Survey of PCBs , PCDDs, PCDFs in Sediment From Contaminated River in Taiwan

Mei-Kuei Lee, Der-Kau Soong and Yong-Chien Ling
Department of Chemistry, National Tsing Hua University
Hsinchu, Taiwan 300, R.O.C.

1. Introduction

Waste electric wires and/or magnetic cards have been incinerated along the riverside of the Er-Jen river, The plastics covering of the wire containing chlorinated compounds were known to produce contaminants such as PCBs, PCDDs,and PCDFs in the fly ash, or flue gas. The fly ash will deposit on ground soil(1) or fly away and deposit in river sediment(2).

The polluted samples from the river passing through the incinerated area were collected, freeze dried and screened by sieve (100 mesh). Weighed samples were pretreated according to the methods of Kapila, et. al.(3), Yamada, et. al.(4) and Afghan(5). The extract samples were analyzed by gas chromatograph/ mass spectrometer and quantized using isotope dilution method for PCBs; using high resolution selected ion monitoring method for PCDDs and PCDFs. This study examines the levels of the PCBs, PCDDs and PCDFs in river sediment, in order to evaluate the degree of pollution.

2. Experimental

Sediment samples were collected from twelve sites (Fig.1) along Er-Jen river passing through Wan-Li area where electric wires and/or magnetic cards were incinerated directly on the ground. Each sediment sample was freeze dried and ground to fine powder, fortified with $^{13}C_{12}$ — labeled PCDDs and PCDFs and $^{13}C_{12}$ — labeled PCBs. The fortified powder samples were extracted with benzene for 16 hours under soxhlet extraction, concentrated to 2 mL, and cleaned-up with a multiple-layer silica gel column containing anhydrous sodium sulfate, silica, sulfuric acid-silica, silica, sodium hydroxide-silica, silica and silver nitrate-silica. The hexane eluate form the multi-layer column was concentrated and passed through an alumina column to separate PCBs, organopesticides from PCDDs and PCDFs.

The PCBs fraction was analyzed on a DB-5 ms (30 m × 0.25 mm, 0.25 μ) capillary column in EI-mode using a Hewlett Packard 5890 gas chromatograph and Hewlett Packard 5971 mass spectrometer and quantized by isotope dilution method. The GC was temperature programmed from 70 ℃ (5 min) to 180 ℃ at a rate of 20 ℃/min, and finally to 320 ℃ (6 min) at a rate of 10 ℃/min. The dioxins and furans fraction were separated on a DB-5 ms (30 m × 0.25 mm, 0.25 μ) capillary column using a HP-5890 GC and quantized by Jeol SX-102A high resolution mass spectrometer with selected ion monitoring method. The GC was temperature programmed from 170 ℃ (10 min) to 320 ℃ (5 min) at a rate of 10 ℃/min. The $^{13}C_{12}$—labeled internal standards were used to correct the recovery of PCBs, PCDDs, and PCDFs in all samples.

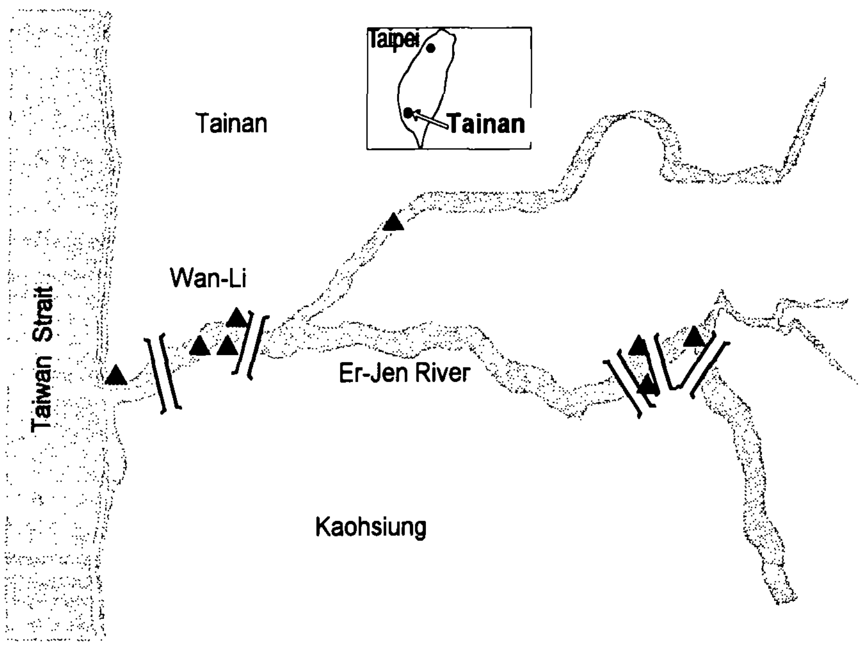

Fig.1 Sediment sampling sites along Er-Jen river

3. Results and discussion

The levels of PCBs, PCDDs, PCDFs in the twelve samples are listed in table I. The levels show distinct differences among these samples. Sample No. 2 has the highest levels of 13.615 ppm, 160.31 ppb, and 287.75 ppb of PCBs, PCDDs, and PCDFs respectively.

This sample is the most contaminated one and is collected from the middle of a river side located near the incineration site. The further from the incineration site (sample No. 10, 11, and 12) the lower the contamination was. For samples collected from the same distant sites from the incineration site, the sediment (sample No. 2) collected from the middle of the river shows higher levels of PCBs, PCDDs, and PCDFs than those (sample No. 3 to 8) collected from the side of the river. The deeper sediments (sample No. 4/5 and 7/8) show higher levels of PCBs, PCDDs, and PCDFs than those (sample No. 3 and 6) collected near the surface. This result reflects the decreasing activity of reclamation of metals in recent years.

The kinds of PCDDs and PCDFs generated from incineration depend on the kind of the waste electric wires and magnetic cards being burned. The PCDDs and PCDFs deposited in the sediments also vary with time. Therefore it is instructive to express the levels of PCDDS and PCDFs as ratio (%) of the different chlorine number containing PCDDs and PCDFs. The results are listed in Table II. Comparing the results to those of Huang, et. al [6], sample No. 2 contain 1/3 or 1/6 times of PCBs, 1 or 1/3 times of PCDDs, 1 or 5 times of PCDFs. However, the PCDD ratio (%) of different chlorine number are similar. Seven and six chlorine number containing PCDDs are dominant. Other samples (sample No. 3 to 8) do not reflect differences in washing any rate. Financial support by the National Science council (NSC84-2113-M-007-040) is acknowledged.

4. References

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Table I : Levels of PCBs, PCDDs and PCDFs in various sample

sample No.	PCB(μg/g)	PCDDs(ng/g)	PCDFs(ng/g)	PCDDs/PCBs(10^{-3})	PCDFs/PCBs(10^{-3})
1	0.090	0.006	0.004	0.067	0.044
2	13.615	160.31	287.75	11.775	21.135
3	0.871	1.256	2.319	1.442	2.662
4	4.431	3.229	3.435	0.729	0.775
5	4.768	2.444	1.784	0.513	0.374
6	1.492	0.071	N.D	0.048	—
7	△	0.397	0.360	—	—
8	4.639	4.093	1.494	0.882	0.322
9	1.463	0.006	N.D	0.004	—
10	0.008	0.006	N.D	—	—
11	0.004	0.006	N.D	—	—
12	1.555	0.062	N.D	0.040	—

note:△— pretreatment failure

Table II : congener ratio(%) of PCDDs and PCDFs in various sample

sample No.	PCDDs					PCDFs				
	4Cl	5Cl	6Cl	7Cl	8Cl	4Cl	5Cl	6Cl	7Cl	8Cl
2	5.40	13.38	26.72	43.33	11.15	19.99	29.58	23.57	21.34	3.78
3	4.46	0.48	15.84	52.07	27.87	5.30	13.97	12.63	47.00	21.09
4	3.22	11.46	14.28	26.91	44.13	17.21	33.07	19.53	16.59	13.62
5	2.66	55.65	10.47	23.98	7.24	9.53	43.33	16.65	30.49	—
6	91.27	8.73	—	—	—	—	—	—	—	—
7	16.12	28.97	26.95	28.46	—	44.44	55.55	—	—	—
8	1.88	10.77	7.62	20.82	58.91	13.78	40.23	22.56	23.43	—