with the import of various electrical equipments after 1929.

Obsolete transformers

According to the 2007 Nepalese National Implementation Plan (NIP) under the Stockholm Convention on POPs, a total of 256 transformers at power stations and 8,468 transformers in distribution stations – containing about 2,764,645 litres of PCBs-contaminated transformer oil- are presently in use. In addition, numerous electrical equipments like capacitors, oil circuit breakers and metering units contain PCBs-contaminated oil. Separately, a total of 106,185 litres of obsolete stocks of PCBs-contaminated transformer oil was found during the NIP preparation.

There are about 10,000-12,000 welding workshops, scattered throughout the country, and each workshop on average possesses two welding machines containing at least 40 litres of oil each. Thus in total about 800,000 – 960,000 litres of PCBs-contaminated transformer oil is inside such machines. Reuse of old oil in welding machines is quite alarming. Among the three samples analyzed, two showed PCBs contamination above 50 ppm level. As a result, quite a high number of the 150,000 employees in those grill workshops are constantly and unknowingly exposed not only to such PCBs-contaminated oil, but also to dioxin and furan gases coming out of the continuous use of welding machines containing PCBs-contaminated oil upon getting heated.

According to CEPHED's study on "PCB oils and its impact on public health and the environment" completed in 2010, some 97% of grill workers that were surveyed (102 out of 105) did not know anything about PCBs and about 85.8 % of the grill workers were not aware of any health impact from transformer oil found to have PCBs contamination. However, skin rashes, skin blacking, eye irritation and respiratory problem are significantly more prevalent among the grill workers. Moreover, PCBs-contaminated transformer oil has

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PCBs-contaminated obsolete transformer oil been found to be used as traditional medicine to heal wounds, cuts and headaches, to stop bleeding and as massage oil for joint and muscular pain by others without knowing about its detrimental health consequences.

Despite current banning on sale of PCBs-contaminated transformer oil from the Nepalese Electricity Authority (NEA), old stocks of PCBs-contaminated obsolete oils still reaches welding machines in unauthorized manners. Thus there was an immediate and urgent need to raise awareness and help grill workers to transform towards dry welding machines. CEPHED did so to prevent them from being exposed to these PCBs, as well as to dioxins and furans POPs. Dioxins and furans are classified by WHO/IARC as known carcinogens, and as unintentionally produced POPs under the Stockholm Convention, to which the Government of Nepal is a Party since 2007. When using oil-based welding machines, dioxins and furans are released into the environment due to incomplete oxidation of the PCBs-contaminated transformer oil.

The most central focus of this success story is how, through studies, publications, briefing papers, and other awareness-raising material and the development of a model metal workshop, it was possible to inspire a transition from oil-based welding machines to dry welding machines which are free of PCB-contaminated oil. The Model Metal Workshop demonstrates Best Available Techniques (BAT) to curb the use of PCBs-contaminated transformer oil and unintentional release of dioxins and furans.

With this brief statement of the PCBs problems in Nepal, CEPHED has completed a detailed research titled "A Study of PCBs and their Impact on Health and Environment (a case study of grill workshop workers in Kathmandu Valley, Nepal)" in 2010. CEPHED also conducted the preparation, production and wide dissemination of briefing papers on PCBs and its impacts on public health and the environment in Nepali, as well as four awareness-raising training workshops on "PCBs-contaminated transformer oil and its impact on public health and the environment", jointly with the Grill Entrepreneur Association. Altogether, 321 potentially affected grill workers and other concerned stakeholders, including civil society and

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PCBs awareness workshop participants

journalists, have directly benefited from participating in these workshops. Mr. Thakur Prasad Sharma, then Environment Minister, from the Ministry of Environment which acts as the focal point for the POPs Convention, took these issues seriously and attended the workshop himself on 29 December 2010 in Kathmandu. He expressed a high commitment from the Ministry to address the issue and today it is currently implementing an Environmental Sound Management of PCBs in Nepal.

Based on our research, awareness programmes and continuous follow-up, the number of oil-based welding machines that have been replaced with dry welding machines is growing.

The great success of this project has gained wide recognitions and praise. CEPHED was awarded one of only two of the '2011 Stockholm Convention's PCB Elimination Network Award for Outreach and Capacity-Building' and the 'Grill Traders National Award 2011'.

The project has assisted in fulfilling the first and foremost national obligations towards the Stockholm Convention: to reduce the generation of POPs and eliminate its sources from Earth by adopting Best Available Techniques (BAT) and Best Environment Practices (BEP). Shifting to PCBs-free welding techniques also created safer jobs for grill workers, protecting them from exposure to POPs.

This has been possible due to CEPHED's continuous efforts of working closely with the potentially affected people, concerned organizations, and by educating and supporting them to this endeavour. Educational and training materials are formatted on both print and electronic media that can be easily replicated, stored, redistributed and modified. The knowledge disseminated to the grill workers, general public, journalists and the capacities built on environmentally friendly operations are sustainable. Broad coordination and collaboration with the governmental agencies, private entrepreneurs, local authorities, media as well as directly affected people are critical to achieve a sustainable impact and transformation during the programme implementation period and beyond, thus having a high potential for replication in other countries with similar problems of using obsolete PCBs oils.


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Transformer oil-based welding machines


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Replication of use of dry welding machines

BUILDING EXPERTISE FOR POPS THROUGH COOPERATION - THE CZECH EXPERIENCE

By Dr. Jana Klánová, Research Centre for Toxic Compounds in the Environment (RECETOX), Masaryk University and Stockholm Convention Regional Centre for capacity-building and transfer of technology in Central and Eastern Europe, Brno, Czech Republic

And Dr. Kateřina Šebková, Ministry of the Environment, Czech Republic

The week-long International Summer School of Environmental Chemistry and Ecotoxicology organized by the Stockholm Convention Regional Centre RECETOX in Brno helps build global capacities for the effectiveness evaluation of the Stockholm Convention and for the Global Monitoring Plan. Almost 290 participants from 74 countries have greatly benefited from lectures, practical training and case studies over the last seven years, and many of them long to come back.

To ensure effective implementation of the sound chemical management including the Stockholm, Basel and Rotterdam Conventions at local, regional and global levels, Parties have to develop and maintain technical abilities enabling them an efficient participation in these agreements. These entail capacities to identify new sources and old burdens of hazardous chemicals and to support sound management of chemicals and wastes, in addition to introducing new cleaner technologies. Experience shows that such capacities are currently lacking in many countries. Endeavours to boost efficient capacity-building became one of the top priorities in support of the Stockholm Convention implementation, triggering the worldwide establishment of regional centres for capacity-building and technology transfer.

The Research Centre for Toxic Compounds in the Environment (RECETOX) of the Science Faculty of the Masaryk University in Brno, Czech Republic, has been involved in the POPs-related activities since the 1980s. Due to availability of extensive research capacities and expertise, RECETOX acted as the implementing agency responsible for the preparation of the national POPs inventory, as well as of the National Implementation Plan (NIP) for the Stockholm Convention in the Czech Republic. This expertise covers, among others, development of sampling and analytical techniques and air monitoring programmes, assessment of toxicity and the associated human and ecotoxicological risks, data handling and analysis, as well as development of environmental databases. The NIP development comprised several years of literature and report screening, field testing, case studies and a lot of research projects. However, this demanding job delivered fruits by creating substantial capacity and expertise.

While presenting the Czech experience with the successful national endeavours related to POPs during several regional and global workshops since the entry into force of the Stockholm Convention, many voices were asking for assistance through training and exchange of experience and knowledge. This inspired RECETOX to organize the first summer school on environmental chemistry and ecotoxicology in 2005. This summer school was a sheer success, hence a tradition has been established and the summer school is organized annually ever since.

Nowadays, the week-long course offers participants from around the globe intensive theoretical and practical training on sampling and analytical techniques related to POPs, assessment of toxicity including human and ecotoxicological risks, data handling and analysis, as well as environmental databases.

The Summer School programme runs in two classes. The first one provides an insight into the state-of-the-art environmental chemistry and exotoxicology, including aspects of analytical and process chemistry, long-range transport, fate and effects, and provides a hands-on experience with the chemical and toxicological tests designed to answer specific environmental problems. The second class focuses on building technical capacity for the analysis of POPs in core matrices in support of the Global Monitoring Plan, and offers intensive laboratory training, including maintenance of instrumentation and aspects of quality assurance/quality control. A solid theoretical foundation of the relevant issues is provided at the same time. In addition, the study plans of both classes include a field trip to the Košetice observatory, the background monitoring station of the European Monitoring and Evaluation Programme.

The introductory lectures and practical courses covering basics of environmental chemistry, ecotoxicology and risk analysis are provided by the RECETOX experts. In addition, five to ten leading international scientists and experts are invited to cover specific topics every year. The first RECETOX summer school (2005) was focused on environmental modelling, followed by the summer schools on photochemical and

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Summer school of 2011: class on state-of-the art environmental chemistry

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Summer school of 2011: laboratory training biological degradation (2006), environmental policies and chemical agreements (2007), integrated monitoring/modelling approaches (2008), exchange processes between environmental compartments (2009), bioavailability and bioaccessibility, passive sampling techniques for air, water, sediment and soil (2010), and finally contamination of the Arctic ecosystems, transport, fate and effects of pollutants in the cold environments (2011). Similarly, the focus of the practical analytical training shifted over the years from the polychlorinated biphenyls (PCBs) and organochlorine pesticides (OCPs) to polychlorinated dioxins and furans (PCDDs/Fs) followed by newly listed POPs –polybrominated diphenylethers (PBDEs) or perfluorinated compounds.

The Secretariat of the Stockholm Convention soon recognized the potential of these summer schools as an efficient capacity-building tool, supporting the worldwide implementation of the Global Monitoring Plan (GMP). In follow-up to the requests by Parties for assistance related to the GMP implementation, the Secretariat started cooperating with RECETOX and has been co-organizing the summer school since 2007.

A total number of 288 students (43, 31, 42, 27, 31, 58, and 56 respectively, in the individual years) from 74 countries have benefited from the international summer school programme over the last seven years. Despite the fact that RECETOX accepts nowadays twice as many participants as at the beginning, a number of applicants have to be turned down due to capacity reasons. Central and Eastern European countries and countries of former Soviet Union, such as Kazakhstan, Armenia, Serbia and Romania were among the Parties sending the most students to the training (respectively: 20, 17, 23 and 11). Altogether, the Stockholm Convention Secretariat supported 53 participants, while other students were supported by the Czech Ministry of Environment, through the NATO projects, through the EU framework programmes, and last but not least, by RECETOX itself.

The excited comments and positive evaluations by the summer school participants confirm that the RECETOX Regional Centre hit the target by answering some urgent needs and offering a course building the much needed global capacity for environmental monitoring and assessment of hazardous chemicals. Here are a few examples:

"I am very grateful for your two consecutive trainings; first in 2007 on POP pesticides and PCBs, and this time on dioxins (2010). I pray that you will help us to build some scientific capacity to provide data that is so urgent!" expressed Vincent Madadi, a regional organization group coordinator for the POPs Global Monitoring Plan from Nairobi.

"The most valuable from my point of view were the practical lectures", said Aliya Aubakirova (2011) from Kazakhstan. *"It would be great to establish a long-term programme that would give a chance to more students to experience this."*

Similar long-term programmes enhance engagement of the scientists as well as policy-makers in the implementation of the international conventions and trigger positive changes in chemical management at the local, regional and global levels.

How to further build on this positive example? Even if a number of regional centres have been established until now, it cannot be expected that each of them will be able to provide a full range of services. We believe that the Regional Centres should focus on areas where they have in-depth expertise and knowledge. Global collaboration should be encouraged and supported between those whose capacity needs development, and those who are able to assist with the specific needs. Furthermore, engagement of universities and research institutions with relevant facilities and a vast experience in the area of toxic compounds seems to be a logical and effective step towards efficient capacity-building. The Czech experience so far proves it right.

IMPLEMENTATION OF THE STOCKHOLM CONVENTION AT GRASSROOTS LEVEL IN TANZANIA

By Ms. Dorah Swai and Mr. Silvani Mng'anya, AGENDA, Dar es Salaam, Tanzania

Introduction

In Tanzanian rural areas, chemicals are mostly used as fertilizers and pesticides for improving agricultural productivity. Some of the chemicals and pesticides used are so persistent that they move far and wide, remaining in the environment for decades, with their effects being felt in even the most remote regions. Although the use of these chemicals –especially pesticides- has increased over recent decades, best practices of their management are very often not followed. This has led to significant health and environmental problems, especially for grassroots communities who are the main users.

Tanzania ratified the Stockholm Convention on 30th April 2004 and is a Party to other chemical conventions, including the Basel and Rotterdam Conventions. In order to prevent the production, use, trade and transboundary movement of Persistent Organic Pollutants (POPs) and its wastes, integration of the Stockholm Convention with other conventions mentioned above is important so as to provide the link which will ensure both prevention of POPs exposure and implementation of other conventions at grassroots level.

Problem statement

The implementation of chemical conventions in developing countries is lagging behind because of inadequate capacity, weak national policies and legislations, and uncoordinated institutional frameworks, just to mention a few. In a country such as Tanzania, endosulfan (a POPs chemical newly listed during the Stockholm Convention's 5th Conference of the Parties in 2011) and paraquat are still used. Implementation setbacks are even more acutely experienced at grassroots level where farmers use illegally imported, decanted or expired chemicals due to lack of awareness on the health and environmental problems associated with them. The situation is worsened by a lack of knowledge and weak advisory services, and application of these pesticides has frequently resulted in injuries to human health, deaths and severe ecological impacts.

How the issue was addressed

The issue was addressed by building the capacity of grassroots farmers and peasants to effectively implement the Stockholm Convention and other chemical conventions. The methodology used was a "Training of Trainers" (TOTs), which included civil society and community-based organizations (CSOs/CBOs) and agriculture field officers, demonstrating the use of non-chemical alternatives to toxic chemicals and enhancing awareness amongst the public. This was done for the Stockholm Convention while integrating it with other chemical conventions and the Strategic Approach to International Chemicals Management (SAICM).

Implementation of the approach

Step 1.

- The approach was implemented by AGENDA *for Environment and Responsible Development* (AGENDA) in 2008 in three zones of Tanzania (Northern, Southern Highlands and Western) where agricultural chemicals are highly used, and access to information related to sound use of chemicals including pesticides is poor.
- It was financed by the UNDP Small Grants Programme (SGP).
- Relevant parts of the Stockholm Convention (articles 1, 3, 7, 9, 10 and 11) and the other two chemical conventions were translated into Kiswahili, which is the national language of Tanzania. The translation was validated by the National Focal Point of the Stockholm Convention.
- Training materials were developed to train the trainers (TOTs).
- 45 TOTs were trained in the three zones, including members from CBO and extension staff.
- TOTs were demonstrated how to train communities on the issues related to the implementation of the Stockholm Convention and other chemical conventions.
- Organic and Integrated Pest Management (IPM) farms were developed for demonstration purposes.
- AGENDA and TOTs developed the materials for training grassroots communities on the implementation of the Stockholm Convention.
- AGENDA and TOTs developed Kiswahili brochures for the public.

Step 2.

- TOTs continue to train the grassroots communities on the implementation of the Stockholm Convention (and other conventions).
- Community groups were formed to record and report the impacts of pesticides applied or found in their localities to relevant institutions in the country and eventually to the Secretariat of the Convention.
- AGENDA monitored the project progress.

Step 3.

- AGENDA collected, compiled and recorded relevant information related to the implementation of the Stockholm Convention in Tanzania and facilitated its airing in the national television for more awareness-raising.

Outcomes / impacts

- As of October 2011, over 340 farmers had already been trained and the TOTs continue to provide training.
- Information has been disseminated through national and local newspapers.
- Public awareness amongst the public has been raised.
- There is an enhanced use of organic and IPM farming methodologies.

Lessons learned / conclusion

- A well coordinated national institutional framework for pesticides management is crucial for proper reporting of pesticides impacts from community level to relevant organizations.

Demonstration farm (potatoes)

- The Stockholm Convention insists on the provision of information, awareness and education materials as well stakeholders' (including farmers') participation in the development and implementation of the National Implementation Plans (NIPs), hence having a catalysis effect at the local level to achieve its objective to protect human health and the environment from POPs.
- Given the important needs to better manage chemicals –especially POPs and their wastes- more technical and financial assistance is required to continue with the implementation of the conventions. This requires more support channelled through the Secretariats or directly to the implementing stakeholders from developed countries, agencies and self co-financing by the Parties and stakeholders.
- The activities could be replicated by training more TOTs and further supporting them.

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Cattle manure to use as organic fertilizer

DESTRUCTION OF POPS IN DEVELOPING COUNTRIES BY USING LOCAL CEMENT KILNS

By Dr. Kåre Helge Karstensen, Chief Scientist, Foundation for Industrial and Scientific Research, Norway

Introduction

Environmentally sound disposal of POPs is costly and complicated, and export may not be affordable to many developing countries. In contrast to incinerators and other treatment techniques, cement kilns already exist in virtually every country and resorting to them may be feasible and cost-efficient for the treatment of POPs wastes and other types of wastes. For almost thirty years, the only treatment option in Norway for organic hazardous wastes and POPs has been high temperature cement kilns. The Foundation for Industrial and Scientific Research (SINTEF) has been instrumental in this development and the Norwegian Government wants to share and disseminate this knowledge within developing countries.

Co-processing of alternative resources and treatment of hazardous wastes in cement kilns should be restricted to BAT/BEP kilns. Emerging markets have the highest demand for construction and subsequently the highest ratio of modern newly built cement kilns, e.g. BAT/BEP kilns. In addition, China and India produce nearly two billion tons of cement (two-thirds of the world production), emitting approximately two billion tons of CO2. Waste treatment in cement kilns implies complete recovery of energy and valuable raw material components in the wastes, i.e. reducing the need for non-renewable fossil fuel and virgin raw materials and thereby contributing to overall reduced CO2 and other greenhouse gas emissions, compared to land filling, building a new incinerator or exporting.

Problem statement

A cement kiln has many inherent features which makes it ideal for hazardous waste treatment: high temperatures, long residence time, surplus oxygen during and after combustion, good turbulence and mixing conditions, thermal inertia, dry scrubbing of the exit gas by alkaline raw material (neutralises acid gases like hydrogen chloride), fixation of the traces of heavy metals in the clinker structure, no production of by-products such as slag, ashes or liquid residues and complete recovery of energy and raw material components in the waste.

It is however of outmost importance to apply best practice and lessons learned when implementing such practices and SINTEF, the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH and Holcim, one of the world's leading suppliers of cement and aggregates, developed best practice guidelines for co-processing of wastes in cement kilns during the period 2003-2006.

How the issue was addressed

Disposal of POPs in cement kilns has always been a sensitive issue. To reduce controversy and possible risks, a "qualification" test should always be conducted to demonstrate that the destruction of a particular POP is sufficiently efficient in the kiln and that compliance with regulations is ensured prior to a full scale disposal.

As part of its social responsibility and sustainability strategy, Holcim decided to investigate systematically into the feasibility of providing its cement kilns as a service to local societies in developing countries to get rid of POPs and other hazardous wastes in a cost-effective manner.

Comprehensive test burns with POPs and other hazardous wastes have been conducted in several developing countries under SINTEF guidance, demonstrating in most cases that local cement kilns can destroy hazardous chemicals including POPs, in a safe and environmentally sound manner, i.e. irreversibly without generating new POPs.

Below are a few examples of such test burns.

Vietnam

A test burn with two obsolete and toxic insecticides was conducted in a cement kiln in Vietnam in 2003. Lessons learned from earlier projects established the basis for a joint test burn project with the Vietnamese authorities and Holcim. The objective was to investigate if their cement kiln in the South of Vietnam was able to co-process and destroy obsolete pesticides/hazardous wastes in an environmentally sound manner, i.e. with no influence on the emissions when fossil fuel was partly replaced by hazardous waste. Information about the test burn was disseminated

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Holcim cement kiln in Hon Chong, Vietnam well in advance to all relevant stakeholders and the actual test burn was inspected by scientists from universities and research institutes in Vietnam.

The destruction efficiency (DE) was measured to be better than 99.9999969% for fenobucarb and better than 99.9999832% for fipronil and demonstrated that the hazardous chemicals had been destroyed in an irreversible and environmentally sound manner. All the test results, except for the NOx, were in compliance with the most stringent regulations. This was the first time PCDD/PCDFs, PCBs and HCB were measured in an industrial facility in Vietnam and all the results were below the detection limits. This proved that the destruction had been complete and irreversible, and in full compliance with the requirements of the Stockholm Convention of being environmentally sound, i.e. not causing any new formation of PCDD/PCDFs, HCB or PCBs.

Sri Lanka

In 2006, PCB-oil had been stored in a warehouse in Colombo for more than 20 years, waiting for a disposal solution to emerge. The bulk of Sri Lanka's PCBs came from the emptying of transformers belonging to the state-owned Ceylon Electricity Board. High concentration PCB-oil was kept in 60 l stainless steel drums; and diesel washings from the transformers' cleaning, in 200 l steel drums. The PCB-oil was confirmed to be pyralene with an average concentration of 59% of PCB, 36% trichlorobenzene and 5% tetrachlorobenzene.

Cement kilns usually have limited tolerance for chlorine and the total input needs to be controlled to avoid process clogging and impacts on the product quality. A blend of the high concentration PCB-oil and the

Test burn with PCB-oil in Sri Lanka

diesel-washings was prepared at the storage site and transported in two chemical resistant tanks to the cement plant located in Puttalam, 120 km North-West of Colombo. The mix of PCB-oil and diesel-washings from Colombo was further blended to a total 10,000 litres with diesel oil in a steel feeding tank at the cement plant; the final PCB-diesel oil mix was homogenised and fed directly to the main burner flame of the cement kiln during two consecutive days of testing with various feeding rates and PCB-concentration. The test burn started with emission measurements when no PCB was fed to the kiln, followed by Test day 1 with a feed rate of 500 l/h of PCB-diesel oil mix with 14.000 mg PCB/l and Test day 2 with a feed rate of 1000 l/h of PCB-diesel oil mix with 10.050 mg PCB/l. The feeding system was calibrated and tested before start up. The three-day test burn demonstrated that it was able to destroy PCBs in an irreversible and environmental sound manner without causing any new formation of PCDD/PCDF or HCB. The destruction and removal efficiency (DRE) was better than 99.9999% at the highest PCB feeding rate.

Venezuela

Soil from an old pesticide formulation plant, contaminated with POPs, constituted a local problem in Venezuela and it was decided to test the feasibility of using a local cement plant for safe destruction. Approximately 6000 m3 of contaminated soil was excavated around the formulation plant and put into 1 m3 big bags and stored in a warehouse. Sixty tons were homogenised and transported to the San Sebastian cement plant by truck. Samples were taken from each of the batches and analysed.

A complete test burn was carried out over a period of four days, split into two baseline measurements and three contaminated soil feeding periods with a fed rate of two tons/hour lasting for a least eight hours

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Unloading of PCB-oil from drums into the feeding tank each. A Venezuelan independent and accredited test company carried out the stack gas sampling and subcontracted accredited laboratories in the United States of America. The testing and analysis complies with international standards and was inspected by University experts, central authorities, test house experts and a third party expert. Contaminated soil with up to 522 ppm dieldrin showed a DRE of 99.9994% for dieldrin at the highest feeding rate.

Outcome / impact

A feasible cement kiln, together with environmentally sound management and operational procedures, adequate safety arrangements and input control, will secure the same level of environmental protection in developing countries as in the European Union and the United States of America. As illustrated by several studies, instead of representing a threat to the environment and health, hazardous chemicals can be safely destroyed in a local cement kiln (while at the same time saving non-renewable fossil fuel). The cost savings of using a local cement kiln are considerable compared to other treatment options –including export- and can contribute to make developing countries self-reliant with regards to hazardous waste treatment. They represent an interesting alternative to the building of hazardous waste incinerators, which imply large investments and high running costs and are normally not affordable to developing countries.

Lessons learned / conclusion

The feasibility and lessons learned of using cement kilns for treatment of various POPs and POPs-contaminated soils have been documented and published in respected scientifically peer-reviewed international journals[6]. It is however always recommended to conduct a test burn to verify the destruction efficiency of the local cement kiln prior to full scale disposal operations.

With financial support from the Norwegian Government, SINTEF is currently building capacity and investigating the feasibility of using cement kilns for waste and hazardous chemicals treatment in China and India, together with the Ministry of Environmental Protection of China, and the Ministry of Environment and Forrest and the Central Pollution Control Board of India.

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[6] Such as *Chemosphere*, 78 (2010): 717-723; *Chemosphere*, 70 (2008): 543–560; *Environmental Science & Policy*, 9 (2006): 577-586.

GUIDE ON FLUORINATED FIRE-FIGHTING FOAM FOR FIRE DEPARTMENTS IN GERMANY

By Regina Saloschin, Scientific Officer, Federal Environment Agency, Dessau-Roßlau, Germany

How to educate fire departments about the environmental and health risks of fluorinated fire-fighting foams? That was the main problem the German Federal Environment Agency (UBA) was facing after the listing of perfluorooctane sulfonic acid (PFOS) in the Stockholm Convention in 2009. The fact is that fluorinated fire-fighting foams can pose a risk to the environment, but there is a lack of knowledge about this reality, in particular about the risks of the foam ingredients for users. In order to educate about the risks associated with the use of fluorinated foams, the UBA established a working group consisting of producers and users of fluorinated fire-fighting foams, associations of fire fighters and UBA representatives. This working group developed a guide on fluorinated foams that has been distributed via the internet and on several UBA events.

Fluorinated fire-fighting foams, for example aqueous film forming foam (AFFF) used since the 1960s, are based on fluoride surfactants. The fluoride surfactants create a thin aqueous film between the foam and the burning/flammable surface. This benefits a rapid spread of the foam and at the same time prevents re-ignition. Due to these attributes, burning liquids (e.g. oil tanks in refineries) can be extinguished faster. On the other hand, per- and polyfluorinated compounds (PFC) have several disadvantages. The fluorine-carbon bonds are very stable and only a high expenditure of energy can break them. They are not degradable, neither biotic nor abiotic, and thus persist in the environment. Because of their potential for long-range transport, these compounds are distributed globally. PFOS, an ingredient of AFFF, turned out to cause reproductive toxicity in long-term animal experiments. It also showed to be tumour-proliferating and has a half time in human body of more than four years.

The UBA pursues a strategy that consists of three steps: exchange, avoid and dispose. AFFF and other fluorine-containing fire-fighting foams need to be exchanged with effective fluorine-free alternatives; the use of fluorine-containing fire-fighting foams needs to be limited to fires where no alternative is useful; after the use of fluorinated fire-fighting foams, the extinguishing water has to be collected and disposed of in an environmentally sound manner.

Since producers of fluorinated fire-fighting foams promote them as the nec-plus-ultra for any kind of fire, it is hard for the user (i.e. fire fighters) to know when to give up on using them. In addition, it is not obvious for every fire fighter to recognize fluorinated foams or to understand why they are problematic. This situation has created a need for the UBA to exchange information and views with the different stakeholders in order to educate the 25,000 fire departments with its 1.3 million members in Germany.

A roundtable was established with authorities, producers, associations of fire fighters, plant fire brigades, airport fire brigades, and so on. It became clear that fire departments were insecure using the alternatives –in some cases also fluorinated. They didn't want to buy "tomorrow's waste". The discussion included all the assets and drawbacks of fluorinated foams. Out of this roundtable, a small working group of about 10 people representing different stakeholders was established. This group worked on the development of a guidance document for fire fighters whose content should clarify what fluorinated fire-fighting foams are, how one can recognize them, why they are problematic for humans and the environment, in which cases can they be given up, in which cases are they essential to use, and how to proceed, in those cases, in order to protect the environment.

The approach of educating fire fighters on fluorinated foams and their alternatives was implemented in different ways. A series of articles highlighting different aspects of fluorinated fire fighting foams was included in the magazine of the German Fire Protection Association. These articles covered environmental problems caused by fluorinated foams, explained the chemistry and function of these, and established a comparison between fluorinated- and fluorine-free agents. The guidance document was developed in addition. No costly promotion was needed: the guide was published on the UBA homepage, where anyone interested can either download the file or order a certain number of copies that are sent to the purchaser for free. The printing and shipping costs are borne by the UBA. The fire fighters associations also have the guide available on their homepages. The guide has been presented at several UBA events on per- and polyfluorinated chemicals, and at conventions and exhibitions concerning rescue and fire prevention as well.

One of the most noteworthy achievements of this roundtable is the clear positioning of the fire fighters associations. They now accept that fluorinated fire-fighting foams pose a serious risk to the environment. The guide currently has a run of about 24,000 copies, and about 5000 downloads. Various parties have acknowledged the document as being very helpful and unique in the European Union. As this represents a preventive activity, it is not possible to quantify the related financial benefits, but if fluorinated fire-fighting foams are used to a lesser extent, this will generate less pollution of surface water, soils and groundwater.

Since having established the roundtable, the UBA is integrated into the sector of fire-fighting foams. It is invited as an expert to venues of different parties in this field and its position and arguments are strong and acknowledged. This is very helpful, given that many producers promote their fire-fighting foams as "environmentally friendly"; however, they still use fluorinated chemicals. The currently used PFOS-free alternatives contain short-chain PFC. Those PFC are more mobile in soil and get into the groundwater faster. They have been measured increasingly in groundwater and surface water. Long-term toxicity studies are not available for short-chain PFC at the moment. Hence, the risk for humans and the environment cannot be estimated. Now the UBA has a chance to shed light on the environmental facts at the different venues.

Very positive about this collaboration is the equitable and constructive discussion it has led to. To begin with, even though producers of fluorinated foams were reserved with their information, essential and obsolete uses for the foam were clarified. For the environment's sake, it would have been much better if the associations had agreed on not using what remained of PFOS-containing foams, even though PFOS-containing foams that were placed on the market before 27 December 2006 may still have been used in the EU until 27 June 2011. It is also not satisfying for the UBA that a research project about fluorine-free alternatives, that are as effective as fluorinated foams, needs to be pushed forward by the UBA.

In conclusion, one can say that it is possible to get different stakeholders together to work towards the same objective. Even though every stakeholder has its own point of view, it was possible to collect facts that now serve as guidance to many people, and clarify where fluorinated foam agents are necessary and how to deal with the fire water containing the foam.

The English version of the guide will be available soon. In addition, information activities will be held at fire fighters schools all over Germany to raise their awareness on the fluorine problem.

Fire fighters extinguishing a fire with foam

IPEN POPS SUCCESS STORIES

By Olga Speranskaya, IPEN Co-Chair

Introduction

IPEN is a global network of more than 700 civil-society organizations working together for the elimination of persistent organic pollutants (POPs) and chemicals of equivalent concern. IPEN's mission is to achieve a Toxics-Free Future where hazardous chemicals no longer pollute the environment, and no longer contaminate our bodies or the bodies of our children and future generations.

In 2008 IPEN celebrated 10 years of catalyzing civil society engagement and contributions to the elimination of toxic chemicals that cause cancers or birth defects, harm reproduction, disrupt hormone functions and accumulate or persist in the environment, food chain and in our bodies. To address chemical problems, IPEN bridges scientific achievements and technological innovations with the work on the ground, identifies hotspots, and monitors toxic chemicals in the environment, products and human bodies. We put policy into practice by implementing concrete projects to identify POPs threats; to generate data and monitor POPs exposure; and to contribute to national and international policy design with expert experience and technical input.

A few examples are highlighted below that illustrate how over the past 10 years, civil society participation in the implementation of the Stockholm Convention has improved.

Case study from Sri Lanka

Problem statement

Low-level awareness on POPs often results in practices that increase POPs levels. Civil society, if informed and empowered, can play a meaningful role in creating better awareness of POPs and contributing to national implementation of the Stockholm Convention.

How the issues were addressed

In 2005 IPEN Participating Organizations in Sri Lanka took up an extensive awareness and training programme for NGOs, government and the media. In addition to an introductory session on POPs and their impacts on health and the environment, the workshop covered topics such as the current implementation status of the Stockholm Convention, the existing legal framework related to POPs in Sri Lanka, pesticides, dioxins, furans and industrial chemicals, particularly PCBs and their impacts. Research findings related to the contamination of POPs and perfluorooctane sulfonate and related fluorochemicals in some aquatic biota of Sri Lanka were also shared. The workshop, which had 70 participants, was very successful and even had a multiplier effect, with participating NGOs sharing the knowledge they had gained in the training with other communities and organizations, increasing POPs awareness and highlighting risks to human health and the environment, as well as the need for elimination of POPs. Subsequent to the workshop, media also became more aware of the topic and spread the message among the wider population through informed news reporting. Concerned government officials now also recognize the important efforts of various stakeholders, contributing to further linkages to ensure smooth implementation of POPs management activities.

Case study from the Philippines

Problem statement

The conversion of rice fields into fishponds in the Philippines resulted in POPs contamination of fishery waters. Approximately 30% of the workers interviewed by NGOs said that chlordane, DDT, dieldrin, endrin and heptachlor were still used in farming areas. More than half occasionally use banned pesticides such as chlordane in fishpond operations to clear grasses. Interviews with workers revealed health effects believed to be related to pesticide exposure.

How the issues were addressed

In 2005 a project was conducted by an IPEN member organization in the Philippines that was focused on field investigation of POPs use in select fishery waters that are considered critical areas along Manila Bay, Laguna Lake and Pasig River. The results of the study were used for massive information dissemination, policy advocacy and lobbying toward legislative and other government measures on POPs, particularly in fishery waters, and other campaign activities intended to create huge public and government awareness on POPs and their various effects.

Fisherman catching fish in the polluted waters of Manila Bay

Case study from Russia

Problem statement

The first survey of PCB sources in Russia was conducted by AMAP (Arctic Monitoring and Assessment Programme) in 1999. Since then the situation has changed significantly. Many equipment items either disappeared in the facilities' reports (but are still actually used), or were decommissioned. PCBs-containing wastes were illegally "recycled" or eliminated.

How the issues were addressed

To clarify the situation, the first citizen-led inventory of PCB sources was conducted in the Russian Federation in 2005 by IPEN member organizations. Water and soil samples were collected in seven cities of Nizhegorodskaya Oblast where PCBs sources were located. These sources included facilities that operate PCBs-containing electric equipment, industrial waste incinerators and municipal landfills. The research studies confirmed PCBs contamination of territories near Dzerzhinsk, a site of PCB manufacturing. The inventory work allowed collection of information on the presence of PCBs-containing liquids and on reduction of equipment stocks at the majority of facilities of Nizhegorodskaya Oblast in 1999-2005. According to the surveys, facilities of the region reported that they now have 92% less PCBs-containing equipment compared to the findings of the AMAP survey in 1999. High officials of governmental environmental bodies of the region agreed that similar developments might be observed in other regions of the country. The study underscored the importance of NGO involvement in inventories.

Case study from Tanzania

Problem statement

Tanzania is a developing country that used PCBs in the past and still has PCBs in use or in storage and/or leaking or failed equipment releasing them into the environment.

How the issues were addressed

In 2005 an IPEN member organization carried out a study focused on identifying PCBs hotspots and practices that release PCBs into the environment in Tanzania, paying particular attention to electrical equipment. It was discovered that electrical equipment constitutes a major source of PCBs releases, as they were used or are still in use in Tanzania in electrical substations, including large transformers, medium size transformers, normal industrial and domestic applications, and water treatment plants. The study also assessed the extent of contamination and availability of alternatives to PCBs locally and globally. Finally, the report gives recommendations on how to deal with the hotspots and PCBs releases in general. The study recommended increased public awareness on PCBs sources and their effects on human health and the environment; promoting further studies on the sites mentioned; and community monitoring to assess the impact of PCBs on human health.

IPEN Global Case Study #1

Problem statement

POPs contamination of food products is one of the main sources of POPs exposure. People living in the vicinity of hotspots are at major risk. In many countries, no research has ever been conducted to indicate the level of POPs contamination in locally-produced food.

How the issues were addressed

In 2005 IPEN issued its "Egg Report" on dioxins, PCBs and POPs pesticides, which was based on the results of its pioneer study of free-range chicken eggs collected near waste incinerators, cement kilns, the metallurgical industry, waste dumps, and chemical production facilities in 17 countries. The report found evidence of high levels of dioxins and PCB contamination. Seventy percent of the samples exceeded the European Union (EU) limit for dioxins in eggs. Sixty percent of them also exceeded proposed EU limits for PCBs in eggs. Three egg samples reported in this study contain some of the highest dioxin levels ever measured in chicken eggs. To our knowledge, this study represents the first data about these substances in chicken eggs for Belarus, Bulgaria, Egypt, India, Mexico, Kenya, Mozambique, Philippines Senegal, Tanzania, Turkey and Uruguay.

IPEN Global Case Study #2

Problem statement

New POPs that are banned globally and are on the list of the Stockholm Convention continue to pose threats to human health as they are part of the make-up of new products sold globally.

Collection of eggs in Slovakia

How the issues were addressed

In 2011, an IPEN study was released that focused on new POPs under the Stockholm Convention. The POPs in Products Report revealed that a type of foam carpet pad commonly sold in the United States of America (USA) and other developed countries contains levels of PBDEs that raise concerns about exposures that can harm human health. The substances, pentaBDE and octaBDE, resemble PCBs in structure and toxic effects, and were recently listed by the Stockholm Convention for global elimination in more than 170 countries. Either one or both chemicals were found in 23 of 26 (88%) samples of foam padding from Canada, Hungary, and the USA. Half the samples contained components of pentaBDE at levels that exceeded the indicative hazardous waste limit under European Union regulation. For octaBDE components, 46% of the samples exceeded the limit. In addition to posting it on the IPEN website, news of this important study was disseminated via email lists worldwide, and was also shared during the Stockholm Convention's Fifth Conference of the Parties in April 2011.

Earlier, from 2008-2009, IPEN initiated expansive global chemical safety outreach by elevating chemicals issues across the labour, health, environment, agriculture and other sectors via our Global Campaign on SAICM. This Campaign engaged over 1,000 varied groups in 113 countries and generated educational material for broad use and in numerous languages on POPs, SAICM, hazardous pesticides and mercury.

Conclusion

Since 2004, more than 200 projects have been implemented by more than 350 IPEN Participating Organizations in 65 countries. These projects significantly contributed to reduce chemical pollution. Additionally, IPEN succeeded in raising toxic issues high on the national agendas of developing countries and countries with economies in transition. In many cases we managed to refocus people's attention from pure economic interests to the interests of human health and the environment.

POPs are not an isolated issue; they are part of a broader chemical safety, human rights and sustainable development agenda. IPEN, together with the international community, has taken on these wide-ranging issues in our mission. We continue global outreach on toxic chemicals and are committed to achieving a Toxics-Free Future by 2020.

CZECH REPUBLIC: FROM DIRTY DOZEN TO THE DECISION-MAKING DATABASE

By Dr. Kateřina Šebková, Ministry of the Environment, Czech Republic

Introduction

Could experience gathered in the management of persistent organic pollutants be a base for a broader decision-making on a chemicals' regime at national level? Requirements on the proposal of the Czech strategy to implement the Stockholm Convention also comprised criteria of maximum effectiveness and consideration of the possible future development of the Convention.

Both articles 7 and 16 of the Stockholm Convention, the relevant decisions on National Implementation Plans (NIP) and those pertaining to Article 16 regarding effectiveness evaluation and the subsequent development of the Global Monitoring Plan (including the selection of matrices), could be considered a necessary base for creating the global capacity to assess whether the Stockholm Convention objectives are being met.

When our experts looked into national challenges resulting from the first national inventory on persistent organic pollutants (POPs) performed in 2003 and translated them into the first NIP finalized in 2005, it became evident that POPs issue cannot be separated from the broader context of the sound chemicals management and the Strategic Approach to the International Chemicals Management (SAICM) goals.

Therefore, decision-makers were presented with several tasks. First, to establish a national coordination mechanism that could bring to one table all relevant stakeholders, not only to pursue the progress but also design it in such a way that it could gradually and swiftly be adjusted in relation to the findings. The second task was to translate NIP priority issues into actions and the third, to fill the identified data gaps.

Establishing a national coordination mechanism

The national coordination mechanism for POPs was derived from the experience with the work of the interministerial committee established to prepare the first national POPs inventory, comprising players from ministries, industry and civil society. The new coordinating body –the National POPs Council, which is an advisory board to the Minister of the environment- comprises representatives of ministries (environment, health, agriculture, industry and trade, transport, defence, education, finance and foreign affairs), as well as experts on waste management, chemicals, site remediation and scientists and members of national bodies observing the compliance with the legislation. The Council meets twice a year at a minimum to observe the implementation of the

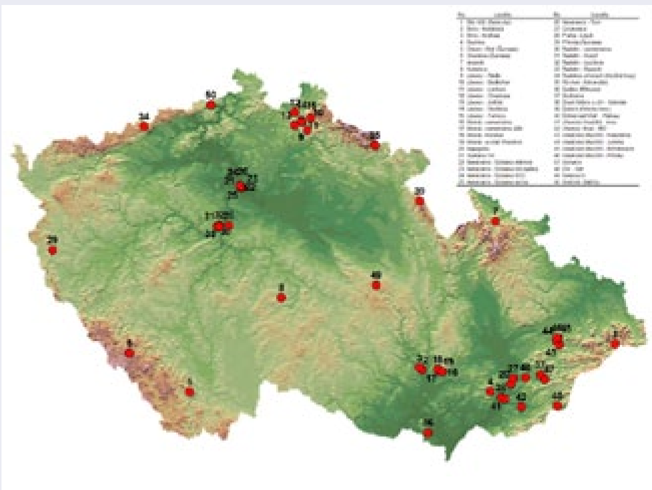
Stockholm Convention nationally and adjusts the immediate priorities of work. To provide an additional scientific platform performing science-related tasks identified in the National Implementation Plan, a National Centre for persistent organic pollutants was established in 2005.

Translating data into action

The Council has adopted the National POPs Monitoring Strategy in early 2007 to bridge data gaps. The actions in the Strategy study background sites as well as significant contamination sources to meet requirements not only of the Stockholm Convention but also other instruments. Moreover, the Strategy combines activities to achieve the highest possible level of effectiveness in relation to the number of samples, analyses, the long-term sustainability of the monitoring programme and data generation, including their use, for a multiplicity of instruments.

Filling the data gaps

The Ministry of the Environment (MoE) prepared three five-year projects in 2007, targeted at research on the fate and transport of POPs in ambient air. The first project addressed the sources of POPs and their distribution between the gas and particulate phase of air, while the second applied the passive samplers to assess the geographical distribution and seasonal variability of atmospheric concentrations at background as well as impacted sites. Selection of the sampling sites was based on the national inventory results as well as requests from the stakeholders. Involvement of local and regional partners (both from the regulatory and the industrial sphere) interested in results of the study was important added value of both projects. The sampling site network established in the framework of these studies became the national air-monitoring



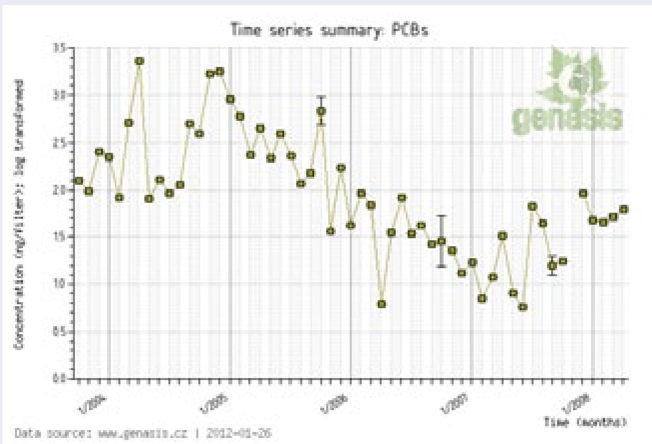
Overview of the ambient air monitoring stations operating in MONET in the Czech Republic between 2005 and 2011 network (MONET=MONitoring NETwork), delivering data on spatial and temporal variability of the POPs contamination. The number of sites fluctuated between 35 and 55, including 15 background locations over the last five years.

The third project of the MoE aims at historically contaminated sites to confirm and quantify as precisely as possible the amount of POPs found on these sites and assess possible risks associated with these sites. This project is still ongoing but the 2010 progress report revealed and confirmed that a total of 1010 unique sites contain either POPs or polyaromatic hydrocarbons. At present these sites are being prioritized and remediation measures, monitoring plans or other activities will be prepared or performed on priority locations as soon as practicable. For some large localities, the work would continue at least until 2015.

The fourth route for filling the identified data gaps was the yearly gathering of existing national data generated in the framework of scientific projects and monitoring programmes executed by various ministries and environmental and health research institutions. Finally, the national information database GENASIS (Global ENvironmental ASsessment Information System) to hold national data on POPs (i.e. from MONET) and their yearly updates was developed to visualise the data and analyse it to ease the subsequent decision-making and national prioritising.

Outcomes

A major achievement of the national MONET monitoring network is the involvement of stakeholders (including from a financial point of view). While often being very reluctant in the beginning, many industrial partners agreed to participate in the screening studies. When they understood



Time series of PCBs concentrations in ambient air from Košetice station (MONET), Czech Republic, between 2003 and 2008 how powerful and beneficial these data could be for their own decision-making, when interpreted properly, their perceptions changed and they became donors supporting the MONET implementation at later stages. The same behavioural pattern was observed when cooperating with the local and regional authorities. Nevertheless, it took us some time before we understood that data and information collected from the national monitoring network can be very efficiently translated to regional and national policies and strategies. The key step was the development and in particular use of the novel features of GENASIS information system such as interpretation tools and visualisation of data from multiple sources at a broader national level.

Subsequent testing of GENASIS at the international level in 2011 proved that it fully respects the requirements of the Global Monitoring Plan and could be a suitable instrument to accommodate large data sets of diverse data from multiple sources and potentially serve at the global level.

Lessons learned

The development of an effective national coordination scheme allowing stakeholders to become partners proved to be a successful way forward in analysing environmental problems and finding effective solutions at the national level. It must be emphasised that the involvement of scientists was crucial to provide a sound foundation for decision-making processes in the area of environmental protection and remediation.

The national experience related to the MONET monitoring networks was also successfully tested and disseminated abroad, namely in the African and CEE regions, and results of these studies provided data for the Global Monitoring Plan and the first effectiveness evaluation report prepared for the Stockholm Convention's 4th Conference of the Parties in 2009.

The GENASIS database is currently a nationally recognized information system in the environment: it not only provides data on environmental concentrations but also information on the properties, behaviour and hazards related to these compounds, as well as information enabling to build models supporting decision-making processes at various levels. We are fully convinced that the model used in GENASIS is viable beyond the management of POPs and we are currently extending the analytical instruments to cover other toxic chemicals and their impact on the environment.

SAFE PLANET

By Barbara Benish, Director, ArtMill / Art Dialogue, Czech Republic

Art Dialogue is a small non-profit organization based in the Czech Republic working closely with the United Nations Safe Planet Campaign to raise public awareness about hazardous chemicals and wastes. Since 2010, Art Dialogue has facilitated nine Arts and Outreach Initiatives for Safe Planet in Mexico, Canada, the USA and at the 5th Meeting of the Stockholm Convention's Conference of the Parties in Geneva, Switzerland. It is our belief that culture –be it visual media, performing arts, music, etc.- can open the mind and soul of the public to complex issues in a way that other forms of communication cannot. In our experience, harnessing the arts as a vehicle for education is a non-threatening approach that can be persuasive by its unique ability to deeply affect the observer with beauty, intelligence, humour and raw content. This approach has proven particularly successful with youth.

Our success story took place on an island in the middle of the Pacific Ocean. Art Dialogue teamed up with 5 Gyres Institute to attend the 5th International Marine Debris Conference, organized by UNEP and NOAA in Honolulu, Hawai'i in March of 2011. We organized a public symposium, film night, state-wide art contest and an exhibition of international artists. Over a one-week period these events demonstrated the power of art to raise awareness and emotional intelligence about pressing environmental crisis, particularly focusing on plastic pollution in the oceans, POPs and the uptake in marine life.

The event at the University of Hawai'i Mānoa included the art exhibition *The Architecture of Plastic Pollution,* featuring artworks that look at the danger and history of marine trash from a conceptual basis via photography, sculpture, installation, film and spoken word. Further, these creative works illustrate the links between consumer waste, plastic production and chemical pollution from POPs. Hundreds attended the symposium *Art & the Ocean* focusing on native Hawaiian practices of land and sea stewardship introduced by *Jonathan Kay Kamakawiwo'ole Osorio,* a talk by Stiv Wilson of 5 Gyres on their recent expeditions to research the distribution of plastic pollution in the world's oceanic gyres, and a keynote by Captain Charles Moore.

Thousands more heard about our events from the radio and newspaper press our activities generated. Many more gathered for a night of films at a downtown Honolulu gallery, featuring ocean rower and eco-warrior Roz Savage.

While the general public in Hawai'i was reading about what was happening at the Marine Debris Conference in Waikiki, they were not granted direct access. At Safe Planet's events, local residents and international visitors alike had the opportunity to come and enjoy art, listen to the speakers, and participate in discussions.

Youth Art Contest

The most moving success of all Art Dialogue's activities in Hawai'i was the state-wide Art Contest, which in a short three months reached over 12,000 youth, challenging them to design a new, non-plastic bag and dispenser. Working with the Hawai'i State Department of Education and a network of academics and local environmental groups, we teamed up to spread the word on plastic pollution, bringing home the hypothesis that social change is possible through community and personal contact.

We were able to speak to the children about these topics as the contest was running, via skype conference discussions before our arrival, and then in person at the schools. Many teachers were able to incorporate the chemical hazards issues into their curriculum.

At Mid Pacific School in Honolulu, teacher Lucy Sanders' 4th and 5th grade students spoke to me about traditional Polynesian tools and musical instruments that they had been learning about and how those materials were sustainable. The ethnographic history of bio-degradable tools easily transferred to our Art Contest proposal to make a sustainable shopping bag. This is but one way to utilize existing school curriculums globally for outreach to youth on issues of hazardous chemicals and wastes. Of the six contest winners, 5th grader Keawe Saizon is from one of the most economically deprived spots on the island of Oahu, Waiahole. His teachers reported that after learning he was a winner, he was a changed boy, full of life with an interest in the environment around him.

The Safe Planet events in Honolulu were commissioned by the Secretariat of the Stockholm Convention, and additionally supported by in-kind contributions and dozens of donated hours of time from Art Dialogue, 5 Gyres, and the other Hawaiian NGOs.

© Chris Jordan

Midway, by Chris Jordan

Perhaps the more important result of the event is that Safe Planet established a permanent outreach network in Hawai'i. We are invited back in 2012, and working with dozens of NGOs, and scientists at the University hope to reach all 180,000 students through the Hawai'i State Department of Education. This has lasting implications in educating the public on changing the way we see and live in the world to protect it for the next generation.

The Honolulu events built upon the earlier successful art contest at the Technological University in Cancun, Mexico, also sponsored by the Stockholm Convention during UNFCCC COP16.

Conclusion

Through the arts, we can challenge our perceptions of the safety of certain chemicals and wastes and stimulate new thinking about how each individual can take responsibility for the protection of the environment and human health. Art Dialogue's Safe Planet Art and Outreach activities have given us a confirmed example on how to affect communities around the world, via creative and personal connections to places and peoples. Our stories, if not personal, mean nothing. And our impact in each place should not be momentary, but lasting.

If Safe Planet's events and exhibitions touch people in various countries in a meaningful way and leave infrastructures in place to continue that process, then we are creating positive change for the future. Art brings inspiration and hope, helps youth in problem-solving by expanding their imagination, and challenges out-moded ways of thinking and feeling about the environment.

SafePlanet

© University of Cancun, Mexico

Students learning about plastic marine debris ingestion at Safe Planet's exhibition "What Will Be" at the Technological University of Cancun, Mexico, in December 2010 (for UNFCC COP16)

CHAPTER 3:

HEALTH BENEFITS FOR CHILDREN, WOMEN AND WORKERS

HUMAN EXPOSURE TO POPS ACROSS THE GLOBE: MONITORING RESULTS AND HUMAN HEALTH IMPLICATIONS

By Dr. Angelika Tritscher, Department of Food Safety and Zoonoses, World Health Organization (WHO)

Introduction

Persistent organic pollutants (POPs) are recognized as chemicals of global concern due to their propensity to long-range transport, persistence in the environment, and ability to bio-accumulate and bio-magnify in ecosystems as well as having significant negative effects on human health and the environment.

Humans are exposed to these compounds by many ways: through the food they eat, the air they breathe, through the environment, and in workplaces. For many POPs, e.g. dioxin-like compounds, food is the major source of human exposure. Many products used in our daily life may contain POPs, which have been added to improve their properties, for example as flame retardants or surfactants. As a result, POPs can be found virtually everywhere on our planet in measurable concentrations, including in our bodies and in human breast milk. There is sufficient evidence that long-term exposure, for some compounds and scenarios even to low levels of POPs leads, among others, to increased cancer risk, reproductive disorders, alteration of the immune system, neurobehavioral impairment, endocrine disruption, genotoxicity and increased birth defects.

In 2001, when the Stockholm Convention was adopted, only limited measured information was available on the actual human exposure to POPs, focusing mainly on developed countries and certain POPs, e.g. PCDD/PCDF. There was virtually no reliable biomonitoring information available from developing countries. In 2005, at the second meeting of the Conference of the Parties to the Stockholm Convention, it was recognized that human biomonitoring is essential to evaluate whether the main objective of the Convention –to protect human health and the environment from POPs- is achieved, and whether the exposure to POPs is indeed decreasing over time. In addition, monitoring of human breast milk allows countries and regions to identify contamination problems as well as take targeted measures to reduce and prevent exposure to these chemicals.

Building on the experience of the previous World Health Organization POPs breast milk monitoring studies, WHO and the United Nations Environment Programme (UNEP) jointly implemented a global study to monitor changes in human exposure over time. The survey measures POPs levels in human breast milk according to a standardized protocol, and is implemented in a wide range of countries with large differences in food consumption patterns and environmental levels of POPs. This long-term programme is part of a comprehensive Global Monitoring Plan for POPs established under the Stockholm Convention.

Scope and implementation

Early surveys performed by WHO in Europe and North America in 1987-1989 and 1992-1993 exclusively focused on PCBs, PCDDs and PCDFs. In 2001-2003, a larger global survey was implemented, covering the 12 POP compounds initially listed in the Stockholm Convention. The Conference of the Parties to the Stockholm Convention decided at its third meeting in 2007 that human milk and human blood, as well as ambient air, are the core media to be monitored under the Global Monitoring Plan. Therefore it was agreed to perform the 4th and 5th rounds of the survey in close collaboration between WHO and UNEP, as a joint study in support of the Stockholm Convention and funded through the Stockholm Convention Voluntary Trust Fund. These two additional global surveys were completed in 2005-2007 and 2008-2010, by significantly enlarging the geographical scope of the study to provide representative results for all regions of the globe.

Thirteen countries took part in the survey between 2005 and 2007: Belgium, Cyprus, Czech Republic, Fiji, Finland, Haiti, Hungary, Kiribati, Luxembourg, Norway, Slovakia, Sudan and Sweden. Furthermore, 23 countries participated in 2008-2010: Antigua and Barbuda, Australia, Chile, Democratic Republic of Congo, Georgia, Ghana, Hong Kong SAR, India, Ivory Coast, Kenya, Republic of Korea, Lithuania, Mali, Mauritius, Moldova, Nigeria, Senegal, Switzerland, Syria, Tajikistan, Tonga, Uganda and Uruguay.

In order to promote reliability and comparability of results, samples were collected by the participating countries following a comprehensive protocol. Individual milk samples were mixed to form a standardized pooled sample, which was analyzed for the 12 POP compounds and

WHO Milk Survey logo

their transformation products. All samples were analyzed by the WHO reference laboratory. In addition to these results, pooled samples from participating countries were archived and analyzed for the ten new POPs added to the Stockholm Convention in May 2009 and April 2011, as well as for other chemicals under consideration by the POPs Review Committee. These results constitute a comprehensive baseline against which trends in POPs levels over time can be measured to assess whether the Stockholm Convention achieves its objective to protect human health from POPs.

Results

The human exposure data show that elevated levels of industrial contaminants or by-products of burning processes like PCDDs/PCDFs, PCBs and HCB are mostly found in Europe, India and some African countries, whereas (sub)tropical countries have a tendency to elevated DDT levels.

These results confirm that the islands of the Southern Hemisphere have comparably low levels of PCDDs, PCDFs as well as dioxin-like PCBs. In Africa, the widest variation in contamination of human milk was observed with distinct differences between PCDD/PCDFs and PCBs. Kenya and Uganda clearly have the lowest levels observed in this study for both groups of compounds. In contrast, West and Central African countries like Ivory Coast, the Democratic Republic of Congo, Ghana, Mali, Nigeria, Sudan and Senegal have much higher levels of PCCDs/PCDFs in human milk, which can be more than four times higher as those observed in the East African region.

As for DDT, the highest levels were found in tropical and sub-tropical countries: Hong Kong, Ivory Coast, Sudan, Uganda, Moldova, Mali, Mauritius, Haiti, India and Tajikistan. This distribution must clearly reflect its use in relation to the occurrence and prevention of malaria in these regions.

In comparison to DDT, the levels of other chlorinated pesticides are low. For example, aldrin and endrin (including endrin ketone) were not found in any of the human samples. Mirex was not detectable in the majority of cases, except in one region. Toxaphene was not detected in about half of the countries included in the surveys.

The levels observed in human breast milk have been compared with the WHO safety standards, with the conclusion that in many countries the levels of dioxin-like compounds are above those associated with these standards, further indicating the need for source directed measures to reduce human exposure.

The detailed results are available at http://chm.pops.int.

Conclusion

Over the last decades, a difficult discussion has taken place regarding the benefits versus risk of breastfeeding in relation to the presence of POPs in human milk. There is compelling evidence that breastfeeding significantly reduces infants' mortality and morbidity in the first year of life. The WHO has always supported breastfeeding because of its positive health aspects for the newborn. Nevertheless, discussions about benefits and risks continue. From a risk assessment point of view, the major question is whether positive health effects by breastfeeding outweigh the adverse effects that may be expected from the levels of POPs in human milk observed in these surveys.

The underlying scientific evidence for positive health effects of breastfeeding has to be taken into consideration and balanced against the possible observed adverse health effects. This is a very difficult task taking into consideration the various uncertainties in analyzing health risks, for instance the concurrence of many POPs in human milk which makes it often difficult to identify the actual causal agents for an observed effect in the breastfed infant.

Based on the current state of knowledge, it can be concluded that while the beneficiary effects of breastfeeding are likely to persist into later life, most POP-related negative effects are mostly transient in nature and less clinically relevant. Nevertheless, some worrisome adverse health effects were observed, for instance the association between dioxin-like compounds in human milk and reduction of cognitive performance, which may persist in later life. Further complexities may arise when taking into account the effects of multiple interactions among all POPs measured in human milk.

Therefore, all efforts should be directed to further reducing human dietary and environmental exposure to these POPs. The results of the surveys show that such remedial actions are necessary in all regions of the globe.

HOW THE STOCKHOLM CONVENTION TRIGGERED POSITIVE CHANGE IN SENEGAL

By Fagamou Sy Diop, National coordinator of the SAICM project on Prevention and Preparation for Industrial Chemical Accidents, Department of Environment, Ministry of the Environment and Nature Protection, Dakar, Senegal

Introduction

In most African developing countries, people live in hard socio-economical conditions which don't give them any choice or decision-making power when it comes to protecting their environment. These people, who are essentially farmers, use a lot of chemicals to increase their agricultural production or to combat endemic vector diseases. Some of these chemicals are Persistent Organic Pollutants (POPs), which are regulated by the Stockholm Convention.

Senegal is one of these countries, located in West Africa. Fortunately, in order to protect its population and nature, the government of Senegal signed and ratified the Stockholm Convention early on (respectively on 23 May 2001 and 8 October 2003). Since then, practices in using and releasing POPs substances have started to change progressively.

Upon having become an effective party to the Stockholm Convention on 17 April 2004 and developed its National implementation Plan one year later, a number of projects have strengthened the capacity of Senegal to address the issues related to POPs.

For instance, projects[7] are being or have been implemented to regulate and phase out the use of DDT in controlling vector diseases. This is a priority concern for Senegal, which is a tropical country where malaria is endemic and should be combated in an environmentally rational way. Such projects consider options for using non-chemicals alternatives, for instance through the use of non-POPs insecticides-treated bed nets; they often build on traditional practices coming from rural areas (bio-insecticides), which have proven effective. These options should be encouraged until our country reaches the total ban of POPs chemicals.

Among all the initiatives taken by Senegal to reduce the presence of POPs substances in the environment, the Project of Mercury and Dioxins management in Biomedical Wastes Disposal will feed our following case study.

[7] Among the projects addressing the use of DDT, we can mention the USAID (United States Agency for International Development) Programme, ongoing since 2007 and dealing with insecticide indoor residual spraying; or the Programme on malaria control using sustainable methods of Prevention and Control, in conformity with the Stockholm Convention, which was launched in September 2011 by Pan Africa, an African NGO dealing with pesticides management.

Problem statement

The health sector is a major source of dioxins and mercury in the environment, primarily as a result of medical waste incineration and the breakage and improper disposal of mercury-containing devices such as thermometers.

A project, funded by the GEF (Global Environment Fund) under the coordination of the Department of Environment of the Ministry of Environment and Nature Protection of Senegal, has been implemented since 2008 to reduce dioxins emissions in the environment, by experimenting best environmental practices and best environmental techniques in biomedical wastes disposal.

How the issue was addressed

The project promotes the following methodology:

- Establish model facilities exemplifying best practices of biomedical wastes management which reduce or eliminate dioxins and mercury emissions in the environment;
- Deploy appropriate commercially-available, non-incineration health-care waste treatment technologies;
- Establish capacity-building and training programmes for best practices and appropriate technologies implementation, building on the work of the model facilities;

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Building for rational treatment of biomedical wastes, under construction, in one of the hospitals selected for the pilot project

- Review relevant policies, seeking the agreement of relevant authorities on recommended best practices and best treatment technologies, to allow their replication and institutionalization at national level;
- Dissemination of results on demonstrated best technologies and practices to relevant stakeholders, and to scale up regionally and globally.

Implementation of the approach

Three hospitals in the sanitary districts of Dakar (the capital city of Senegal) have been selected to host the pilot project. The first hospital is situated in an urban area, the second between an urban and a rural area and the third one is in a rural area.

The three pilot hospitals have put in place the following actions:

- The incineration of biomedical wastes has stopped;
- The health-care wastes are sterilized in autoclaves and crushed in grinders. Thus they become less dangerous and can finally be disposed, as simple household wastes, in municipal landfills.

© Ousmane Sow

Vertical autoclave

- The staff of the hospitals has been trained on new techniques of health-care wastes treatment and on how to maintain the new materials to last longer;
- The awareness of local communities and the State decisions makers have also been raised to ensure the sustainability of the project.

Outcomes

The population and the environment are not exposed to dioxins emissions anymore and are healthier. As for the selected hospitals, they have gained new health-care wastes treatment equipments and become cleaner, while learning about new techniques of health-care wastes disposal without using incinerators.

Coordination has also been established between the Ministry of Health and that of the Environment, in order to solve a common sanitary and environmental problem. Finally, local communities and the private sector are more sensitized to participate in replication projects, in order to cover the whole territory with such improved practices.

© Ousmane Sow

Horizontal autoclave

Lessons learned

This project has proven to be successful despite some backlogs, such as the delay experienced in acquiring the health-care treatment technology and in receiving national matching funds.

This project is one of the flagship projects showing that Senegal is making every possible effort to protect the health of its citizens and their environment from POPs and thus that good progress has been made to implement the Stockholm Convention.

Thanks to the project and the funds received to implement the Convention, the activities will be replicated in Senegal in other sanitary districts and hospitals which showed an important interest in the project. This will be favoured by the willingness of the Senegalese Government to place the extension of this initiative in its national priorities.

CASE STUDY: MEXICO - ENVIRONMENTALLY SOUND MANAGEMENT AND DESTRUCTION OF POLYCHLORINATED BIPHENYLS (PCBS)

By Dr. Suely Carvalho, Chief, Montreal Protocol Unit and Principal Technical Adviser on Chemicals, Environment and Energy Group, Bureau for Development Policy, United Nations Development Programme (UNDP)

And Eduardo Enrique Gonzalez Hernández, Director General, Integrated Management of Risky Materials and Activities, Ministry of Environment and Natural Resources (SEMARNAT), Mexico

Introduction

Mexico signed the Stockholm Convention on 23 May 2001 and ratified it on 10 February 2003, becoming the first Latin American nation to ratify the Stockholm Convention. Environmentally sound management of PCBs and their safe phase-out are national priorities as outlined in Mexico's National Implementation Plan (NIP) for the Stockholm Convention, which was submitted on 12 February 2008.

The Federal Ministry of Environment of Mexico (SEMARNAT), with support from GEF and UNDP, is working towards eliminating the threat from PCBs to human health by instituting a necessary legal framework, building capacity, raising awareness and piloting innovative schemes to cost-effectively manage and destroy PCBs. These efforts aim to implement activities to ensure Mexico's compliance with Stockholm Convention requirements for PCB management and destruction through the follow-up to the NIP, thereby minimizing risks of exposure from PCBs to Mexicans, including vulnerable populations, and to the environment.

In Mexico, the national inventory originally estimated about 31,000 tons of PCB-containing materials above the norms, indicating that the whole country is affected by PCBs. As some of the sources of PCBs are located in populated areas and sensitive sites such as hospitals, water supply wells, education establishments, etc., the PCBs have a potential to adversely affect society, especially children and workers, if left unchecked and unmanaged. Considering the extent of the PCB issue and the potential risks to human health and the environment, in 2009 the Government of Mexico and UNDP initiated a project, co-funded by GEF, to address the situation.

The project, executed in partnership with SEMARNAT, aims at strengthening the capacity for a sound management of PCBs, materials and equipment which may contain or may be contaminated by PCBs. To achieve these goals, the project is implementing various activities, ranging from a legal review and an inventory of PCBs to piloting innovative schemes for PCB management and destruction as well as raising awareness on the health and environmental consequences of poor PCB management. The project is also expected to destroy 3,215 tons of PCBs, which constitute about 10.6% of the total estimated remaining national inventory.

PCB inventory verification

The first stage of the national PCB inventory verification undertaken by the project has found PCB containing oils (over 50 ppm and most of it under 600 ppm) in approximately 5.7% of the transformers when sampling and analyzing oils in 1,900 transformers in 618 sites located in 19 (out of the 32) states in the country. Inventory verification shows that there could still be more than 45,000 tons of PCB containing materials in the country. Moreover, half of the samples with PCBs come from sensitive sites: hospitals, water supply wells for agriculture and cities, food processing facilities and education centres. PCBs have been found in 9 out of 105 transformers sampled in 39 hospitals, while 8 out of 109 transformers sampled in water wells had traces of PCBs. Transformers at airports and railroad installations were also sampled, while transformers in water wells and hospitals in rural communities have yet to be sampled in detail.

Policy strengthening for PCB management

Based on the analysis of the current management practices and a regulatory gap assessment, the project has proposed a revised technical Standard for PCB management. The proposed Standard, as a federal regulation, will emphasize the control of electrical maintenance workshops at municipal and provincial levels, in order to assure proper management of PCBs-containing oils by avoiding poor management practices resulting in further PCB cross-contamination of transformers in Mexico. This revised Standard has been presented to federal authorities in November 2011, for review and adoption.

Reduction of PCB risks at electrical maintenance workshops

Project activities in pilot areas enabled to reveal that the main source of PCB-containing materials is the cross-contamination caused by bad practices of electrical maintenance workshops. The project has developed a general recommendations document for small and medium-size enterprises (SME) on how to manage their electrical transformers, particularly urging them to select for servicing those maintenance workshops which assume responsibility and undertake necessary correction measures in case PCB contamination is detected.

Since concentration of PCBs in oils is mostly below 600 ppm and 30% of samples in the inventory contain levels of PCBs between 5 and 50 ppm (which indicate cross-contamination related to electrical maintenance workshops), the project analyzed the hazardous waste management practices at seven maintenance facilities. Based on the findings, the project put forward recommendations to lower exposure risks for employees handling PCB-containing materials and to ensure overall environmentally sound management of PCBs and other hazardous waste at these facilities. These recommendations were further refined on the basis of the experience during the training of over 40 workers of these facilities and a "Best practices technical guide for electrical maintenance workshops" has been developed.

Capacity-building and awareness-raising

The project is supporting the strengthening of government and private entities' capacity regarding inspection and chemical analytical techniques. For example, targeted two-day training sessions for over 350 participants from authorities at federal, state and municipal levels, SMEs, chemical laboratories and even fire and civil protection services have been organized; a guide on best practices for PCBs inspection for local level authorities has been prepared. In order to stimulate the responsible PCB waste management and increase awareness among SMEs, the project has publicly acknowledged the non-existence of PCBs in about 500 enterprises and sensitive sites operators during events gathering representatives of local authorities and press coverage to raise awareness.

Community-level benefits

SEMARNAT's earlier study in the community of San Felipe Nuevo Mercurio (population of 300 inhabitants) in the state of Zacatecas found above-limits PCBs content in the blood level of the population. As a particular case, during the inventory of PCBs in the country, the project confirmed SEMARNAT's information that people in a poor community used barrels, formerly used for storage of illegally imported PCB contaminated oils, as building materials and water containers. As part of the awareness and outreach efforts, the project has disposed and replaced 252 tons of PCB-contaminated materials in this small community.

Integrated Services Management System (ISMS) for PCB disposal

The high cost of destroying small quantities of PCBs is a barrier for small and medium-sized enterprises and operators of sensitive sites, since they cannot take advantage of the economies of scale with respect to costs of transport, interim storage and decontamination and/or destruction. Therefore, the project has devised a PCB management system that envisages different actions, from identification of PCBs, their safe storage and transport through to their destruction and appropriate reporting to government. The ISMS also includes capacity-building of inspection authorities and analytical laboratories as well as an awareness-raising and communication strategy.

Among the benefits, this will allow a large number of PCB possessors to pool their waste and achieve environmentally sound disposal of PCBs at a reasonable cost. The ISMS was developed and tested as a pilot in the State of Guanajuato (5.5 million inhabitants) and in Cuautitlán Izcalli (a municipality with 600,000 inhabitants). The ISMS is being further tested and refined in three other states of the country: Nuevo Leon, Chiapas and Distrito Federal (Mexico City) with a view of being later expanded to the whole country. Through the ISMS, 33 tons of contaminated transformers and oils have been destroyed directly, another 30 tons were eliminated by companies, 252 tons of contaminated materials were eliminated in the small community and 337 tons incorporated at the official register. Results so far demonstrate that the unit cost of destruction for pooled PCB waste (where companies can bring as little as one piece of equipment) is already 25% lower than before the project and is starting to approach the cost for large possessors of PCB-containing equipment, like Mexico's Federal Electricity Commission (CFE).

Lessons learned / conclusion

The experience of the project so far demonstrates that, in order to sustainably manage PCBs use and destruction without harm to human health and environment, it is essential to adopt a comprehensive approach to the issues, particularly considering the size of the country

Decontamination operation of a transformer in a sensitive site in Mexico State and the dispersion of contaminated equipment. It is important that the destruction activities are economically feasible and have an enabling regulatory environment. Active involvement and increased awareness of SMEs and sensitive sites operators will help to ensure the absence of illegal and improper use of PCB-containing materials, as well as control of maintenance activities to prevent further cross-contamination. The results of the project will assist SEMARNAT in implementing the sound management of PCBs at a national scale.

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Decontamination operation of a transformer in a sensitive site in Mexico State

HOUSE DESIGN MODIFICATIONS FOR "MOSQUITO-FREE HOMES": AN INNOVATIVE, EFFECTIVE AND ENVIRONMENTALLY SOUND ALTERNATIVE TO DDT

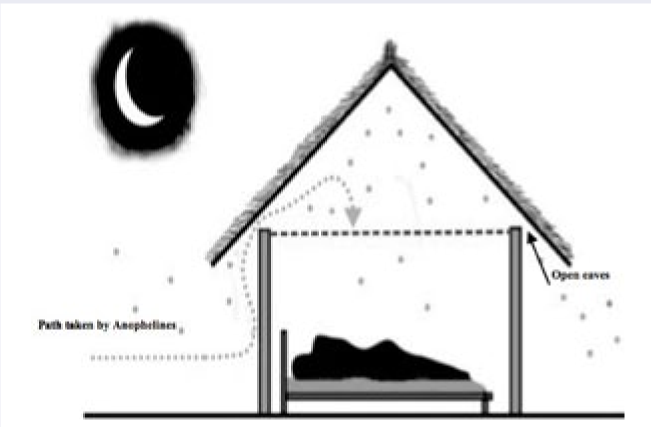
By Harrysone Etemesi Atieli, Kenya Medical Research Institution, Kisumu, Kenya

Introduction

Simple non-chemical modifications of a typical rural house design can be an effective and relatively inexpensive method of reducing indoor mosquito vector densities and consequently decreasing malaria transmission (Lindsay *et al.,* 2002, 2003, Kirby *et al.*, 2008c, Atieli *et al.,* 2009). In most parts of Africa, entry and feeding by the principal malaria vectors, *An. gambiae* and *An. funestus* takes place indoors (Githeko *et al.,* 1994b). As a result, vector entry rates and hence malaria transmission is affected by poor quality housing which has long been associated with ill health (UNCHS, 1996). Thus, improved housing construction by simply installing a ventilated ceiling could go a long way to prevent malaria, which is killing millions of people every year.

Problem Statement

The high malaria burden in sub-Saharan Africa justifies not only 'home grown' affordable and long lasting malaria control strategies, but also implementation of comprehensive efforts on intervention strategies. In recent years, malaria control programmes have scaled-up the use of



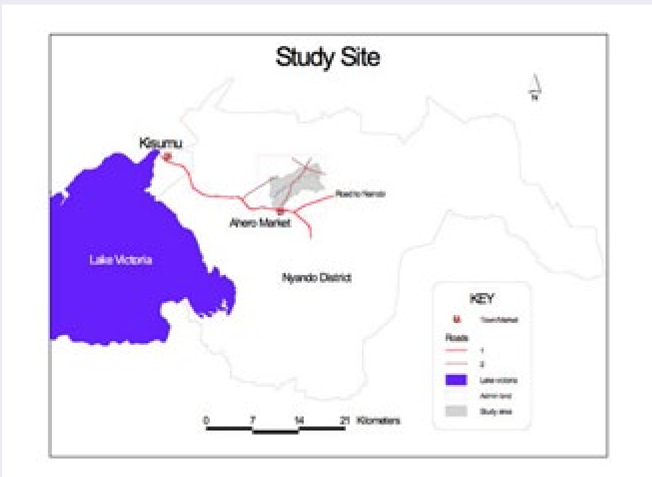
Malaria mosquito pathway into houses

chemical vector control strategies through provision of free Insecticide Treated Nets (ITNs), Indoor Residual Spraying (IRS) using chemicals such as DDT, and permethrin-based chemicals and drug use with reported decrease in disease incidence (Okiro *et al*., 2008, 2010). However it has been observed in past control programmes that the vectors are changing biting behaviour, developing resistance to the insecticides and the malaria parasite is developing resistance to drugs (Morgan *et al.,* 2010, Koekemoer *et al.,* 2011).

On that note, there is an urgent need for the development of alternatives or supplementary methods to anti-malarials and chemicals/insecticides for controlling malaria. Although the importance of housing for health is recognized (UNCHS, 1996, UNDP, 1996, WHO 1998), few well-designed studies have quantified its impact on malaria vectors control, especially in the developing world. This new and innovative malaria control strategy can be applied in a number of ecosystems and environments, particularly in irrigation schemes, flood plains, near micro-dams and indeed in the highlands where malaria is now a threat. This strategy will play a role in saving the environment from over 4,000-5,000 tons of DDT used each year and with reported increase in production from China and North Korea, if successfully adapted as a complement in malaria control.

Objective

The objective of the study, funded by the University of California, Davis, Department of Entomology, was to determine the effects of a house design modification of a typical rural house using chemical-free local papyrus reeds mats as ceilings, on the densities of indoor resting malaria vectors in a malaria-endemic rice irrigation scheme, located in the lowlands of western Kenya.



Study site (in grey)

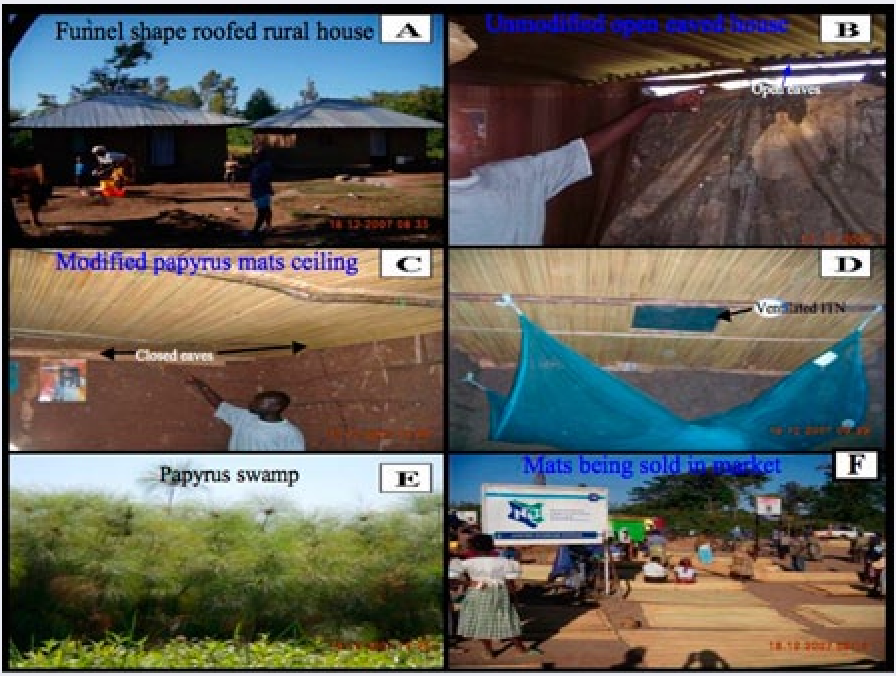
Methodology

Twenty houses were selected randomly for the study. Ten houses were assigned intervention and the other half were used as controls.

Intervention houses were fitted with locally made and available ceilings from papyrus mats known locally as *majamvi*. The ceiling was fixed below the open eave to provide a mechanical barrier to vectors entering through the eaves, thus preventing them from entering the living areas of the house. Eaves remained open to allow vectors entrance to roof space, but not down into the living area.

A small 1.5 feet square opening was made through the ceiling inside the sleeping room and fixed with insecticide-impregnated mosquito netting as a chemical barrier to vectors trying to enter into the living area. The ITN acted as a decoy trap. Presumably, host odours from the room pass up through the netting and out the eaves, attracting mosquitoes into the roof space. The ITN was meant to kill vectors that came into contact with it.

This design, combining papyrus mats ceilings and ITN, was intended to use a smaller amount of insecticide and netting material than in an IRS or 100% ITN strategy. It also provided important information for specialists seeking to reduce malaria transmission with vector control using reduced amounts of POPs.



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Control houses were not treated (no papyrus ceiling or fitted ITN were used), but they were sampled at the same frequency and using the same patterns as treated houses, and they fulfilled identical eligibility criteria.

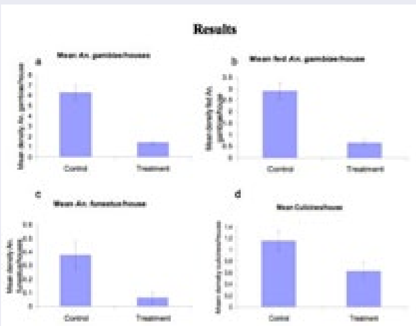
Outcome / impact

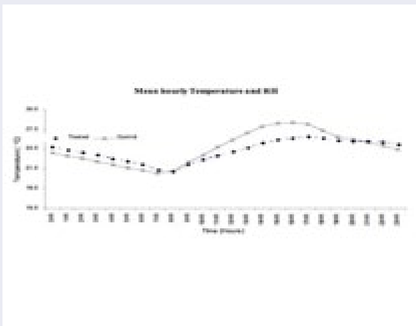
Papyrus mats ceilings-modified houses significantly reduced the entry of indoor malaria vectors densities by between 78-80% for *An. gambiae s.l.* and 86% for *An. funestus* compared with unmodified houses.

Although a minute amount of insecticide was used in the ventilation screens, this mosquito control strategy is effective, sustainable and affordable. In addition it lowers indoor temperatures during the day and keeps the houses warm during the night, making residents respond favourably to this mode of vector control.

Conclusion

House modifications involving insect screen ceilings and smaller ITN incorporated in house construction have the potential to reduce human exposure to malaria vectors, and thus parasite infection in malaria endemic regions and likewise reduce the use of chemicals in the environment. Ceilings made from locally available materials are likely to be well accepted. Currently there is an ongoing study funded by BioVision to demonstrate and evaluate the acceptance and viability of this strategy. This study may be of greatest benefit when used in combination with other environmentally sound malaria control strategies. There is a need to carry out a larger field trial of this strategy to determine to what extent it can reduce malaria transmission/disease incidence and also to determine its sustainability in different ecosystems.





Among other benefits of the strategy as a non-chemical option for sustainable development would be the economic benefit/ empowerment to women groups who weave mats, as there would be an increased demand and a market for their papyrus mats. Likewise, the local population would be educated about the fact that swampy areas such as those covered with papyrus swamps do not support the breeding of malaria vectors, as these vectors thrive well in open well sun-lit habitats (Minakawa *et al.,* 2005, Munga *et al.,* 2006, 2009). In that case, swamps should be sustained and used as a source of income and larval source management strategy for vector control (Wamae *et al*., 2010).

INTEGRATING LARVAL SOURCE MANAGEMENT IN THE NATIONAL MALARIA CONTROL PROGRAMME IN ZAMBIA

By Emmanuel Chanda, Chief Entomologist, Ministry of Health, Lusaka, Zambia

Executive Summary

In Zambia, indoor residual spraying and insecticide treated bed nets are deployed for malaria vector control. The supplementation of these interventions with Larval Source Management has enhanced their efficacy by suppressing the abundance of vectors, particularly in urban areas. The mean densities of larvae reduced from 45 per 250 ml in 2003 to 1.2 in 2010 and that of adults reduced from 1.7 per room in 2003 to zero in 2010 in urban areas. In rural areas, an average of 9.7 adult *Anopheles mosquitoes* was demonstrated. Malaria prevalence reduced from 25.3% to less than 1% and was suppressed at the same level with Larval Source Management. This has enhanced the acceptability of other vector control interventions by communities. Larval Source Management has been successfully integrated as a complementary tool and an indispensable resistance management strategy for the malaria control programme. However, insecticide resistance surveillance and determination of underlying mechanisms is essential for rational resistance management. Country-specific guidelines and information, communication and education materials are critical to facilitate objective deployment of interventions and enhance community participation.

Female Anopheles mosquito

Background

Zambia implements an Integrated Vector Management (IVM) strategy for malaria vector control, using insecticide treated bed nets (ITN) and indoor residual spraying (IRS)[8]. However, the Stockholm Convention on Persistent Organic Pollutants promotes countries using DDT for malaria vector control to augment their efforts through implementation of alternative products, methods and strategies; development of safe alternative chemical and non-chemical products, methods and strategies; and ensuring that viable alternatives present less risk to human health and the environment.

Larval Source Management (LSM) is the application of environmental management and the use of mosquito larvicides to prevent the development of adult mosquito vectors. The use of microbial mosquito larvicides in the context of LSM offers an alternative with very low risk to human health and the environment[9]. The integration of LSM into malaria vector control programmes offers the potential to significantly enhance the protection afforded by existing strategies[10]. General vector population suppression afforded by LSM may also reduce selection pressure towards insecticide resistance by reducing the rate of insect-chemical contact in localized populations.

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A community resource person applying Bacillus thuringensis var. israelensis to the canal

In this regard, Zambia is supplementing IRS and ITNs with LSM, using larviciding with microbial larvicides coupled with environmental management where applicable, as alternative interventions.

Methods

In 2004 the National Malaria Control Programme (NMCP) introduced the IVM strategy in accordance with the WHO steps towards implementation[11]. The systematic introduction of LSM began with the launch of environmental management in October 2005 in Lusaka. In 2007, studies to evaluate the efficacy of larvicides; *Bacillus thuringensis* var *israelensis*, Temephos and Insect Growth Regulators were conducted in accordance with the WHO guidelines for Laboratory and Field Testing of Mosquito Larvicides[12]. Feasibility assessments for the integration of larviciding in the malaria control programme were conducted in Lusaka by Durham University, Valent BioSciences and WHO in 2008[13].

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The entomology team monitoring mosquito densities

A stakeholders' consensus meeting to scaling up LSM (larviciding and environmental management using land reclamation, drainage clearing and filling) within the IVM context was conducted in January 2009[14]. This was followed by LSM needs assessments and its implementation in eight urban districts. In April 2009, biological control using *Gambusia affinis* fish was launched in Lusaka as part of the IVM strategy. In 2010 the Larviciding programme scaled up to 15 districts in Eastern and Northern provinces, with further scale-up planned. Entomological and epidemiological surveillance, including insecticide resistance monitoring, was introduced to consolidate the gains attained in malaria control.

Results

The marked suppression of the mosquito abundance by LSM has been demonstrated in Lusaka Urban district. The densities of mosquito larvae reduced from 45 per 250 ml in 2003 to 1.2 in 2010. The density of adult mosquitoes in the same area reduced from 1.7 per room in 2003 to zero in 2010.

At Mutenguleni, a rural area in Eastern province, the average indoor density of *Anopheles mosquitoes* remained high at 9.7 during the rainy season, following intensive LSM programme.

The prevalence of malaria in Lusaka urban district was 25.3% in 2003, with the introduction of IRS and ITNs; this was reduced to less than 1% in 2010 and maintained at this low level with LSM.

[14] MoH (2009) Integrating Larval Source Management in the National Malaria Control Programme. A stakeholders consensus meeting Report. January 2009.

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Health workers conducting a malaria parasite prevalence survey

The benefits of LSM have translated into enhanced acceptability of IRS and ITNs by community members in urban areas. High level insecticide resistance to DDT and pyrethroids has been detected in: *An. gambiae s.s, An. arabiensis and An. funestus*, the major malaria vectors in the country.

Discussion

This study demonstrates the effectiveness of LSM in sustaining low levels of malaria prevalence and vector densities. However this success cannot be ascribed to LSM alone, as IRS and ITNs have been deployed extensively.

In sub-Saharan Africa, the ubiquitous nature of breeding attributes of major malaria vectors precludes the amenability of LSM in rural areas, particularly in the rainy season. Successful LSM should be deployed in a discreet, targeted and highly organized fashion appropriate for the location and ecotype, particularly in urban and peri-urban areas.

LSM strategies have contributed markedly to reductions of malaria transmission in urban areas[15]. Integrated and well-managed larval control strategies (environmental management and larviciding) have historically shown to be successful at controlling malaria, as staged during the early 1900s in Zambia[16].

Following the detection of high levels of insecticide resistance in major malaria vectors[17], LSM will be an essential resistance management strategy for the malaria control programme. However, guidelines and information, education and communication (IEC) materials are still lacking for the LSM strategy.

Conclusion

Zambia has successfully integrated LSM within the National Malaria Control Programme as an indispensable adjunct to effectively complement the contemporary frontline vector control interventions, i.e. IRS and ITNs. Insecticide resistance surveillance and determination of underlying mechanisms is essential for a rational resistance management strategy. Country-specific LSM guidelines and IEC materials are imperative for objective deployment and enhancement of community participation respectively.

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DEMONSTRATION OF SUSTAINABLE ALTERNATIVES TO DDT FOR MALARIA VECTOR CONTROL IN MEXICO AND CENTRAL AMERICA

By Jan Betlem, United Nations Environment Programme

Background

Malaria is a transboundary problem affecting most tropical countries. In Central American and Mexico, the main malaria vectors are A. Pseudopunctipenis, A. Albimanus, A. darlingi and A. Vestitipenis. It is estimated that 89,128,000 people in Mesoamerica live in areas environmentally suitable for the transmission of malaria, of which 23,445,000 (35%) live in highly endemic areas. Migration of infected people and environmental conditions such as rainfall patterns, altitude and temperature all facilitate the movement of the disease across national borders. Only an integrated regional approach can address the human and environmental challenges in malaria prone areas.

DDT is a persistent organic pesticide that has been extensively used as an insecticide for malaria vector control and in agriculture in Mexico and Central America since the 1950s. During the 1980s and the 1990s, concerns regarding environmental contamination by DDT compounds as well as the development of vector resistance to the organochlorine insecticides motivated the countries to initiate policies to gradually discontinue DDT sprayings.

DDT and its metabolites, especially p,p' DDE, are highly stable toxic compounds that persist in the environment for many years and can accumulate in living organisms. They can persist decades on soils in association with organic matter and clay particles. DDT is transported through the environment and can be carried to remote areas by the atmosphere as well, thus contributing to environmental contamination at a global level.

Concerns about DDT residues in water, sediment and soil, as well as in the food chain in Mexico and Central America contributed to the development of a project aiming at malaria vector control in Mexico and Central America without the use of DDT.

Achievements

The eight countries which participated in the project reported significant progresses in the implementation of the malaria vector integrated control model without using DDT or other persistent organic pollutants, comprised by several interventions aimed at the early diagnosis of the vector and timely treatment of malaria cases, with broad participation from the beneficiary population.

Key characteristics of the project:

Project name: Regional Programme of Action and Demonstration of sustainable alternatives to DDT for Malaria Vector Control in Mexico and Central America

Participating countries: Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua and Panama

Partners: United Nations Environment Programme (UNEP), Pan American Health Organization (PAHO), Commission for Environmental Cooperation (CEC) and ministries of Health of Belize, Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua and Panama

Cost of the project:

- Global Environment Facility co-funding: USD 7,495,000

- Co-funding from CEC, PAHO and governments: USD 6,410,000

Period of project implementation: 2003-2007

Website:

http://new.paho.org/hq/index.php?option=com_content&task=view&id=2712&Itemid=2172

The project was highly successful in adopting alternatives measure of vector control at the demonstrative areas, without using DDT. A multidisciplinary approach to the problem was adopted with the integration of professionals from different disciplines (medical doctors, epidemiologists, biologists, nurses, educators, communities, politicians, etc.). As a result, the amount of non persistent chemical insecticides used in vector control was also significantly reduced.

Major outputs of the project included:

a) **Strengthened institutional/individual capacities:** All countries have developed institutional capacity-building activities focusing on the introduction and promotion of alternative approaches/methodologies to vector control, through the training of national personnel and the delivery of specific equipment. Technical teams, national committees and local committees promoting alternative approaches were constituted. The local committees have been inserted in the structures of the Ministry of Health, using the technical and management experience of the malaria control programmes applying alternative approaches to DDT in vector control.

b) Knowledge products:

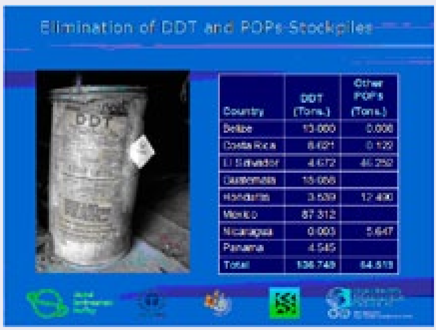
- Detailed data concerning malaria presence, malaria houses, repeated malaria cases, positive breeding sites, controlled breeding sites, Annual Parasite Rate (API), the larvae index, etc.;
- An operating monitoring and surveillance system;
- A Guide for the Implementation and Demonstration of sustainable alternatives for Integrated Control of Malaria in Mexico and Central America (Spanish and English versions);
- An Operational Manual for the control of the malaria vector through a multi-sectoral approach in various project countries;
- A guidance document: "The role of municipal government and community participation in the integrated management of the malaria vector without the use of DDT in Central America";
- An educational game for the integrated prevention and control of malaria at the household and community level without the use of DDT and other persistent organic pollutants;

First project component: Community participation to clean breeding areas

- Various country project intervention videos;
- Various community experiences/educational booklets and videos;
- A preliminary cost comparison between malaria vector control with DDT and malaria vector control with alternative approaches.

c) **New tools, materials or methodologies**: Alternative integrated and multi-sectoral technical approaches to DDT in malaria vector control with extensive community participation in the participating project countries.

Second project component: GIS survey of malaria cases



Third project component: Disposal of POPs pesticides stocks

REDUCTION OF HARMFUL RELEASES FROM HOUSEHOLD HEATING AND COOKING WITH OPEN WOOD STOVES IN MEXICO

This story provides an example of a government project to reduce emissions from open wood stoves, which are commonly used for cooking in Mexico. The replacement of this archaic cooking technology by "improved stoves" translates into lower releases of both unintentionally produced POPs and GHGs.

By Beatriz Cardenas, Director of Experimental Research in Atmospheric Pollution, Division of Research and Environmental Training, National Institute of Ecology, SEMARNAT (Ministry of Environment and Natural Resources), Mexico

More than half of the world's population uses solid fuels such as wood, crop waste or coal to meet their most basic energy needs for cooking, lighting, and heating. In most developing countries, these fuels are burned in the open or in rudimentary stoves. Because of high indoor concentration levels of a variety of pollutants and consequent exposure time, women and small children are at higher risk of pneumonia and other respiratory infections. Indoor air pollution is responsible for nearly half of the 2 million deaths caused every year by acute respiratory infections, and the first cause for children mortality worldwide (Bruce et al. 2011).

Typical open wood stove

In Mexico, wood accounts for approximately 30% of the total energy supply, and it is primarily used in rural areas for cooking in traditional open fires. According to the most recent census, 14.5% of the Mexican homes, mostly in rural and semirural areas, use wood as a major fuel for heating and cooking. In areas with the lowest human development index, nine out of ten homes use wood.

Over the last decades, different programs have been implemented to substitute open fires with improved stoves and protect human health by reducing indoor air pollutants. Lately, recognizing the need to mitigate greenhouse gas emissions through more efficient use of renewable fuels, wood stoves implementation programs are now part of CO_2 mitigation strategies and address the need to reduce risks for vulnerable populations exposed to wood smoke as well. Improved stoves reduce fuel consumption by up to 50% and indoor levels of particulate matter and other combustion gases by up to 90% (Bruce et al. 2011, Rehfuess et al. 2011).

Woman cooking tortillas

In Mexico, carbon mitigation policies are integrated into the Special Climate Change Programme to reduce greenhouse gas emissions to 50% of their 2000 levels by 2050 and promote adaptation to climate change. Among mitigation actions in the forestry sector, the implementation of efficient rural stoves is foreseen for the period 2008-2012. This program considers the implementation of 600,000 improved wood stoves to substitute open fire by 2012, with an expected reduction of 1.6 million tons of CO_2eq in this period assuming a 50% fuel reduction. Reduced emissions of dioxins and furans from this source will also be observed. Cardenas et al. 2010 estimate that approximately 30g TEQ were emitted due to the use of wood for heating and cooking in Mexico in 2004 (Cardenas et al. 2010, Maíz y Cárdenas 2010).

According to recent assessments, implementation of improved stoves will also reduce emissions of black carbon and produce significant health benefits. Among the strategies for a low-carbon economy in Mexico, a total replacement of open fires with improved stoves is considered by 2030. This strategy could bring a reduction of 9.95 million tons of CO_2 eq, as well as a reduction of short lived climate forces such as black carbon (FAO 2010). Further reductions of emissions of unintentional POPs of approximately 30 g ITEQ/year are expected. These reductions may be even higher if other technologies, such as liquefied petroleum gas, are implemented.

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CHAPTER 4:

INNOVATIVE METHODS TO INTRODUCE ALTERNATIVES TO POPS

FAO - SAVE AND GROW: FEWER PESTICIDES AND HIGHER YIELDS AND INCOMES

FAO's West African Regional Integrated Production and Pest Management (IPPM) Programme

By Jan Breithaupt, William Settle and Mark Davis, United Nations Food and Agricultural Organization, Plant Production and Protection Division (AGP)

Problem statement

Trends in agriculture over the past decades in West Africa have seen an increasing use of highly toxic pesticides –including POPs- in higher-value and frequently irrigated crops. Cotton production has one of the worst impacts on the environment of any crop in the region, due to the effects on the fragile soils and excessive use of pesticides such as endosulfan. In 2011, endosulfan became a POP under the Stockholm Convention hence this ongoing programme contributes directly to the implementation of the Convention in provision of sustainable alternatives to POPs.

There is a general lack of knowledge in the region of the negative impacts of pesticides on the production, economy and health of communities and on the environment; as well as a lack of knowledge of positive (low toxicity) alternatives.

Introduction

Simple experiments in the field, as practiced by farmers during season-long Farmer Field Schools (FFS), have given smallholders the knowledge to produce in a more environmentally friendly way, to substantially increase yields and earn a better income.

Capacity-building at community level is key to the sustainable intensification of food production, which will contribute to increased food security and improved livelihoods in the region, an important step towards achieving the first Millennium Development Goal, which is to reduce hunger and poverty.

Many West African farmers have succeeded in cutting the use of toxic pesticides, increasing yields and incomes and diversifying farming systems as a result of an international project promoting sustainable farming practices.

The *West African Regional Integrated Production and Pest Management (IPPM) Programme* is working with farmers to sustainably intensify the cotton production system, by boosting yields through improved agronomic practices, including the application of compost, the planting of leguminous cover crops, and the use of improved seeds and plant management techniques. Farmers are diversifying their systems through the use of cereals and soil-improving crops (legumes and forage) that can be fed to animals or sold on local markets.

How the issue was addressed

Around 130,000 farmers in Benin, Burkina Faso, Mali and Senegal have so far participated in a training programme based on "discovery learning" called Integrated Production and Protection Management (IPPM), and executed by FAO.

Working in small groups during season-long trainings called Farmer Field Schools (FFS), smallholders are exploring, adapting and adopting improved agricultural practices through hands-on field experiments under their control.

The IPPM programme works with farmers to explore a variety of soil improvement practices and alternatives to chemical pesticides, such as the use of beneficial insects, tolerant varieties, natural pesticides and pest-suppressive cropping practices. Marketing and food safety issues are also part of the training programme.

Implementation of the approach: Collectively searching for alternatives

Typically, a group of around 25 farmers coordinated by a trained facilitator prepares two training plots in their village, one using local conventional farming methods, including the application of chemical pesticides, and another plot using best practices appropriate to the crop and location based on IPPM, to observe and compare results from the two plots.

Participant in Training-of-Trainers event from Benin discusses field observations of pest and beneficial insects from cotton test plots during the weekly AESA (Agro-Ecosystem Analyses) exercise in 2008

Over 2,000 facilitators coming from dozens of local government, private sector and civil society organizations have been trained to work with farmers to develop sustainable farming methods appropriate to their contexts.

The IPPM project is also monitoring pesticide residue levels in water samples taken from 17 sites in six West African countries along both the Niger and Senegal rivers. The programme is working in partnership with Oregon State University (USA) to build capacities of local laboratories to detect pesticides in water. The project has also introduced a risk assessment model, based on the best available global database of pesticide impacts (PRiME http://ipmprime.org/cigipm/about.aspx) that uses data on pesticide practices to estimate impacts on human health and various biological indicators, including soil, avian and aquatic life.

The IPPM project in Benin, Burkina Faso, Mali and Senegal has been funded by the Government of the Netherlands for the past 10 years. Additional funding and partnerships are provided by the Global Environment Facility (GEF), the UN Environment Programme, the European Union and Spain.

Impacts

In Mali, following the training, a survey was conducted in 65 villages of cotton farmers who were trained in 2007-2008. It showed a 94% reduction in the use of chemical pesticides and a 400% increase in the use of organic material like compost and manure, substances that can reverse the decline in soil fertility. Farmers of these villages have almost entirely eliminated their dependence on toxic chemicals.

©FAO/WH Settle

A Farmers' Club demonstrates pesticide-free produce and locally made alternatives to toxic pesticides. The Farmers' Club is a group often formed directly from the Farmer Field School that offers a continued platform for discussion and experimentation (FFS Baguinda, Mali, 2006)

"We started producing rice here in 1971 and now we produce nothing else in this area other than rice. We never received any support in training until the IPPM programme. With the IPPM programme, this is the first time that we have had this opportunity. This training has contributed so much, and after only one year, almost all the inhabitants of this area are or will be part of the programme. We told this to the Minister of Agriculture when he passed through here a few months ago. We will also bring this to the attention of the President of the Republic when he comes to see us, because the results (returns) that we have recorded through the programme are spectacular for us. Here are our practices and the results we have achieved:"

Practice	Before IPPM	After IPPM
Seeds	Not quantified	20% to 25% of what was used previously
Seedling age	45 days	15-20 days
Number of seedlings/hill	10+	1 or 2
Planting spacing	transplanted randomly	transplanted in line, 20 - 25 cm
Chemical fertilizers (NPK + Urea)	up to 400 kg /ha	150 kg / ha
Pesticides	none	none
Use of rice straw	sold in Niger markets	buried prior to transplanting
Yields	6-7 sacks of 84 KG = 2.3 t/ha	14-15 sacks of 84 kg = 5.0 t/ha

Source: Report from the President of the General Union of Producers of the irrigated perimeter in Malanville, Benin, 2008

In Benin, focus has been on rice and cotton production systems in the northern part of the country. In 2008, a dramatic success was noted in the irrigated rice system in the extreme northern part of Benin. The town of Malanville has 400 ha under production, involving 793 producers in 24 producer groups. The IPPM FFS training in Malanville led to a more than doubled production and a 66% decrease in use of chemical fertilizers (see box below). After one year, most of the entire group of farmers had adapted their practices based on their experience in the IPPM Field School.

In Burkina Faso, IPPM helped increase yields from between 14-70%. About 30,000 cotton farmers had been trained in the project by the end of 2011.

Data from Senegal and Mali, from surveys conducted one-to-two years after the training, show more than 90% reductions in the use of chemical pesticides among participating farmers. An increasing numbers of farmers are now moving towards various alternatives to the use of toxic chemical pesticides.

In Senegal, farmers also shifted towards the use of botanical and biological pesticides. Farmers increased the use of organic material such as compost and rice straw.

FAO'S PESTICIDE MANAGEMENT EFFORTS TO PROMOTE COOPERATION AND COORDINATION IN SUPPORT OF THE STOCKHOLM CONVENTION'S IMPLEMENTATION AT NATIONAL LEVEL

By Jan Breithaupt and Mark Davis, United Nations Food and Agricultural Organization, Plant Production and Protection Division (FAO/AGP)

Introduction

Through its Pesticide Risk Reduction Programme, FAO's pesticide management group works on helping countries effectively implement and meet their obligations under the Rotterdam, Stockholm and Basel Conventions. It focuses on the different aspects of pesticide management:

- Legislation and registration (including de-registration) of pesticides (Rotterdam, Stockholm);
- Life-cycle management of pesticides (Rotterdam, Stockholm);
- Import controls of pesticides (Rotterdam, Stockholm);
- Management and disposal of obsolete pesticides (Stockholm, Basel, Rotterdam);
- Reduction of risks from Highly Hazardous Pesticides (Rotterdam);
- Identification and reporting of Highly Toxic Pesticide Formulations (Rotterdam);
- Capacity-building for implementation of the Rotterdam Convention (Rotterdam);
- Export of obsolete pesticides for environmentally sound management (Basel).

Need for collaboration

There is a need for a systematic and coordinated intervention to set the stage for long term, sustainable growth and food security. This will be achieved by advocating the development of policy strategies and providing technical support and institutional strengthening, led by the specific needs of each sub-region and/or country, but based on best practices within the countries as well as from various parts of the world.

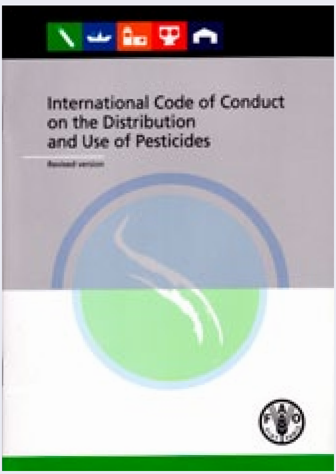
The global priorities of FAO evolve over time and include many global conventions, treaties and agreements which FAO member countries adhere to. With regard to pesticide management, these include on-going conventions and agreements such as the Rotterdam Convention (RC) and the implementation of the Code of Conduct on the Distribution and Use of Pesticides (CoC).

Implementation of FAO's plant production and protection overall objectives towards Pesticide Risk Reduction

Bearing in mind the overall need for a sustainable intensification of crop production, cross-cutting initiatives such as Good Agricultural Practices in the use of pesticides (GAP) (e.g. Integrated Pest Management/IPM strategies, Conservation Agriculture, organic farming), and legal issues (e.g. insertion of convention obligations into national laws), are included in FAO plant production and protection programmes.

FAO/AGP provides technical guidance and support for pesticide risk reduction through strengthened life-cycle management of pesticides and promotion of IPM.

Technical guidance and tools are provided through the FAO/WHO Joint Meeting on Pesticides Management and as outputs from field projects and programmes. Standards for food safety and pesticide quality are provided through the FAO/WHO Joint Meeting on Pesticide Residues and the Joint Meeting on Pesticide Specifications. Institutional and technical support to countries expands the uptake and implementation of IPM and ecologically based crop production and protection systems by farmers. Pesticide management in accordance with the International CoC on the Distribution and Use of Pesticides is strengthened through improved legislation, regulation and enforcement. Pesticide registration and control systems are strengthened through the provision of guidance and tools

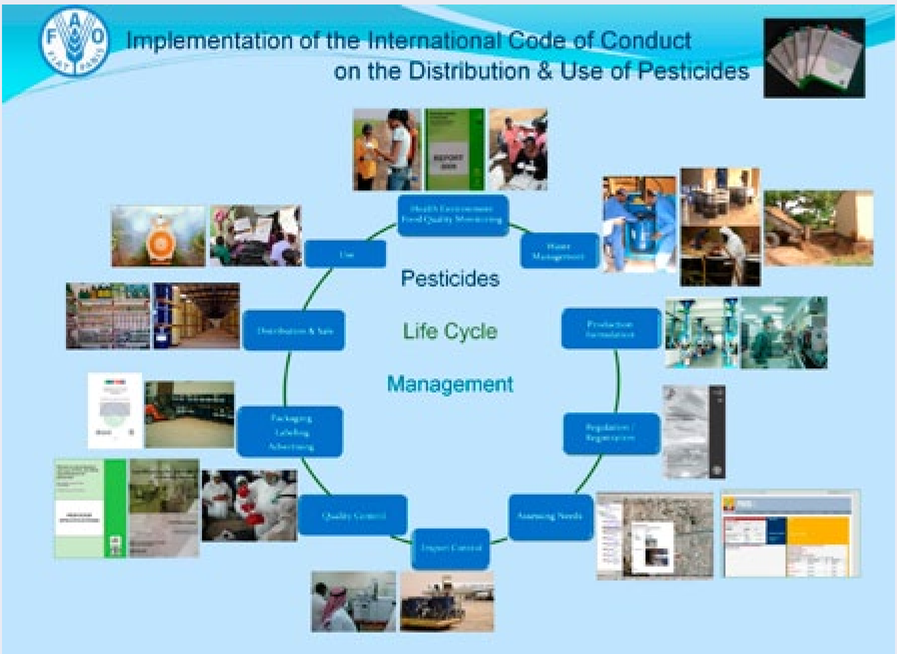


International Code of Conduct on the Distribution and Use of Pesticides and risks from pesticides are reduced by identifying and replacing highly hazardous pesticides such as POPs with less hazardous alternatives, and by improving all aspects of trade and use. Countries' capacity to monitor environmental and health impacts of pesticides is improved. Countries are also provided with guidance and tools to assist in the effective management of quality and quantities of strategic pesticide stocks for migratory pest control, and to eliminate obsolete pesticide stockpiles in compliance with international and national regulations and international best practice.

Outcomes of the FAO Pesticide Management approaches

In terms of mechanisms, FAO/AGP and its sub-/regional offices capitalise on existing and proven approaches on capacity-building, such as Farmers Field Schools (FFS) and support linkages and collaboration with farmer associations/cooperatives and similar private sector associations in the agricultural sector where training is involved.

With its mandate extending along the whole food chain, FAO can also uniquely promote a life-cycle approach to pesticide management. It can do so through strengthening decision-making on the types of pesticide and how they are used, by encouraging use of pesticides only as needed and in the form of reduced risk compounds, and as part of an integrated



Pesticides life-cycle management chart

approach to pest management. The end result is that when products are used, they are of an acceptable quality and when residues occur in treated food commodities, they neither represent a risk to consumers nor represent barriers to trade.

In particular, FAO/AGP assists countries to sustainably reduce pesticide risks to human health and the environment through the implementation of the Rotterdam-, Stockholm- and Basel Conventions, as well as the CoC on the Distribution and Use of Pesticides through implementation of GAP including IPM and application of bio-pesticides to control (migratory) pests (examples include the Emergency Prevention System/EMPRES-Desert Locust programme: Successful replacement of HHP formulations with Biopesticide *Metarhizium anisopliae* to control desert locusts in the EMPRES regions).

In close cooperation with the Stockholm and Basel Conventions, FAO/AGP also supports the development of regional and national programmes for pesticide management in accordance with International Codes and Conventions for the joint implementation of the three Conventions (e.g. the joint development of Regional- and National Action Plans and follow-up seminars conducted worldwide to provide assistance with the implementation of the conventions on pesticide management).

In addition, FAO/AGP provides assistance to national and regional institutions to develop strategies for life-cycle management of pesticides in accordance with the Rotterdam-, Stockholm- and other conventions, CoC on Pesticides, and towards implementation of IPM policies and programmes in keeping with a sustainable ecosystems approach in order to reduce reliance on pesticides (examples include projects where FFS was established as the official national extension approach, based on IPM to control pests like banana wilt; cotton IPM strategies replacing the use of Endosulfan were successfully implemented in West African countries).

FAO/AGP further provides assistance towards enhancing national and regional capacity for pesticide management (e.g. GEF-funded projects, like *Reducing Dependence on POPs and other Agro-Chemicals in the Senegal and Niger River Basins through Integrated Production, Pest and Pollution Management*). It facilitates the development and establishment of pesticide registration tools for adoption at national level (e.g. the ongoing field-testing of a Pesticide Stock Management System and a registration toolkit) as well as the process for a plan of action for the development of supportive laboratory services for countries (e.g. for risk assessment of pesticide residues; quality control). Finally, in collaboration with partners in the Regional Economic Communities, the FAO/AGP Division assists in harmonizing pesticide management legislation (e.g. pesticide registration legislation).

Ongoing partnerships include links with universities (e.g. Cape Town University to conduct pesticide management courses; Oregon State University to develop risk indices related to farmer pesticide practices) and centres of excellence, through internship/attachment and sabbatical partnerships as well as partnerships with other international players in the fields of information and other specialised capacity development, as opportunities arise.

Some selected examples of quantitative measures of the impact of the work of FAO/AGPP include the following:

- **IPM**: Over 30 countries use national policies to support IPM and reduce pesticide risks to trade, environment, and health. As a result of FAO involvement, India reduced by over 30,000 tons and Indonesia reduced by over 10,000 tons their national annual use of pesticides between 1990 and 2002 while maintaining growth in staple food production.
- **EMPRES**: Between 2003 and 2011 countries in the Central Region (surrounding the Red Sea) cooperating and applying FAO's EMPRES strategy of early warning and rapid response prevented four distinct outbreaks of Desert Locust from becoming upsurges or plagues, hence significantly reducing the application of insecticides.
- **Obsolete pesticides programme**: There are in the order of 150,000 metric tons of obsolete pesticides and heavily contaminated soils in 53 African countries. Initial efforts were focused in nine countries which contain 10,000 tons of pesticides, of which more than 2,000 tons have been destroyed.
- **Rotterdam Convention:** More than 30 countries have developed national action plans or strategies for the implementation of the Convention. For the 43 chemicals presently subject to the PIC procedure and/or Stockholm Convention, more than 1,200 individual decisions on the future import of these chemicals were received from 79 countries.

PFOS - CARPETS

By Peter Hofbauer, Anke Joas, Milos Milunov and Alexander Potrykus, BiPRO GmbH, Munich, Germany

Introduction

In 2005, PFOS was proposed for listing under the Stockholm Convention. Four years later, in May 2009, it was added to Annex B of the Stockholm Convention. The amendment entered into force on 26 August 2010 for all Parties that had not submitted a notification pursuant to the provisions of paragraph 3(b) of Article 22.

PFOS has been used for many applications due to its outstanding surface properties as a water repellent. This physical property is especially used to increase water and stain repellence of leather, paper or textiles such as carpets.

Due to increased awareness, legal action and the voluntary production stop of the main producer 3M, many PFOS applications have decreased or completely stopped between 2000 and 2004. The European carpet industry has also stopped impregnating carpets with PFOS. Based on several information sources[18] [19], it can be estimated that before the year 2000, the share of PFOS used for the carpet industry was about one third of the worldwide PFOS production.

[18] *OECD (2002) Environmental Directorate, Joint meeting of the chemicals committee and the working party on chemicals, pesticides and biotechnology, Co -operation on existing chemicals, Hazard assessment of perfluorooctane sulfonate (PFOS) and its salts, JT00135607, ENV/JM/RD(2002)17/FINAL, 21.11.2002.*

[19] *SHER (2004) Scientific Committee on Health and Environmental Risks, SCHER Opinion on "RPA´s report"Perfluorooctane Sulphonates Risk reduction strategy and analysis of advantages and drawbacks" (Final report-August 2004).*

Coffee stain on carpet

Problem statement

By the end of last century, the annual consumption of PFOS for impregnation of carpets for stain and water repellence in the European Union has been estimated to be about 150 t[20]. PFOS is part of the final product and is leaching out over time, which can lead to health and environmental risks via direct exposure to humans via skin contacts and air emissions due to wear, and releases into water due to washing.

The use of PFOS for carpet impregnation was phased out at the beginning of this century. However, due to the long lifetime of carpets (about 14 years), it can be expected that until 2016 many of the disposed carpets containing PFOS will end up in bulky waste. Since several years, different programmes have been started to recycle carpets. Even though most of the carpets are thermally recycled for energy recovery, some of the PFOS is subject to material recycling and is therefore maintained in the production cycle. A usual PFOS-impregnated carpet has a PFOS concentration of about 88 ppm. If all recycled carpets would be PFOS-impregnated, the produced recycled product would have a similar concentration and would therefore exceed existing European Union limit values for PFOS (see below). This would consequently lead to a halt in carpet material recycling.

How the issue was addressed

The issue was addressed in different ways, ranging from increased awareness-raising regarding possible risks related to PFOS, to the voluntary production phase-out of the main producer and finally the expected occurrence of international legislation.

It is estimated that the global production of PFOSF, which is the basic chemical for the production of PFOS, has been 96,000 tons between 1970 and 2002. On 16 May 2000, 3M, the major global producer of PFOS, announced its phase-out of PFOS production. The increased awareness about concerns for PFOS led to a strong decrease in the use of PFOS between 2000 and 2004. PFOS was substituted by relevant alternatives, particularly perfluorinated telomeres with shorter chain length.

PFOS is listed in Annex I, IV and V to the EU POPs Regulation (EC) No. 850/2004. Annex I sets out values for unintentional trace contaminant in substances. For coated material for textiles or other coated materials, the trace contamination has to be lower than 1 µg/m^2 (for carpets this corresponds to a concentration of about 1 ppb).

Moreover, following Annex XVII, entry No. 53 of REACH (Regulation (EC) No 1907/2006), PFOS shall not be placed on the European Union market for textiles or other coated materials, if the amount of PFOS is equal to or higher than 1 µg/m^2 of the coated material.

[20] *European Commission (2011) Study on waste related issues of newly listed POPs and candidate POPs. Study prepared by BiPRO GmbH as part of the ESWI Consortium on behalf of the European Commission. Final Report, April 2011.*

Implementation of the approach

The negative image of PFOS has led to a rethinking in the carpet industry. As there have been no satisfying alternatives in place and impregnation of carpets with PFOS is not absolutely necessary, the carpet industry stopped impregnating carpets with PFOS.

Outcomes / impacts

As an effect of the awareness-raising activities related to the risks associated with the use of PFOS, the European carpet producers have started to phase out the use of PFOS since the beginning of this century. The advantage of an environmentally-friendly product outbalanced the advantage of an increased water and stain repellent carpet.

The annual consumption of PFOS was reduced in total by 150 tons due to the phase-out of PFOS impregnation of the carpet industry.

Recently a nanotech-based carpet finishing technology was developed, which allows dirt and water to simply run off the surface of the textiles. The natural non-stick and cleaning process, also known as the self-cleaning effect, is transferred to the surface of textiles by means of nanotechnology. According to industry sources, this technology would achieve significantly better results compared to traditional textile impregnation processes with regards to:

- Water and dirt repelling properties;
- Oil repelling properties;
- Washing permanence.

The protective function of this impregnation material would still be retained after frequent use and numerous washing cycles and would have no effect on clothing comfort, look, feel, breath ability or elasticity.

Lessons learned / conclusion

The success of the halt of PFOS use in the European carpet industry is mainly based on four circumstances.

The first circumstance is that the impregnation of PFOS was not absolutely necessary for this product: PFOS improved the quality of carpets by increasing water and stain repellence, an advantage which is considered desirable but not essential.

The second circumstance was the increased awareness regarding the risks related to PFOS in the beginning of this century. End consumers react increasingly strongly on chemicals which are hazardous to health, especially if they are prone to get in direct contact with workers or family members. As carpets are sold to these customers, it was considered reasonable by the carpet industry to avoid PFOS in such products.

The third circumstance was the voluntary phase-out of the PFOS production by 3M, the main PFOS producer. In 2002, 3M decided to phase-out its production of PFOS, which has encouraged the whole carpet industry to omit the PFOS impregnation step in carpet production.

The fourth circumstance was international and legal action. After awareness of risks rose, the carpet industry became aware that it was only a matter of time before corresponding action at international level and legislation restricting the marketing and use would follow, which further supported the pro-active decision to stop the use of PFOS for the impregnation of carpets.

C-PENTABDE AND C-OCTABDE (POLYBROMINATED DIPHENYL ETHERS)

By Peter Hofbauer, Anke Joas, Milos Milunov and Alexander Potrykus, BiPRO GmbH, Munich, Germany

Introduction

Polybrominated diphenyl ethers (PBDEs) are a group of brominated flame retardants which have been used in various applications all over the world. PBDEs were produced at different degrees of bromination and commercially available PBDEs are complex mixtures of various congener groups. In 2005 and 2006 commercial pentaBDE (c-PentaBDE) and commercial octaBDE (c-OctaBDE) respectively were proposed for listing under the Stockholm Convention. In May 2009, the main congeners contained in these commercial mixtures, tetraBDE and pentaBDE and hexaBDE and heptaBDE, were listed under the Stockholm Convention. The amendment of the Convention to list these BDEs entered into force for most Parties in August 2010.

Burning upholstery

C-PentaBDE was produced in Israel, Japan, United States of America (USA) and the European Union (EU). Since the late 1990s, C-PentaBDE was mainly produced in the USA, whereas the production in the EU ceased in 1997. The sole producer of C-PentaBDE in the USA voluntarily ended the production in 2005. The production of C-OctaBDE took place in the Netherlands, France, USA, Japan, United Kingdom and Israel. Two producers of octabromodiphenyl ethers were reported in the EU in 1994. However, both producers stopped their production within the EU in 1996/98. Currently, there should be no production of C-Penta- and C-OctaBDE in any parts of the world[21]. The intentional use of these PBDEs has been completely phased out.

Problem statement

The most common use of C-PentaBDE in Europe was in flexible polyurethane (PUR) foams, accounting for approximately 95 % of the total use. The treated PUR foams were in turn mainly used for the production of automotive and upholstery applications (e.g. automotive seating, sofas, mattresses). Other reported applications and finished articles possibly containing C-PentaBDE were polyvinylchloride, epoxy resins, unsaturated polyesters, rubber, paint/lacquers, textiles, etc. The most common historic use of C-OctaBDE was in acrylonitrilebutadiene-styrene (ABS) polymers. Around 95% of C-OctaBDE supplied in the EU was used in ABS (globally ~70%). The ABS in turn was mainly used in housing of electrical and electronic equipment, typically of office equipment and business machines. Other minor uses were in high impact polystyrene, polybutylene terephthalate, polyamide polymers, etc.

As mentioned, C-Penta- and C-OctaBDE were used as additive flame retardants for different applications all over the globe. The term 'additive' in this connection means that the flame retardants were blended with the product rather than covalently bound into plastics as in the case of 'reactive' flame retardants. This makes them more prone to be released into the environment.

C-PentaBDE is highly persistent in the environment, bioaccumulative and has a high potential for long-range environmental transport. It has been detected in humans in all regions and there is evidence of its potential for toxic effects in wildlife, including mammals. C-OctaBDE is also highly persistent, has a high potential for bioaccumulation and food-web biomagnification, as well as for long-range transport. Under certain conditions it may convert to lower, and possibly more toxic, congeners[22].

The use of C-Penta- and C-OctaBDE for the above-mentioned applications is therefore related to possible risks for environment and health.

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[21] *Source: European Commission, Study on waste related issues of newly listed POPs and candidate POPs. Study prepared by BiPRO GmbH as part of the ESWI Consortium on behalf of the European Commission. Final Report, April 2011.*

[22] *Source: Stockholm Convention, Listing of POPs in the Stockholm Convention, Annex A (Elimination),* http://chm.pops.int/Convention/ThePOPs/tabid/673/Default.aspx

How the issue was addressed

POPs related provisions:

Tetra-, penta-, hexa-, and heptabromodiphenyl ether are listed under Annex A of the Stockholm Convention with a specific exemption for use as articles containing these chemicals for recycling in accordance with the provision in Part IV of Annex A. Annex I of the POP Regulation (EC) No. 850/2004 sets out values for unintentional trace contaminants – identically in place for all concerned PBDE congener groups (i.e. tetraBDE, pentaBDE, hexaBDE and heptaBDE)- in substances, preparations, articles or as constituents of the flame-retarded parts of articles equal to or below 0.001% by weight (10 ppm). Market restrictions are listed in Annex I for all congeners. Production, placing on the market and use shall be allowed:

- Without prejudice to subparagraph (b), articles and preparations containing concentrations below 0.1% by weight (1,000 ppm) of a congener by weight when produced partially or fully from recycled materials or materials from waste prepared for re-use;
- Electrical and electronic equipment within the scope of Directive 2002/95/EC (RoHS).

Restriction on marketing and use (REACH Regulation, RoHS Directive):

Following Annex XVII, entry No. 44 and 45 of the REACH Regulation (EC) No. 1907/2006, “Diphenylether, pentabromo derivative ($C_{12}H_5Br_5O$)” and “Diphenylether, octabromo derivative ($C_{12}H_5Br_8O$)” may not be placed on the EU market or used as a substance or a constituent of substances or of preparations in concentrations higher than 0.1% (1000 ppm) by weight. The same applies for finished articles, which may not be placed on the EU market if they, or flame-retardant parts thereof, contain pentaBDE or octaBDE in concentrations higher than 0.1% (1000 ppm) by weight. This restriction is in force since August 2004. Since pentaBDE is now restricted under the POP Regulation, entry No. 44 of the REACH Regulation has been deleted according to Regulation (EU) No. 207/2011.

The RoHS Directive 2002/95/EC, in particular Article 4(1), together with Annex 1, No. 29 prohibits the use of PBDE in new EEE in concentrations above 0.1% by weight (1,000 ppm) in homogeneous material. This restriction is in force since July 2006 and applies to the sum of PBDE congeners.

Waste management related provisions (WEEE Directive, ELV Directive):

WEEE Directive 2002/96/EC aims at preventing WEEE[23] by promoting reuse, recycling and recovery. According to Annex II “Selective treatment for materials and components of WEEE in accordance with Article 6(1)” as a minimum [...] [e.g. plastic containing brominated flame retardants] have to be removed from any separately collected WEEE. Thereby, member states of the European Union shall ensure that manufacturers or third

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[23] *Waste electrical and electronic equipment.*

parties acting on their behalf set up WEEE treatment systems which may be done on the individual basis and/or collectively.

Directive 2000/53/EC sets out provisions with respect to end-of-life vehicles (ELV) aiming at the prevention of waste from vehicles and, in addition, at the reuse, recycling and other forms of recovery of end-of life vehicles and their components.

Classification and other fields (e.g. water and food):

PentaBDE (substance "diphenyl ether, pentabromo derivative"– CAS No 32534-81-9) is classified under CLP (classification, labelling and packaging) Regulation as specific target organ toxic, and acute and chronic aquatic toxic and under Directive 67/548/EEC as harmful and dangerous for the environment. OctaBDE is not classified under the CLP Regulation or under Directive 67/548/EEC. The Water Framework Directive lists OctaBDE and DecaBDE among relevant substances to be monitored and established Environmental Quality Standards (EQS), both for annual average (AA-EQS) and for Maximum Allowable Concentration (MAC-EQS) for inland surface water for "brominated diphenyl ethers". PBDEs are not subject to EU regulations in the field of food and feed safety.

Producer responsibility and increased awareness:

Society and industry became aware of possible risks related to PBDEs. As a consequence, the relevant industry (e.g. the EU car manufacturing industry) reflected increasingly upon possible alternatives.

Implementation of the approach

Several countries in the European Union and around the world introduced actions to regulate or voluntarily phase-out PBDEs. For instance, by the end of the 1990s, around 100 companies manufactured foam and moulded PUR specifically for the automotive market. At that time, C-PentaBDE was used in applications such as car ceilings and headrests in the United Kingdom. For other EU member states it was reported that the use of C-PentaBDE already ceased by the end of the 1990s (e.g. in Italy, Spain, Germany). This mainly happened due to the pressure from car manufacturers. Several manufacturers declared C-PentaBDE as 'substance of concern' (e.g. Volvo). The German Automotive Federation black-listed C-PentaBDE, so the German car manufacturers were forced to replace it with other substances. In the case of car seating, other flame retardants, such as C-DecaBDE, replaced C-PentaBDE over time. In 2000 the use of C-PentaBDE in automotive applications significantly decreased and currently no brominated flame retardants are used for the manufacturing of cars, except DecaBDE, according to the European Automobile Producers Association. With regard to C-OctaBDE, the use in ABS was declining throughout the 1990s as it was increasingly replaced by alternative flame retardants such as Tetrabromobisphenol A. Besides, there was a shift from the ABS (during the 1990s) towards PC/ABS and HIPS for outer casings. For monitors and personal computers PC/ABS dominates at present, while HIPS is mainly used for TV casings.

Outcomes / impacts

C-Penta- and C-OctaBDE are no longer produced nor used on the global market. Estimations of the current C-PentaBDE stocks indicate that the peak of C-PentaBDE containing articles being delivered to waste in the EU was during the period 2005-2007. This is mainly due to the comparatively small amounts used in the EU, the early phase-out dates and relatively short product lifetimes of articles containing C-PentaBDE. Therefore, it can be concluded that only low levels of C-PentaBDE should currently be present in waste streams being delivered for disposal in the EU. Recent estimations of the current stocks of C-OctaBDE indicate a similar situation, with the vast majority of stocks having reached the end of their useful lives. The remaining wastes have been treated through the existing waste management infrastructure.

Conclusion

Increasing awareness due to listing of substances under the Stockholm Convention as well as regional legal activities, combined with appropriate producer responsibility, contribute to trigger industry initiatives to substitute substances of concern.

PFOS (PERFLUOROOCTANE SULFATE) - SEMICONDUCTOR INDUSTRY

By Peter Hofbauer, Anke Joas, Milos Milunov and Alexander Potrykus, BiPRO GmbH, Munich, Germany

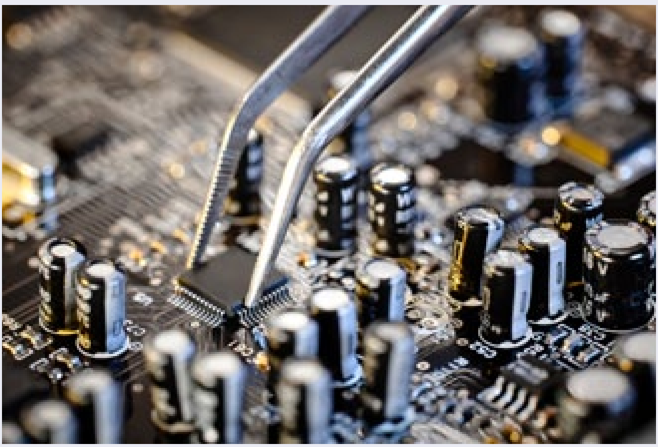
Introduction

In 2005, PFOS was proposed for listing under the Stockholm Convention and added to Annex B four years later, in May 2009. The amendment entered into force on 26 August 2010 for all Parties that had not submitted a notification pursuant to the provisions of paragraph 3(b) of Article 22.

PFOS was and is still used for many applications due to its outstanding surface properties, such as lowering surface tension. Due to this physical property, PFOS-based chemicals are used in the semiconductor industry for the manufacture of imaging devices such as digital cameras, cell phones, printers, scanners, etc. The amount of PFOS needed for production has already been significantly reduced, entailing a reduction in releases to the environment and related risks. But there is still the need to use it for some applications of the semiconductor production, so research is ongoing to further reduce the need for PFOS in this industry.

Problem statement

PFOS, which has been produced since the end of the 1940s, has been used in the semiconductor industry in photoresists (resists), anti-reflective coatings (ARCs), developers and for chemical etchants, etc. at a global level since the early 1980s.



Circuit board

The use of PFOS leads to emissions to the environment, especially water, which occur during storage, handling and use of PFOS-containing liquids. Non critical applications, such as use for developers and etchants, caused the most relevant environmental impacts as the substance was emitted into wastewater.

How the issue was addressed

Legal action at the European Union level:

PFOS is listed in Annex I, IV and V to the EU POPs Regulation (EC) No. 850/2004. Annex I sets out values for unintentional trace contaminant in substances. However, for the semiconductor industry, there is an exemption within the European Union and the Stockholm Convention (Annex B) due to PFOS's unique properties and the essential needs of this industry.

Following Annex XVII, entry No. 53 of REACH (Regulation (EC) No 1907/2006), PFOS (similarly identified as within the EU POPs Regulation) is only allowed in trace amounts.

Industry action:

The World Semiconductor Council (WSC) has categorized the usage of PFOS to:

- "Critical use", which includes resists and ARCs essential for the photolithography process; and
- "Non-critical use" which means other than resists and ARCs such as developers and etchants etc.

WSC issued a statement that "critical use" of PFOS shall be tightly controlled in semiconductor manufacturing to realize minimal discharge to the environment. This agreement also confirmed that all solvent wastes containing PFOS were to be sent to incineration and therefore destroyed. "Non-critical use" of PFOS had to be completely abolished by 2009, by substituting other chemicals that serve the same purpose adequately.

Implementation of the approach

The global semiconductor industry has undertaken significant research and development activities in an attempt to work towards PFOS substitution. The elimination of PFOS in non-critical uses is one example of success in this area.

The Japan Electronics & Information Technology Industries Association (JEITA) stated that discussions initiated in 2007 to list several new chemicals under the Stockholm Convention (see UNEP/POPS/COP.4/17) sent a key message to take urgent steps to provide limited exemption of PFOS from the ban for critical uses for photo acid generator resist and anti-reflecting coatings in the semiconductor industry.

The European electronic component manufacturers association EECA stated that the industry, together with their material suppliers, have been involved for many years on this topic at the industrial level, to eliminate PFOS use, due to the nature of its criticality to the manufacturing process to produce semiconductor devices.

Outcomes/impacts

PFOS continues to perform an important role in semiconductor manufacturing. Resists and ARCs are used to form the patterns that are then transferred into the semiconductor chip to form the tens of millions of conductors, resistors and transistors that make up a single integrated circuit. The unique chemical properties of PFOS used in all critical uses (i.e. photolithography) prevent a comprehensive substitution for all PFOS utilised in critical uses.

However, the efforts of industry have led to a strong decrease of PFOS in the semiconductor industry, as stated by the European semiconductor industry association. About 280 kg of PFOS for non-critical applications were used by the semiconductor industry in the European Union in 2002, deriving from 85.3 kg as edge bead remover (EBR) and 195 kg as developer. While the PFOS from the EBR was largely incinerated (99.99%), the PFOS from the developer was emitted to wastewater. In 2007, the PFOS amount in non-critical applications was down to zero and the goal to phase out PFOS by 2009 in non-critical applications was achieved [24]. For critical applications, about 240 kg of PFOS were used in Europe in the semiconductor industry in 2007, of which about 16 kg were emitted to water[25]. By 2009 the PFOS amount for critical applications has dropped to 9 kg, of which about 0.4 kg were emitted to water.

Similarly, the Japan Electronics & Information Technology Industries Association (JEITA) stated that the non-critical use of PFOS has dropped in Japan from about 3,000 kg in 2003 down to 6 kg in 2006[26].

The agreement of the global semiconductor industry further confirms that all solvent waste containing PFOS has to be sent to incineration for destruction. The industry is continuing to work in this area and significant efforts are ongoing across the supply chain.

Lessons learned / conclusion

Since 2000, when the effects of PFOS on the environment were identified as a problem, semiconductor manufacturers have been considering the reduction of PFOS and alternatives have been introduced, in collaboration with chemical materials suppliers and equipment manufacturers.

[24] *European Commission (2011) Study on waste related issues of newly listed POPs and candidate POPs. Study prepared by BiPRO GmbH as part of the ESWI Consortium on behalf of the European Commission. Final Report, April 2011.*

[25] *Source: e-mail Shane Harte, European Semiconductor Industry Association (EECA-ESIA), 13.12.2010.*

[26] *Source: Chemical Management Policy Division, Ministry of Economy Trade and Industry of Japan, Tesuro Matumoto, Chair of Semiconductor Policy & Operation Semiconductor Policy, Jeita.*

The use of PFOS was phased out in non-critical applications and significantly dropped in critical applications. Releases to the environment were minimised due to process optimisation and appropriate waste management (destruction of the PFOS content). An important aspect in the process of reasonably reducing the use of PFOS was the action of industry associations, who categorised the use of PFOS in critical and non-critical applications and the subsequent pressure to better control critical uses and abolish non-critical ones.

HEXABROMOCYCLODODECANE (HBCD) - POLYSTYRENE IN CONSTRUCTION

By Peter Hofbauer, Anke Joas, Milos Milunov and Alexander Potrykus, BiPRO GmbH, Munich, Germany

Introduction

In 2008, hexabromocyclododecane (HBCD) was proposed for listing under Annex A to the Stockholm Convention and the substance is currently under review by the Convention's Persistent Organic Pollutants Review Committee. At present, the main uses of HBCD are in the polymer and textile industries. HBCD is used in four principal product types, which are Expandable Polystyrene (EPS), Extruded Polystyrene (XPS), High Impact Polystyrene (HIPS) and in polymer dispersions for textiles. Due to the increasing awareness related to HBCD and proposed restrictions, the European Union Polystyrene (PS) foam industry is carrying out intensive research on possibilities to substitute HBCD in PS foams. The industry is confident that within five to ten years, at least one appropriate alternative will be available and that the use of HBCD in this important sector will be completely phased out.

Problem statement

The table on the next page summarizes the emissions and discharges to waste of HBCD from investigated sources in the European Union and shows that significant amounts of HBCD are currently incorporated into new flame retarded products (more than 10,000 tons in 2010).

Polystyrene boards for construction

As shown in the table below, the most relevant quantities of HBCD are currently incorporated into EPS and XPS for construction. The waste figures for EPS and XPS for construction may significantly increase, due to huge amounts of HBCD incorporated into new EPS/XPS products for construction purposes and the relatively long lifetimes of the products.

In construction, EPS and XPS are mainly used for insulation purposes. It is expected that the market for these products will significantly increase in the next decades due to the necessity for better thermal insulation of buildings, in order to reduce greenhouse gas emissions.

Based on data of HBCD consumption in Europe, the consumption since the late 1980s can be estimated.

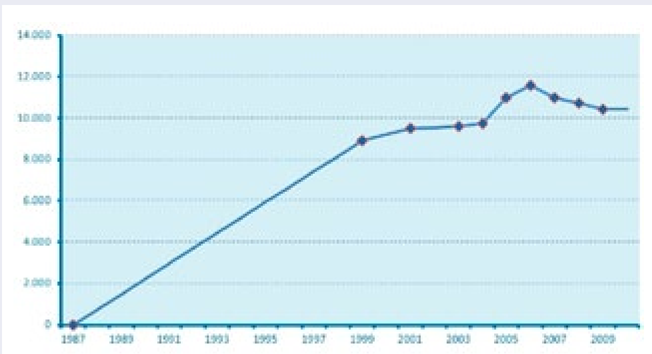
The development of the consumption in the future will depend on the market situation, changes in the legal situation and the availability of alternatives. The PS foam industry expects a significant increase for all types of insulation materials for construction due to changes in the construction sector.

If the use of HBCD in EPS and XPS products were to continue, very significant quantities of waste containing HBCD would have to be managed in the future (particularly after 2050) and may cause significant environmental and health risks, depending on the future deconstruction and waste management practices.

How the issue was addressed

International action:

HBCD is expected to be listed under the UNECE POPs Protocol and is being reviewed by the POPs Review Committee for possible inclusion in the Stockholm Convention, which will lead to increased awareness concerning possible risks related to HBCD.



Emissions and discharge of HBCD from investigated sources in the European Union (2010)[27]

[27] *European Commission (2011) Study on waste related issues of newly listed POPs and candidate POPs. Study prepared by BiPRO GmbH as part of the ESWI Consortium on behalf of the European Commission. Final Report, April 2011.*

Legal action at the European Union level:

At the European Union-level, HBCD was considered as a candidate for inclusion into the planned Annex III of the former RoHS Directive 2002/95/EC. In the current version of the Directive 2011/65/EU, which was approved by the European Parliament on 24 November 2010, Annex III is deleted. However, the substances which were listed in the planned Annex III were moved to recital 10 of the Directive: "The annexes to this Directive should be reviewed periodically to take into account, inter alia, Annexes XIV and XVII to REACH. In particular, the risks to human health and the environment arising from the use of HBCD, DEHP, BBP and DBP should be considered as a priority. With a view to further restriction of substances, the Commission should re-investigate the substances, which were subject to previous assessments, in accordance with the new criteria of this Directive as part of the first review". A review and amendment of the list of restricted substances shall be considered by the Commission within three years after the entry into force of the Directive, and periodically thereafter on its own initiative or following the submission of a proposal by a Member State (see Article 6 of the current version of the Directive).

Under REACH, HBCD and all major diastereoisomers has been identified as a "substance of very high concern" (SVHC) and is included in the candidate list of SVHC since 28 October 2008 due to its "persistent bioaccumulative and toxic" (PBT) properties (Decision number ED/67/2008). As a consequence, HBCD underlies specific obligations resulting from the inclusion in the Candidate List of SVHC. The specific provisions on obligations linked to the substances on the Candidate List of SVHC are laid down in the REACH Regulation in Articles 7.2 (Notification to ECHA), 7.3 (Supply of appropriate instructions), 31.1 (Provision of Safety Data Sheet) and 33 (Duty to communicate safe use information or responding to customer requests).

Producer responsibility and increased awareness:

Society and the PS foam industry have become aware of the possible risks related to HBCD. As a consequence, the PS foam industry and the construction sector have been increasingly deliberating upon possible alternatives but no appropriate drop-in chemical alternative which would fulfil the specific requirements for EPS and XPS products was found to be available.

Sector/Activity	Emission [t/y]	Waste [t/y]	Product [t/y]
EPS for Construction	0.65	68.82	4,471
XPS for Construction	0.71	75.8	4,922
EPS/XPS (other than Construction)	0.10	3.9	626
HIPS for EEE	0.03	181	208.8
Polymer dispersions for Textiles	1.35	866.7	207.4
Total	~2.84	~1,196	~10,435

Estimation of the consumption of HBCD in tons in Europe from the late 1980s until 2010 (estimation taken from EC 2011)

Implementation of the approach to developing sustainable alternatives

Industry therefore started carrying out intensive research on alternative flame retardants for EPS and XPS products with the aim to develop sustainable alternatives with no PBT properties and entailing no health or environmental risks[27]. The stepwise approach puts the emphasis on demonstrating that the substances are not PBT/POPs. It consists of three Tiers:

- Tier 1: Screening (physical and chemical properties; modelling including ecotoxicity);
- Tier 2: Ecotoxicity and health (base set ecotoxicity: biodegradability/ aquatic toxicity etc; base set human health: mutagenicity, acute toxicity, sensitization etc);
- Tier 3: Ecotoxicity and health (longer term ecotoxicity tests depending on Tier 1/2: bio-concentration factor (BCF), sediment toxicity, etc.; human health: mammalian repeated dose toxicity/reproductive toxicity, etc.).

In 2003, a programme was initiated by the European PS insulation industry and common tests were carried out at companies in the region. Thirty to forty commercial substances and some novel substances were selected for screening and testing on laboratory scale. As a result, a short-list of possible chemical alternatives was generated, and made subject to larger scale samples tested on pilot scale. The most promising substances were tested for further optimization at individual companies with the objective to produce EPS and XPS products with appropriate suspension stability and bead size distribution (for EPS), extrusion heat stability (for XPS) product properties, fire performance and cell size.

Currently industry considers two options for scale-up on the basis of pilot plant testing and is confident that within five to ten years, appropriate alternatives will be available[28].

Outcomes / impacts

The bulk of HBCD used in new products becomes waste upon the end of the products' lifetime. Depending on the practices, deconstruction and waste management may thus be related to environmental and health risks due to the HBCD content of waste. According to the long lifetime of EPS and XPS products for construction of 50 years and longer, these problems will particularly arise in the long term (after 2050).

Considering the current and increasing demand for insulation products for construction purposes, huge quantities of corresponding waste will have to be managed in the future. The substitution of HBCD in EPS and

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[28] *Source: PlasticsEurope, Exiba, EUMEPS: Track B Report on HBCD - The Perspective of HBCD Users, Comments by the European Polystyrene Insulation Industry. Presentation at UN-ECE POPs Task Force Meeting 18-20 May 2010.*

XPS products will therefore have a particularly important impact on the future waste management and is an essential contribution to sustainable production. Risks arising from construction and demolition would be eliminated in the long term.

Currently about 10,000 tons of HBCD are consumed annually within the European Union, with more than 9,000 tons used for EPS/XPS for construction. If it is possible to substitute this use, related releases to the environment and future waste management problems will be avoided.

This possible success should not override the fact that about 200,000 tons of HBCD, which have been incorporated into products by now, will in any case become waste within the next decades, with an expected peak around 2050. The corresponding waste will have to be managed in a safe and appropriate way.

Lessons learned / conclusion

Increasing awareness due to the proposal and review of substances under the Stockholm Convention as well as regional legal activities and appropriate producer responsibility contribute to trigger industry initiatives to substitute substances of concern. Action should generally be taken as soon as possible in order to minimise the amount of POPs circulating in products, waste and the environment.

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