

The Control Strategies for POPs in Taiwan

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Abstract

Management of the persistent organic pollutants (POPs) in Taiwan is a responsibility shared by the Environmental Protection Administration (EPA), the Council of Agriculture (COA), the Department of Health (DOH) and the Ministry of Economic Affairs (MOEA). In this paper, the strategies and actions has been taken or are proposed to be taken by the organizations are introduced. Taiwan exercises control of POPs listed in the Stockholm Convention through several legislation and regulations, either prohibits or has never registered the use of these chemicals. The POPs in this paper are divided into three categories to describe: nine organochlorine pesticides, PCBs and Dioxin and Furans, and the control strategies are addressed through legal basis and the duties of the four organizations, analysis of current situation and monitoring of environmental media and the biological matrix separately. For the new nine chemicals added to the convention in COP4, chlordecone, lindane and pentaBDE are already controlled or prohibited in Taiwan, and others are now under evaluation and discussion.

Introduction

The problem of persistent organic pollutants (POPs) has been addressed through the many years of hard work by the United Nations Environment Programme (UNEP), which resulted in the drafting of the Stockholm Convention on Persistent Organic Pollutants by the UN. In accordance with Article 7 of the convention, to ensure implementation of prescribed items, each party to the convention shall draft an implementation plan and submit the plan to the Conference of the Parties for review. While Taiwan is currently not a party to the Stockholm Convention, it has specially drafted the "National Implementation Plan of the Stockholm Convention on Persistent Organic Pollutants" in order to serve as a basis for domestic implementation work. This plan also seeks to convey that Taiwan's current policies are in compliance with the convention's control schedules and tasks, and to highlight Taiwan's control strategies and proactive stance in dealing with POPs.

Current Situation in Taiwan

Management of POPs in Taiwan is a responsibility shared by the Environmental Protection Administration (EPA), the Council of Agriculture (COA), the Department of Health (DOH) and the Ministry of Economic Affairs (MOEA). Taiwan exercises control of POPs listed in the Stockholm Convention through several legislation and regulations, either prohibits or has never registered the use of these chemicals. The status of POPs management in Taiwan is shown in Table 1. The organizations which are responsible for the legislation and the POPs controlled by the legislation are listed in Table 2.

In addition, in order to enhance cross-agency communication and coordination, the EPA, DOH, and the COA have established the "DOH/EPA/COA Deputy Head Food Safety and Environmental Protection Liaison Conference", which meets on a regular basis and works together to handle time-sensitive food safety and environmental protection issues. Furthermore, the three agencies have jointly created the "DOH/COA/EPA Environmental Protection and Food Safety Notification and Response Handling Procedures" to serve as standard operating procedures for the handling of environmental protection and food safety incidents.

Table 1 Current State of Management in Taiwan of Chemicals Listed under the Stockholm Convention

No.	Chemical	State of domestic management
1	PCBs	1. Manufacture, import, sale, and use prohibited since 1988. 2. The Toxic Chemical Substances Control Act announced full-scale prohibition of use starting in 2001. Capacitors and transformers containing PCBs must be immediately disposed of after end of use.
2	Chlordane	1. Use prohibited by the Toxic Chemical Substances Control Act in 1988.

		2. Use prohibited by the Environmental Agents Control Act in 1998.
3	Dieldrin	1. Use as a pesticide prohibited by the Pesticide Management Act in 1975. 2. Use prohibited by the Toxic Chemical Substances Control Act in 1989. 3. Use prohibited by the Environmental Agents Control Act in 1998.
4	DDT	1. Use as a pesticide prohibited by the Pesticide Management Act in 1973. 2. Use prohibited by the Toxic Chemical Substances Control Act in 1989. 3. Use prohibited by the Environmental Agents Control Act in 1998.
5	Toxaphene	1. Use as a pesticide prohibited by the Pesticide Management Act in 1983. 2. Use prohibited by the Toxic Chemical Substances Control Act in 1989.
6	Endrin	1. Use as a pesticide prohibited by the Pesticide Management Act in 1971. 2. Full-scale prohibition of use under the Toxic Chemical Substances Control Act starting in 1989.
7	Heptachlor	1. Use as a pesticide prohibited by the Pesticide Management Act in 1975. 2. Prohibition of use under the Toxic Chemical Substances Control Act starting in 1989. 3. Use prohibited by the Environmental Agents Control Act in 1998.
8	Aldrin	1. Use as a pesticide prohibited by the Pesticide Management Act in 1975. 2. Full-scale prohibition of use under the Toxic Chemical Substances Control Act starting in 1989.
9	Hexachlorobenzene	Use prohibited by the Toxic Chemical Substances Control Act in 1993.
10	Mirex	Never registered for use in Taiwan.
11	Dioxin	Emissions and concentration control standards are prescribed in the Air Pollution Control Act; Waste Disposal Act; and Soil and Groundwater Pollution Remediation Act.
12	Furans	

Table 2 The legal basis and organizational duties for nine pesticides, PCB and Dioxin and Furans

Organization	Legal Basis	Controlled POPs
EPA	"Toxic Chemical Substances Control Act" "Environmental Agents Control Act" "Waste Disposal Act" "Air Pollution Act" "Soil and Groundwater Pollution Remediation Act" "Soil Pollution Control Standards"	➤ Nine pesticides; PCB ➤ Nine pesticides ➤ PCB; Dioxin & Furans ➤ Dioxin & Furans ➤ Dioxin & Furans ➤ Dioxin & Furans
COA	"Pesticide Management Act" "Fisheries Act" "Veterinary Drugs Control Act" "Feeds Control Act" "Animal Industry Act"	➤ Nine pesticides ➤ PCB; Dioxin & Furans ➤ PCB; Dioxin & Furans ➤ PCB; Dioxin & Furans ➤ Dioxin & Furans
DOH	"Act Governing Food Sanitation" "Pesticide Residue Limits in Foods" "Pesticide Residue Limit Standards in Meat and Poultry Products" "Standards for the Tolerance of PCB in Food" "Maximum Levels for Dioxins in Foods"	➤ Nine pesticides; PCB; Dioxin & Furans ➤ Nine pesticides ➤ Nine pesticides ➤ PCB ➤ Dioxin and Furans
MOEA	"Statute for Upgrading Industries" "Law Governing Factory Administration and Assistance"	➤ Nine pesticides; PCB; Dioxin & Furans ➤ Nine pesticides; PCB; Dioxin & Furans

1. Control Strategy for Nine Organochlorine Pesticides

(1) Legal basis and organizational duties

- a. EPA: Use of the eight pesticides is prohibited by the EPA, but experimental, research, educational uses are not subject to this restriction. Mirex has never been registered for use in Taiwan.

- b. COA: Under the legislation controlled by the COA, a pesticide may be manufactured, processed, or imported only after it has passed testing by the central competent authority, which must approve registration and issuance of a pesticide permit. Consequently, when applying for pesticide registration, pesticide specification examination and field tests must be conducted, and technical data such as toxicology test reports and physical/chemical data must be submitted for review.
- c. DOH: According to "Pesticide Residue Limits in Foods", the nine organochlorine pesticides may not be detectable in agricultural products on the market.
- d. MOEA: The MOEA assists and guides factories in adopting pollution control and alternative product use measures, and provides technical assistance to restricted industries.

(2) Analysis of current situation

The uses of the eight pesticides were successively prohibited in Taiwan. Mirex has never been registered for use in Taiwan.

(3) Monitoring of environmental media and the biological matrix

- a. According to the results of EPA surveys of the organochlorine pesticides listed in the convention, and their metabolites in rivers conducted from 2002 to 2006, most measured values from bottom sediment samples were less than the detectable limit, which indicates that the concentration of organochlorine pesticides and their metabolites in river bottom sediment has gradually decreased. In addition, starting in 2006, the EPA has performed risk assessments of the hazard bottom sediment poses to aquacultural organisms and the hazard bottom sediment and edible river fish pose to human health. The organic pollutant measurements from the selected four rivers revealed that, apart from a small number of Tier 2 test points, pollutant concentrations at other points were below the hazardous threshold.

Furthermore, since 1973 the COA has performed sampling and testing work at approximately ten-year intervals to determine the concentration of pesticide residues in farmland soil. Testing results from 2004 indicated that the amounts of pesticide residues in soil samples had fallen significantly and steadily.

- b. With regard to the biological matrix, surveys conducted since 2002 have measured residues of the organochlorine pesticides in various types of foods. Surveys were performed of fish and shellfish, dairy products and infant and toddler foods, eggs and meat, edible fats and oils, and commercial cereals and their products from 2002 to 2006. Only five items of fish and shellfish contained DDT in 2002 and four edible fat and oil items contained DDT in 2005.

2. Control Strategy for PCBs

(1) Legal basis and organizational duties

- a. EPA: The EPA listed PCBs as Class 1 toxic chemicals in 1988, and prohibited their manufacture, import, sale, and use by the food industry. A full-scale ban on the use of PCBs, with the exception of experimental, research, educational purposes, took effect in January 2001.
- b. COA: The COA performs feed testing and monitoring and major marine monitoring project tasks, and simultaneously monitors PCBs to prevent pollution by these hazardous substances.
- c. DOH: The DOH monitors and controls PCBs in dairy products, meat, eggs, fish and shellfish, infant and toddler foods, and paper food packaging.
- d. MOEA: The MOEA assists and guides factories in adopting pollution control and alternative product use measures, and provides technical assistance to restricted industries.

(2) Analysis of current situation

The import of PCBs and toxic chemical engineering raw materials similar to PCBs was banned in 1978, and the use of PCBs-containing additives in capacitors and transformers was stopped in 1983. As a consequence, Taiwan has no new sources of PCBs. According to data from the EPA, reported PCB waste in temporary storage amounted to 4.15 tons as of September 2006. Because there are no approved PCB waste disposal facilities in Taiwan, all PCB waste must be exported for processing in developed countries such as France, Finland, and the US.

(3) Control strategy

In view of the fact that some under service and impossible to be tested PCBs-containing capacitors manufactured between June 1980 and December 1982 were allowed to be used till the end of their lifetime, the current control measures aimed to manage and check that kind of factories, and to deal with their methods of waste treatment. By exporting the waste to the developed countries for proper treatment, most of the domestic PCBs waste had been cleaned before 1998.

(4) Monitoring of environmental media and the biological matrix

a. PCBs monitoring surveys of 21 principal rivers in Taiwan were conducted from 1999 to 2006; the vast majority of measured values from bottom sediment samples were less than the detectable limit. In addition, human exposure to PCBs estimated from the concentration of coplanar PCBs in fish, is far less than the WHO's acceptable intake of dioxin-like chemicals. These show that environmental concentrations have fallen within the safe range.

b. With regard to the biological matrix, successive tests in livestock feed, aquacultural products and aquacultural feed from 2003 to 2006 yielded no detection of any PCB residues or detected values uniformly lower than the standard values in domestic and foreign regulations.

Furthermore, surveys of PCB residues in fish and shellfish, honey, dairy products, infant and toddler foods, meats, eggs, domestically-produced edible oil, and imported edible oil from 2002 to 2005 uniformly yielded results complying with domestic sanitation standards.

3. Control Strategy for Dioxin and Furans

(1) Legal basis and organizational duties

a. EPA: The legal basis for the control of dioxin and furans by the EPA can be explained with respect to air pollution source, waste and soil and groundwater pollution remediation management. Although Taiwan has no effluent control standards for dioxin in wastewater, the EPA is performing surveys of targets with dioxin emissions potential to assess the necessity of determining control values.

b. COA: The COA is responsible for the monitoring of agricultural, livestock, and aquacultural products, and the said authority also performs inspection in order to prevent contamination from hazardous substances.

c. DOH: The DOH is responsible for determining dioxin limits for various types of foods, notification and handling procedures for relevant cases, and product disposal and health risk communication mechanisms.

d. MOEA: The MOEA assists and guides factories in adopting pollution control and alternative product use measures, and provides technical assistance to restricted industries.

(2) Current state of controls

a. Pollution sources and environmental media

With regard to control of dioxin, the EPA includes dioxin emissions from newly established or existing stationary pollution sources within the scope of controls. Non-stationary pollution sources resulting from open-air combustion of rice straw or waste or burning of 'gold and silver spirit-offering

money', are audited and controlled via behavioral prohibitions. In addition, the EPA has determined the control standards for industrial waste and soil pollution.

b. Biological matrix and drinking water

Because 90%-95% of human dioxin intake is derived from foods, in 2006 the DOH announced the "Maximum Levels for Dioxins in Foods," which is modeled on European Union standards. Also the EPA has drafted drinking water dioxin content standards modeled on US methods.

c. Estimation of emission (release) quantities:

From 2001, the EPA started to estimate the quantities of dioxin emitted into the air in Taiwan, and established an annually updated emission inventory. The estimated amounts for 2004 to 2006 show that the targets in total quantity control have been successfully met.

d. Estimation of total intake:

DOH began monitoring the dioxin content of foods including meats and processed meat products, fish and shellfish and processed aquacultural products, dairy products, eggs and processed egg products, vegetables, and fruits in 2001. The results show that the estimated value of dioxin ingests by adults in Taiwan from 2001 to 2006 complies with the values recommended by WHO.

(3) Reduction targets

Since the current estimates of dioxin emissions and emission inventory for Taiwan are chiefly for pollution sources emitting into the atmosphere, current reduction targets are thus provisionally for pollution sources emitting gaseous dioxin. With regard to other media (such as in waste and discharge water, etc.), annual reduction targets suitable for Taiwan's conditions will be formulated following review of the results of background testing surveys, technological feasibility assessments, and economic efficiency assessments conducted by relevant competent authorities.

(4) Control strategy

Because dioxin and furans are never produced intentionally, but only as byproducts of various production processes, management in Taiwan will focus on source reduction and clean production, end-of-pipe control technology and waste reuse assistance. The following is a general explanation of dioxin and furan control strategies from the viewpoint of the EPA, COA, and DOH:

a. EPA: For air management, the EPA has focused on the formulation of control standards, establishment of emission inventories, implementation of environmental dispersal surveys, and strengthening of audit and control. For waste management, there are regulations to control the incineration disposal facilities for hazardous industrial waste containing dioxin and waste incineration fly ash. In addition, the EPA will make efforts in implementation of a source reduction approach, strengthened trash classification and testing for dioxin in waste. For effluent management, the EPA has compiled control measures adopted in Japan and the US to determine whether Taiwan should formulate effluent dioxin control standards and emission standards. And for drinking water, the EPA currently plans to revise dioxin content standards, limiting the maximum dioxin concentration in drinking water to 12 pg per liter.

b. COA: The COA has strengthened promotion of the chopping of rice straw, recycling of fruit trees branches as organic fertilizer, and use of straw as a source of biomass energy in order to increase the reuse value of straw and ease the problem of open-air burning.

c. DOH: Chiefly focuses on food monitoring work. Funding is budgeted on an annual basis for monitoring of dioxin in various types of common foods and in blood samples of people. In addition, in order to enable relevant agencies to undertake the necessary disposal measures, the DOH notifies the COA and EPA in accordance with the "Maximum Levels for Dioxins in Foods" whenever the dioxin content in food is found to exceed the limiting value. Foods with a dioxin content exceeding the limiting value are confiscated and destroyed to prevent them from reaching the market.

(5) Monitoring of environmental media and biological matrix

- a. The EPA budgets funds on an annual basis for dioxin and furan environment dispersal and site monitoring, R&D of testing methods and technologies, and active integration of different environmental media in order to establish dioxin dispersal control mechanisms in stages. The EPA has monitored or estimated the concentration of dioxin and furans in emission sources, ambient air, waste, environmental water bodies, soil environment and bottom sediment environment respectively, and the results so far all showed the concentration of dioxin and furans has significantly decreased or below the limiting value.
- b. With regard to the agricultural competent authority's duties, the COA continued to perform monitoring of dioxin content in livestock/poultry/aquacultural feed in order to strengthen management of production and sanitation thereof.
- c. With regard to the health competent authority's duties, the DOH conducted several research projects under the titles "Assessment of Dietary Dioxin Exposure and Risk Analysis" and "Survey of Dioxin Background Values in Human Blood" in order to determine whether dioxin poses a potential health risk to humans. The DOH performed a contaminant analysis of foods that are edible after cooking as part of a total diet survey, and established a food safety risk assessment and management system including background data on contaminants in food and long-term monitoring.

Future Response Strategies to Persistent Organic Pollutants

1. Actively participating in the Stockholm Convention and the POPRC, staying abreast of Stockholm Convention development trends, promptly adjusting domestic control methods. In the COP4 held in May, 2009, nine new chemicals were added to the convention. In the nine chemicals, the use of chlordecone is already prohibited by the COA, and the use of lindane and pentaBDE are controlled by EPA. As for the other six new chemicals, the use, transfer and control situation in Taiwan will be evaluated by the related organizations to comply with the international management trends.
2. Conducting dispersal surveys of environmental media including air, water bodies, waste, and soil, and determining relevant control standards.
3. Establishing and implementing agricultural/livestock/aquacultural product and food safety monitoring mechanisms.
4. Drafting of alternative product R&D goals and timetables, assessment of economic issues connected with the use and reduction of POPs, and helping manufacturers to implement POPs pollution prevention and improvement work, including source reduction, in-plant pollution prevention and improvement management, and adequate clearance and disposal of waste containing POPs.

Conclusion

With the growth of national incomes and consciousness of environmental protection, Taiwan is increasingly eager to acquire a better environmental quality. For achieving the strategic target of this state's execution program, the promotional tasks involves widely and requires the proper conduct of control strategies, laws and regulations by various competent entities such as environmental protection, agricultural, health and economic affairs entities based on their authorities and responsibilities. The promotional tasks, such as enhancing the reduction and control strategies on various POPs, integrating the periodic inspection and testing and auditorial control, continuously conducting a national investigation on the POPs distribution in the environment and cautiously assessing the new controlled materials, shall be executed with step by step. For assessing the new controlled materials, Taiwan has already followed the steps of COP4, banned or controlled lindane, pentaBDE and chlordecone, and the use, transfer and control of the six other chemicals are also currently under evaluation and discussion. Through the execution of above control strategies and management mechanism, the elimination or tremendous reduction of the POPs in the environment and the emission of harmful chemicals to global detriment are to be expected.

Reference

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