Background levels of PCDD/Fs in soil of Beijing area, China

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Introduction

Polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCDD/Fs) are well known as persistent and ubiquitous organohalogen pollutants in environment, which has been paid more and more attention to in China. Soil is the last reservoir of PCDD/Fs emitted from various sources to atmosphere and an important media, which can present the environmental pollution level, and many researchers have investigated a local PCDD/Fs pollution level using soil samples[1,2]. In order to evaluate background levels of PCDD/Fs pollution in Beijing area, this paper studied 42 soil samples of different land uses collected throughout the area. PCDD/Fs levels in soil of different land uses were compared, and the patterns of PCDD/Fs in soil of Beijing area were also discussed.

Methods and Materials

sampling

42 soil samples were collected in September 2002, classified as grassland (12), farmland 22) and park (8). Sampling sites were far from potential PCDD/Fs sources, and were illustrated in Fig. 1. At each site, soil samples were collected by five-point method[3]. The sampling depth is 5cm (for grassland and park) or 10cm (for farmland), and sampling diameter is 6cm. Then soil samples were air dried, sieved (2 mm mesh), mixed and homogenized[3].

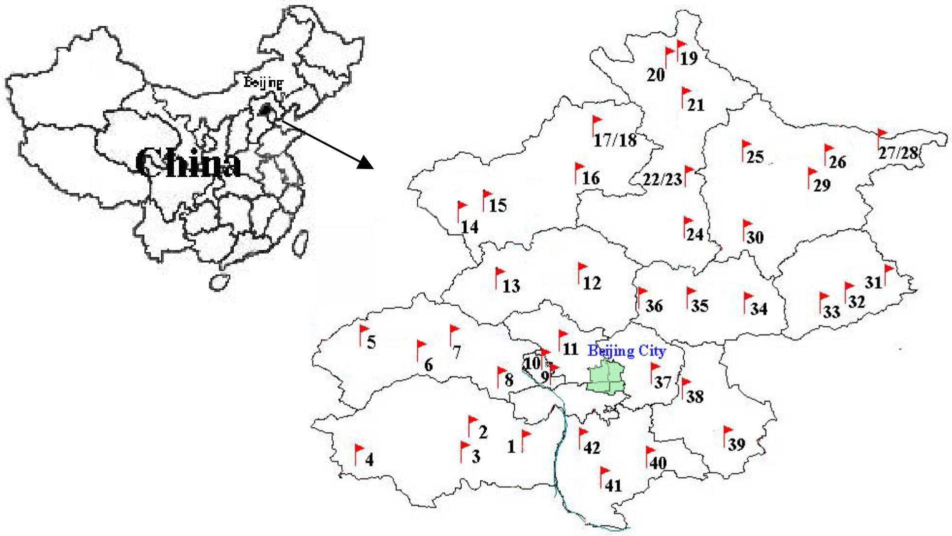

Fig. 1 Map showing sampling sites

Accelerated Solvent Extraction

ASE extraction was performed by the ASE-300 from Dionex Corporation. Extraction temperature was 185 °C and the pressure was 1500 psi. About 20.0g of the homogenized Soil samples were prepared in 33ml cell and statically extracted three times by toluene, under the condition of static time 7min, flush volume 90%, and purge time 120 second.

Each sample was extracted twice under the upper extraction condition. Then ^{13}C labelled cleanup internal standards were added to the extract, and the extract was treated by sulphuric acid, cleaned-up by multilayer silica column, which is described elsewhere[3,4].

HPLC fractionation

After cleanup by multiplayer silica column, soil samples were fractionated by .HPLC (Shimadzu) with HyperCarb column (100×4.6mm,Thermo Quest Hyersil). Under 25 , soil samples were fractionated by 8ml hexane, 40ml 50% methylene chloride/toluene and 40ml 30% toluene/hexane, then the temperature increased to 50 , and samples were back-flushed by 40ml toluene. The flow velocity was 2ml/min.

HRGC-HRMS analysis

The back-flushed fractionation was concentrated and analyzed by HRGC-HRMS (JMS-700D, JEOL) operating under the selected ion monitoring (SIM). The mass resolution was 10,000 and GC column were SP-2331 and DB-17. The analytical condition was described elsewhere[3,4].

Results and Discussion

Concentration levels

Table 1 shows background levels of PCDD/Fs in soil of Bejing area, China. It reveals that PCDD/Fs are detected in all soil samples, and the background levels of PCDD/Fs in soil of Beijing area (average of all samples) is 0.81 (0.086~3.7) pg WHO-TEQ/g (d.w.), which is comparable with the background levels of PCDD/Fs in soil in Sweden (1pg I-TEQ/g,1992)[5], Spain (0.27~2.24 pg I-TEQ/g,1993~1999)[6], England (0.79~1.4 pg I-TEQ/g,1856~1913)[7]and America (0.4±0.6 pg I-TEQ/g, 1999)[8], but is lower than the background levels in Korea (7.31 pg I-TEQ/g ,1999)[9]and Japan (lower than 10 pg I-TEQ/g,1999)[10].

Table 1 also reveals that the background levels of soil samples from farmland, park and grassland are separately 0.87(0.16~3.7), 1.1(0.42~2.3), and 048(0.086~2.3) pg WHO-TEQ/g (d.w.). So the PCDD/Fs background level of parks is lightly higher than of farmland, which is slightly higher than of grassland. This difference may be attributed to the different land utilization.

Patterns of PCDD/Fs

Fig.2~Fig.4 show three different average patterns of PCDD/Fs in soil of Beijing area. These figures reveal that the concentration of OCDD is much higher than any other toxic isomer, but the TEQ of 12378-PeCDD and 23478-PeCDF is the highest, accounting for about an half of the total TEQ. And compared with other homologues, the concentration of OCDD and TeCDDs was higher.

Acknowledgements

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References

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Table 1 The WHO-TEQ background levels of PCDD/Fs in soil of Beijing area

Utilization & sites	WHO-TEQ (pg/g)			Utilization & sites	WHO-TEQ (pg/g)		
	PCDDs	PCDFs	Sum		PCDDs	PCDFs	Sum
farmland				**park**			
1	0.29	0.47	0.76	2	0.25	0.56	0.81
3	0.84	0.65	1.5	9	0.37	0.94	1.3
6	0.36	0.52	0.89	10	0.71	1.5	2.3
13	0.40	0.56	0.96	11	0.56	1.2	1.8
14	0.13	0.16	0.29	15	0.16	0.26	0.42
16	0.040	0.19	0.23	24	0.17	0.48	0.65
18	0.057	0.10	0.16	33	0.35	0.5	0.85
20	0.070	0.26	0.33	35	0.50	0.51	1.0
23	0.22	0.39	0.61	average	0.38	0.74	1.1
25	0.064	0.21	0.27	**grassland**			
27	0.050	0.14	0.19	4	0.17	0.17	0.34
29	0.15	0.19	0.34	5	0.040	0.16	0.2
30	0.14	0.24	0.38	7	0.14	0.25	0.39
32	0.35	0.61	0.96	8	1.6	0.69	2.3
34	0.17	0.25	0.41	12	0.23	0.42	0.64
36	0.50	0.71	1.2	17	0.033	0.053	0.086
37	1.4	2.2	3.6	19	0.030	0.11	0.14
38	1.6	2.1	3.7	21	0.040	0.17	0.21
39	0.31	0.54	0.85	22	0.19	0.41	0.6
40	0.28	0.50	0.78	26	0.034	0.19	0.23
41	0.10	0.20	0.30	28	0.012	0.18	0.19
42	0.18	0.34	0.51	31	0.090	0.27	0.36
average	0.35	0.52	0.87	average	0.22	0.26	0.48
				average of all samples			
					0.35	0.53	0.88

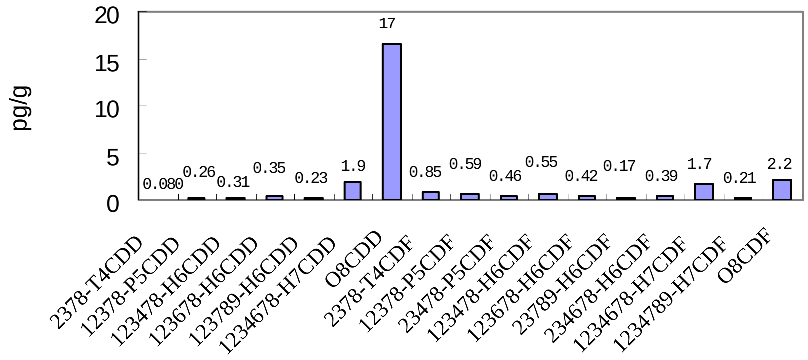

Figure 1 Average concentration pattern of 2378-PCDD/Fs in soil of Beijing area

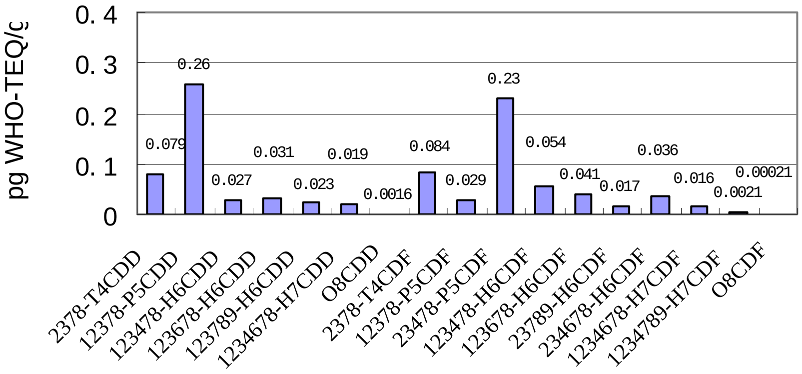

Figure 2 Average TEQ pattern of 2378-PCDD/Fs in soil of Beijing area

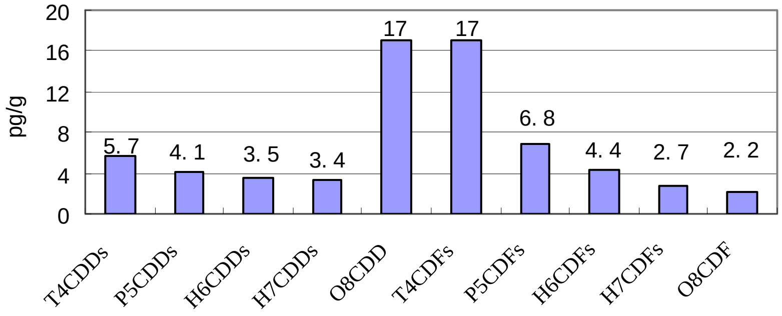

Figure 3 Average concentration pattern of homologues in soil of Beijing area