# Influence of PCDD/Fs from a Simple Waste Incinerator on the Plant Environment

**Gang Zhang[1], Shimin Kang[1,*], Xiangxuan Huang[1], Wenbo Liao[1], Jing Hai[2], Mingzhong Ren[2], Rujin Chen[1], Wantong Nin[1], Hanjie Weng[1,] and Doudou Wu[1]**

[1]School of Chemical Engineering and Energy Technology, Dongguan University of Technology, Dongguan 523808, China
[2]South China Institute of Environmental Sciences, Ministry of Environmental Protection, Guangzhou 510000, China

[*]Corresponding author e-mail: 2013068@dgut.edu.cn

**Abstract**. The influence of polychlorinated dib Enzo-*p*-dioxin and dibenzofuran (PCDD/Fs) on the plant environment were investigated on the basis of analyzing PCDD/Fs content and congener profiles in the soil and waste water by washing ash from a simple waste incinerator (SWI). The mean PCDD/F concentrations for soil and wastewater by washing ash was 318.33 ng/kg and 151.04 ng/L, respectively, and the corresponding mean I-TEQ concentrations were 24.08 ng I-TEQ/kg and 10.52 ng I-TEQ/L. The high I-TEQ concentration in soil from the plant area indicated that the impact of PCDD/F emissions from the SWI on the plant environment was quite significant.

## 1. Introduction

Polychlorinated dibenzo-p-dioxins (PCDDs) and Polychlorinated dibenzofurans (PCDFs) are commonly known as dioxins that have become a global environmental problem because of their high toxicity and potential carcinogenic and mutagenic effect [1, 2]. PCDD/Fs originate from different sources, including waste incinerations, forest fires, chemical industries, vehicles and even cigarette smoking [3, 4]. Identifying potential PCDD/F sources is an essential key step to determine what kind of sources should be prioritized when implementing strict emission control.

As the largest developing country, China has constructed about 100 large MSWs in large and medium-sized cities by the year 2014. Based on remarkable advances in both combustion and air pollution control technologies in recent years, PCDD/F emissions from these large MSWs can be effectively controlled below Chinese environmental standard (0.1 ng I-TEQ/$Nm^3$). Due to the disparity between cities and rural areas, there still exist some simple small waste incinerators (SWIs) in the suburban and rural areas.

The objective of this study was to assess the influence of PCDD/Fs from the SWI on the plant environment. So the PCDD/F concentrations in the soil and waste water by washing ash of the plant area were examined.

## 2. Materials and methods

### *2.1. Basic information on the simple SWI*

The investigation was carried out in a simple small-scale waste incinerator in the suburban area of South China. The SWI, with a combustion capacity of 400 kg/hr, operated for 8 h per day. The SWI was equipped with a grate and an air inlet at the bottom of furnace. Waste was fed from the top of the furnace. Combustion air and flue gas for the incinerator are highly dependent on natural draft. The incinerator was not equipped with APCDs and gas cooling systems.

### *2.2. Sampling and analytical methodologies*

To assess the influence of PCDD/F from the SWI on the plant environment, the soil and waste water by washing ash of the plant area were aslo sampled. The average value was determined from the three PCDD/F values. The PCDD/F flue gas samples were sampled isokinetic ally from the stack sampling point with a sampling time ranging between 120 and 180 min, according to the American Standard Method EPA 23A. The methods used for the PCDD/F analysis were adopted from EPA Method 1613B. These analytical procedures were reported previously [5-8].

## 3. Results and discussion

**Table 1.** The PCDD/Fs in soil and wastewater by washing ash

| | Soil (ng/kg) | wastewater by washing ash (ng/L) |
|---|---|---|
| PCDD | 172.87 | 74.16 |
| PCDF | 145.46 | 76.88 |
| total PCDD/F | 318.33 | 151.04 |
| total I-TEQ PCDD/F | 24.08 | 10.52 |

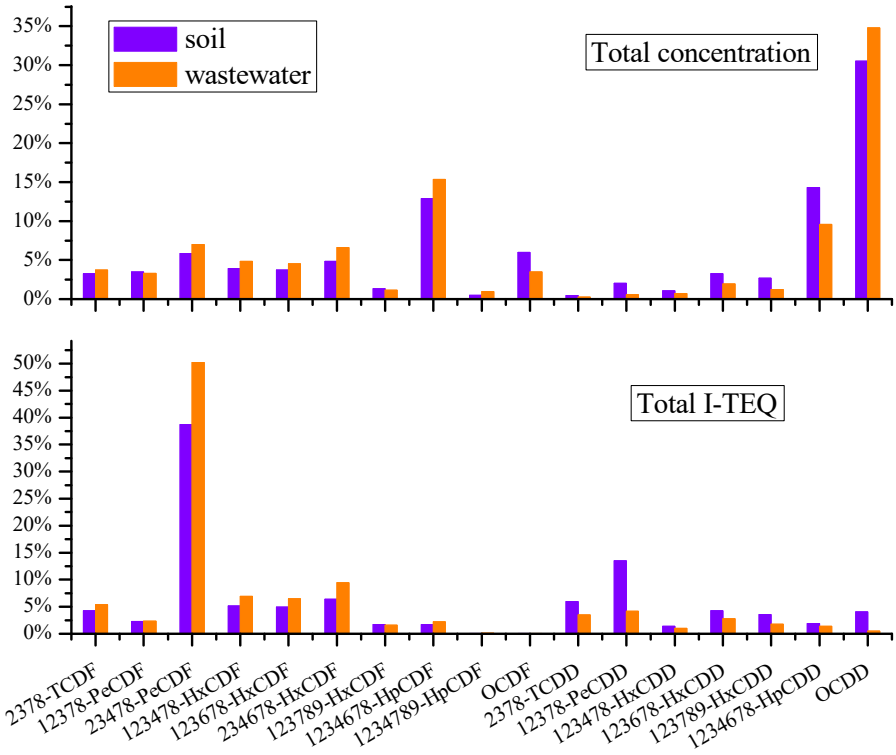


**Figure 1.** PCDD/F congener profiles in soil and wastewater by washing ash.

To assess the influence of PCDD/F from the SWI on the plant environment, the PCDD/F concentrations in the soil and waste water by washing ash of the plant area were examined. Table 1 shows the mean PCDD/F concentrations for soil and wastewater by washing ash was 318.33 ng/kg and 151.04 ng/L, respectively, and the corresponding mean I-TEQ concentrations were 24.08 ng I-TEQ/kg and 10.52 ng I-TEQ/L. The I-TEQ concentrations in soil are the same order of magnitude as that from Spain (1.22-34.28 ng I-TEQ/kg), Finland (13-252 ng I-TEQ/kg), and Korea (1.25-74.98 ng I-TEQ/kg), but higher than that from Japan (average 7.10 ng I-TEQ/kg) and the United States (average 4.0 ng I-TEQ/kg) [9-12].

The observed PCDD/F I-TEQ concentrations in the present study all exceed the 5 ng I-TEQ/kg limit in Germany which restricts the cultivation of certain vegetables [13]. According to the soil dioxin guideline concentrations of Germany, the soil should be limited to cultivation of plants with minimum dioxin transfer, e.g., corn and soybeans [12]. In addition, the I-TEQ concentrations in waste water were much higher than those from the waste water of MSWI [14]. Fig. 4 shows the congener profiles of PCDD/Fs in soil and wastewater by washing ash in terms of total concentration and I-TEQ, respectively. Table 2 provides the complete data on the analyses conducts. The profiles were consistent with those found in stack gas, fly ash and bottom ash from the SWI, which indicated that PCDD/Fs in soil and wastewater derived from PCDD/F emissions of the SWI.

**Table 2.** The complete PCDD/F data in soil and wastewater by washing ash

| PCDD/Fs | I-TEF | soil | | wastewater | |
|---|---|---|---|---|---|
| | | ng/kg | ng I-TEQ/kg | ng/L | ng I-TEQ/L |
| 2378-TCDF | 0.100 | 10.30 | 1.03 | 5.68 | 0.57 |
| 12378-PeCDF | 0.050 | 11.10 | 0.56 | 4.98 | 0.25 |
| 23478-PeCDF | 0.500 | 18.60 | 9.32 | 10.56 | 5.28 |
| 123478-HxCDF | 0.100 | 12.40 | 1.24 | 7.31 | 0.73 |
| 123678-HxCDF | 0.100 | 11.90 | 1.19 | 6.82 | 0.68 |
| 234678-HxCDF | 0.100 | 15.40 | 1.54 | 9.95 | 0.99 |
| 123789-HxCDF | 0.100 | 4.15 | 0.42 | 1.70 | 0.17 |
| 1234678-HpCDF | 0.010 | 41.00 | 0.41 | 23.16 | 0.23 |
| 1234789-HpCDF | 0.010 | 1.51 | 0.02 | 1.44 | 0.01 |
| OCDF | 0.001 | 19.10 | 0.02 | 5.28 | 0.01 |
| 2378-TCDD | 1.000 | 1.43 | 1.43 | 0.37 | 0.37 |
| 12378-PeCDD | 0.500 | 6.51 | 3.26 | 0.89 | 0.44 |
| 123478-HxCDD | 0.100 | 3.43 | 0.34 | 1.05 | 0.11 |
| 123678-HxCDD | 0.100 | 10.30 | 1.03 | 2.94 | 0.29 |
| 123789-HxCDD | 0.100 | 8.50 | 0.85 | 1.86 | 0.19 |
| 1234678-HpCDD | 0.010 | 45.50 | 0.46 | 14.51 | 0.15 |
| OCDD | 0.001 | 97.20 | 0.97 | 52.54 | 0.05 |
| Total PCDD/Fs | | 318.33 | 24.08 | 151.04 | 10.52 |

## 4. Conclusion

The plant environment became a serious problem since high I-TEQ concentration soil was found. An appropriate control strategy should be taken immediately with the purpose of eliminating PCDD/F emissions from the SWI sources.

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