Environmental Monitoring Report

on

Persistent Organic Pollutants (POPs)

in Japan

2002-2004

Environmental Health and Safety Division

Environmental Health Department

Ministry of the Environment of JAPAN (MOE)

September 2006
Environmental Monitoring Report on Persistent Organic Pollutants (POPs) in Japan 2002-2004

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# List of Acronyms

## Substances

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<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>HCB</td>
<td>Hexachlorobenzene</td>
</tr>
<tr>
<td>DDT</td>
<td>Dichlorodiphenyltrichloroethane</td>
</tr>
<tr>
<td>DDE</td>
<td>Dichlorodiphenyldichloroethylene</td>
</tr>
<tr>
<td>DDD</td>
<td>Dichlorodiphenyldichloroethane</td>
</tr>
<tr>
<td>PCBs</td>
<td>Polychlorinated biphenyls</td>
</tr>
<tr>
<td>PCDDs</td>
<td>Polychlorinated dibenzo-p-dioxins</td>
</tr>
<tr>
<td>PCDFs</td>
<td>Polychlorinated dibenzofurans</td>
</tr>
<tr>
<td>HCH</td>
<td>Hexachlorocyclohexane (Benzenehexachloride)</td>
</tr>
<tr>
<td>PFOS</td>
<td>Perfluorooctane sulfonic acid</td>
</tr>
</tbody>
</table>

## Others

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FY</td>
<td>Fiscal Year (from April to March)</td>
</tr>
<tr>
<td>GC/MS</td>
<td>Gas Chromatography/Mass Spectrometry</td>
</tr>
<tr>
<td>LC/MS</td>
<td>Liquid Chromatography/Mass Spectrometry</td>
</tr>
<tr>
<td>MOE</td>
<td>Ministry of the Environment of Japan</td>
</tr>
<tr>
<td>MQL</td>
<td>Method Quantification Limit</td>
</tr>
<tr>
<td>MDL</td>
<td>Method Detection Limit</td>
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<td>24</td>
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<td>32</td>
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<td>1-4-5-1</td>
<td>Detected Frequency and Detection Range of Chlordanes (cis-Chlordane)</td>
<td>34</td>
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<td>1-4-5-2</td>
<td>Detected Frequency and Detection Range of Chlordanes (trans-Chlordane)</td>
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<td>1-4-5-3</td>
<td>Detected Frequency and Detection Range of Chlordanes (Oxychlordane)</td>
<td>38</td>
</tr>
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<td>1-4-5-4</td>
<td>Detected Frequency and Detection Range of Chlordanes (cis-Nonachlor)</td>
<td>40</td>
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<tr>
<td>1-4-5-5</td>
<td>Detected Frequency and Detection Range of Chlordanes (trans-Nonachlor)</td>
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</tr>
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<td>46</td>
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<td>Detected Frequency and Detection Range of Toxaphenes</td>
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<td>Detected Frequency and Detection Range of Toxaphenes (Parlar-26)</td>
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<tr>
<td>1-4-8-2</td>
<td>Detected Frequency and Detection Range of Toxaphenes (Parlar-50)</td>
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<td>1-4-8-3</td>
<td>Detected Frequency and Detection Range of Toxaphenes (Parlar-62)</td>
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<td>1-4-9</td>
<td>Detected Frequency and Detection Range of PCBs (total)</td>
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Figure 1-4-10-3 Detected Frequency and Detection Range of DDTs $(p,p'-DDE)$

Figure 1-4-10-4 Detected Frequency and Detection Range of DDTs $(o,p'-DDE)$

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Figure 1-4-10-6 Detected Frequency and Detection Range of DDTs $(o,p'-DDD)$

Figure 1-4-11 Detected Frequency and Detection Range of PCDDs/PCDFs

Figure 2-3-2-1 Detected Frequency and Detection Range of HCHs $(\alpha\text{-HCH})$

Figure 2-3-2-2 Detected Frequency and Detection Range of HCHs $(\beta\text{-HCH})$

Figure 2-3-2-3 Detected Frequency and Detection Range of HCHs $(\gamma\text{-HCH})$

Figure 2-3-2-4 Detected Frequency and Detection Range of HCHs $(\delta\text{-HCH})$
Foreward

Persistent organic pollutants (POPs) such as PCBs and DDTs are toxic, persistent and bioaccumulative and are transferred through the air, water and migratory species across international boundaries and deposited far from their location of emission and accumulate in terrestrial and aquatic ecosystems. It came to be internationally recognised that there are concerns about health impacts, *inter alia*, upon women and future generations due to exposure to POPs especially in developing countries.

It had been increasingly stressed that actions by only a limited number of countries were insufficient for the worldwide elimination and reduction of POPs, thus the Stockholm Convention on Persistent Organic Pollutants (Stockholm Convention) was adopted at the Conference of Plenipotentiaries held in Stockholm in May 2001. The Stockholm Convention entered into force on 17 May 2004. The Government of Japan had positively contributed to the work to establish the internationally-binding document, and acceded to the Stockholm Convention on 30 August 2002.

According to Article 16 of the Stockholm Convention, its effectiveness shall be evaluated starting four years after the date of entry into force of the Stockholm Convention, i.e. before 17 May 2008. Comparable monitoring data on 12 POPs under the Stockholm Convention from national, regional and global monitoring programmes are needed for a scientifically sound and meaningful evaluation.

In Japan, triggered by the environmental problems due to PCBs in the 1970s, the Ministry of the Environment of Japan (MOE) has systematically conducted the “Environmental Survey and Monitoring of Chemicals” Programme and identified actual existence/non-existence and/or temporal and spatial trends of 837 chemicals (as of the end of FY2004) including POPs in the environment over a 30-year period.

Since FY2002, MOE has continued to refine the methodologies for sampling and analysing for 10 substance groups among 12 POPs listed in the Annexes to the Stockholm Convention – Aldrin, Dieldrin, Endrin, Heptachlors, Chlordanes, HCB, Mirex, Toxaphenes, PCBs and DDTs, following the renovations of sampling/analysis procedures for PCDDs/PCDFs in the 1990s, with reference to the outcome of the “Workshop to Develop a POPs Global Monitoring Programme (GMP) to support the Effectiveness Evaluation of the Stockholm Convention on POPs” held in Geneva in 2003. Thus, MOE has conducted the refined environmental monitoring of “12 POPs”since FY2002 as a part of the “Environmental Survey and Monitoring of Chemicals” Programme. MOE is convinced that the data on “12 POPs” obtained in the Programme will contribute to the effective evaluations of the Stockholm Convention.

This report comprises two chapters. Chapter 1 shows monitoring data on the substances relevant to “12 POPs” listed in the Annexes to the Stockholm Convention, and Chapter 2 summarises the data on 5 substances that were proposed for listing in Annex A of the Stockholm Convention and considered at the first meeting of the Persistent Organic Pollutants Review Committee (POPRC) held in November 2005 – Pentabromodiphenyl ether, Chlordcone, Hexabromobiphenyl, HCHs (although the proposal was for Lindane, this report includes data on alpha, beta, gamma and delta isomers of HCH.) and Perfluorooctane sulfonate (PFOS).
CHAPTER 1

ENVIRONMENTAL MONITORING OF “12 PERSISTENT ORGANIC POLLUTANTS (POPs)” IN JAPAN

1. Purpose of the Monitoring

In 1974, Ministry of the Environment of Japan (MOE) commenced the “Environmental Survey and Monitoring of Chemicals” Programme. Under this Programme, environmental survey and monitoring of chemicals including persistent organic pollutants (POPs) have been carried out in a systematic and uniform manner.

The Programme consists of 2 parts: (1) environmental survey of various chemicals to elucidate the presence (i.e., existence/not existence in the environment); and (2) environmental monitoring of specific persistent and bioaccumulative substances to identify temporal and spatial trends in the environment. The data obtained and evaluations thereto in the Programme have been compiled and published as an annual report – “Kagaku-busshitsu To Kankyo” (chemicals in the environment).

This Chapter extracts and summarises the environmental monitoring data on the substances relevant to the 12 POPs listed in Annexes A, B and/or C of the Stockholm Convention on the Persistent Organic Pollutants (hereinafter referred to as “Stockholm Convention”) which were obtained under the Programme supplemented with additional data of other surveys conducted by MOE for FY2002-2004.

2. Target substances and sites

The FY2002-2004 environmental monitoring under the “Environmental Survey and Monitoring of Chemicals” Programme targeted the total 25 substance groups (see Table 1-2-1) relevant to the 12 POPs listed in the Stockholm Convention. The focussed 25 substances were selected with reference to the “essential analytes” for the determination of POPs by the Workshop to Develop a POPs Global Monitoring Programme (GMP) to Support the Effectiveness Evaluation of the Stockholm Convention on POPs, held in Geneva from 24 to 27 March 2003. Within the scheme of the Programme, the Expert Group on POPs Monitoring reviewed the obtained data and its subgroup verified each of the actual sampling and analytical procedures. The data on PCDDs/PCDFs were also appraised by other expert groups.
The monitoring sites are shown in Figures 1-2-1 to 1-2-4. The number of the sites for “12 POPs” environmental monitoring in FY2002-2004 were: 34 to 37 for atmospheric air and precipitation (Figure 1-2-1); 21 to 23 for wildlife (bivalves, fish, and birds) (Figure 1-2-2); 38 to 40 for surface water (Figure 1-2-3); and 62 to 63 for bottom sediment (Figure 1-2-4).

Table 1-2-1 Target Substances/Media for 12 POPs Monitoring in FY2002-2004

<table>
<thead>
<tr>
<th>No.</th>
<th>Target Substances/Media</th>
<th>Atmospheric Air &amp; Precipitation</th>
<th>Wildlife</th>
<th>Surface Water</th>
<th>Bottom Sediment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Aldrin</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>2.</td>
<td>Dieldrin</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>3.</td>
<td>Endrin</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>4.</td>
<td>Heptachlors</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>5.</td>
<td>Chlordane</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>6.</td>
<td>HCB</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>7.</td>
<td>Mirex</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>8.</td>
<td>Toxaphenes</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>9.</td>
<td>PCBs (total)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>10.</td>
<td>DDTs</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>11.</td>
<td>PCDDs</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>12.</td>
<td>PCDFs</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
Figure 1-2-1 Sites for 12 POPs Monitoring for Atmospheric Air and Precipitation (FY2002-2004)

Legend to this Figure: The red-coloured sites mean the sites where the monitoring was conducted only in the indicated fiscal year(s) during FY2002-2004.
Figure 1-2-2 Sites for 12 POPs Monitoring for Wildlife (FY2002-2004)

Legend to this Figure: The red-coloured sites mean the sites where the monitoring was conducted only in the indicated fiscal year(s) during FY2002-2004.
Figure 1-2-3 Sites for 12 POPs Monitoring for Surface Water (FY2002-2004)

Legend to this Figure: The red-coloured sites mean the sites where the monitoring was conducted only in the indicated fiscal year(s) during FY2002-2004.
Figure 1-2-4 Sites for 12 POPs Monitoring for Bottom Sediment (FY2002-2004)

Legend to this Figure: The red-coloured sites mean the sites where the monitoring was conducted only in the indicated fiscal year(s) during FY2002-2004.
3. Methods of sampling/analysis

(1) Selection of the monitoring sites

The points where chemical substances were being released (i.e., near the outlet for waste water of a factory, etc. where the substances were being manufactured or used, or near points through which transportation facilities passed, etc.) and points directly affected by pollution were excluded from sampling sites.

(2) Sampling methods

The methodologies for sampling 12-POPs-relevant substances other than PCDDs/PCDFs in each of the targeted matrices were shown below. Collected samples were placed in bags or containers so that the samples would not elute or adsorb, and were analysed as soon as possible. For preservation, samples were kept in refrigerators or freezers, etc. in a manner according to the documented protocol.

A. Air and precipitation

Sampling should take place, in principle, between September and November when the weather is stable. Samples should be collected by adsorption to resin, glass fiber filters, etc. or sucked by canister. The sites for air sampling should be on the location where information on status of air is available. The sites significantly affected by a particular source of chemicals, by transportation facilities, etc. should be avoided.

Information collected at sampling sites:
Information on weather, temperature, humidity, wind direction, wind velocity, surrounding geography and traffic conditions at neighbouring roads during the sampling time should be recorded.

B. Wildlife

In sea areas, a sea bass or young sea bass should be the first choice and, if not available, a goby, striped mullet or flatfish could be accepted. At lakes, marshes and rivers, a dace should be used and, if not available, a carp or crucian carp could be accepted as a standard sample. Although it is preferable to use a single body of the sample, pool of several bodies could be also allowed. In such a case, a small-bodied sample could be used after sufficient cleansing. For fish, a collection of 3 samples from the site should be considered sufficient.

Preparation of fish for analysis:
Edible parts (muscles) should be used. Any part of the fish could be used, but more than approximately 100g should be ensured for analytical samples. In cases where the body weight of the fish is under 100g, the edible parts of several fish should be carved and homogenised.

Preparation of bivalves for analysis:
Edible parts of the required quantity should be collected and homogenised for use as samples. Sludge should be removed to the most extent as possible.

For wildlife samples, lipid weight (%) is measured by the following method:
Five grams of the sample is placed in a homogeniser cup, after which 20 mL of chloroform and 40 mL of methanol are added, and then homogenised for 2 minutes. An additional 20 mL of chloroform is added, followed by 2-minutes homogenising. The sample is then filtered with a Buchner funnel and homogenised with 80 mL of chloroform and methanol mixture (1:1). 60 mL
of distilled water is added to the entire chloroform-methanol fraction placed in the separation funnel, and should be then shaken gently. The lower chloroform fraction is collected and dried with anhydrous sodium sulfate, and the solvent should be evaporated using a rotary evaporator. The residue is dried using phosphorus pentoxide, and the weight is measured.

Information collected at sampling sites: Standard Japanese vernacular name should be confirmed, and body length (excluding tail), body weight and lipid weight should be recorded.

C. Surface water

Water sampling is conducted at a time when the days preceding the day of sampling has been relatively sunny and the water quality is stable. In monitoring, three samples should be collected at spots within a unit range of 500 square meters, so that they are collected in as widespread spots as possible. The depth for sampling point should be, in principle, 0–50 cm beneath the surface vertically under the spot selected within the unit range. However, water in 0–2 cm depth should be avoided for sampling so that floating garbage and oils should not be contained in the samples.

Preparation for analysis:
No filtration or centrifugal separation, etc. should be conducted.

Information collected at sampling sites:
Temperature, colour by visual (eye) observation, transparency and turbidity should be recorded.

D. Bottom sediment

In monitoring, three samples should be collected within a unit range of 500 square meters so that they are collected in as widespread points as possible. In this case, the sample for bottom sediment is a mixture of samples from 3 spots in equal quantities.

The bottom sediment collected using an Ekman-Birge bottom sampler or other proportionate bottom samplers is placed on a clean tray. The sampled sediment, after being removed from extraneous substances such as pebbles, shells and bits of animals and plants, should be sieved with a 16-mesh sieve (hole diameter: 1 mm) and provided for analysis. The sludge content (weight of sample through the sieve/weight of original sample) (%) is measured. Dry weight (105–110°C for about 2 hours) and ignition loss (600 ± 25°C for about 2 hours) should be measured for part of the samples.

Samples for analysis should be, in principle, not air- or heat-dried, and the measured value per dry weight should be calculated.

Information collected at sampling sites: Appearance, odour, foreign substance, depth of water at sampling point, water content, ignition loss and sludge content should be recorded.

(3) Analytical methods

The analytical methods utilised for the “12 POPs” monitoring in FY2002-2004 for each of the monitored matrices are shown in the Appendix.
## 4. Monitoring results

Summaries of the detection results of the FY2002-2004 monitorings are shown in Table 1-4-1 to 1-4-4.

### Table 1-4-1  Results of 12 POPs Monitoring (Air and Precipitation) in FY2002-2004

<table>
<thead>
<tr>
<th>Substance</th>
<th>FY2002</th>
<th>FY2003</th>
<th>FY2004</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min</td>
<td>Max</td>
<td>Mean</td>
</tr>
<tr>
<td>Aldrin</td>
<td>&lt;0.020</td>
<td>0.3</td>
<td>0.035 (w)</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Dieldrin</td>
<td>0.75</td>
<td>110</td>
<td>5.6</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Endrin</td>
<td>&lt;0.030</td>
<td>2.5</td>
<td>0.22</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Hexachlor</td>
<td>Hexachlor</td>
<td>0.20</td>
<td>220</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>epoxide</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>trans-Hexachlor</td>
<td>&lt;0.033</td>
<td>0.30</td>
<td>0.034 (w)</td>
</tr>
<tr>
<td>epoxide</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Chlorodane</td>
<td>Chlorodane</td>
<td>0.36</td>
<td>670</td>
</tr>
<tr>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>trans-Chlorodane</td>
<td>0.62</td>
<td>820</td>
<td>36</td>
</tr>
<tr>
<td>Dioxin</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>epoxide</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>cis-Trichlorin</td>
<td>0.071</td>
<td>62</td>
<td>3.1</td>
</tr>
<tr>
<td>trans-Trichlorin</td>
<td>0.64</td>
<td>550</td>
<td>24</td>
</tr>
<tr>
<td>HCB</td>
<td>57</td>
<td>3,000</td>
<td>99</td>
</tr>
<tr>
<td>Mirex</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PCDDs/PCDFs</td>
<td>PCDDs/PCDFs</td>
<td>0.021</td>
<td>0.45</td>
</tr>
<tr>
<td>Legend and Note to this Table</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Unit is pg/m³ whereas pg-TEQ/m³ was used for PCDDs/PCDFs. TEF was calculated according to WHO-TEF(1998).</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>tr = value less than Method Quantification Limit (MQL) but over than Method Detection Limit (MDL), w = warm season (Aug.-Oct.), c = cold season (Nov.-Dec.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>mean = geographical mean, whereas arithmetical mean for PCDDs/PCDFs, assuming the data less than MDL as a half of MDL.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total number of the sites was: 34 in FY2002; 35 (34 in cold season) in FY2003; and 37 in FY2004 for the substances excluding PCDDs/PCDFs whereas 48 sites for PCDDs/PCDFs.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Table 1-4-2 Results of 12 POPs Monitoring (Wildlife) in FY2002-2004

<table>
<thead>
<tr>
<th>Substance</th>
<th>FY2002</th>
<th>FY2003</th>
<th>FY2004</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min</td>
<td>Max</td>
<td>Mean</td>
</tr>
<tr>
<td>Chlordanes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>cis-Chlordane</td>
<td>v</td>
<td>24</td>
<td>26,000</td>
</tr>
<tr>
<td>trans-Chlordane</td>
<td>v</td>
<td>33</td>
<td>2,500</td>
</tr>
<tr>
<td>4,5-Dichloro-3,6-TCDD</td>
<td>v 0.2</td>
<td>5,600</td>
<td>76</td>
</tr>
<tr>
<td>cis-Nonachlor</td>
<td>v</td>
<td>8.6</td>
<td>870</td>
</tr>
<tr>
<td>trans-Nonachlor</td>
<td>v</td>
<td>21</td>
<td>1,800</td>
</tr>
<tr>
<td>HCB</td>
<td>v</td>
<td>2.4</td>
<td>330</td>
</tr>
<tr>
<td>Mirex</td>
<td>v</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Toxicophenes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parath-26</td>
<td>v</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Parath-50</td>
<td>v</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Parath-62</td>
<td>v</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PCBs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>p,p'-DDD</td>
<td>v</td>
<td>38</td>
<td>1,200</td>
</tr>
<tr>
<td>p,p'-DDE</td>
<td>v</td>
<td>22</td>
<td>480</td>
</tr>
<tr>
<td>p,p'-DDE</td>
<td>v</td>
<td>41</td>
<td>4,600</td>
</tr>
<tr>
<td>p,p'-DDT</td>
<td>v</td>
<td>13</td>
<td>1,100</td>
</tr>
<tr>
<td>p,p'-DDE</td>
<td>v</td>
<td>11</td>
<td>3,200</td>
</tr>
<tr>
<td>p,p'-DDE</td>
<td>v</td>
<td>9</td>
<td>5.6</td>
</tr>
</tbody>
</table>

**Legend and Note to this Table**

- **Mean**: Geographical mean, whereas arithmetic mean for PCDDs/PCDFs, assuming the data less than MDL, as a half of MDL.
- **Max**: Total numbers of the sites for bivalves, fish and birds were: 8, 14 and 2 in FY2002; 6, 14 and 2 in FY2003; and 7, 14 and 2 in FY2004.
### Table 1-4-3: Results of 12 POPs Monitoring (Surface Water) in FY2002-2004

<table>
<thead>
<tr>
<th>Substance</th>
<th>FY2002</th>
<th></th>
<th>FY2003</th>
<th></th>
<th>FY2004</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min</td>
<td>Max</td>
<td>Mean</td>
<td>Min</td>
<td>Max</td>
<td>Mean</td>
</tr>
<tr>
<td><strong>Aldrin</strong></td>
<td>&lt;0.2</td>
<td>1.1</td>
<td>0.69</td>
<td>2.7</td>
<td>3.5</td>
<td>2.5(n)</td>
</tr>
<tr>
<td><strong>Dieldrin</strong></td>
<td>3.3</td>
<td>540</td>
<td>41</td>
<td>9.7</td>
<td>510</td>
<td>57</td>
</tr>
<tr>
<td><strong>Endrin</strong></td>
<td>&lt;2.0</td>
<td>31</td>
<td>4.7(tr)</td>
<td>0.7</td>
<td>78</td>
<td>5.7(tr)</td>
</tr>
<tr>
<td><strong>Heptachlor</strong></td>
<td>&lt;0.5</td>
<td>25</td>
<td>1.1(tr)</td>
<td>1.2</td>
<td>170</td>
<td>9.8</td>
</tr>
<tr>
<td><strong>cis-Heptachlor epoxide</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>&lt;0.4</td>
<td>2</td>
<td>&lt;0.4(tr)</td>
</tr>
<tr>
<td><strong>trans-Heptachlor epoxide</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>&lt;0.3</td>
<td>&lt;0.3</td>
<td>&lt;0.3(tr)</td>
</tr>
<tr>
<td><strong>cis-Chlordane</strong></td>
<td>2.5</td>
<td>880</td>
<td>41</td>
<td>12</td>
<td>920</td>
<td>69</td>
</tr>
<tr>
<td><strong>trans-Chlordane</strong></td>
<td>3.1</td>
<td>780</td>
<td>32</td>
<td>6</td>
<td>410</td>
<td>34</td>
</tr>
<tr>
<td><strong>cis-Dichlorodiphenylchloroethane</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>&lt;0.23</td>
<td>250</td>
<td>7.6</td>
</tr>
<tr>
<td><strong>trans-Dichlorodiphenylchloroethane</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>13</td>
<td>130</td>
<td>8.0</td>
</tr>
<tr>
<td><strong>cis-Nonachlor</strong></td>
<td>1.8</td>
<td>780</td>
<td>29</td>
<td>4.0</td>
<td>450</td>
<td>26</td>
</tr>
<tr>
<td><strong>trans-Nonachlor</strong></td>
<td>9.8</td>
<td>1,400</td>
<td>36</td>
<td>11</td>
<td>340</td>
<td>29</td>
</tr>
<tr>
<td><strong>HCB</strong></td>
<td>9.8</td>
<td>1,400</td>
<td>36</td>
<td>11(tr)</td>
<td>340</td>
<td>29(tr)</td>
</tr>
<tr>
<td><strong>Parlar-26</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>&lt;20</td>
<td>&lt;20</td>
<td>&lt;20</td>
</tr>
<tr>
<td><strong>Parlar-50</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>&lt;30</td>
<td>&lt;30</td>
<td>&lt;30</td>
</tr>
<tr>
<td><strong>Parlar-62</strong></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>&lt;36</td>
<td>&lt;38</td>
<td>&lt;38</td>
</tr>
<tr>
<td><strong>PCBs (total)</strong></td>
<td>60</td>
<td>11,000</td>
<td>460</td>
<td>230</td>
<td>3,100</td>
<td>530</td>
</tr>
<tr>
<td><strong>DDTs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>p,p'-DDT</strong></td>
<td>0.19</td>
<td>770</td>
<td>5.1</td>
<td>1.3(tr)</td>
<td>160</td>
<td>6(tr)</td>
</tr>
<tr>
<td><strong>o,p'-DDT</strong></td>
<td>0.19</td>
<td>770</td>
<td>5.1</td>
<td>1.3(tr)</td>
<td>160</td>
<td>6(tr)</td>
</tr>
<tr>
<td><strong>p,p'-DDE</strong></td>
<td>&lt;0.3</td>
<td>680</td>
<td>2.3</td>
<td>0.42(tr)</td>
<td>170</td>
<td>2.2(tr)</td>
</tr>
<tr>
<td><strong>o,p'-DDE</strong></td>
<td>0.27</td>
<td>150</td>
<td>7.5</td>
<td>4(tr)</td>
<td>160</td>
<td>7.5</td>
</tr>
<tr>
<td><strong>p,p'-DDD</strong></td>
<td>0.62</td>
<td>130</td>
<td>5.5</td>
<td>1.1</td>
<td>150</td>
<td>7.1</td>
</tr>
<tr>
<td><strong>o,p'-DDD</strong></td>
<td>0.62</td>
<td>130</td>
<td>5.5</td>
<td>1.1</td>
<td>150</td>
<td>7.1</td>
</tr>
<tr>
<td><strong>PCDDs/PCDFs</strong></td>
<td>0.018</td>
<td>2.7</td>
<td>0.27</td>
<td>0.020</td>
<td>7.9</td>
<td>0.24</td>
</tr>
</tbody>
</table>

**Legend and Note to this Table**

Unit is pg/L whereas pg-TEQ/L was used for PCDDs/PCDFs. TEF was calculated according to WHO-TEF(1998).

tr = value less than Method Quantification Limit (MQL) but over than Method Detection Limit (MDL).

mean = geographical mean, whereas arithmetical mean for PCDDs/PCDFs, assuming the data less than MDL as a half of MDL.

Total number of the sites was: 38 in FY2002; 36 in FY2003; and 38 in FY2004 for the substances excluding PCDDs/PCDFs whereas 1,340 sites for PCDDs/PCDFs in FY2004.
### Table 1-4-4 Results of 12 POPs Monitoring (Bottom Sediment) in FY2002-2004

<table>
<thead>
<tr>
<th>Substance</th>
<th>FY2002</th>
<th>FY2003</th>
<th>FY2004</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min</td>
<td>Max</td>
<td>Mean</td>
</tr>
<tr>
<td>Aldrin</td>
<td>&lt;2</td>
<td>570</td>
<td>12</td>
</tr>
<tr>
<td>Dieldrin</td>
<td>4.9</td>
<td>3,400</td>
<td>63</td>
</tr>
<tr>
<td>Lindane</td>
<td>&lt;2</td>
<td>19,000</td>
<td>7</td>
</tr>
<tr>
<td>Hexachlor</td>
<td>&lt;0.6</td>
<td>120</td>
<td>3.5</td>
</tr>
<tr>
<td>cis-4-Heptachlor</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>trans-4-Heptachlor</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Chlordane</td>
<td>cis-Chlordane</td>
<td>1.8</td>
<td>10,000</td>
</tr>
<tr>
<td></td>
<td>trans-Chlordane</td>
<td>2.1</td>
<td>10,000</td>
</tr>
<tr>
<td>Dicyclorane</td>
<td>&lt;0.5</td>
<td>120</td>
<td>2.2</td>
</tr>
<tr>
<td>cis-Naphthalin</td>
<td>&lt;0.7</td>
<td>7,800</td>
<td>66</td>
</tr>
<tr>
<td></td>
<td>trans-Naphthalin</td>
<td>2.8</td>
<td>11,000</td>
</tr>
<tr>
<td>HCB</td>
<td>7.6</td>
<td>19,000</td>
<td>210</td>
</tr>
<tr>
<td>Mean</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Polychlor</td>
<td>Parlar-26</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Parlar-50</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Parlar-62</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PCBs (total)</td>
<td>39</td>
<td>630,000</td>
<td>9,200</td>
</tr>
<tr>
<td>DDTs</td>
<td>p,p'-DDT</td>
<td>3(tr)</td>
<td>81,000</td>
</tr>
<tr>
<td></td>
<td>o,p'-DDT</td>
<td>&lt;2</td>
<td>27,000</td>
</tr>
<tr>
<td></td>
<td>p,p'-DDE</td>
<td>8.4</td>
<td>23,000</td>
</tr>
<tr>
<td></td>
<td>o,p'-DDE</td>
<td>&lt;1</td>
<td>16,000</td>
</tr>
<tr>
<td></td>
<td>p,p'-DDD</td>
<td>&lt;2</td>
<td>14,000</td>
</tr>
<tr>
<td>PCDDs/PCDFs</td>
<td>p,p'-DDT</td>
<td>3(tr)</td>
<td>81,000</td>
</tr>
<tr>
<td></td>
<td>o,p'-DDT</td>
<td>&lt;2</td>
<td>27,000</td>
</tr>
<tr>
<td></td>
<td>p,p'-DDE</td>
<td>8.4</td>
<td>23,000</td>
</tr>
<tr>
<td></td>
<td>o,p'-DDE</td>
<td>&lt;1</td>
<td>16,000</td>
</tr>
<tr>
<td></td>
<td>p,p'-DDD</td>
<td>&lt;2</td>
<td>14,000</td>
</tr>
</tbody>
</table>

Legend and Note to this Table

- Unit is pg/g-dry whereas pg-TEQ/g was used for PCDDs/PCDFs. TEF was calculated according to WHO-TEF(1998).
- tr = value less than Method Quantification Limit (MQL) but over than Method Detection Limit (MDL).
- Mean = geometric mean, whereas arithmetical mean for PCDDs/PCDFs, assuming the data less than MDL as a half of MDL.
- Total number of the sites was: 63 in FY2002; 62 in FY2003; and 63 in FY2004 for the substances excluding PCDDs/PCDFs whereas 961 sites for PCDDs/PCDFs in FY2004.
5. Assessment of monitoring results

The target substances analysed in this environment monitoring were Aldrin, Dieldrin, Endrin, three substances relevant to Heptachlors (heptachlor, cis-heptachlor epoxide and trans-heptachlor epoxide), five substances relevant to Chlordanes (cis-chlordane, trans-chlordane, oxychlordane, cis-nanochlor and trans-nanochlor), HCB, Mirex, three substances relevant to Toxaphenes (Parlar-26, Parlar-50 and Parlar-62), total PCBs and six substance relevant to DDTs (p,p’-DDT, o,p’-DDT, p,p’-DDE, o,p’-DDE, p,p’-DDD and o,p’-DDD).

High-sensitivity analyses were carried out in FY2004, in succession from FY2002 and FY2003. The “12 POPs” were detected in all the media except that toxaphenes were not detected in surface water and bottom sediment. Results and assessment of the environment monitoring for each substance (group) are described below.

(1) Aldrin

Atmospheric air and precipitation: The persistence of the substance has been monitored since FY2002. The persistent concentrations of the substance in FY2004 were comparable to those in FY2002. In FY2003 the values were higher in warm season than in cold season, while the results in FY2004 showed no apparent differences between the warm season and cold season. The substance had been detected at approximately a half of the monitoring sites or more since FY2002, and its persistence in the atmospheric air and precipitation was still recognized in widespread areas.

Wildlife:

Bivalves: The persistent concentrations in FY2004 were comparable to those in FY2002 and FY2003. The substance was detected at about a half of the monitoring sites from FY2002 to FY2004, and its persistence in bivalves in the environment was still recognized in widespread areas.

Fish: The substance was detected at two monitoring sites in FY2004, though the values were below the detection limit. The substance had been detected since FY2002: in one of the total 70 samples at one of the 14 sites (FY2002); in sixteen of the total 70 samples at seven of the 14 sites (FY2003); and in five of the total 70 samples at two of the 14 sites (FY2004). Its persistence in fish in the environment was still recognized in widespread areas.

Birds: Although it is difficult to grasp the tendency of its persistence in birds in the environment because of variance of the sites, in addition to the fact that only two sites had been monitored, its persistence in birds in the environment was still recognized.

Surface water and bottom sediment: The substance was detected at almost all the monitoring sites from FY2002 to FY2004, and its persistence in surface water as well as bottom sediment was still recognized in widespread areas.
Figure 1-4-1  Detected Frequency and Detection Range of Aldrin

Aldrin (Air and Precipitation)

Aldrin (Wildlife/Bivalves)

Aldrin (Wildlife/Fish)

Aldrin (Wildlife/Birds)

Aldrin (Surface Water)

Aldrin (Bottom Sediment)

Aldrin (Wildlife/Fish)

Aldrin (Aldrin (Air and Precipitation))

Aldrin (Wildlife/Bivalves)

Aldrin (Wildlife/Fish)

Aldrin (Wildlife/Birds)

Aldrin (Surface Water)

Aldrin (Bottom Sediment)

Aldrin (Wildlife/Fish)

Aldrin (Aldrin (Air and Precipitation))

Aldrin (Wildlife/Bivalves)

Aldrin (Wildlife/Fish)

Aldrin (Wildlife/Birds)

Aldrin (Surface Water)

Aldrin (Bottom Sediment)

Aldrin (Wildlife/Fish)
(2) Dieldrin

Atmospheric air and precipitation: The persistence of the substance has been monitored since FY2002. The persistent concentrations of the substance in the warm season of FY2004 were comparable to those in the warm season of FY2003, while the values in the cold season of FY2004 were comparable to those in FY2002 and in the cold season of FY2003. In FY2004, the values were higher in warm season than in cold season, as also seen in FY2003, showing differences in persistent concentrations depending on monitoring seasons and meteorological conditions. The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence atmospheric air and precipitation was still recognised in widespread areas.

Wildlife:

Bivalves and fish: The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence in bivalves and fish was still recognised in widespread areas.

Birds: Although it is difficult to grasp the tendency of its persistence in birds because of variance of the sites, in addition to the fact that only two sites had been monitored, its persistence was still recognised.

Surface water: The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.

Bottom sediment: The substance has been detected in all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.
Figure 1-4-2  Detected Frequency and Detection Range of Dieldrin

### Dieldrin (Air and Precipitation)

<table>
<thead>
<tr>
<th>Year</th>
<th>Detection (pg/m³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>5.6</td>
</tr>
<tr>
<td>2003</td>
<td>19</td>
</tr>
<tr>
<td>2004</td>
<td>5.7, 17, 5.5</td>
</tr>
</tbody>
</table>

### Dieldrin (Wildlife/Bivalves)

<table>
<thead>
<tr>
<th>Year</th>
<th>Detection (pg/g-wet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>490</td>
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<tr>
<td>2003</td>
<td>410</td>
</tr>
<tr>
<td>2004</td>
<td>510</td>
</tr>
</tbody>
</table>

### Dieldrin (Wildlife/Fish)

<table>
<thead>
<tr>
<th>Year</th>
<th>Detection (pg/g-wet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>280</td>
</tr>
<tr>
<td>2003</td>
<td>210</td>
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<tr>
<td>2004</td>
<td>240</td>
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</table>

### Dieldrin (Wildlife/Birds)

<table>
<thead>
<tr>
<th>Year</th>
<th>Detection (pg/g-wet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>1,200</td>
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<tr>
<td>2003</td>
<td>1,300</td>
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<tr>
<td>2004</td>
<td>590</td>
</tr>
</tbody>
</table>

### Dieldrin (Surface Water)

<table>
<thead>
<tr>
<th>Year</th>
<th>Detection (pg/L)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>41</td>
</tr>
<tr>
<td>2003</td>
<td>57</td>
</tr>
<tr>
<td>2004</td>
<td>55</td>
</tr>
</tbody>
</table>

### Dieldrin (Bottom Sediment)

<table>
<thead>
<tr>
<th>Year</th>
<th>Detection (pg/g-dry)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>63</td>
</tr>
<tr>
<td>2003</td>
<td>59</td>
</tr>
<tr>
<td>2004</td>
<td>58</td>
</tr>
</tbody>
</table>
(3) Endrin

Atmospheric air and precipitation: The persistence of the substance has been monitored since FY2002. The persistent concentrations of the substance in the warm season of FY2004 were comparable to those in the warm season of FY2003, while the values in the cold season of FY2004 were comparable to those in FY2002 and in the cold season of FY2003. In FY2004, the values were higher in warm season than in cold season, as also seen in FY2003, showing differences in persistent concentrations depending on monitoring seasons and meteorological conditions. The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.

Wildlife:

Bivalves: The substance had been detected in most of the samples from almost all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.

Fish: In FY2004, the substance was detected in 57 of the 70 samples at 13 of the 14 monitoring sites. The substance had been detected in most of the samples from almost all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.

Birds: Although it is difficult to grasp the tendency of its persistence because of variance of the sites, in addition to the fact that only two sites had been monitored, its persistence was still recognised.

Surface water and bottom sediment: The substance had been detected in most of the samples from almost all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.
Figure 1-4-3  Detected Frequency and Detection Range of Endrin

Endrin (Air and Precipitation)

Endrin (Wildlife/Bivalves)

Endrin (Wildlife/Fish)

Endrin (Wildlife/Birds)

Endrin (Surface/Water)

Endrin (Bottom/Sediment)
(4) Heptachlors

Atmospheric air and precipitation: The persistence of Heptachlor has been monitored since FY2002, and Heptachlor epoxides thereof since FY2003. The persistent concentrations of Heptachlor and *cis*-Heptachlor epoxide in the warm season of FY2004 were comparable to those in the warm season of FY2003, while the values in the cold season of FY2004 were comparable to those in FY2002 and in the cold season of FY2003. In FY2004, the values of the two substances were higher in warm season than in cold season, as also seen in FY2003, showing differences in persistent concentrations depending on monitoring seasons and meteorological conditions. Heptachlor and *cis*-Heptachlor epoxide had been detected in all the samples from all the monitoring sites since FY2002 and FY2003, and their persistence was still recognised in widespread areas.

Wildlife:

Bivalves: *cis*-Heptachlor had been detected in all the samples from all the monitoring sites since FY2003, and Heptachlor had been detected in most of the samples from almost all the monitoring sites since FY2002, and their persistence was still recognised in widespread areas.

Fish: *cis*-Heptachlor had been detected in all the samples from all the monitoring sites since FY2003, and Heptachlor had been detected in most of the samples from almost all the monitoring sites since FY2002, and their persistence was still recognised in widespread areas.

Birds: Although it is difficult to grasp the tendency of their persistence because of variance of monitoring sites, in addition to the fact that only two sites had been monitored, their persistence was still recognised.

Surface water and bottom sediment: The Heptachlor and *cis*-Heptachlor had been detected in most of the samples from almost all the monitoring sites since FY2002 and FY2003, and their persistence was still recognised in widespread areas.
Figure 1-4-4-1  Detected Frequency and Detection Range of Heptachlors (Heptachlor)

**Heptachlor (Air and Precipitation)**

- 2002: 11
- 2003: 27
- 2003(c): 10
- 2004(w): 23
- 2004(c): 11

**Heptachlor (Wildlife/Bivalves)**

- 2002: 3.6
- 2003: 2.8
- 2004: 3.5

**Heptachlor (Wildlife/Fish)**

- 2002: 4.0
- 2003: <2.2
- 2004: 1.9

**Heptachlor (Wildlife/Birds)**

- 2002: 2.1
- 2003: <2.2
- 2004: <1.4

**Heptachlor (Surface Water)**

- 2002: 1.1
- 2003: 1.8
- 2004: <2

**Heptachlor (Surface Water)**

- 2002: 3.5
- 2003: 2.4
- 2004: 2.5

**Heptachlor (Bottom Sediment)**

- 2002: 167
- 2003: 50
- 2004: 70

**Heptachlor (Wildlife/Insects)**

- 2002: 9
- 2003: 36
- 2004: <2
Figure 1-4-4-2  Detected Frequency and Detection Range of Heptachlors (cis-Heptachlor epoxide)

**cis**-Heptachlorepoxide (Air and Precipitation)

<table>
<thead>
<tr>
<th>Year</th>
<th>2002</th>
<th>2003(w)</th>
<th>2003(c)</th>
<th>2004(w)</th>
<th>2004(c)</th>
</tr>
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<tr>
<td>Value</td>
<td>3.5</td>
<td>1.3</td>
<td>2.8</td>
<td>1.1</td>
<td></td>
</tr>
</tbody>
</table>

**cis**-Heptachlorepoxide (Wildlife/Bivalves)

<table>
<thead>
<tr>
<th>Year</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>42</td>
<td>57</td>
<td></td>
</tr>
</tbody>
</table>

**cis**-Heptachlorepoxide (Wildlife/Fish)

<table>
<thead>
<tr>
<th>Year</th>
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<th>2003</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>46</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**cis**-Heptachlorepoxide (Wildlife/Birds)

<table>
<thead>
<tr>
<th>Year</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>520</td>
<td>270</td>
<td></td>
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</tbody>
</table>

**cis**-Heptachlorepoxide (Surface Water)

<table>
<thead>
<tr>
<th>Year</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>9.8</td>
<td>10</td>
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</tr>
</tbody>
</table>

**cis**-Heptachlorepoxide (Bottom Sediment)

<table>
<thead>
<tr>
<th>Year</th>
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<th>2003</th>
<th>2004</th>
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<tbody>
<tr>
<td>Value</td>
<td>4</td>
<td>4.4</td>
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</tbody>
</table>

**cis**-Heptachlorepoxide (Wildlife/Birds)

<table>
<thead>
<tr>
<th>Year</th>
<th>2002</th>
<th>2003</th>
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</tr>
</thead>
<tbody>
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<table>
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</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 1-4-4-3  Detected Frequency and Detection Range of Heptachlors (trans-Heptachlor epoxide)

- trans-Heptachlorepoxide (Air and Precipitation)
- trans-Heptachlorepoxide (Wildlife/Bivalves)
- trans-Heptachlorepoxide (Wildlife/Fish)
- trans-Heptachlorepoxide (Wildlife/Birds)
- trans-Heptachlorepoxide (Surface Water)
- trans-Heptachlorepoxide (Bottom Sediment)

<p>| | | | | |</p>
<table>
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<tr>
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<tbody>
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<td>18/35</td>
<td>3/34</td>
<td>4/37</td>
</tr>
<tr>
<td>V</td>
<td>-</td>
<td>5/30</td>
<td>9/31</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>-</td>
<td>0/70</td>
<td>2/70</td>
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<tr>
<td>B</td>
<td>-</td>
<td>0/10</td>
<td>0/10</td>
<td></td>
</tr>
<tr>
<td>W</td>
<td>-</td>
<td>4/36</td>
<td>0/38</td>
<td></td>
</tr>
<tr>
<td>S</td>
<td>-</td>
<td>0/186</td>
<td>1/189</td>
<td></td>
</tr>
</tbody>
</table>
(5) Chlordanes

A. \textit{cis}-chlordane

\textbf{Atmospheric air and precipitation:} The persistence of the substance has been monitored since FY2002. The persistent concentrations of the substance in the warm season of FY2004 were comparable to those in the warm season of FY2003, while the values in the cold season of FY2004 were comparable to those in the cold season of FY2003. In FY2004, the values were higher in warm season than in cold season, as also seen in FY2003, showing differences in persistent concentrations depending on monitoring seasons and meteorological conditions. The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.

\textbf{Wildlife:}

\textbf{Bivalves and fish:} The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.

\textbf{Birds:} Although it is difficult to grasp the tendency of its persistence because of variance of the sites, in addition to the fact that only two sites had been monitored, its persistence was still recognised.

\textbf{Surface water:} The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.

\textbf{Bottom sediment:} The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.
Figure 1-4-5-1  Detected Frequency and Detection Range of Chlordanes (<i>cis</i>-Chlordane)

<i>cis</i>-Chlordane (Air and Precipitation)

<i>cis</i>-Chlordane (Wildlife/Bivalves)

<i>cis</i>-Chlordane (Wildlife/Fish)

<i>cis</i>-Chlordane (Wildlife/Birds)

<i>cis</i>-Chlordane (Surface Water)

<i>cis</i>-Chlordane (Bottom Sediment)
B. trans-chlordane

_Atmospheric air and precipitation:_ The persistence of the substance has been monitored since FY2002. The persistent concentrations of the substance in the warm season of FY2004 were comparable to those in the warm season of FY2003, while the values in the cold season of FY2004 were comparable to those in FY2002 and in the cold season of FY2003. In FY2004, the values were higher in warm season than in cold season, as also seen in FY2003, showing differences in persistent concentrations depending on monitoring seasons and meteorological conditions. The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.

_Wildlife:_

_Bivalves and fish:_ The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.

_Birds:_ Although it is difficult to grasp the tendency of its persistence because of variance of the sites, in addition to the fact that only two sites had been monitored, its persistence was still recognised.

_Surface water:_ The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.

_Bottom sediment:_ The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.
Figure 1-4-5-2  Detected Frequency and Detection Range of Chlordanes (*trans*-Chlordane)

*trans*-Chlordane (Air and Precipitation)

*trans*-Chlordane (Wildlife/Bivalves)

*trans*-Chlordane (Wildlife/Fish)

*trans*-Chlordane (Wildlife/Birds)

*trans*-Chlordane (Surface Water)

*trans*-Chlordane (Bottom Sediment)
C. Oxychlordane

Atmospheric air and precipitation: The persistence of the substance has been monitored since FY2002. The persistent concentrations of the substance in the warm season of FY2004 were comparable to those in the warm season of FY2003, while the values in the cold season of FY2004 were comparable to those in FY2002 and in the cold season of FY2003. In FY2004, the values were higher in warm season than in cold season, as also seen in FY2003, showing differences in persistent concentrations depending on monitoring seasons and meteorological conditions. The substance had been detected in all the samples of all the monitoring sites since FY2002, and their persistence was still recognised in widespread areas.

Wildlife:

Bivalves and fish: The substance had been detected in most of the samples from all the monitoring sites since FY2002, and their persistence was still recognised in widespread areas.

Birds: Although it is difficult to grasp the tendency of the persistence because of variance of the sites, in addition to the fact that only two sites had been monitored, its persistence was still recognised.

Surface water: The substance had been detected in most of the samples from almost all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.

Bottom sediment: The substance has been detected in most of the samples from almost all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.
Figure 1-4-5-3  Detected Frequency and Detection Range of Chlordanes (Oxychlordane)

Oxychlordane (Air and Precipitation)

Oxychlordane (Wildlife/Bivalves)

Oxychlordane (Wildlife/Fish)

Oxychlordane (Wildlife/Birds)

Oxychlordane (Surface Water)

Oxychlordane (Bottom Sediment)
D. cis-nonachlor

Atmospheric air and precipitation: Cis-nonachlor had been subject to the monitoring programme since FY2002. The persistent concentrations of the substance in the warm season of FY2004 were comparable to those in the warm season of FY2003, while the values in the cold season of FY2004 were comparable to those in FY2002 and in the cold season of FY2003. In FY2004, the values were higher in warm season than in cold season, as also seen in FY2003, showing differences in persistent concentrations depending on the monitoring seasons and meteorological conditions. The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.

Wildlife:

Bivalves and fish: The substance had been detected in all the samples from all the monitoring sites since FY2002, and their persistence was still recognised in widespread areas.

Birds: Although it is difficult to grasp the tendency of their persistence because of variance of the sites, in addition to the fact that only two sites had been monitored, its persistence was still recognised.

Surface water: The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.

Bottom sediment: The substance had been detected in most of the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.
Figure 1-4-5-4  Detected Frequency and Detection Range of Chlordanes (cis-Nonachlor)

**cis-Nonachlor (Air and Precipitation)**

<table>
<thead>
<tr>
<th>Year</th>
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<th>2003(w)</th>
<th>2003(c)</th>
<th>2004(w)</th>
<th>2004(c)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
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<td>12</td>
<td>2.7</td>
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<td>2.7</td>
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</tbody>
</table>

**cis-Nonachlor (Wildlife/Bivalves)**

<table>
<thead>
<tr>
<th>Year</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>190</td>
<td>290</td>
<td>280</td>
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</table>

**cis-Nonachlor (Wildlife/Fish)**

<table>
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<th>Year</th>
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<th>2003</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>420</td>
<td>350</td>
<td>410</td>
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</table>

**cis-Nonachlor (Wildlife/Birds)**

<table>
<thead>
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<th>Year</th>
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<th>2003</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>10</td>
<td>200</td>
<td>130</td>
</tr>
</tbody>
</table>

**cis-Nonachlor (Surface Water)**

<table>
<thead>
<tr>
<th>Year</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
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</thead>
<tbody>
<tr>
<td>Value</td>
<td>7.6</td>
<td>8.0</td>
<td>7.5</td>
</tr>
</tbody>
</table>

**cis-Nonachlor (Bottom Sediment)**

<table>
<thead>
<tr>
<th>Year</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>66</td>
<td>59</td>
<td>46</td>
</tr>
</tbody>
</table>
E. *trans*-nonachlor

**Atmospheric air and precipitation:** *Trans*-nonachlor had been subject to the monitoring programme since FY2002. The persistent concentrations of the substance in the warm season of FY2004 were comparable to those in the warm season of FY2003, while the values in the cold season of FY2004 were comparable to those in FY2002 and in the cold season of FY2003. In FY2004, the values were higher in warm season than in cold season, as also seen in FY2003, showing differences in persistent concentrations depending on the monitoring seasons and meteorological conditions. The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.

**Wildlife:**

**Bivalves and fish:** The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.

**Birds:** Although it is difficult to grasp the tendency of the persistence because of variance of the sites, in addition to the fact that only two sites had been monitored, its persistence was still recognised.

**Surface water:** The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.

**Bottom sediment:** The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.
Figure 1-4-5-5  Detected Frequency and Detection Range of Chlordanes (trans-Nonachlor)

trans-Nonachlor (Air and Precipitation)

trans-Nonachlor (Wildlife/Bivalves)

A  102/102  35/35  34/34  37/37  37/37

V  38/38  30/30  31/31

trans-Nonachlor (Wildlife/Fish)

trans-Nonachlor (Wildlife/Birds)

F  70/70  70/70  70/70

B  10/10  10/10  10/10

trans-Nonachlor (Surface Water)

trans-Nonachlor (Bottom Sediment)

W  114/114  36/36  38/38

S  189/189  186/186  189/189
(6) HCB

Atmospheric air and precipitation: The persistence of the substance has been monitored since FY2002. The persistent concentrations of the substance in the warm season of FY2004 were comparable to those in the warm season of FY2003, while the values in the cold season of FY2004 were comparable to those in FY2002 and in the cold season of FY2003. In FY2004, the values were higher in warm season than in cold season, as also seen in FY2003, showing differences in persistent concentrations depending on monitoring seasons and meteorological conditions. The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.

Wildlife:

Bivalves: The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.

Fish: The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.

Birds: Although it is difficult to grasp the tendency of its persistence in birds because of variance of the sites, in addition to the fact that only two sites had been monitored, its persistence was still recognised.

Surface water: The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.

Bottom sediment: The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.
Figure 1-4-6  Detected Frequency and Detection Range of HCB

HCB (Air and Precipitation)

HCB (Wildlife/Bivalves)

HCB (Wildlife/Fish)

HCB (Wildlife/Birds)

HCB (Surface Water)

HCB (Bottom Sediment)
Monitoring has been carried out since FY2003 to investigate mirex persisting in each of all the media. Japan has never produced or imported mirex. In FY2003 and FY2004, however, it was detected in all the samples of wildlife (bivalves, fish and birds) and atmospheric air from all the monitoring sites, as well as in samples of surface water and bottom sediment from half of the monitoring sites.

**Atmospheric air and precipitation:** The persistence of the substance has been monitored since FY2003. The persistent concentrations of the substance in the warm season of FY2004 were comparable to those in the warm season of FY2003, while the values in the cold season of FY2004 were comparable to those in the cold season of FY2003. In FY2004, the values were higher in warm season than in cold season, as also seen in FY2003, showing differences in persistent concentrations depending on monitoring seasons and meteorological conditions. The substance had been detected in all the samples from all the monitoring sites since FY2003, and its persistence was still recognised in widespread areas.

**Wildlife:**

**Bivalves:** The substance had been detected in all the samples from all the monitoring sites since FY2003, and its persistence was still recognised in widespread areas.

**Fish:** The substance had been detected in all the samples from all the monitoring sites since FY2003, and its persistence was still recognised in widespread areas.

**Birds:** Although it is difficult to grasp the tendency of its persistence in birds because of variance of the sites, in addition to the fact that only two sites had been monitored, its persistence was still recognised.

**Surface water:** The substance had been detected in most of the samples from most of the monitoring sites since FY2003, and its persistence was still recognised in widespread areas.

**Bottom sediment:** The substance had been detected in most of the samples from most of the monitoring sites since FY2003, and its persistence was still recognised in widespread areas.
Figure 1-4-7  Detected Frequency and Detection Range of Mirex

Mirex (Air and Precipitation)

- 2002 2003(w) 2003(c) 2004(w) 2004(c)

Mirex (Wildlife/Bivalves)

- 2002 2003 2004

Mirex (Wildlife/Fish)

- 2002 2003 2004

Mirex (Wildlife/Birds)

- 2002 2003 2004

Mirex (Surface Water)

- 2002 2003 2004

Mirex (Bottom Sediment)

- 2002 2003 2004

| A | - | 35/35 34/34 37/37 37/37 |
| V | - | 30/30 31/31 |
| F | - | 70/70 70/70 |
| B | - | 10/10 10/10 |
| W | - | 25/36 18/38 |
| S | - | 137/186 153/189 |
(8) Toxaphenes

The persistence of toxaphens in birds is believed to be attributable to their prey and habitat, because Japan has never produced or imported toxaphens and they had not been detected in surface water nor bottom sediment.

**Atmospheric air and precipitation:** The persistence of the substances has been monitored since FY2003. The persistent concentrations of Parlar-26 in the warm season of FY2004 were comparable to those in the warm season of FY2003, while the values in the cold season of FY2004 were comparable to those in the cold season of FY2003. In FY2004, the values were higher in warm season than in cold season, as also seen in FY2003, showing differences in persistent concentrations depending on monitoring seasons and meteorological conditions. Parlar-26 had been detected in all the samples from all the monitoring sites since FY2003, and its persistence was still recognised in widespread areas.

**Wildlife:**

**Bivalves:** Parlar-26 and Parlar-50 had been detected in approximately a half of the samples from the monitoring sites since FY2003, and their persistence was still recognised in widespread areas.

**Fish:** Parlar-26 and Parlar-50 had been detected in more than a half of the samples from the monitoring sites since FY2003. Parlar-62 had been also detected in less ratio. Their persistence was still recognised in widespread areas.

**Birds:** Although it is difficult to grasp the tendency of their persistence in birds because of variance of the sites, in addition to the fact that only two sites had been monitored, their persistence was still recognised.

**Surface water:** The substances had not been detected in all the samples from all the monitoring sites since FY2003.

**Bottom sediment:** The substances had not been detected in all the samples from all the monitoring sites since FY2003.
Figure 1-4-8-1  Detected Frequency and Detection Range of Toxaphenes (Parlar-26)

Parlar-26 (Air and Precipitation)

Parlar-26 (Wildlife/Bivalves)

Parlar-26 (Wildlife/Fish)

Parlar-26 (Wildlife/Birds)

Parlar-26 (Surface Water)

Parlar-26 (Bottom Sediment)
Figure 1-4-8-2  Detected Frequency and Detection Range of Toxaphenes (Parlar-50)

Parlar-50 (Air and Precipitation)

Parlar-50 (Wildlife/Bivalves)

Parlar-50 (Wildlife/Fish)

Parlar-50 (Wildlife/Birds)

Parlar-50 (Surface Water)

Parlar-50 (Bottom Sediment)
Figure 1-4-8-3  Detected Frequency and Detection Range of Toxaphenes (Parlar-62)

Parlar-62 (Air and Precipitation)

Parlar-62 (Wildlife/Bivalves)

Parlar-62 (Wildlife/Fish)

Parlar-62 (Wildlife/Birds)

Parlar-62 (Surface Water)

Parlar-62 (Bottom Sediment)
(9) PCBs

Atmospheric air and precipitation: The persistence of the substances was monitored during FY2002 to FY2004. The persistent concentrations of the substances in the warm season of FY2002 were comparable to those in the warm season of FY2003, while the values in the cold season of FY2004 were comparable to those in FY2002 and in the cold season of FY2003. In FY2004, the values were higher in warm season than in cold season, as also seen in FY2003, showing differences in persistent concentrations depending on monitoring seasons and meteorological conditions. The substances were detected in all the samples from all the monitoring sites in FY2002, FY2003 and FY2004, and their persistence was still recognised in widespread areas.

Wildlife:

Bivalves: Comparable detection limits were used in FY2002 and later, which allow the continuous evaluation of the results. Changes were made to the monitoring sites as follows: two sites were excluded in FY2003 (Mytilus edulis galloprovincialis [blue mussel] at the Miura Peninsula, and Septifer virgatus [purplish bifurcate mussel] at Mishima); one site was added in FY2004 (Mytilus edulis galloprovincialis [blue mussel] at Takamatsu Port in Kagawa Prefecture); and monitored species were changed at one monitoring site (Mytilus edulis galloprovincialis [blue mussel] → Septifer virgatus [purplish bifurcate mussel] at Dokai Bay in Kitakyushu City). The substances were detected in all the samples from all the monitoring sites during FY2002-FY2004, and their persistence was still recognised in widespread areas.

Fish: The substances were detected in all the samples from all the monitoring sites during FY2002-FY2004, and their persistence was still recognised in widespread areas.

Birds: Although it is difficult to grasp the tendency of their persistence in birds because of variance of the sites, in addition to the fact that only two sites had been monitored, their persistence was still recognised.

Surface water: The substances were detected in all the samples from all the monitoring sites during FY2002-FY2004, and their persistence was still recognised in widespread areas.

Bottom sediment: The geometric means showed decreases in FY2002, FY2003 and FY2004. The substances were detected in all the samples from all the monitoring sites during FY2002-FY2004, and their persistence was still recognised in widespread areas.
Figure 1-4-9  Detected Frequency and Detection Range of PCBs (total)

PCB (Air and Precipitation)

PCB (Wildlife/Bivalves)

PCB (Wildlife/Fish)

PCB (Wildlife/Birds)

PCB (Surface Water)

PCB (Bottom Sediment)
(10) DDTs

A. \( p,p'\)-DDT

\[ \text{Cl} \quad \text{Cl} \quad \text{Cl} \quad \text{Cl} \quad \text{Cl} \]

Atmospheric air and precipitation: The persistence of the substance has been monitored since FY2002. The persistent concentrations of the substance in the warm season of FY2004 were comparable to those in the warm season of FY2003, while the values in the cold season of FY2004 were comparable to those in FY2002 and in the cold season of FY2003. In FY2004, the values were higher in warm season than in cold season, as also seen in FY2003, showing differences in persistent concentrations depending on monitoring seasons and meteorological conditions. The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.

Wildlife:

Bivalves: The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.

Fish: The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.

Birds: Although it is difficult to grasp the tendency of its persistence because of variance of the sites, in addition to the fact that only two sites had been monitored, its persistence was still recognised.

Surface water: The substance has been detected in most of the samples from almost all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.

Bottom sediment: The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.
Figure 1-4-10-1  Detected Frequency and Detection Range of DDTs (p,p’-DDT)

\[ p,p'\text{-DDT (Air and Precipitation)} \]

\[ p,p'\text{-DDT (Wildlife/Bivalves)} \]

\[ p,p'\text{-DDT (Wildlife/Fish)} \]

\[ p,p'\text{-DDT (Surface Water)} \]

\[ p,p'\text{-DDT (Bottom Sediment)} \]

\[ p,p'\text{-DDT (Wildlife/Birds)} \]

A 102/102 35/35 34/34 37/37 37/37

V 38/38 36/36 31/31

F 70/70 70/70 70/70

B 10/10 10/10 10/10

W 114/114 36/36 36/36

S 189/189 186/186 189/189

52
B. \( \alpha,\beta^\prime\)-DDT

\[
\text{\begin{tikzpicture}
\draw[thick] (0,0) -- (1,0) -- (1,1) -- (0,1) -- cycle;
\draw[thick] (0,0) -- (0.5,1);
\draw[thick] (1,0) -- (0.5,1);
\draw[thick] (1,1) -- (0.5,0);
\draw[thick] (0,1) -- (0.5,0);
\end{tikzpicture}}
\]

**Atmospheric air and precipitation:** The persistence of the substance has been monitored since FY2002. The persistent concentrations of the substance in the warm season of FY2004 were comparable to those in the warm season of FY2003, while the values in the cold season of FY2004 were comparable to those in FY2002 and in the cold season of FY2003. In FY2004, the values were higher in warm season than in cold season, as also seen in FY2003, showing differences in persistent concentrations depending on monitoring seasons and meteorological conditions. The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.

**Wildlife:**

**Bivalves:** The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.

**Fish:** The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.

**Birds:** Although it is difficult to grasp the tendency of its persistence because of variance of the sites, in addition to the fact that only two sites had been monitored, its persistence was still recognised.

**Surface water and bottom sediment:** The substance had been detected in most of the samples from mostly all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.
Figure 1-4-10-2 Detected Frequency and Detection Range of DDTs (o,p’-DDT)

### o,p’-DDT (Air and Precipitation)

<table>
<thead>
<tr>
<th>Year</th>
<th>2002</th>
<th>2003</th>
<th>2003(c)</th>
<th>2004</th>
<th>2004(c)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>2.2</td>
<td>6.9</td>
<td>1.6</td>
<td>5.1</td>
<td>1.5</td>
</tr>
</tbody>
</table>

### o,p’-DDT (Wildlife/Bivalves)

<table>
<thead>
<tr>
<th>Year</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>100</td>
<td>130</td>
<td>130</td>
</tr>
</tbody>
</table>

### o,p’-DDT (Wildlife/Fish)

<table>
<thead>
<tr>
<th>Year</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>110</td>
<td>80</td>
<td>130</td>
</tr>
</tbody>
</table>

### o,p’-DDT (Surface Water)

<table>
<thead>
<tr>
<th>Year</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentration (pg/L)</td>
<td>5.1</td>
<td>6</td>
<td>4.5</td>
</tr>
</tbody>
</table>

### o,p’-DDT (Bottom Sediment)

<table>
<thead>
<tr>
<th>Year</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentration (pg/g-dry)</td>
<td>524</td>
<td>35</td>
<td>80</td>
</tr>
</tbody>
</table>

### o,p’-DDT (Wildlife/Birds)

<table>
<thead>
<tr>
<th>Year</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentration (pg/g-wet)</td>
<td>7.7</td>
<td>18</td>
<td>10</td>
</tr>
</tbody>
</table>

### o,p’-DDT (Wildlife/Fish)

<table>
<thead>
<tr>
<th>Year</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentration (pg/g-wet)</td>
<td>130</td>
<td>80</td>
<td>110</td>
</tr>
</tbody>
</table>

### o,p’-DDT (Wildlife/Birds)

<table>
<thead>
<tr>
<th>Year</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentration (pg/g-wet)</td>
<td>7.7</td>
<td>18</td>
<td>10</td>
</tr>
</tbody>
</table>

### o,p’-DDT (Wildlife/Fish)

<table>
<thead>
<tr>
<th>Year</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Concentration (pg/g-wet)</td>
<td>130</td>
<td>80</td>
<td>110</td>
</tr>
</tbody>
</table>
C. \( p,p'-\text{DDE} \)

\[ \text{\textbf{Atmospheric air and precipitation:}} \] The persistence of the substance has been monitored since FY2002. The persistent concentrations of the substance in the warm season of FY2004 were comparable to those in the warm season of FY2003, while the values in the cold season of FY2004 were comparable to those in FY2002 and in the cold season of FY2003. In FY2004, the values were higher in warm season than in cold season, as also seen in FY2003, showing differences in persistent concentrations depending on monitoring seasons and meteorological conditions. The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.

\[ \text{\textbf{Wildlife:}} \]

\[ \text{\textbf{Bivalves:}} \] The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.

\[ \text{\textbf{Fish:}} \] The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.

\[ \text{\textbf{Birds:}} \] Although it is difficult to grasp the tendency of its persistence because of variance of the sites, in addition to the fact that only two sites had been monitored, its persistence was still recognised.

\[ \text{\textbf{Surface water:}} \] The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.

\[ \text{\textbf{Bottom sediment:}} \] The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.
Figure 1-4-10-3  Detected Frequency and Detection Range of DDTs (p,p’-DDE)

- **p,p’-DDE (Air and Precipitation)**
  - 2002: 2.8 pg/m^3
  - 2003: 7.2 pg/m^3
  - 2004: 6.1 pg/m^3

- **p,p’-DDE (Wildlife/Bivalves)**
  - 2002: 1,100 pg/g-wet
  - 2003: 1,100 pg/g-wet
  - 2004: 1,000 pg/g-wet

- **p,p’-DDE (Wildlife/Fish)**
  - 2002: 2,500 pg/g-wet
  - 2003: 2,000 pg/g-wet
  - 2004: 2,500 pg/g-wet

- **p,p’-DDE (Surface Water)**
  - 2002: 24 pg/L
  - 2003: 26 pg/L
  - 2004: 36 pg/L

- **p,p’-DDE (Wildlife/Birds)**
  - 2002: 66,000 pg/g-wet
  - 2003: 63,000 pg/g-wet
  - 2004: 34,000 pg/g-wet
D.  $\alpha,p'$-DDE

Atmospheric air and precipitation: The persistence of the substance has been monitored since FY2002. The persistent concentrations of the substance in the warm season of FY2004 were comparable to those in the warm season of FY2003, while the values in the cold season of FY2004 were comparable to those in FY2002 and in the cold season of FY2003. In FY2004, the values were higher in warm season than in cold season, as also seen in FY2003, showing differences in persistent concentrations depending on monitoring seasons and meteorological conditions. The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.

Wildlife:

Bivalves: The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.

Fish: The substance had been detected in most of the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.

Birds: Although it is difficult to grasp the tendency of its persistence because of variance of the sites, in addition to the fact that only two sites had been monitored, its persistence was still recognised.

Surface water and bottom sediment: The substance had been detected in most of the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.
Figure 1-4-10-4  Detected Frequency and Detection Range of DDTs (o,p′-DDE)
E.  \(p,p'\)-DDD

\[ \begin{array}{c}
\text{Cl} \\
\text{Cl}
\end{array} 
\begin{array}{c}
\text{Cl} \\
\text{Cl}
\end{array}
\begin{array}{c}
\text{Cl} \\
\text{Cl}
\end{array}
\begin{array}{c}
\text{Cl} \\
\text{Cl}
\end{array}
\]

**Atmospheric air and precipitation**: The persistence of the substance has been monitored since FY2002. The persistent concentrations of the substance in the warm season of FY2004 were comparable to those in the warm season of FY2003, while the values in the cold season of FY2004 were comparable to those in FY2002 and in the cold season of FY2003. In FY2004, the values were higher in warm season than in cold season, as also seen in FY2003, showing differences in persistent concentrations depending on monitoring seasons and meteorological conditions. The substance had been detected in almost all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.

**Wildlife:**

**Bivalves**: The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.

**Fish**: The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.

**Birds**: Although it is difficult to grasp the tendency of its persistence in birds because of variance of the sites, in addition to the fact that only two sites had been monitored, its persistence was still recognised.

**Surface water**: The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.

**Bottom sediment**: The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.
Figure 1-4-10-5  Detected Frequency and Detection Range of DDTs (p,p’-DDD)

**p,p’-DDD (Air and Precipitation)**

- **2002**: 0.12
- **2003(w)**: 0.30
- **2003(c)**: 0.13
- **2004(w)**: 0.24
- **2004(c)**: 0.12

**p,p’-DDD (Wildlife/Bivalves)**

- **2002**: 340
- **2003**: 380
- **2004**: 300

**p,p’-DDD (Wildlife/Fish)**

- **2002**: 610
- **2003**: 500
- **2004**: 640

**p,p’-DDD (Wildlife/Birds)**

- **2002**: 560
- **2003**: 590
- **2004**: 310

**p,p’-DDD (Surface Water)**

- **2002**: 15
- **2003**: 19
- **2004**: 19

**p,p’-DDD (Bottom Sediment)**

- **2002**: 540
- **2003**: 590
- **2004**: 550
**F. \( \alpha,\beta^\prime\)-DDD**

**Atmospheric air and precipitation:** The persistence of the substance has been monitored since FY2002. The persistent concentrations of the substance in the warm season of FY2004 were comparable to those in the warm season of FY2003, while the values in the cold season of FY2004 were comparable to those in FY2002 and in the cold season of FY2003. In FY2004, the values were higher in warm season than in cold season, as also seen in FY2003, showing differences in persistent concentrations depending on monitoring seasons and meteorological conditions. The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.

**Wildlife:**

**Bivalves:** The substance had been detected in all the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.

**Fish:** The substance had been detected in most of the samples from all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.

**Birds:** Although it is difficult to grasp the tendency of their persistence in birds because of variance of the sites, in addition to the fact that only two areas had been monitored, its persistence was still recognised.

**Surface water and bottom sediment:** The substance had been detected in most of the samples from almost all the monitoring sites since FY2002, and its persistence was still recognised in widespread areas.
Figure 1-4-10-6  Detected Frequency and Detection Range of DDTs ($o,p^\prime$-DDD)

**$o,p^\prime$-DDD (Air and Precipitation)**

<table>
<thead>
<tr>
<th>Year</th>
<th>2002</th>
<th>2003(w)</th>
<th>2003(c)</th>
<th>2004(w)</th>
<th>2004(c)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>0.14</td>
<td>0.37</td>
<td>0.15</td>
<td>0.31</td>
<td>0.14</td>
</tr>
</tbody>
</table>

**$o,p^\prime$-DDD (Wildlife/Bivalves)**

<table>
<thead>
<tr>
<th>Year</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>130</td>
<td>200</td>
<td>160</td>
</tr>
</tbody>
</table>

**$o,p^\prime$-DDD (Wildlife/Fish)**

<table>
<thead>
<tr>
<th>Year</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>83</td>
<td>73</td>
<td>100</td>
</tr>
</tbody>
</table>

**$o,p^\prime$-DDD (Wildlife/Birds)**

<table>
<thead>
<tr>
<th>Year</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>15</td>
<td>14</td>
<td>5.6</td>
</tr>
</tbody>
</table>

**$o,p^\prime$-DDD (Surface Water)**

<table>
<thead>
<tr>
<th>Year</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>5.5</td>
<td>7.1</td>
<td>6</td>
</tr>
</tbody>
</table>

**$o,p^\prime$-DDD (Bottom Sediment)**

<table>
<thead>
<tr>
<th>Year</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Value</td>
<td>140</td>
<td>140</td>
<td>120</td>
</tr>
</tbody>
</table>

A 97/102 35/37 34/37 37/37 37/37

V 38/38 30/30 31/31

F 70/70 66/70 68/70

B 10/10 10/10 9/10

W 113/114 36/36 38/38

S 184/189 186/186 189/189
(11) PCDDs and PCDFs

**Atmospheric air and precipitation:**
The monitoring of PCDDs and PCDFs in the environmental air has been conducted in the scheme other than the “Environmental Survey and Monitoring of Chemicals” Programme – Environmental Survey on Dioxins (hereinafter referred to as “Dioxins Survey”). Dioxins Survey was operated under the supervision of other divisions/offices of MOE. In Dioxins Survey, more than nine hundred sites were targeted every year, and 48 sites among them were selected and fixed for continuous monitoring. The present report refers to the data obtained at the 48 sites. The report of the Dioxins Survey for FY2004 said that the average value – 0.074 pg-TEQ/m³ in FY2004 was significantly low comparing to the data in FY1997 (0.54 pg-TEQ/m³).

**Wildlife:** The monitoring of PCDDs and PCDFs has been conducted in the scheme other than the “Environmental Survey and Monitoring of Chemicals” Programme, which does not target bivalves, etc.

**Surface water:** Dioxins Survey targeted 1,340 sites for continuously monitoring of PCDDs/PCDFs in surface water in FY2004. The average value in FY2004 – 0.22 pg-TEQ/L was lower than those in FY2002 and 2003 (0.27 pg-TEQ/L and 0.24 pg-TEQ/L, respectively).

**Bottom sediment:** Dioxins Survey targeted 961 sites for continuously monitoring of PCDDs/PCDFs in bottom sediment in FY2004. The average value in FY2004 – 8.0 pg-TEQ/g was lower than those in FY2002 and 2003 (11 pg-TEQ/g and 8.9 pg-TEQ/g, respectively).
Figure 1-4-11  Detected Frequency and Detection Range of PCDDs/PCDFs

PCDDs/PCDFs (Air and Precipitation)

PCDDs/PCDFs (Surface Water)

PCDDs/PCDFs (Bottom Sediment)
CHAPTER 2

ENVIRONMENTAL SURVEY AND MONITORING OF OTHER POPs IN JAPAN

1. Target substances and areas

This Chapter extracts and summerises the environmental survey and/or monitoring data on the chemicals relevant to 5 substances that were proposed for listing in Annex A of Stockholm Convention and considered at the first meeting of the Persistent Organic Pollutants Review Committee (POPRC) held in November 2005, i.e., Pentabromodiphenyl ether, Chlordecone, Hexabromobiphenyl, Lindane and Perfluorooctane sulfonate (PFOS). Although the proposal was made for Lindane, this Chapter includes the obtained data on alpha, beta, gamma as well as delta isomers of HCH. The media covered by the surveys/monitorings for the substances during FY2002-2004 was as shown in Table 2-1-1.

Table 2-1-1 Target Substances/Media for Other POPs Survey and Monitoring during FY2002-2004

<table>
<thead>
<tr>
<th>No.</th>
<th>Target Substances</th>
<th>Atmospheric Air &amp; Precipitation</th>
<th>Wildlife</th>
<th>Surface Water</th>
<th>Bottom Sediment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Chlordecone</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>HCHs</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>α-HCH</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>β-HCH</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>γ-HCH</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>δ-HCH</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Pentabromodiphenylether</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Hexabromobiphenyl</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>PFOS</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Survey/monitoring results

Summary of the detection results of the FY2002-2004 surveys and/or monitorings is shown in Table 2-2-1 to 2-2-4.
### Table 2-2-1 Results of Other POPs Survey and Monitoring (Air and Precipitation) during FY2002-2004

<table>
<thead>
<tr>
<th>Substance</th>
<th>FY2002</th>
<th>FY2003</th>
<th>FY2004</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min</td>
<td>Mean</td>
<td>Min</td>
</tr>
<tr>
<td>Chlordecone</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>α-HCH</td>
<td>&lt;0.5</td>
<td>&lt;0.5</td>
<td>&lt;0.5</td>
</tr>
<tr>
<td>β-HCH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>γ-HCH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Σ-HCH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pentabromodiphenylether</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hexabromobiphenyl</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PFOS</td>
<td>&lt;0.09</td>
<td>44</td>
<td></td>
</tr>
</tbody>
</table>

Legend and Note to this Table
- Unit is pg/m³.
- tr = value less than Method Quantification Limit (MQL) but over than Method Detection Limit (MDL), w = warm season (Aug.-Oct.), c = cold season (Nov.-Dec.)
- mean = geographical mean assuming the data less than MDL as a half of MDL.

### Table 2-2-2 Results of Other POPs Survey and Monitoring (Wildlife) during FY2002-2004

<table>
<thead>
<tr>
<th>Substance</th>
<th>FY2002</th>
<th>FY2003</th>
<th>FY2004</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min</td>
<td>Max</td>
<td>Mean</td>
</tr>
<tr>
<td>Chlordecone</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>α-HCH</td>
<td>&lt;120</td>
<td>1,800</td>
<td>35</td>
</tr>
<tr>
<td>β-HCH</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>γ-HCH</td>
<td>&lt;120</td>
<td>1,800</td>
<td>35</td>
</tr>
<tr>
<td>δ-HCH</td>
<td>&lt;120</td>
<td>1,800</td>
<td>35</td>
</tr>
<tr>
<td>Pentabromodiphenylether</td>
<td>70</td>
<td>24,000</td>
<td>1,400</td>
</tr>
<tr>
<td>Hexabromobiphenyl</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PFOS</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Legend and Note to this Table
- Unit is pg/g-wet.
- tr = value less than Method Quantification Limit (MQL) but over than Method Detection Limit (MDL).
- v = bivalves (Mytilus edulis, Sepia virgata or Mytilus coruscus).
- f = fish (Hexagrammos otakii, H. lagicophilus, Cololabis saira, Lateolabrax japonicus, Acanthopagrus sivicolus or Tribolodon hakonensis).
- b = birds (Strumus cineraceus or Larus crassirostris).
- mean = geographical mean assuming the data less than MDL as a half of MDL.

### Table 2-2-3 Results of Other POPs Survey and Monitoring (Surface Water) during FY2002-2004

<table>
<thead>
<tr>
<th>Substance</th>
<th>FY2002</th>
<th>FY2003</th>
<th>FY2004</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min</td>
<td>Max</td>
<td>Mean</td>
</tr>
<tr>
<td>Chlordecone</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>α-HCH</td>
<td>&lt;120</td>
<td>1,800</td>
<td>35</td>
</tr>
<tr>
<td>β-HCH</td>
<td>&lt;120</td>
<td>1,800</td>
<td>35</td>
</tr>
<tr>
<td>γ-HCH</td>
<td>&lt;120</td>
<td>1,800</td>
<td>35</td>
</tr>
<tr>
<td>δ-HCH</td>
<td>&lt;120</td>
<td>1,800</td>
<td>35</td>
</tr>
<tr>
<td>Pentabromodiphenylether</td>
<td>70</td>
<td>24,000</td>
<td>1,400</td>
</tr>
<tr>
<td>Hexabromobiphenyl</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PFOS</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Legend and Note to this Table
- Unit is pg/L.
- tr = value less than Method Quantification Limit (MQL) but over than Method Detection Limit (MDL).
- mean = geographical mean assuming the data less than MDL as a half of MDL.
Table 2-2-4 Results of Other POPs Survey and Monitoring (Bottom Sediment) during FY2002-2004

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
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<th></th>
<th></th>
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<tbody>
<tr>
<td>Chlordecone</td>
<td>-</td>
<td>-</td>
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<td>-</td>
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<tr>
<td>α-HCH</td>
<td>2.0</td>
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<td>140</td>
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<td>140</td>
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<tr>
<td>β-HCH</td>
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<td>000</td>
<td>220</td>
<td>5.9</td>
<td>000</td>
<td>220</td>
<td>4.9</td>
<td>000</td>
<td>220</td>
</tr>
<tr>
<td>γ-HCH</td>
<td>&gt;87</td>
<td>&gt;87</td>
<td>&gt;87</td>
<td>&gt;87</td>
<td>&gt;87</td>
<td>&gt;87</td>
<td>&gt;87</td>
<td>&gt;87</td>
<td>&gt;87</td>
</tr>
<tr>
<td>δ-HCH</td>
<td>&gt;87</td>
<td>&gt;87</td>
<td>&gt;87</td>
<td>&gt;87</td>
<td>&gt;87</td>
<td>&gt;87</td>
<td>&gt;87</td>
<td>&gt;87</td>
<td>&gt;87</td>
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<tr>
<td>PentaBromodiphenyl Ether</td>
<td>-</td>
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<td>-</td>
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<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Hexabromophenyl</td>
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<td>PFOS</td>
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<td>-</td>
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<td>-</td>
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<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

Legend and Note to this Table
Unit is pg/g-dry.
tr = value less than Method Quantification Limit (MQL) but over than Method Detection Limit (MDL).
mean = geographical mean assuming the data less than MDL as a half of MDL.

3. Assessment of survey and/or monitoring results

The “Environmental Survey and Monitoring of Chemicals” Programme covered in its surveys and/or monitorings the 5 substances proposed for listing in Annex A of Stockholm Convention and considered at the first meeting of the POPRC – Pentabromodiphenyl ether, Chlordecone, Hexabromobiphenyl, HCHs and Perfluorooctane sulfonate (PFOS). Results and assessment of the environment survey and/or monitoring for each substance (group) are described below.

(1) Chlordecone

A survey of chlordecone in the environmental air was conducted in FY2003 for the first time in Japan. The detection limit was 0.5pg/m³. The sampling was done at 1 site, and the substance was not detected. No surveys and/or monitoring has been done for chlordane for other matrices – wildlife, surface water nor bottom sediment – in the Programme.
(2) HCHs

Atmospheric air and precipitation: The persistence of the substances has been monitored since FY2003. The persistent concentrations of the substances in the warm season of FY2004 were comparable to those in the warm season of FY2003, while the values in the cold season of FY2004 were comparable to those in the cold season of FY2003. In FY2004, the values were higher in warm season than in cold season, as also seen in FY2003, showing differences in persistent concentrations depending on monitoring seasons and meteorological conditions. Each of α-HCH, β-HCH, γ-HCH and δ-HCH had been detected in all the samples from all the monitoring sites, and their persistence was recognised in widespread areas.

Wildlife

Bivalves and fish: The substances had been detected in more than a half of the samples from most of the monitoring sites since FY2003, and their persistence was still recognised in widespread areas. Till FY2002, ideal detection limits for γ-HCH and δ-HCH were not achieved, thus both substances were not detected in FY2002.

Birds: α-HCH and β-HCH were detected in all the samples from all the monitoring sites in FY2002-FY2004, and their persistence was still recognised. No monitorings were conducted on γ-HCH and δ-HCH in FY2002 for the same reason as described in “Bivalves and fish” above. γ-HCH and δ-HCH were detected in all the samples from all the monitoring sites in FY2004 as well as in FY2003, and their persistence was recognised in widespread areas.

Surface water: The substances had been detected in all the samples from all the monitoring sites since FY2002 (since FY2003 for γ-HCH and δ-HCH), and their persistence was still recognised in widespread areas.

Bottom sediment: α-HCH and β-HCH had been detected in all the samples from all the monitoring sites since FY2002, and their persistence was still recognised in widespread areas.

γ-HCH and δ-HCH were detected in most of the samples from nearly all the monitoring sites in FY2003 and in all the samples from all the monitoring sites in FY2004. Their persistence was recognised in widespread areas.
Figure 2-3-2-1  Detected Frequency and Detection Range of HCHs (α-HCH)

α-HCH (Air and Precipitation)

α-HCH (Wildlife/Bivalves)

α-HCH (Wildlife/Fish)

α-HCH (Wildlife/Birds)

α-HCH (Surface Water)

α-HCH (Bottom Sediment)
Figure 2-3-2-2  Detected Frequency and Detection Range of HCHs (β-HCH)

β-HCH (Air and Precipitation)

<table>
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<th>Year (w)</th>
<th>Year (c)</th>
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<tbody>
<tr>
<td>2002</td>
<td>2003</td>
</tr>
<tr>
<td>2004</td>
<td>2004</td>
</tr>
</tbody>
</table>

β-HCH (Wildlife/Bivalves)

<table>
<thead>
<tr>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
</tr>
<tr>
<td>2003</td>
</tr>
<tr>
<td>2004</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Concentration (pg/g-dry)</th>
</tr>
</thead>
<tbody>
<tr>
<td>69</td>
</tr>
<tr>
<td>62</td>
</tr>
<tr>
<td>62</td>
</tr>
</tbody>
</table>

β-HCH (Wildlife/Fish)

<table>
<thead>
<tr>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
</tr>
<tr>
<td>2003</td>
</tr>
<tr>
<td>2004</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Concentration (pg/g-wet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>99</td>
</tr>
<tr>
<td>78</td>
</tr>
<tr>
<td>100</td>
</tr>
</tbody>
</table>

β-HCH (Surface Water)

<table>
<thead>
<tr>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
</tr>
<tr>
<td>2003</td>
</tr>
<tr>
<td>2004</td>
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<table>
<thead>
<tr>
<th>Concentration (pg/L)</th>
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</thead>
<tbody>
<tr>
<td>210</td>
</tr>
<tr>
<td>250</td>
</tr>
<tr>
<td>260</td>
</tr>
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</table>

β-HCH (Wildlife/Birds)

<table>
<thead>
<tr>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
</tr>
<tr>
<td>2003</td>
</tr>
<tr>
<td>2004</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Concentration (pg/g-wet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3,000</td>
</tr>
<tr>
<td>3,400</td>
</tr>
<tr>
<td>2,200</td>
</tr>
</tbody>
</table>

β-HCH (Bottom Sediment)

<table>
<thead>
<tr>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
</tr>
<tr>
<td>2003</td>
</tr>
<tr>
<td>2004</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Concentration (pg/g-dry)</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
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<tr>
<td>220</td>
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<table>
<thead>
<tr>
<th>Concentration (pg/g-wet)</th>
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</thead>
<tbody>
<tr>
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<tr>
<td>30</td>
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<tr>
<td>31</td>
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</tbody>
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<table>
<thead>
<tr>
<th>Concentration (pg/m3)</th>
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</thead>
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<tr>
<td>9.6</td>
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<tr>
<td>2.1</td>
</tr>
<tr>
<td>6.6</td>
</tr>
<tr>
<td>2.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Concentration (pg/g-wet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>114</td>
</tr>
<tr>
<td>56</td>
</tr>
<tr>
<td>38</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Concentration (pg/g-wet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>189</td>
</tr>
<tr>
<td>186</td>
</tr>
<tr>
<td>189</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Concentration (pg/g-dry)</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
</tr>
<tr>
<td>220</td>
</tr>
<tr>
<td>220</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Concentration (pg/g-dry)</th>
</tr>
</thead>
<tbody>
<tr>
<td>189</td>
</tr>
<tr>
<td>189</td>
</tr>
<tr>
<td>189</td>
</tr>
</tbody>
</table>
Figure 2-3-2-3  Detected Frequency and Detection Range of HCHs (γ-HCH)

γ-HCH (Air and Precipitation)

γ-HCH (Wildlife/Bivalves)

A

γ-HCH (Wildlife/Fish)

γ-HCH (Wildlife/Birds)

F

γ-HCH (Surface Water)

γ-HCH (Bottom Sediment)

W

γ-HCH (Wildlife/Fish)

γ-HCH (Wildlife/Birds)

B

F

W

S
Figure 2-3-2-4   Detected Frequency and Detection Range of HCHs (δ-HCH)

δ-HCH (Air and Precipitation)

δ-HCH (Wildlife/Bivalves)

δ-HCH (Wildlife/Fish)

δ-HCH (Wildlife/Birds)

δ-HCH (Surface Water)

δ-HCH (Bottom Sediment)

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
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<td>34/37</td>
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<td>V</td>
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<td>29/30</td>
<td>29/31</td>
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<tr>
<td>F</td>
<td>-</td>
<td>59/70</td>
<td>54/70</td>
</tr>
<tr>
<td>B</td>
<td>-</td>
<td>10/10</td>
<td>10/10</td>
</tr>
<tr>
<td>W</td>
<td>-</td>
<td>36/36</td>
<td>38/38</td>
</tr>
<tr>
<td>S</td>
<td>-</td>
<td>180/186</td>
<td>189/189</td>
</tr>
</tbody>
</table>
(3) Pentabromodiphenyl ether

\[
\begin{array}{c}
\text{Br}_m \\
\text{O} \\
\text{Br}_n \\
m+n=5
\end{array}
\]

**Atmospheric air and precipitation:** A survey was conducted in FY2001 with a detection limit of 0.09 pg/m\(^3\), and the substance was detected at all of the surveyed sites (12 sites) with a detection range between 0.10-9.3 pg/m\(^3\). The survey conducted in FY2004 with a detection limit of 0.06 pg/m\(^3\) detected the substance at all of the surveyed sites (3 sites) with a detection range between 0.35-5.4 pg/m\(^3\). The persistence levels of the substance were comparable to the previous data.

**Bottom sediment:** A survey of the substance in bottom sediment was conducted for the first time in FY2004 with a detection limit of 0.035 ng/g-dry, and the substance was detected at one of the four survey sites with a detection value of 0.050 ng/g-dry.

Pentabromodiphenyl ether has not been surveyed or monitored for other media – wildlife and bottom sediment in the “Environmental Survey and Monitoring of Chemicals” Programme.

(4) Hexabromobiphenyl

\[
\begin{array}{c}
\text{Br}_m \\
\text{Br}_n \\
m+n=6
\end{array}
\]

**Atmospheric air and precipitation:** A survey of this substance in the environmental air was conducted for the first time in FY2004 with a detection limit of 0.25 pg/m\(^3\). The substance was not detected at the surveyed site (1 site only).

**Surface water:** A survey for hexabromobiphenyl in the surface water was conducted in FY2003. The detection limit was 15 pg/L. The substance was not detected at any of the surveyed sites (4 sites).

**Bottom sediment:** A survey of the substance in bottom sediment was conducted in FY2003 with a detection limit of 8,700 pg/g-dry, and the substance was not detected at any of the two surveyed sites.

Hexabromobiphenyl has not been surveyed or monitored for biota in the “Environmental Survey and Monitoring of Chemicals” Programme.
(5) PFOS

Atmospheric air and precipitation: This was the first survey to investigate the substance persisting in atmospheric air. The survey was conducted with a detection limit of 0.09 pg/m$^3$, and the substance was detected in 57 of the 60 samples from all the 20 survey sites, with a maximum detection concentration of 44 pg/m$^3$.

Surface water: A survey for PFOS in the surface water, which was the first environmental survey/monitoring for the substance in Japan, was conducted in FY2002. The detection limit was 40 ng/L. The substance was detected at all the surveyed sites (20 sites). Maximum concentration was 24,000pg/L.

PFOS has not been surveyed nor monitored for biota and bottom sediment in the “Environmental Survey and Monitoring of Chemicals” Programme.
Appendix

Analytical Methods for “12 POPs” Monitoring

Air
Sampled by high-volume air sampler (HV) with quartz-fiber filter (QFF), polyurethane foam (PUF) and active carbon felt (ACF) sorbent media.

<table>
<thead>
<tr>
<th>Substance</th>
<th>Analytical Method / Flow Chart</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCBs, DDTs, p,p'-DDT, p,p'-DDE, p,p'-DDD, o,p'-DDD, o,p'-DDE, o,p'-DDO</td>
<td>Sample (QFF), Soxhlet extraction, Acetone 2<del>3hrs, Toluene 16</del>24hrs, Dehydration, Concentration, GC/HRMS</td>
<td>For all target substances</td>
</tr>
<tr>
<td></td>
<td>Sample (PUF), Soxhlet extraction, Acetone 16~24hrs, Dehydration, Concentration, GC/HRMS</td>
<td>For all target substances</td>
</tr>
<tr>
<td></td>
<td>Sample (ACF), Soxhlet extraction, Acetone 16~24hrs, Dehydration, Concentration, GC/HRMS</td>
<td>For all target substances</td>
</tr>
<tr>
<td>Other than toxaphene</td>
<td></td>
<td>GC/LRMS</td>
</tr>
</tbody>
</table>
| Toxaphene | GC/MCT-MS, Column : HT8-PCB, Length : 60m, L.D. : 0.25mm, Film thickness : 0.15μm | }

PCBs, DDTs, HCB, Aldrin, Chlordane, Heptachlor, Mirex, Toxaphene, HCHs

Soxhlet extraction
Acetone 2~3hrs, Toluene 16~24hrs
Dehydration
Concentration
GC/HRMS
GC/LRMS

PCBs, DDTs, HCB, Aldrin, Chlordane, Heptachlor, Mirex, Toxaphene, HCHs

Soxhlet extraction
Acetone 16~24hrs
Dehydration
Concentration
GC/HRMS
GC/LRMS

PCBs, DDTs, HCB, Aldrin, Chlordane, Heptachlor, Mirex, Toxaphene, HCHs

Soxhlet extraction
Acetone 2~3hrs
Dehydration
Concentration
GC/HRMS
GC/LRMS
### Analytical Method / Flow Chart

**Substance**
- PCBs
- DDTs
- p,p'-DDT
- p,p'-DDE
- p,p'-DDD
- p,p'-DDE
- o,p'-DDT
- o,p'-DDE
- o,p'-DDD
- HCB
- Dieldrin
- Aldrin
- Chlorophene
- flurochlor dane
- c/o-Chlorodane
- p,p'-Chlorodane
- p,p'-Nonachlor
- Oxychlor dane
- Heptachlor
c/o-Heptachlor epoxide
- c/o-Heptachlor epoxide
- Mirex
- Toxaphene
- Parlar-26
- Parlar-50
- Parlar-62
- HCHs
- Є-HCH
- Ѕ-HCH
- І-HCH
- Ѕ-HCH

**Remarks**
- Other than toxaphene: GC/HRMS
- Column: DB-17HT
- Length: 30m
- ID: 0.25mm
- Film thickness: 0.25 μm

**PCBs**
-GC/HRMS
- Column: HT8-PCB
- Length: 60m
- ID: 0.25mm
- Film thickness: 0.15 μm

**Other than toxaphene**
- GC/LRMS
- Column: HT8
- Length: 60m
- ID: 0.25mm
- Film thickness: 0.15 μm

**Procedure**

**Method (A-1)**

1. **Sample**: 20g (wet base)
2. **Dehydration**
   - Anhydrous sodium sulfate
3. **Add surrogate**
4. **Soxlet extraction**
   - Dichloromethane 5mL
5. **Concentration**
   - N\textsubscript{2} gas blow 500 L
6. **Internal standard** (syringe spike)
7. **Concentration**
8. **GC/HRMS**

**Method (A-2)**

1. **Sample**: 20g (wet base)
2. **Dehydration**
   - Anhydrous sodium sulfate
3. **Concentration**
   - Rotary evaporator
4. **Evaporation**
   - 30 °C, 5 mL
5. **Concentration**
6. **GC/LRMS**

**Method (A-3)**

1. **Sample**: 20g (wet base)
2. **Dehydration**
   - Anhydrous sodium sulfate
3. **Concentration**
   - Rotary evaporator
4. **Evaporation**
   - 30 °C, 5 mL
5. **Concentration**
6. **GC/LRMS**

**Choose from method (A-1) or (A-2) or (A-3)**

**Wildlife (1)**

**Method (A) For all target substances**

1. **Sample**: 20g (wet base)
2. **Dehydration**
   - Anhydrous sodium sulfate
3. **Add surrogate**
4. **Soxlet extraction**
   - Dichloromethane 5mL
5. **Concentration**
   - N\textsubscript{2} gas blow 500 L
6. **Internal standard** (syringe spike)
7. **Concentration**
8. **GC/HRMS**

**Silica gel column chromatography**

- Flurin 5g
- Anhydrous sodium sulfate 2g
- Washing: 5% Diethylether / hexane
- Elution: Fr. 1 20% Dichloromethane / hexane 80mL
- Elution: Fr. 2 Dichloromethane 150mL

**Method (A-1)**

1. **PCBs, DDTs, HCB, Aldrin, Chlorodane, Heptachlor, Mirex, Toxaphene, HCHs**
2. **Florisil column chromatography**
   - Flurin 5g
   - Anhydrous sodium sulfate 2g
   - Washing: 5% Diethylether / hexane
   - Elution: Fr. 1 20% Dichloromethane / hexane 80mL
   - Elution: Fr. 2 Dichloromethane 150mL
3. **Concentration**
   - N\textsubscript{2} gas blow 500 L
4. **Internal standard** (syringe spike)
5. **Concentration**
6. **GC/HRMS**

**Method (A-2)**

1. **PCBs, DDTs, HCB, Aldrin, Chlorodane, trans/cis-Heptachlor epoxide, Mirex, Toxaphene, HCHs**
2. **Florisil column chromatography**
   - Flurin 10g
   - Anhydrous sodium sulfate 2g
   - Washing: 5% Diethylether / hexane
   - Elution: Fr. 1 5% Diethylether / hexane 100mL
   - Elution: Fr. 2 20% Diethylether / hexane 100mL
3. **Concentration**
   - N\textsubscript{2} gas blow 500 L
4. **Internal standard** (syringe spike)
5. **Concentration**
6. **GC/LRMS**

**Method (A-3)**

1. **PCBs, DDTs, HCB, Aldrin, Chlorodane, trans/cis-Heptachlor epoxide, Mirex**
2. **Rotary evaporator**
   - 30 °C, 5 mL
3. **Concentration**
4. **GC/HRMS**

**Other than toxaphene**

**Method (A-2)**

1. **Florisil column chromatography**
   - Flurin 5g
   - Anhydrous sodium sulfate 2g
   - Washing: 5% Diethylether / hexane
   - Elution: Fr. 1 20% Dichloromethane / hexane 80mL
   - Elution: Fr. 2 Dichloromethane 150mL
3. **Concentration**
   - N\textsubscript{2} gas blow 500 L
4. **Internal standard** (syringe spike)
5. **Concentration**
6. **GC/HRMS**

**Method (A-3)**

1. **Silica gel column chromatography**
   - Flurin 5g
   - Anhydrous sodium sulfate 2g
   - Washing: 5% Diethylether / hexane
   - Elution: Fr. 1 Hexane 30mL
   - Elution: Fr. 2 25% Diethylether / hexane 30mL
3. **Concentration**
   - N\textsubscript{2} gas blow 500 L
4. **Internal standard** (syringe spike)
5. **Concentration**
6. **GC/HRMS**

**Choose from method (A-1) or (A-2) or (A-3)**

**Florisil column chromatography**

- Flurin 5g
- Anhydrous sodium sulfate 2g
- Washing: 5% Diethylether / hexane
- Elution: Fr. 1 20% Dichloromethane / hexane 80mL
- Elution: Fr. 2 Dichloromethane 150mL

**Silica gel column chromatography**

- Flurin 5g
- Anhydrous sodium sulfate 2g
- Washing: 5% Diethylether / hexane
- Elution: Fr. 1 Hexane 30mL
- Elution: Fr. 2 25% Diethylether / hexane 30mL

**Silica gel column chromatography**

- Flurin 5g
- Anhydrous sodium sulfate 2g
- Washing: 5% Diethylether / hexane
- Elution: Fr. 1 Hexane 30mL
- Elution: Fr. 2 25% Diethylether / hexane 30mL
### Wildlife (2)

**Method (B): For all target substances**

1. **Sample**: 20g (net base)
2. **Add surrogate**
3. **Homogenizer extraction**: 33% Acetone / hexane 80mL
4. **Washing**: 33% Acetone / hexane 20mL
5. **Centrifugal separation**: 2500rpm, 5min
6. **Homogenizer extraction**: 33% Acetone / hexane 100mL
7. **Centrifugal separation**: 2500rpm, 5min
8. **Extract**
9. **Shaking Purified water 200mL Slowly**
10. **Still standing**
11. Split
   - **Hexane phase**
   - **Aqueous phase**
12. **Shaking Purified water 100mL Slowly**
13. **Still standing**
14. **Hexane phase**
15. **Aqueous phase**
16. **Dehydration Anhydrous sodium sulfate**
17. **Concentration Rotary evaporator Hexane 5mL**
   - **Choose from method (B-1) or (B-2)**

**Method (B-1)**

- **Cell permeation chromatography**
  - BioBeads S-X3 50g 50% Dichloromethane / cyclohexane 5mL/min
- **Concentration Rotary evaporator Hexane 5mL**
- **Dehydration Anhydrous sodium sulfate**
- **Concentration Rotary evaporator Hexane 5mL**

**Method (B-2)**

- **Shaking Hexane 50mL**
- **Still standing**
- **Hexane phase**
- **Aqueous phase**

*There is a possibility of decreasing HCB recovery rate.*

**Choose from method (B-3) or (B-4) or (B-5)**

### Substance

- PCBs
- DDTs
  - p,p’-DDT
  - p,p’-DDE
  - o,p’-DDT
  - o,p’-DDE
  - p,p’-DDD
  - HCB
  - Aldrin
  - Dieldrin
  - Endrin
  - Chlordane
  - trans-Chlordane
  - cis-Chlordane
  - trans-Chlordane
  - cis-Chlordane
  - trans-Nonachlor
  - cis-Nonachlor
  - Oxychlordane
  - Endosulfan
  - Heptachlor
  - trans-Heptachlor
  - cis-Heptachlor
  - trans-Heptachlor epoxide
  - cis-Heptachlor epoxide
  - Mirex
  - Toxaphene
  - Parlar-26
  - Parlar-50
  - Parlar-62
  - PCBs
  - HCHs
    - Ћ-HCH
    - Ќ-HCH
    - У-HCH

### Remarks

- Other than toxaphene
  - GC/HRMS
  - Column: DB-17HT
  - Length: 75m
  - I.D.: 0.25mm
  - Film thickness: 0.25 µm

- Toxaphene
  - GC/NICI-MS
  - Column: HT8-PCB
  - Length: 60m
  - I.D.: 0.25mm
  - Film thickness: 0.15 µm
Wildlife (4)

**Substance**
- PCBs
- DDTs
  - p,p'-DDT
  - p,p'-DDE
  - p,p'-DDD
  - o,p'-DDT
  - o,p'-DDE
  - o,p'-DDD
- HCB
- Drosa
- Aldrin
- Dieldrin
- Endrin
- Chlordanes
  - trans-Chlordane
  - cis-Chlordane
- cis-Chlorinated
- trans-Chlorinated
- 2,3,7,8-Tetrachlorodibenzo-p-dioxin
- cis-2,3,7,8-Tetrachlorodibenzo-p-dioxin
- Mixes
  - Toxaphene
  - Parlar-26
  - Parlar-50
  - Parlar-62
  - HCHs
  - Ћ-HCH
  - Ќ-HCH
  - Ќ- HCH

**Analytical Method / Flow Chart**

1. **Sample**
   - 20g (wet base)
   - Add surrogate
   - 1.2mol/L KOH / ethanol 50mL
   - 12hrs at room temperature or 3hr at 80°C

2. **Liquid solution**
   - Filtration
   - Glass fiber filter

3. **Residual**
   - Washing
   - 50% Ethanol / hexane 20mL
   - Hexane 30mL
   - Hexane 50mL

4. **Liquid solution**
   - Filtrate
   - Transfer 500mL separating funnel
   - Purified water 100mL, 10min
   - Shaking
   - Still standing

5. **Hexane phase**
   - Aqueous phase
     - Shaking
     - Hexane 50mL
     - Shaking
     - Still standing
     - Remove sulfuric acid phase
     - Shaking
     - Saturated NaCl solution
     - Equal amount of hexane
     - Dehydration
     - Anhydrous sodium sulfate
     - Concentration
     - Rotary evaporator
     - Choose from method (C-1) or (C-2) or (C-3)

6. **Concentrated sulfuric acid 10mL**
   - Shaking
   - Still standing
   - Remove aqueous phase

7. **Concentrated sulfuric acid 10mL**
   - Shaking
   - Still standing
   - Remove aqueous phase

**Remarks**

Other than toxaphene
- GC/HRMS
  - Column: DB-17HT
  - Length: 30m
  - I.D.: 0.32mm
  - Film thickness: 0.15μm
- GC/HRMS
  - Column: HT8
  - Length: 30m
  - I.D.: 0.22mm
  - Film thickness: 0.25μm

Toxaphene
- GC/NICI-MS
  - Column: HT8-PCB
  - Length: 60m
  - I.D.: 0.25mm
  - Film thickness: 0.15μm

PCBs
- GC/HRMS
  - Column: HT8-PCB
  - Length: 60m
  - I.D.: 0.25mm
  - Film thickness: 0.15μm
### Wildlife (5)

**Analytical Method / Flow Chart**

**Substance**
- PCBs
- DDTs
  - p,p'-DDT
  - p,p'-DDE
  - p,p'-DDD
  - o,p'-DDT
  - o,p'-DDD
  - HCB
- Dieldrin
- Endrin
- Chlordane
  - trans-Chlordane
  - cis-Chlordane
- Aldrin
- Dieldrin
- Endrin
- Heptachlor
  - trans-Heptachlor
  - cis-Heptachlor
- Oxychlordane
- Heptachlor epoxide
  - trans-Heptachlor epoxide
  - cis-Heptachlor epoxide
- Mirex
- Toxaphene
- Parlar-26
- Parlar-50
- Parlar-62
- HCHs
  - –HCH
- Carbonyl
  - –HCH
- Other than toxaphene

**Remarks**
- Analytical Method / Flow Chart
  - Substances
  - Remarks
  - Analytical Method
  - Flow Chart
  - Substance
  - PCBs, DDTs, HCB, Aldrin, Chlordane, Heptachlor, Mirex, Toxaphene, HCHs
  - Method (C-1)
    - Florisil column chromatography
    - Florisil 10g
    - Anhydrous sodium sulfate 2g
    - Washing: 5% Diethyl ether / Hexane
    - Elution: Fr.1 20% Diethyl ether / Hexane 80mL
    - Elution: Fr.2 Dichloromethane 150mL
  - Method (C-2)
    - Florisil column chromatography
    - Florisil 10g
    - Anhydrous sodium sulfate 2g
    - Washing: 5% Diethyl ether / Hexane
    - Elution: Fr.1 20% Diethyl ether / Hexane 100mL
    - Elution: Fr.2 20% Diethyl ether / Hexane 100mL
  - Method (C-3)
    - Florisil column chromatography
    - Florisil 10g
    - Anhydrous sodium sulfate 2g
    - Washing: 5% Diethyl ether / Hexane
    - Elution: Fr.1 20% Diethyl ether / Hexane 100mL
    - Elution: Fr.2 20% Diethyl ether / Hexane 100mL

**Other than toxaphene**
- GC/HRMS
  - Column: DB-17HT
  - Length: 30m
  - I.D.: 0.32mm
  - Film thickness: 0.15μm
- GC/LRMS
  - Column: HT8
  - Length: 50m
  - I.D.: 0.22mm
  - Film thickness: 0.25μm
- Toxaphene
  - GC/NICI-MS
  - Column: HT8-PCB
  - Length: 60cm
  - I.D.: 0.25mm
  - Film thickness: 0.152μm

**PCBs**
- GC/HRMS
  - Column: HT8-PCB
  - Length: 60cm
  - I.D.: 0.25mm
  - Film thickness: 0.152μm

**Hexane redissolution**
- Silica gel column chromatography
  - Silica gel 5g
  - Anhydrous sodium sulfate 2g
  - Washing: Hexane
  - Elution: Fr.1 Hexane 30mL
  - Elution: Fr.4 25% Diethyl ether / Hexane 30mL

**Concentration**
- N2 gas blow
- Rotary evaporator 30°C, 5mL
- Rotary evaporator 30°C, 5mL
- Internal standard (syringe spike)
- Concentration
- GC/HRMS
- GC/LRMS

**Silica gel column chromatography**
- Silica gel 5g
  - Anhydrous sodium sulfate 2g
  - Washing: Hexane
  - Elution: Fr.3 Hexane 30mL
  - Elution: Fr.4 Hexane 30mL
  - Elution: Fr.5 Dichloromethane 150mL

**Fr.1**
- PCBs, DDTs, HCB, Aldrin, Chlordane, Heptachlor, Mirex, Toxaphene, HCHs
- Florisil column chromatography
- Florisil 10g
- Anhydrous sodium sulfate 2g
- Washing: 5% Diethyl ether / Hexane
- Elution: Fr.1 Dichloromethane 150mL

**Fr.2**
- Dieldrin, Endrin, Aldrin, Chlordane, Heptachlor, Mirex, Toxaphene, HCHs
- Florisil column chromatography
- Florisil 10g
- Anhydrous sodium sulfate 2g
- Washing: 5% Diethyl ether / Hexane
- Elution: Fr.1 20% Diethyl ether / Hexane 80mL
- Elution: Fr.2 20% Diethyl ether / Hexane 100mL
- Elution: Fr.3 20% Diethyl ether / Hexane 100mL

**Fr.3**
- PCBs, DDTs, HCB, Aldrin, Chlordane, Heptachlor, Mirex, Toxaphene, HCHs
- Florisil column chromatography
- Florisil 10g
- Anhydrous sodium sulfate 2g
- Washing: 5% Diethyl ether / Hexane
- Elution: Fr.1 20% Diethyl ether / Hexane 80mL
- Elution: Fr.2 20% Diethyl ether / Hexane 100mL
- Elution: Fr.3 20% Diethyl ether / Hexane 100mL

**Fr.4**
- PCBs, DDTs, HCB, Aldrin, Chlordane, Heptachlor, Mirex, Toxaphene, HCHs
- Florisil column chromatography
- Florisil 10g
- Anhydrous sodium sulfate 2g
- Washing: 5% Diethyl ether / Hexane
- Elution: Fr.1 20% Diethyl ether / Hexane 80mL
- Elution: Fr.2 20% Diethyl ether / Hexane 100mL
- Elution: Fr.3 20% Diethyl ether / Hexane 100mL

**Multilayer silica gel column chromatography**
- Silica gel 0.9g
  - 2% KOH / silica gel 3g
  - Silica gel 0.9g
  - 44% H2SO4 / silica gel 4.5g
  - Silica gel 0.9g
  - Anhydrous sodium sulfate 6g
  - Washing: Hexane
  - Elution: Hexane 120mL

**Concentration**
- N2 gas blow
- Rotary evaporator 30°C, 5mL
- Rotary evaporator 30°C, 5mL
- Internal standard (syringe spike)
- Concentration
- GC/HRMS
- GC/LRMS
Surface water (1)

Substance

- PCBs
- DDTs
- p,p'-DDT
- p,p'-DDE
- p,p'-DDD
- o,p'-DDT
- o,p'-DDE
- o,p'-DDD
- HCB
- Aldrin
- Dieldrin
- Endrin
- Chlordanes
- o,o-Chlordane
- p,p'-Chlordane
- o,p'-Chlordane
- trans-Chlordane
- cis-Chlordane
- cis-Nonachlor
- trans-Nonachlor
- Oxychlorodane
- Heptachlor
- trans-Heptachlor
- cis-Heptachlor
- cis-Heptachlor epoxide
- trans-Heptachlor epoxide
- Heptachlor epoxide
- Mirex
- Toxaphene
- HCHs
- α-HCH
- β-HCH
- γ-HCH
- δ-HCH
- Parlar-26
- Parlar-50
- Parlar-62
- HCHs
- α-HCH
- β-HCH
- γ-HCH
- δ-HCH
- Other than toxaphene

Analytical Method / Flow Chart

1. Sample 10L
2. Add surrogate
3. Filtration / Solid phase extraction
   - Filter: GMIF50 (Pore size: 2 μm)
   - Extraction disc: C18(FF)
4. Choose from method (A) or (B)
5. Washing
6. Dehydration / Concentration
7. Hexane redissolution
8. Methanol 10mL, 3times
9. Acetone 10mL, 3times
10. Toluene 10mL, 3times
11. Ultrasonic extraction
   - Acetone 50mL, 20min, 3times
12. Dehydration
13. Anhydrous sodium sulfate
14. Concentration / Redissolution
   - Rotary evaporator
   - Hexane 5mL
15. Choose from method (D) or (E) or (F)
16. Method (D)
17. Method (E)
18. Method (F)

Remarks

- Analytical Method
- GC/HRMS
  - Column: DB-17HT
  - Length: 30m
  - I.D.: 0.32mm
  - Film thickness: 0.15 μm
- GC/LRMS
  - Column: HT8
  - Length: 30m
  - I.D.: 0.25mm
  - Film thickness: 0.25 μm
- Toxaphene
  - GC/NICI-MS
  - Column: HT8-PCB
  - Length: 60m
  - I.D.: 0.25mm
  - Film thickness: 0.15 μm
- PCBs
  - GC/HRMS
  - Column: HT8-PCB
  - Length: 60m
  - I.D.: 0.25mm
  - Film thickness: 0.15 μm
### Surface water (2)

**Analytical Method / Flow Chart**

<table>
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<th>Substance</th>
<th>Method (D)</th>
<th>Method (E)</th>
<th>Method (F)</th>
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<td>For all target substances</td>
<td>For PCBS</td>
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<tr>
<td>p,p'-DDT</td>
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**Remarks**

- GC/HRMS
  - Column: DB-17HT
  - Length: 30m
  - I.D.: 0.32mm
  - Film thickness: 0.15 μm
- GC/LRMS
  - Column: HT8
  - Length: 50m
  - I.D.: 0.22mm
  - Film thickness: 0.25 μm

**Other than toxaphene**

- Toxaphene
  - GC/NICI-MS
  - Column: HT8-PCB
  - Length: 60m
  - I.D.: 0.25mm
  - Film thickness: 0.15 μm

**Flow Chart**

1. **Silica gel column chromatography**
   - Hexane redissolution
   - Silica gel 5g
   - Anhydrous sodium sulfate 2g
   - Washing: Hexane
   - Elution: Fr.1 25% Dichloromethane / hexane 30mL

2. **Florisil column chromatography**
   - Florisil 5g
   - Anhydrous sodium sulfate 2g
   - Washing: 5% Diethylether / hexane
   - Elution: Fr.1 20% Dichloromethane / hexane 80mL
   - Elution: Fr.2 Dichloromethane 150mL

3. **Silica gel column chromatography**
   - Hexane redissolution
   - Silica gel 5g
   - Anhydrous sodium sulfate 2g
   - Washing: Hexane 30mL
   - Elution: Fr.4 25% Diethylether / hexane 30mL

4. **Florisil column chromatography**
   - Florisil 5g
   - Anhydrous sodium sulfate 2g
   - Washing: 5% Diethylether / hexane
   - Elution: Fr.1 5% Diethylether / hexane 100mL
   - Elution: Fr.2 20% Diethylether / hexane 100mL

5. **Silica gel column chromatography**
   - Hexane redissolution
   - Silica gel 5g
   - Anhydrous sodium sulfate 2g
   - Washing: Hexane 30mL
   - Elution: Fr.3 Hexane 30mL
   - Elution: Fr.4 25% Diethylether / hexane 30mL

6. **Florisil column chromatography**
   - Florisil 5g
   - Anhydrous sodium sulfate 2g
   - Washing: 5% Diethylether / hexane
   - Elution: Fr.1 5% Diethylether / hexane 100mL
   - Elution: Fr.2 20% Diethylether / hexane 100mL
### Substances

**PCBs**

- DDTs
- p,p'-DDT
- p,p'-DDE
- p,p'-DDD
- p,p'-DDE
- p,p'-DDD
- HCB

**DDTs**

- p,p'-DDT
- p,p'-DDE
- p,p'-DDD
- o,p'-DDT
- o,p'-DDE
- o,p'-DDD

**Chloroform**

- o,p'-DDT
- o,p'-DDE
- o,p'-DDD
- HCB
- Drins
- Aldrin
- Dieldrin
- Endrin

**Chlordanes**

- o,p'-DDT
- o,p'-DDE
- o,p'-DDD
- HCB
- Drins
- Aldrin
- Dieldrin
- Endrin

**Heptachlor**

- o,p'-DDT
- o,p'-DDE
- o,p'-DDD
- HCB
- Drins
- Aldrin
- Dieldrin
- Endrin

**CCl₃**

- o,p'-DDT
- o,p'-DDE
- o,p'-DDD
- HCB
- Drins
- Aldrin
- Dieldrin
- Endrin

**Heptachlor epoxide**

- o,p'-DDT
- o,p'-DDE
- o,p'-DDD
- HCB
- Drins
- Aldrin
- Dieldrin
- Endrin

**Mirex**

- o,p'-DDT
- o,p'-DDE
- o,p'-DDD
- HCB
- Drins
- Aldrin
- Dieldrin
- Endrin

**Toxaphene**

- o,p'-DDT
- o,p'-DDE
- o,p'-DDD
- HCB
- Drins
- Aldrin
- Dieldrin
- Endrin

**Parlar**

- o,p'-DDT
- o,p'-DDE
- o,p'-DDD
- HCB
- Drins
- Aldrin
- Dieldrin
- Endrin

**HCHs**

- o,p'-DDT
- o,p'-DDE
- o,p'-DDD
- HCB
- Drins
- Aldrin
- Dieldrin
- Endrin

- —HCH
- —HCH
- —HCH
- —HCH

### Remarks

**Analytical Method / Flow Chart**

- Method (A-1) For all target substances
  - Sample: 20g (wet base)
  - Add surrogate
  - Soxhlet extraction
  - Acetonate 3hrs
  - Toluene 18hrs
  - Shaking 20min
  - Separating centrifugal separator
  - Organic phase
  - Dehydration
  - Anhydrous sodium sulfate
  - Concentration
  - Redissolution
  - Rotary evaporator
  - Hexane 5mL
  - N₂ gas blow
  - 1mL
  - Transfer 50mL glass bottle
  - Shaking
  - 100mL glass bottle
  - Shaking
  - Tetrabutylammonium sulfite 10mL
  - 2-propanol 2mL
  - Over 1min
  - Shaking
  - Add sodium sulfate 0.1g at a time until it remains after shaking
  - Over 5min
  - Shaking
  - Add purified water washing by hexane 5mL
  - Over 1min
  - Still standing
  - Over 5min
  - Dehydration
  - Anhydrous sodium sulfate
  - Extract
  - Rotary evaporator 5mL
  - Shaking
  - Purified water 50mL
  - 1min
  - Remove aqueous phase
  - Dehydration
  - Anhydrous sodium sulfate
  - Extract 100mL

- Method (B-1) For all target substances
  - Sample: 20g (dry base)
  - Add surrogate
  - Ultrasound extraction
  - Concentration
  - Residual
  - Soxhlet extraction
  - Acetonate 20min, twice
  - Organic phase
  - Dehydration
  - Anhydrous sodium sulfate
  - Concentration
  - Hexane, 20—30mL
  - Liquid-liquid extraction
  - Dichloromethane 20mL
  - Dehydration
  - Anhydrous sodium sulfate
  - Concentration
  - Redissolution
  - Rotary evaporator
  - Hexane 5mL
  - N₂ gas blow
  - 1mL
  - Transfer 100mL glass bottle
  - Shaking
  - Tetrabutylammonium sulfite 10mL
  - 2-propanol 2mL
  - Over 1min
  - Shaking
  - Add sodium sulfate 0.1g at a time until it remains after shaking
  - Over 5min
  - Shaking
  - Add purified water washing by hexane 5mL
  - Over 1min
  - Still standing
  - Over 10min
  - Shaking
  - Hexane 50mL
  - Purified water 50mL
  - 1min
  - Remove aqueous phase
  - Dehydration
  - Anhydrous sodium sulfate
  - Extract
  - Rotary evaporator 5mL
  - Shaking
  - Purified water 50mL
  - 1min
  - Remove aqueous phase
  - Dehydration
  - Anhydrous sodium sulfate
  - Extract 100mL
<table>
<thead>
<tr>
<th>Substance</th>
<th>Analytical Method / Flow Chart</th>
<th>Remarks</th>
</tr>
</thead>
</table>

**Bottom sediment (2)**

- **Method (A-2)**
  - Extract
  - Silica gel column chromatography
    - Fr.1: PCBs, HCB, Aldrin, Mirex
    - Fr.2: DDTs, Dieldrin, Endrin, Chlordanes, Heptachlor, trans/cis-Heptachlor epoxide, Toxaphene, HCHs
    - Concentration
      - N2 gas blow
      - Concentration
        - Method (A-3)
          - Florisil column chromatography
            - Fr.3: DDTs, Chlordanes, Heptachlor, trans/cis-Heptachlor epoxide, Toxaphene, HCHs
            - Concentration
              - Rotating evaporator 30°C, 5 mL
              - Internal standard
              - N2 gas blow 500 mL
              - Concentration
                - Method (A-4)
                  - Florisil column chromatography
                    - Fr.4: DDTs, Chlordane, Heptachlor, trans/cis-Heptachlor epoxide, Toxaphene, HCHs
                    - Concentration
                      - N2 gas blow 500 mL
                      - Concentration

- **Other than toxaphene**
  - GC/HRMS
    - Column: DB-17HT
    - Length: 30 m
    - I.D.: 0.32 mm
    - Film thickness: 0.15 μm
  - GC/LRMS
    - Column: HT8
    - Length: 30 m
    - I.D.: 0.22 mm
    - Film thickness: 0.25 μm

- **Toxaphene**
  - GC/NICI-MS
    - Column: HT8-PCB
    - Length: 60 m
    - I.D.: 0.25 mm
    - Film thickness: 0.15 μm

**PCBs**
- GC/HRMS
  - Column: HT8-PCB
  - Length: 60 m
  - I.D.: 0.25 mm
  - Film thickness: 0.15 μm
**Substance**

- PCBs
- DDTs
- p,p'-DDT
- p,p'-DDE
- p,p'-DDD
- a,a'-DDD
- BCB
- Dinas
- Aldrin
- Dieldrin
- Endrin
- Chlordane
- cis-Chlordane
- trans-Chlordane
- cis-Nonachlor
- trans-Nonachlor
- Oxychlordane
- Heptachlor
- trans-Heptachlor epoxide
- cis-Heptachlor epoxide
- Mirex
- Toxaphene
- Parlar-26
- Parlar-50
- Parlar-62
- HCHs
- \( \alpha \)-HCH
- \( \gamma \)-HCH
- \( \delta \)-HCH
- \( \beta \)-HCH
- HCHs
- \( \tau \)-HCH
- \( \kappa \)-HCH
- \( \iota \)-HCH
- \( \upsilon \)-HCH

**Analytical Method / Flow Chart**

1. **Extract**
2. **Aliquot of 1:2 30mL**
   - Multilayer silica gel column chromatography
     - 50% H2SO4 / silica gel 3g
     - Anhydrous sodium sulfate 2g
     - Washing : Hexane
     - Elution : Hexane 200mL
   - PCBs, BCB, Mirex, DDTs, Chlordane, HCHs and the others
3. **Aliquot of 1:4 25mL**
   - Silica gel column chromatography
     - Silica gel 10g
     - Anhydrous sodium sulfate 2g
     - Washing : Hexane
     - Elution : 5% Diethyl ether / hexane 100mL
   - PCBs, HCB, Mirex, DDTs, Chlordane, HCHs and the others
4. **Concentration**
   - Internal standard (syringe spike)
   - Recovery 100% L
5. **Concentration**
   - Internal standard (syringe spike)
   - Recovery 50 mL

**Remarks**

- Other than toxaphene
  - GC/HRMS
  - Column : DB-17HT
  - Length : 50m
  - I.D. : 0.32mm
  - Film thickness : 0.15 \( \mu \)m
- Toxaphene
  - GC/NICI-MS
  - Column : HT8-PCB
  - Length : 60m
  - I.D. : 0.25mm
  - Film thickness : 0.15 \( \mu \)m
- PCBs
  - GC/HRMS
  - Column : HT8-PCB
  - Length : 60m
  - I.D. : 0.25mm
  - Film thickness : 0.15 \( \mu \)m
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<th>Substance</th>
<th>Analytical Method / Flow Chart</th>
<th>Remarks</th>
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<tbody>
<tr>
<td>PCBs</td>
<td>Method (C) For PCBs</td>
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<tr>
<td>DDTs</td>
<td>Sample 20g (wet base)</td>
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<tr>
<td>p,p'-DDT</td>
<td>Add surrogate</td>
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<td>1.2mol/L KOH / ethanol 50mL</td>
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<td>o,p'-DDT</td>
<td>12hrs at room temperature or 3hrs at 80 °</td>
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</tbody>
</table>

**Analytical Method / Flow Chart**

1. **Sample**: 20g (wet base)
2. **Add surrogate**
3. **Alkaline degradation**: 1.2mol/L KOH / ethanol 50mL, 12hrs at room temperature or 3hrs at 80 °
4. **Filtration**
5. **Glass fiber filter**
6. **Transfer**: 500mL separating funnel
7. **Shaking**: Purified water 100mL, 10min
8. **Still standing**
9. **Hexane phase**
10. **Aqueous phase**
11. **Extract**
12. **Shaking**: Concentrated sulfuric acid 30mL
13. **Still standing**
14. **Repeat until color of hexane phase fade out and sulfuric acid phase become clear**
15. **Dehydration**: Anhydrous sodium sulfate
16. **Concentration**: Rotary evaporator 60 L, 3ml
17. **Multilayer silica gel column chromatography**
18. **Silica gel 0.9g**
19. **2%-KOH / silica gel 3g**
20. **Silica gel 0.9g**
21. **44%-H₂SO₄ / silica gel 4.5g**
22. **Silica gel 0.9g**
23. **Anhydrous sodium sulfate 6g**
24. **Washing**: Hexane
25. **Elution**: Hexane 120mL
26. **Concentration**: Rotary evaporator 60 L, 3ml
27. **Internal standard** (syringe spike)
28. **Concentration**: N₂ gas blow 500 mL
29. **GC/HRMS**