DDIOXIN EMISSION INVENTORY 2000 IN JAPAN

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Introduction

Emission inventory of dioxins is annually prepared according to the National Reduction Plan based on Law Concerning Special Measures against Dioxins.

The first emission inventory was published in June 1999 using the international toxic equivalency factors (I-TEF (1988)), where emission amount of PCDDs/DFs by the source for the year 1997 and 1998 was estimated. After that, as the definition of dioxins and TEF to be used were provided in the newly established law (*), the second emission inventory for the year 1997, 1998 and 1999 was re-estimated or prepared in June 2000 using WHO-TEF (1998) for dioxins including co-planar PCBs. The third one for the year 1997, 1998, 1999 and 2000 was published in December 2001.

These emission inventories are utilized for knowing the achievement of the policy goal of about 90 % reduction by the end of March 2003 that was declared in the above plan as well as deciding the priority sources for regulations. In this paper, the method to prepare the inventory and the result of the estimation of emission amounts will be discussed.

Methods and Materials

Dioxin sources are roughly classified into three; waste incinerators, industrial sources and other miscellaneous sources. In principle, total emission amount from regulated sources was calculated as the sum of emission amount from each facility using dioxin concentration measured by enterprisers at least once a year according to the related laws. Total emission amount from other unregulated sources was estimated by multiplying relevant emission factor and activity quantity.

Waste incinerators

Waste incinerators are classified into 3 categories; municipal waste incinerators, industrial waste incinerators and small-scale waste incinerators. Total emission amount from municipal or industrial waste incinerators more than 200kg/h in incineration capacity was calculated as the sum of emission amount from each facility that was derived by multiplying dioxin concentration in the flue gas, flue gas volume per unit incineration weight (flue gas volume factor) and annual incineration weight, together. Flue gas volume factor was set 5,000 m3/t for municipal wastes and prepared several factors by the kind of waste for industrial wastes. Total emission amount from small-scale waste incinerators with an incineration capacity of 50-200 kg/h was calculated as the sum of emission amount from each facility that was derived by multiplying dioxin concentration in the flue gas, flue gas volume per day and running day per year. As for small-scale waste incinerators less than 200 kg/h in incineration capacity, two methods were applied. One was the method to multiply emission factor per hour in average operation hours and annual operation days. Another was the one to multiply emission factor per unit

(*) “Dioxins” mean PCDDs, PCDFs and coplanar PCBs in the Law concerning Special Measures against Dioxins established in July 1999.

incineration weight and annual incineration weight. In both cases, the number of unregulated incinerators was estimated based on the sample survey on the number ratio (1.73) of unregulated/ regulated incinerators. The inventory 2000 included the emission from sludge incinerators at night soil and sewage treatment plants.

Industrial sources

Emission amounts from industrial sources were estimated for 4 main business categories that are regulated because of having relatively large emission amount and for other 15 business categories that are not regulated. Its method is to calculate emission factor by the unit production volume and then to multiply annual production amount. For example, average dioxin concentration of emission gases from sintering furnaces in steel industry was obtained firstly. Based on this result, emission factor was derived. Then, annual emission amount from sintering furnaces was calculated to be *69.8g-TEQ* multiplied by annual production volume.

Other miscellaneous sources

Emission amounts from crematoriums, cigarette smoke and automobile exhaust as well as emission to aquatic environment were estimated as other miscellaneous sources. They were calculated with multiplying emission amount per body by the number of cremations conducted annually for crematoriums and emission factor per cigarette by the number of cigarette consumed annually for cigarette smoke. As for automobile exhaust, dividing into two categories; gasoline and diesel automobiles, each emission amount was estimated by multiplying emission factor per fuel consumption derived from exhaust gas concentration by annual fuel consumption. Emissions to aquatic environment were also estimated from emission gas cleaning facilities and wet dust collecting facilities, pulp industry, aluminum production facilities, cleaning facilities for vinyl chloride production and final disposal sites and so on.

Results and Discussion

The results of the estimations from 1997 to 2000 based on the above methods and materials are shown in the following table. As shown in the table, emissions to aquatic environment are found to be negligibly small compared with that to the air. Another observation is that more than 70 % reduction was achieved during past three years due mostly to the application of stringent emission and effluent standards. This result is well reflected in the monitoring result, where the ambient air quality drops down from 0.55 pg-TEQ/m3 in 1997 to 0.23 pg-TEQ/m3 in 2000. (The figures are the average concentrations in the ambient air of PCDDs + PCDFs at 46 continuous monitoring stations.) The remaining less than 20 % reduction will be needed to attain the goal of about 90 % reduction by the end of March 2003. However, it is expected to be realized through compliance and enforcement to the strengthening of emission control from December 2002.

As regards the accuracy of the inventory, it is sometimes pointed out that such data taken by incinerator owners give underestimates because the owners tend to measure dioxin concentrations at the best operation so as to obtain lowest value. However, even once a year, this is the most reliable method as long as estimations are based on actual measurement.

As mentioned in the introduction, this inventory does not include some dioxin sources whose emission amounts cannot be estimated even though they are known to emit dioxins. Open burning, forest fires and environmental release from stored waste PCB and other products including various organic chlorine compounds are the examples. There is no way to estimate such emission amount at present.

Table. Emission Inventory of Dioxins (PCDDs+PCDFs+coplanar PCBs)

Source	Emission Amount			
	1997	1998	1999	2000
(I) Emission to Air				
Municipal waste incinerators	5,000	1,550	1,350	1,019
Industrial waste incinerators	1,500	1,100	690	555
Small-scale waste incinerators	368 - 619	368 - 619	307 - 509	353 - 370
Crematoriums	2.1 - 4.6	2.2 - 4.8	2.2 - 4.9	2.2 - 4.9
Industrial sources				
Electric steelmaking furnaces	228.5	139.9	141.5	131.1
Steel industry: sintering facilities	135.0	113.8	101.3	69.8
Zinc recovery facilities	47.4	25.4	21.8	26.5
Aluminum production facilities	25.066	23.166	17.366	16.566
Others	22.7640	21.9719	14.0309	14.6977
	6.0825	5.6095	5.7115	4.7345
Cigarette smoke	0.1- 0.2	0.1- 0.2	0.1- 0.2	0.1- 0.2
Automobile exhaust	1.61	1.61	1.61	1.61
				0.126
(II) Emission to water				
Municipal waste incinerators	0.044	0.044	0.035	0.037
Industrial waste incinerators	5.27	5.27	5.29	2.47
Industrial sources	6.0825	5.6095	5.7115	4.7345
Sewage work plant	1.09	1.09	1.09	1.09
Joint waste water treatment facility	0.126	0.126	0.126	0.126
Final waste disposal sites	0.093	0.093	0.093	0.056
Total	7,343 - 7,550	3,358 - 3,612	2,659 - 2,864	2.198 – 2.218

Note 1: Unit is g-TEQ/year using WHO-TEF(1998).
Note 2: * indicates emission to aquatic environment.

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References

1. Ministory of Environment “Emission Inventory of Dioxins” (June 2001), *Japanese*