Environmental Survey of Dioxins—FY 2000 Results

1. Introduction

Pursuant to the Revised Air Pollution Control Law that came into effect in April 1997, dioxins in the air have been monitored nationwide by local governments since FY 1997. The then Environment Agency conducted the Nationwide Emergency Survey of Dioxins (hereinafter called "FY 1998 Survey") for the air, water of the public water areas, groundwater, sediment in public water areas, and soil in FY 1998. The Agency again conducted the FY 1999 Survey of Dioxins in Public Water Areas, etc. (hereinafter called "FY 1999 Survey") in FY 1999 to survey the water in public water areas, groundwater, and sediment in public water areas.

Later on, the Law Concerning Special Measures against Dioxins (hereinafter called "Law") was enacted in July 1999 and came into effect in January 2000. The Law stipulated governors of prefectures and mayors of government ordinance-designated cities (hereinafter called "ordinance-designated cities") to constantly monitor the air, water (including sediment), and soil with respect to the state of pollution by dioxins and to report the monitored results to the Minister of the Environment. In accordance with the Law, surveys of dioxins in the air, public water areas, groundwater, sediment in public water areas, and soil have been carried out regularly throughout the nation since FY 2000.

This report summarized the survey results that were derived from the regular monitoring of dioxins in FY 2000 and were reported to the Minister of the Environment by the governors of prefectures and mayors of ordinance-designated cities.

2. Numbers of Survey Points and Samples

Table 1 shows the numbers of survey points in and samples from various environmental media in FY 2000. The survey was of the largest scale ever conducted in all media.

(1) Air

The FY 2000 Survey of air was carried out at 961 points nationwide, using 3,605 samples.

Prefectures and ordinance-designated cities selected these survey points, taking into consideration points that had been used for the monitoring of dioxins since FY 1997 in accordance with the Air Pollution Control Law. The survey points also included points where the Ministry of the Environment conducted fixed point monitoring and points where cities designated by the Air Pollution Control Law conducted independent monitoring.

At 920 of the 961 points, surveys were conducted more than twice a year, including summer and winter.

Additional Table 1 shows the survey points by area types (general environment, the vicinity of pollution sources, and roadside) of each prefecture (including points used by the Ministry of the Environment for fixed point monitoring and points used by cities designated by the Air Pollution Control Law for independent monitoring).

(2) Water in Public Water Areas

The FY 2000 Survey of water quality of the public water areas was carried out at 2,116 points nationwide (1,612 points at rivers, 104 points at lakes and marshes, and 400 points at coastal areas), using 2,424 samples.

In principle, the prefectures and ordinance-designated cities selected survey points that were representative of the water areas. With consideration to factors such as the source of dioxins, the pollution level of effluent, and the state of water utilization in the water areas, points where effective monitoring could be carried out were selected. Surveys were carried out by prefectures, ordinance-designated cities, and cities designated by the Water Pollution Control Law. The Regional Construction Bureau of the Ministry of Land, Infrastructure and Transport also conducted surveys at the sections of Class-I Rivers that were directly under the jurisdiction of the national government.

Additional Table 2 shows the number of survey points by prefecture.

(3) Groundwater

The FY 2000 Survey of the groundwater was carried out at 1,479 points nationwide, using 1,486 samples.

For the survey, prefectures and ordinance-designated cities selected survey points where the condition of groundwater could be monitored, taking into consideration the source of dioxins and the state of water utilization of groundwater.

Additional Table 2 shows the number of survey points by prefecture.

(4) Sediment in Public Water Areas

The FY 2000 Survey of sediments in public water areas was carried out at 1,836 points nationwide,

(1,367 points at rivers, 102 points at lakes and marshes, and 367 points at coastal areas), using 1,887 samples.

In principle, the same survey points used for the survey of water in public water areas was applied to the Survey. They were the points where prefectures and ordinance-designated cities selected as being representative of the water areas. Surveys were carried out by prefectures, ordinance-designated cities, and cities designated by the Water Pollution Control Law. The Regional Construction Bureau of the Ministry of Land, Infrastructure and Transport also conducted survey at the sections of Class-I Rivers that were directly under the jurisdiction of the national government.

Additional Table 2 shows the number of survey points by prefecture.

(5) Soil

For the constant monitoring of soil, the following surveys were carried out to find out the actual state of pollution and the concentration of dioxins in the soil in order to identify as soon as possible the areas that would require immediate countermeasures.

A. General Survey of the Areas

(a) Survey of the General Environment

A survey of the area's general environment to find out the concentration of dioxins in the soil

(b) Survey of the Vicinity of Pollution Sources

A survey to find out the effect of dioxins generated and emitted from waste incinerators and other facilities (pollution sources) on soil in the general environment

(c) Surveys of the State of Target Areas

A survey to find out the state of target areas showing the possibility of pollution by dioxins through the study of available information

B. Survey for the Verification of Survey Index

A survey to find out the concentration of dioxins in the vicinity of points found to have exceeded the index value (250 pg-TEQ/g) of the survey

C. Survey for the Determination of Scope

A survey to determine the scope and depth of soil exceeding the environmental quality standard at points found to have exceeded the environmental quality standard for soil (standard value: 1,000

pg-TEQ/g or less)

D. Survey for Verification of the Efficacy of Measures

A survey to verify the effectiveness of measures implemented such as the removal of pollutants

E. Survey for Continued Monitoring

A survey implemented three to five years after a monitoring point had been found with values exceeding the survey index value, in order to find out the changes in the concentration of dioxins in soil.

Of these surveys, the General Survey of Areas, the Survey for the Verification of Survey Index, and the Survey for the Determination of Scope were carried out in FY 2000 at 3,187 points nationwide, using the same number of samples. The surveys were carried out at points selected by prefectures and ordinance-designated cities.

Of these survey points, Survey of the General Environment and Survey of the Vicinity of Pollution Sources were carried out at 3,031 points nationwide.

Additional Table 3 shows the number of survey points by prefecture.

3. Substances Subject to Measurement and Methods of Showing the Measured Results

The substances subject to measurement were dioxins (among the PCDDs, PCDFs, and coplanar PCBs, the isomers showed in the reference). The results were shown as toxic equivalents (TEQs). WHO-TEF (1998) was used as the toxicity equivalent factor (TEF) of isomers.

The methods of calculating toxic equivalents for each medium are as follows:

(1) Air, Water in Public Water Areas, Groundwater, and Sediment in Public Water Areas

For the measured values that were over the lowest quantitative limit and values that were less than the lowest quantitative limit but over the lowest detection limit, the measured values were applied as they were in the calculation of TEQ for each isomer. For values that were below the lowest detection limit, only half the lowest limit was used in the calculation. The total TEQs was derived by adding up these values.

(2) Soil

For the measured values that exceeded the lowest quantitative limit, the measured values were

applied as they were in the calculation of TEQ for each isomer. For the values below the lowest quantitative limit, they were regarded as 0 in the calculation. The total TEQs were calculated by adding up the TEQs of these isomers.

4. Methods of Measurement

(1) Air

"Manual for the Survey of Dioxins in the Atmospheric Environment" (June 2000, Air Pollution Control Division, Air Quality Bureau, Environment Agency)

(2) Water in Public Water Areas and Groundwater

JIS K 0312 (method for measuring dioxins and coplanar PCBs in industrial effluent and effluent discharged from factories)

(3) Sediment in Public Water Areas

"Manual for the Survey and Measurement of Dioxins in Sediment" (March 2000, Water Quality Management Division, Water Quality Bureau, Environment Agency)

(4) Soil

"Manual for the Survey and Measurement of Dioxins in Soil" (January 2000, Soil and Agricultural Chemicals Division, Water Quality Bureau, Environment Agency)

5. Results of Survey

Table 1 shows the survey results of various environmental media in FY 2000.

(1) Air

Only the average annual values taken at points where surveys were conducted more than twice a year, including summer and winter, were assessed using the environmental quality standard for air. There were 920 of these survey points nationwide. The average value of dioxin concentration was 0.15 pg-TEQ/m^3 and the range of concentration was 0.0073–1.0 pg-TEQ/m^3.

Four out of 705 points in the Survey of the General Environment and 6 out of 189 points in the Survey of the Vicinity of Pollution Sources exceeded the environmental quality standard for air (standard value: average annual value shall be 0.6 pg-TEQ/m^3 or less). All 26 roadside points met the environmental quality standard. In total, 10 out of 920 points (1.1%) exceeded the environmental quality standard. Compared to the survey results of the environmental monitoring of air undertaken in FY 1999 (7 out of 463 points, or 1.5%, exceeded the environmental quality standard), the

percentage of survey points exceeding the environmental quality standard decreased by 0.4%.

Since 41 of the 961 points did not conduct surveys more than twice in the year, including summer and winter, they could not be used for the calculation of average annual values for assessment with the environmental quality standard. However, they provided valuable information about the concentration of dioxins in the air. For this reason, these points were also included in the distribution of dioxin concentrations shown in Figure 1.

Table 2 shows the changes in the surveys of dioxins in the air since the environmental monitoring of air started in accordance with the Air Pollution Control Law. The average annual values of dioxin concentration in Japan were 0.55 pg-TEQ/m^3 in FY 1997, 0.23 pg-TEQ/m^3 in FY 1998, 0.18 pg-TEQ/m^3 in 1999, and 0.15 pg-TEQ/m^3 in 2000. The concentration of dioxins shows a downward trend despite the fact that only PCDDs and PCDFs from among the dioxins were surveyed before FY 1998, that the method for calculating toxic equivalents were different in the past, and that the data gathered were not from the same survey points.

Table 3 and Figure 2 show the changes in the concentrations of PCDDs and PCDFs from surveys conducted continuously by the Ministry of the Environment and local governments from FY 1997 to 2000.

A continuous survey is being carried out at 43 points nationwide. The average value of PCDDs and PCDFs at these points in FY 2000 was 0.23 pg-TEQ/m^3, a tremendous decrease compared to the average value of 0.53 pg-TEQ/m^3 in FY 1997.

For the survey results, WHO-TEF (1998) was used for the calculation of toxic equivalents since FY 1999 and I-TEF (1988) was used for the calculation of toxic equivalents before FY 1998.

(2) Water in Public Water Areas

The water in public water areas was surveyed at 2,116 points nationwide. The average value of dioxin concentration was 0.31 pg-TEQ/l. The range of concentration was 0.012–48 pg-TEQ/l. The survey indicated that 83 points (3.9%: 80 points at rivers, 2 points at lakes and marshes, and 1 point at coastal area) exceeded the environmental quality standard for water quality (standard value: 1pg-TEQ/l or less). Figure 3 shows the distribution of concentration.

Compared to the FY 1999 survey (568 points nationwide; average value 0.24 pg-TEQ/l; range of concentration 0.054–14 pg-TEQ/l; and 10 points (1.8%) exceeded the environmental quality

standard), the number of survey points had increased substantially, extending the range of concentration and raising the average value. Consequently, the percentage of points exceeding the environmental quality standard also increased by 2.1%.

(3) Groundwater

The groundwater was surveyed at 1,479 points nationwide. The average value of dioxin concentration was 0.097 pg-TEQ/l and the range of concentration was 0.00081–0.89 pg-TEQ/l. All points met the environmental quality standard for water quality (standard value: average annual value shall be 1 pg-TEQ/l or less). Figure 4 shows the distribution of concentration.

Compared to the FY 1999 survey (296 points nationwide; average value 0.096 pg-TEQ/l; and the range of concentration 0.062–0.55 pg-TEQ/l), the number of survey points had increased substantially, extending the range of concentration. However, the average value remained at a similar level.

(4) Sediment in Public Water Areas

The quality of sediment in public water areas was surveyed at 1,836 points nationwide. The average value of dioxin concentration was 9.6 pg-TEQ/g and the range of concentration was 0.0011–1,400 pg-TEQ/g. Figure 5 shows the distribution of concentration.

Compared to the FY 1999 survey (542 points nationwide; average value 5.4 pg-TEQ/g; and the range of concentration 0.066–230 pg-TEQ/g), the number of survey points had increased substantially, extending the range of concentration and raising the average value.

(5) Soil

Soil was surveyed in the Survey of the General Environment and the Survey of the Vicinity of Pollution Sources at 3,031 points nationwide. The average value of dioxin concentration was 6.9 pg-TEQ/g, the range of concentration was 0–1,200 pg-TEQ/g, and 1 site (0.03%) exceeded the environmental quality standard for soil (standard value: 1,000 pg-TEQ/g or less). Figure 6 shows the distribution of concentration.

Compared to the FY 1998 survey (286 points nationwide; average value 6.5 pg-TEQ/g; and the range of concentration 0.0015–61 pg-TEQ/g), the number of survey points had increased substantially, extending the range of concentration. The average value, however, remained at a similar level.

In the Survey of the General Environment (1,942 points), the average value was 4.6 pg-TEQ/g and the range of concentration was 0–280 pg-TEQ/g. In the Survey of the Vicinity of Pollution Sources (1,089 points), the average value was 11 pg-TEQ/g and the range of concentration was 0–1,200 pg-TEQ/g.

In addition, the Surveys of the State of Target Areas (76 points at 9 sites) and the Survey for the Verification of Survey Index (27 points at 6 sites) were carried out. The surveys indicated that 2 sites had exceeded the environmental quality standard. The Survey for the Determination of Scope was carried out at 53 points at 2 sites, including 1 site that exceeded the environmental quality standard.

6. Conclusion

(1) Assessment of Survey Results

The groundwater at all survey points met the environmental quality standard but there were points in the surveys of air, the water in public water areas, and soil that exceeded their respective environmental quality standards. The survey of sediments in public water areas also identified points that had relatively high concentration of dioxins. Despite the fact that some points met the environmental quality standard for soil, the concentration of dioxins at these points were above the survey index value.

Comparing the results of air with past surveys, the average values showed a decline.

The highest values in water and sediment in public water areas and soil all exceeded the values recorded in past surveys. This is considered to derive from the substantial increase in the number of survey points.

For water and sediment in public water areas, the average values and the ratio of points exceeding the environmental quality standards also increased. This was probably affected by the emphasis in selecting points that had been known for being polluted by dioxins from previous surveys.

For these reasons, it is not possible to discuss the secular change in the concentration of dioxins in other media, except air, by simply comparing to the results of national surveys conducted in the past.

(2) Future Measures

At present, the Law regulates the emission of dioxins. Efforts will be made to properly enforce the Law to further reduce the discharge of dioxins into the environment. In terms of constant monitoring, it is necessary to ensure the proper and effective enforcement of the Law and the correct

understanding of the actual state of dioxin concentration and their movement in the environment to help verify the effects of measures undertaken and to identify potential pollution sources.

With regard to points that exceeded the environmental quality standards, the local governments are reviewing the necessary investigation and measures. Remedial measures have already begun at some points. For constant monitoring after FY 2001, environmental surveys with emphasis on these points will be conducted.

In terms of sediment in public water areas, the environmental quality standard is being reviewed now. The result of this survey will be used in the review as reference.