

## CONCENTRATION AND PROFILES OF PCDD/Fs IN FARMLAND SOIL OF AN ELECTRONIC WASTES DISMANTLING AREA, CHINA

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### Abstract

An extensive survey of PCDD/Fs in farmland soil of Guiyu (China) was performed, which was a highly polluted electronic wastes dismantling area. 19 representative samples in different districts of Guiyu showed an I-TEQ range from 0.82 to 57pg TEQ/g, I-TEQ profiles of seventeen congeners appeared two modes between the northern and southern of the town, it was due to different disposal manner of electronic wastes in actually, especially the existence of thermal process. Coincidentally, the distribution of disposal manner had obvious regional character in Guiyu.

### Introduction

As well known, persistent organic pollutants and heavy metals risk in the electronic wastes (EWs) dismantling area have been global concern. Guiyu, a small town located in the southeastern of Guangdong province, China, has become the most serious polluted area all over the world. It's a traditional rice-growing region, but farming has been desolated since 1995 due to more than 80% of local families are involved in EWs dismantling vocation. More than 1 million tons of EWs are dismantled annually in Guiyu, although it covers an area of 52km<sup>2</sup> only. The main disposal manner including manual disassembly of electronic equipment, roasting of circuit board, shredding of circuit board and cable, open combustion and acid leaching of electronic scrap, chipping and melting of plastic, open dumping of processed EWs. These crude behavior cause severe pollution of PBDEs, PCBs, PAHs, PCDD/Fs and heavy metals<sup>1,2,3</sup> to environment and human health, some data on PCDD/Fs level in part soil of Guiyu have been reported, but comprehensive survey covered whole town range is unprecedented. It is performed in our research.

### Materials and Methods

#### Sampling

The study area were farmland of entire Guiyu town and two northwestern adjacent villages called Yaocouwei (YCW) and Longmen (LM), which had the same EWs disposal situation as Guiyu. Guiyu was divided into three districts, Nanyang district (NY) located in the northern of the town, Shanglian district (SL) and Huamei district (HM) were at the southeast and southwest, respectively. As shown in Figure1, 5 sites in every district and 2 sites in YCW and 1 site in LM were designed, a background site was selected near northern hill, where away from EWs disposal sites and on the windward direction of the town. 0-20cm of top soil was collected with a stainless steel shovel and stored in brown glass jar.

#### Analysis processes

The experimental procedure followed HJ/77.4 method (MEP, 2008). Briefly, soil samples were air dried in the shadow and sifted using 60 mesh sieve, 20g samples were extracted by ASE with toluene after spiking <sup>13</sup>C<sub>12</sub>-labeled surrogate standards (EPA-1613 LCS, Wellington Laboratories), extract was solvent exchanged to hexane and concentrated to approximately 2ml, a multi-layer silica column and an active carbon impregnated silica column were applied to purify extract, toluene fraction was evaporated and blew to near dryness under a gentle nitrogen stream. 5μl <sup>13</sup>C<sub>12</sub>-labeled surrogate standards (EPA-1613 ISS, Wellington Laboratories) was spiked for recovery determination, the final volume was 50μl decane for analysis. A HRGC/HRMS (Agilent 6890N/Autospec Ultima NT) with a DB-5MS fused silica capillary column (60m×0.25mm×0.25μm) was used to determine PCDD/Fs, EI source with 35eV electron energy and 650μA trap current were applied, accelerating voltage was 8000V, and instrument was operated under 10000 resolution power (10% peak valley definition). The temperatures of inlet, source and interface were 270°C, 250°C and 270°C, respectively. International Toxic Equivalency Factor (I-TEF) was used to calculate TEQ values.

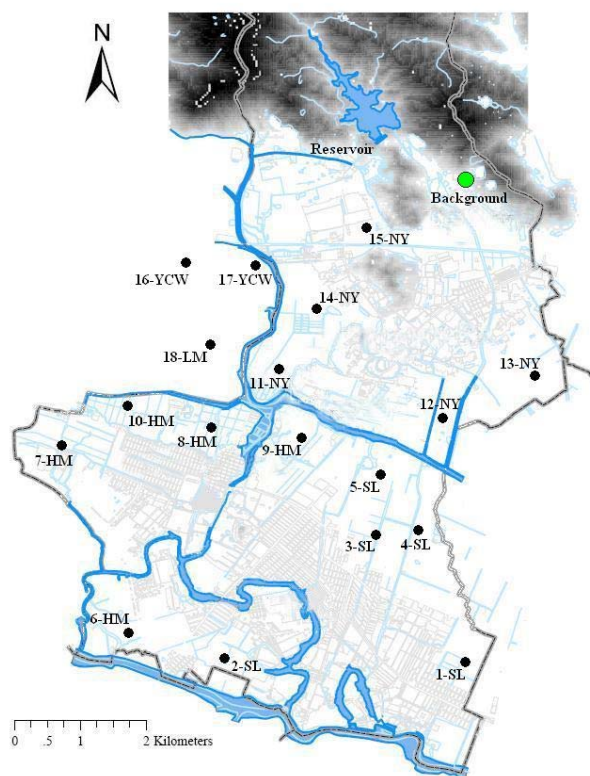


Figure1 Map of Guiyu and sampling sites

## Results and discussion

### Levels of PCDD/Fs in farmland of Guiyu

I-TEQ of 19 samples were shown in Figure2, concentration range from 5.7 to 57pg TEQ/g, the value of background was 0.82pg TEQ/g. Levels of SL district were commonly higher than other areas, which had no obvious difference each other. Compared with reporting from Leung *et al.*<sup>4</sup>, some soil samples from Guiyu were determined, the average WHO-TEQ were 506pg TEQ/g (acid leaching), 34pg TEQ/g (duck pond), 11.7pg TEQ/g (rice field), 4.86pg TEQ/g (printer roller dump site) and 0.8pg TEQ/g (reservoir, background). With the exception of reservoir site located 6km away from EWs dismantling area, the others were all close to disposal sites, contamination degree in our research was similar to their data, except for acid leaching site. It was not far distance between our background site and literature's, and lower results were matched each other (0.82 and 0.8pg TEQ/g). International guidelines for PCDD/Fs in agricultural land were 4pg I-TEQ/g (Canada), 10pg I-TEQ/g (New Zealand and Sweden), 40pg I-TEQ/g (Germany), 500pg I-TEQ/g (Finland) and 1000pg I-TEQ/g (The Netherlands), China had no soil guideline for dioxins, however, PCDD/Fs pollution in farmland of Guiyu had exceeded several country's regulations, the healthy risk couldn't be ignored.

### Congener profiles of PCDD/Fs in farmland of Guiyu

I-TEQ profiles of seventeen congeners were shown in Figure3, pattern of which could be concluded to two modes. The one showed in sites 1-11, i.e. all of SL and HM districts in addition to a NY district site, where located in the southern of Guiyu, 2,3,4,7,8-PeCDF was dominant toxicity contributors, followed with 1,2,3,7,8-PeCDD, and contribution from PCDDs and PCDFs were equal, generally. The other mode appeared in sites 12-18 in the northern of Guiyu, including most of NY district and YCW, LM villages, OCDD and 1,2,3,4,6,7,8-HpCDD were primary toxicity contributors, contribution from PCDDs were largely higher than PCDFs. This difference might be derived from disposal manner of EWs, an interesting phenomena has been existing in Guiyu, some specific

disposal manner prevailed over particular region due to strong clan force locally. SL district majored in chipping and melting of plastic, open combustion and acid leaching of electronic scrap; HM district had abundance workshop of circuit board roasting; NY district, YCW and LM villages were occupied in manual disassembly of EWs. Obviously, whether existence of thermal process was key causes, congener TEQ profile in the southern of the town represented thermal process emission mode.

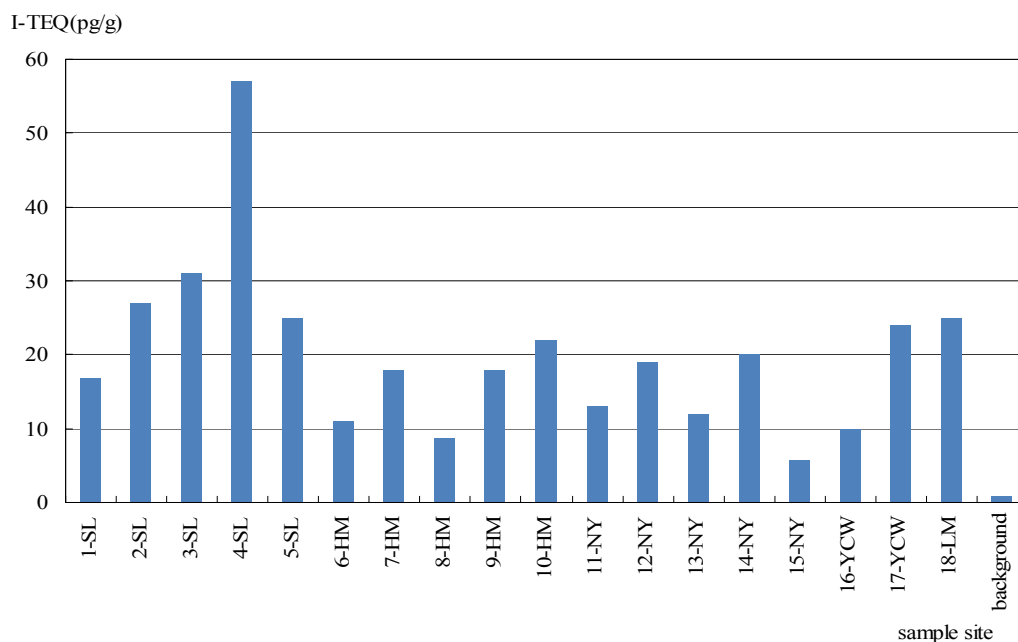


Figure2 I-TEQ of farmland soil in different districts of Guiyu

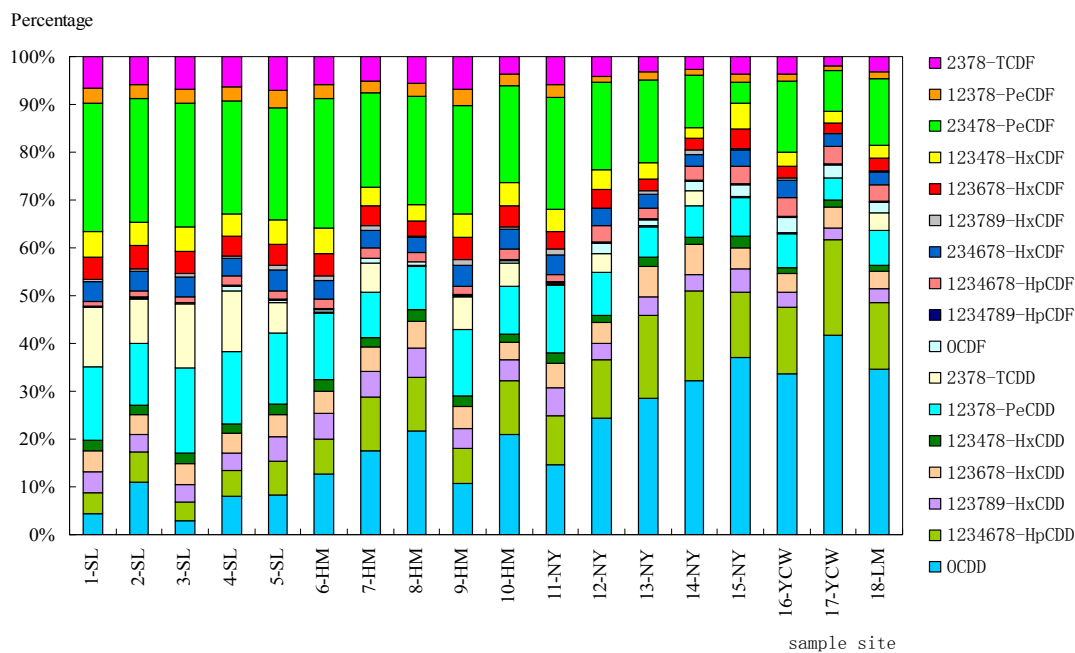


Figure3 I-TEQ profiles of seventeen congeners in farmland soil of different districts of Guiyu

### **Acknowledgements**

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### **References**

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