DISTRIBUTION AND CONGENARIC PATTERNS OF PCDD/Fs IN ENVIRONMENTAL COMPONENTS FROM MATSUYAMA, JAPAN

Nobuyasu Seike[1], Jun Hasegawa, Mariko Nishimori, Megumi Matsumoto, Genta Takahashi, Naomi Sawamoto, Muneaki Matsuda, Masahide Kawano and Tadaaki Wakimoto

Faculty of Agriculture, Ehime Univ., 3-5-7 Tarumi, Matsuyama, Ehime 790-8566, Japan
[1]Present Address: National Institute for Agro-Environmental Sciences, 3-1-3 Kannondai, Tsukuba, Ibaraki 305-8604, Japan

Introduction

Polychlorinated dibenzo-*p*-dioxins and dibenzofurans (PCDD/Fs) could be emitted to the environment from municipal waste incinerators, paper and pulp mills, sewage sludge, and chlorinated chemicals. PCDD/Fs are widely distributed in many environment components such as air, soil and water and finally take up by organisms such as fish, bird and human. When the fate of PCDD/Fs in environment is studied, it is important to investigate concentrations and patterns of PCDD/Fs in various environment components. Levels and patterns of PCDD/Fs are not only given us the present state of contamination but also importance of their sources and accumulation.

We have been investigated PCDD/Fs in environment components from Matsuyama, Japan[1-5](Fig.1) as a model area to study distribution and fate. There are two municipal waste incinerators, domestic incinerators and paddy fields that are thought to be important sources of PCDD/Fs in Matsuyama. Therefore, we thought that it is a suitable location to collect environment samples and to assess PCDD/Fs contamination.

In this study, we present comprehensive investigation of distribution and patterns of PCDD/Fs in Matsuyama, Japan.

Materials and Methods

Environment components such as air (n=58), dry deposition (n=12), rain (n=12), paddy soil (n=36), urban soil (n=34), forest soil (n=54), river water (n=24), pond water (n=4), coastal water, (n=4), river sediment (n=15), pond sediment (n=3), coastal sediment (n=7), fish (n=23), bird (n=10), and human adipose tissue (n=20), were collected from 1992 to 1998. These samples were Soxhlet extracted with toluene or dichloromethane. Purification and separation were carried out by sulfuric acid, silica gel, alumina and activated carbon column chromatography. All samples were analyzed by HRGC/HRMS (HP5890 II /JEOL-102A) equipped with a CP-Sil88 for Dioxins (CHROMPACK) and DB-5 (J&W SCIENTIFIC).

Results and Discussion

Fig.2 shows relative congener composition of PCDDs and PCDFs in some environmental components and

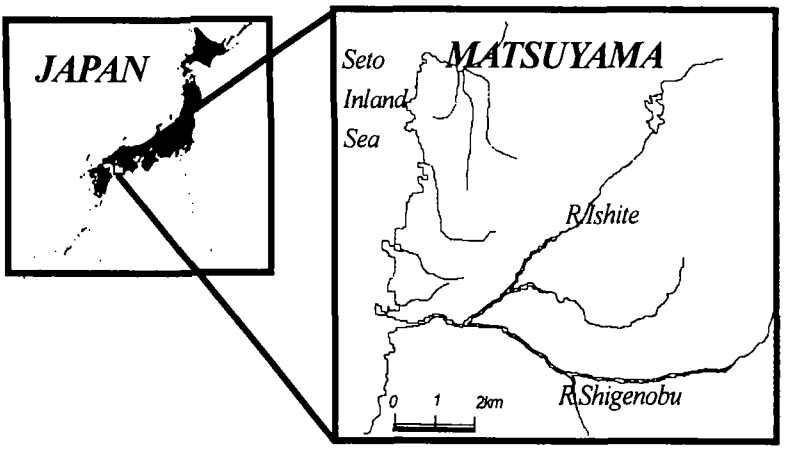

Fig.1 Map of Matsuyama, Japan

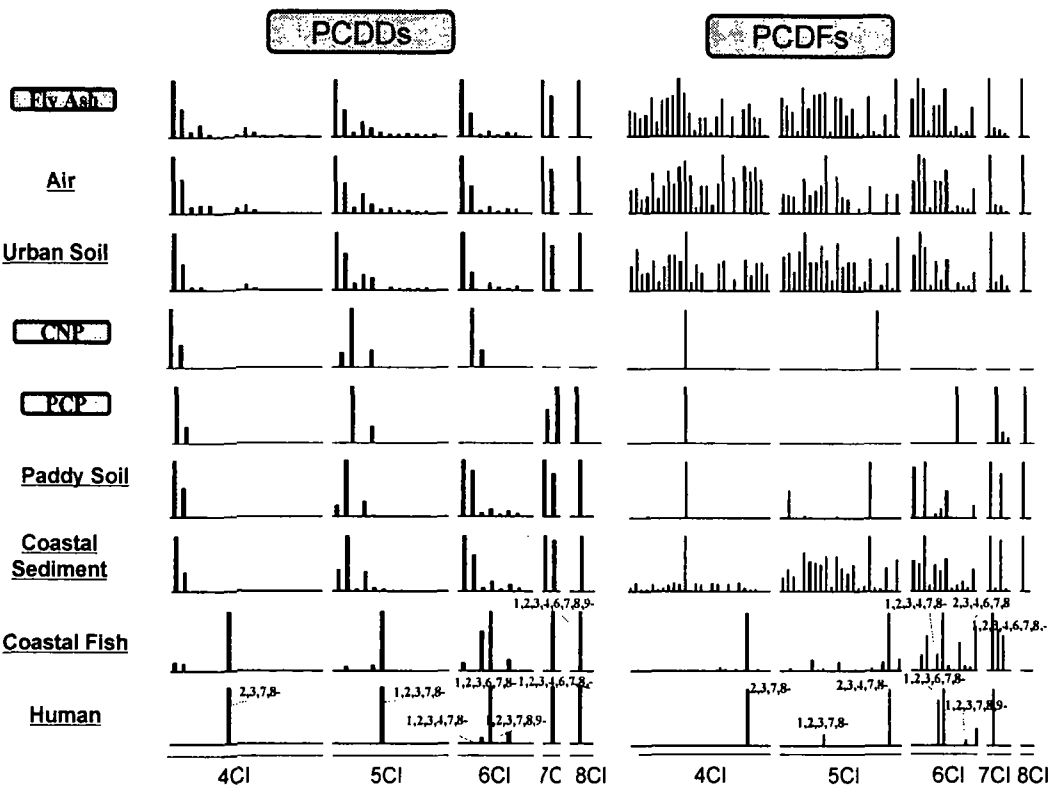

Fig.2 Congener Compositions of PCDD/Fs in Some Environmental Components from Matsuyam Japan

Table 1 Concentrations of PCDDs/Fs and TEQ in Environmental Component from Matsuyama, Japan

	PCDDs			PCDFs			TEQ		
	Min.	Max.	Ave.	Min.	Max.	Ave.	Min.	Max.	Ave.
Air (pg/m^3)	1.5	11	5.1	2.7	17	8.3	0.067	0.30	0.16
Rain (pg/L)	28	380	120	290	13	86	0.42	8.2	2.5
River Water (pg/L)	0.10	1400	170	0.10	48	6.1	0.001	2.5	0.31
Pond Water (pg/L)	39	510	250	3.5	25	11	0.34	1.9	0.84
Seawater (pg/L)	12	120	45	0.1	44	11	0.011	0.16	0.041
Urban Soil (pg/g-dw)	98	3200	730	25	360	130	0.30	9.4	3.1
Forest Soil (pg/g-dw)	100	10000	1700	22	400	130	0.60	13	3.9
Paddy Soil (pg/g-dw)	22000	170000	73000	330	22000	3900	4.5	230	120
River Sediment (pg/g-dw)	560	3900	1800	89	380	200	1.3	8.4	3.9
Pond Sediment (pg/g-dw))	700	3000	2200	64	190	130	2.8	18	10
Coastal Sediment (pg/g-dw)	1100	10000	5100	360	15000	3000	8.2	148	44
Freshwater Fish (pg/g-ww)	0.29	5.5	1.2	0.51	0.96		0.047	1.3	0.67
Coastal Fish (pg/g-ww)	0.26	2.5	1.1	1.6	14	4.1	0.24	1.8	0.75
Bird (pg/g-fw)							21	2800	480
Human (pg/g-fw)	240	14000	3500	9.5	330	120	9.0	210	84

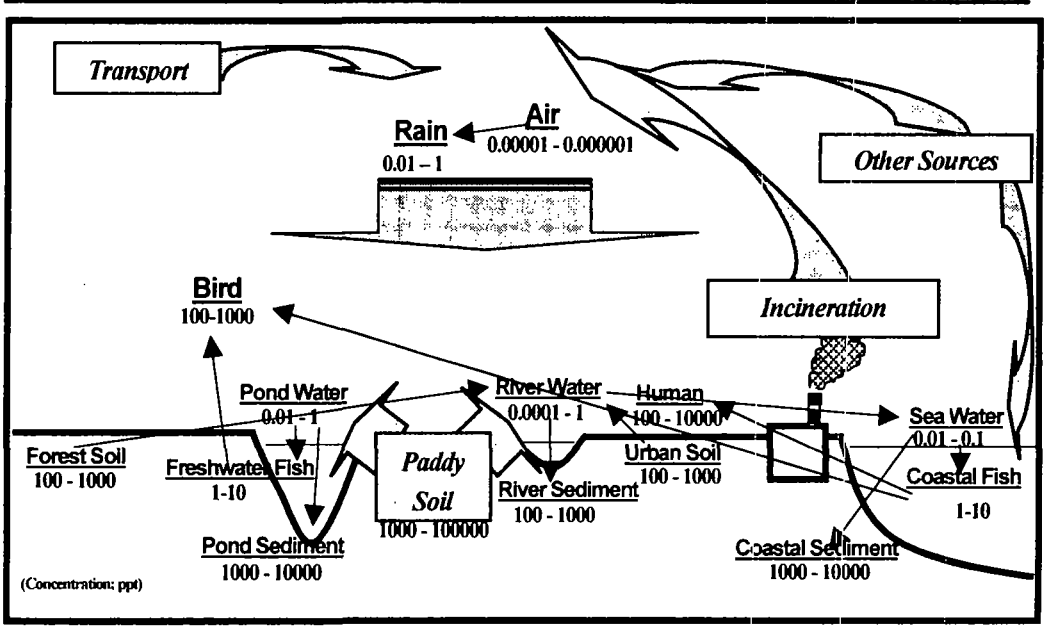

Fig.3 Environmental Behavior of PCDD/Fs in Matsuyama, Japan

possible important sources, such as Fly Ash, 2,4,6-Trichlorophenyl 4-nitrophenylether (CNP) and Pentachlorophenol (PCP), respectively. Congener composition of PCDDs and PCDFs in air and urban soil were similar with those in fly ash. It can be indicated that PCDD/Fs in atmosphere were originated from combustion process such as municipal waste incinerators and domestic incinerators. Congeners of 1,3,6,8-TeCDD, 1,3,7,9-TeCDD and 2,4,6,8-TeCDF in paddy soil, river sediment and coastal sediment were dominantly detected. These congeners were impurities of CNP and PCP that were used in paddy fields as herbicides in the past. The PCDD/Fs pattern in aquatic environment was complicated where contamination may be originated from combustion process and impurity of herbicides.

Table 1 shows concentrations of PCDD/Fs in environment components from Matsuyama, Japan. Concentrations of PCDD/Fs in air, rain river water and seawater were considerably lower than other environment components. It is revealed that air, rain, river water and seawater play the transportation role of PCDD/Fs in environment. On the other hand, concentrations of PCDD/Fs in soils, sediments and organisms were high. It is indicated that soils, sediments and organisms are the accumulation media of PCDD/Fs in environment.

Concentration of PCDD/Fs in paddy soil was considerably higher than other soils. It is indicated that paddy soils could also be a secondary source for PCDD/Fs in aquatic environment in Japan. Use of CNP and PCP were stopped in the past. However, few toxic congeners of PCDD/Fs could be originated from these pesticides

From these results, we try to find out PCDD/Fs behavior in Matsuyama area. Approximately determined concentration ranges of PCDD/Fs in environmental components are shown in Fig.3. The PCDD/Fs in atmosphere were mainly originated from combustion process and then, dry and wet deposited into soil. These PCDD/Fs in soils were entered to aquatic environment through run off. PCDD/Fs in paddy soil that contaminated from impurity of herbicides also flow out to the sea through the rivers. Then PCDD/Fs in river and seawater deposited to the bottom sediment. Especially 2,3,7,8-chlorine substituted congeners were remained in organisms as those were accumulated through the food chain.

References

1. Seike N., Sakiyama T., Matsuda M. and Wakimoto T. (1994) Organohalogen Compounds, 20, 147-150
2. Seike N., Yoshida M., Matsuda M., Kawano M. and Wakimoto T. (1997) Organohalogen Compounds, 33, 169-174
3. Seike N., Matsuda M., Kawano M. and Wakimoto T. (1998) Journal of Environmental Chemistry, 8, 23-31
4. Seike N., Matsumoto M., Matsuda M., Kawano M. and Wakimoto T. (1998) Organohalogen Compounds, 39, 97-100
5. Sawamoto N., Matsuda M. Moriwaki S., Mandai K. and Wakimoto T. (1994) Organohalogen Compounds, 21,141-145