Analysis of PCDD/Fs from Sediments of Dongting Lake in China

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Introduction

Dongting lake is located in the south of China. The total area of the lake is about 2,740 km^2. The average of the lake depth is about 6-7 m, and the deepest of the lake is about 31 m. It is an important source of freshwater fish in China. However schistosoma japonica prevailed in this region for a long time and sodium pentachlorophenate (Na-PCP) has been sprayed since the 1960s to control the spread of snailborne schistosomiasis. Being contaminants of technical Na-PCP, PCDD/Fs may enter the environment and contribute to human exposure after the treatment. The low water solubilities and high adsorption to sediment of PCDD/Fs do not rule out their movement in the environment. The levels of PCDD/Fs was examined in 1996 [1].The aim of this study is to investigate PCDD/Fs pollution in the Dongting lake by sediment and a change in levels of PCDD/Fs after the catastrophic flood in1998. The study is a part of the research on the distribution, migration and fate of organic micropollutants in the environment of the Dongting lake.

Methods and Materials

Samples were taken in April 1999. The sampling locations for the study are indicated in Fig. 1. These locations are on the profiles of national or the province key monitoring areas, which can represent conditions of lake pollution. Each sample was an aliquot of the mixture from at least 3 sites of each location.

Sediments were collected with a grab sampler from shipboard. Samples were wrapped in aluminium foil and deep frozen until analysis, which was performed within 2 weeks.
Samples are air dried and sieved (φ2mm) to eliminate any solid objects. Ten grams of sieved samples are spiked respectively with ^{13}C-labelled 2,3,7,8-substituded PCDD/Fs congeners (Cambridge Isotope laboratories). Samples were extracted with toluene for 24 hr in a Soxhlet extractor. The extracts were concentrated to 1ml using a rotary evaporator. The bulk of co-extracted organic materials were removed by successively passing the extract through the following series of chromatographic columns: acid silica, acid-base and silver nitrate silica multiplayer, and basic alumina. Just prior to GC/MS analysis, 4μl of two ^{13}C-labelled recovery standards (Cambridge Isotope laboratories) were added for the quantification of surrogated recovery. One sample blank was analyzed. All analyses were carried out by Agilent 6890 gas chromatography equipped with 5973N-MSD using a 60 m DB-5 fused-silica column (J&W). Quantification of PCDD/Fs was performed in selected-ion monitoring mode. For each congener two most abundant ions of molecular ion clusters were measured.

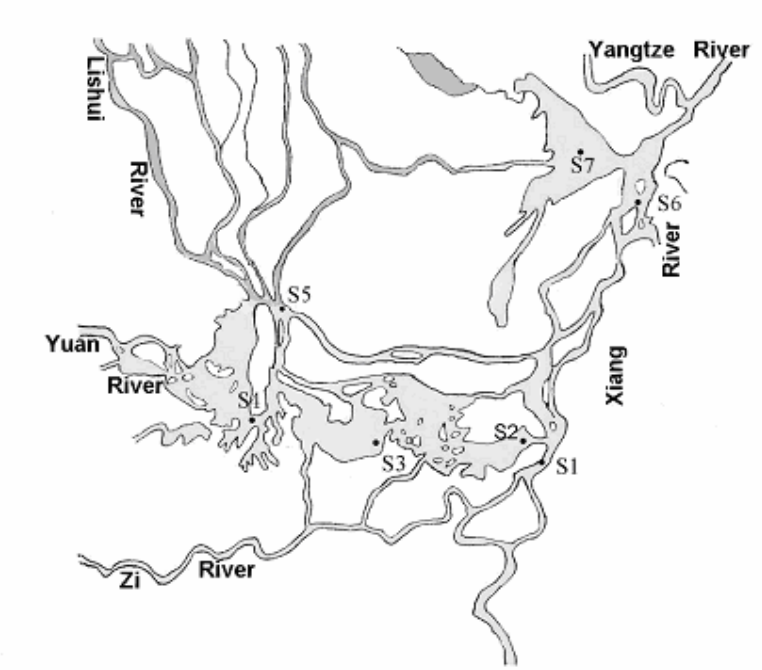

Figure 1. Locations of sampling sites at Dongting lake.

Results and Discussion

Table 1 shows the concentrations of the 2,3,7,8-substitued PCDD/Fs in Chinese products of Na-PCP [2]

Table 1. PCDD/Fs in PCP-Na (ng/g sample)

PCDDs		PCDFs	
2,3,7,8-TCDD	4.0	2,3,7,8-TCDF	3.1
1,2,3,7,8-P_5CDD	2.1	1,2,3,7,8-P_5CDF	40.9
		2,3,4,7,8-P_5CDF	2.4
1,2,3,4,7,8-H_6CDD	244	1,2,3,4,7,8-H_6CDF	76.1
1,2,3,6,7,8-H_6CDD	13.8	1,2,3,6,7,8-H_6CDF	9.4
1,2,3,7,8,9-H_6CDD	2.1	1,2,3,7,8,9-H_6CDF	0.3
		2,3,4,6,7,8- H_6CDF	0.9
1,2,3,4,6,7,8-H_7CDD	1702	1,2,3,4,6,7,8-H_7CDF	135
		1,2,3,4,7,8,9-H_7CDF	18.3
OCDD	12514	OCDF	1467
Total PCDDs	15760	Total PCDFs	2260

The results of sediments analyses, expressed in pg/g of dry weight (d.w.) for the toxic 2,3,7,8-substituded PCDD/Fs congeners and also in international toxic equivalence factors (I-TEQ) are given in table 2. The mean recoveries of the samples are in the range from 60 up to 75%.

Table 2. The concentration of PCDD/Fs in sediments from Dongting lake in China (pg/g)

	S1	S2	S3	S4	S5	S6	S7
2378-TCDF	2.2	8.0	5.3	4.9	ND	19.1	3.1
2378-TCDD	4.1	11.2	3.3	6.2	44.1	5.8	3.7
12378-PCDF	ND	ND	ND	ND	ND	7.1	ND
23478-PCDF	ND	ND	ND	ND	ND	ND	ND
12378-PCDD	19.6	ND	5.7	22.0	7.4	8.8	8.1
123478-H_6CDF	20.8	4.7	ND	ND	ND	ND	ND
123678-H_6CDF	19.7	4.6	ND	ND	ND	ND	ND
123789-H_6CDF	ND	30.1	ND	ND	ND	9.0	19.5
234678-H_6CDF	ND	11.1	ND	ND	5.5	4.0	18.2
123478-H_6CDD	13.4	ND	ND	ND	ND	ND	ND
123678-H_6CDD	15.5	ND	ND	ND	ND	ND	ND
123789-H_6CDD	17.1	ND	ND	ND	ND	ND	ND
1234678-H_7CDF	42.1	23.9	ND	11.9	ND	ND	24.3
1234789-H_7CDF	220	ND	ND	ND	ND	ND	38.2
1234789-H_7CDD	87.3	124	29.7	47.5	3.3	40.1	49.4
OCDF	76.3	ND	ND	ND	ND	34.0	ND
OCDD	1343	13812	2282	600	581	727	799
I-TEQ	27.68	32.34	9.25	18.88	48.96	14.93	13.75

The high PCDD/Fs concentration were detected in the sediment. Octachlorodibenzo-p-dioxin (OCDD) and octachlorodibenzofurans (OCDF) were the most predominant congeners. The pattern of PCDD/Fs in the sediments characterized by higher OCDD could be related to use of sodium pentachlorophenate (Na-PCP). The decrease in the levels of PCDD/Fs was observed comparing to that of in 1996. This can be explained by “dilution effect” of sediment movements by the flood in 1998.

Acknowlegments

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References

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