

國立屏東科技大學 九十九 學年度 碩士班甄試 招生考試

環境工程與科學系 碩士班（乙組） 環境科學概論試題（99N102013）

一、 解釋名詞(50 分，請先英翻中完再進一步解釋，每題五分，英翻中僅佔一分，解釋四分)

1. Acid Deposition
2. Bioaccumulation
3. Commensalism
4. Dichlorodiphenyltrichloroethane
5. Endemic species
6. Epidemiology
7. Hazardous Waste
8. Host
9. Recycling
10. Smog

二、 請將下列兩種物質(A) Polychlorinated dibenzo-*p*-dioxins (B) Polychlorinated Biphenyls 詳細寫出它們的化學式(2/5)，自然界中存在多少物種?(1/5)產生源?(1/5)以及對環境或生物體的危害?(1/5)(10 分)

三、 請說明生態系中食物鏈的相對關係?(10 分)

四、 簡易說明污水處理廠中初級與次級污水處理流程?(10 分)

五、 請針對下列文章回答問題(20 分)

1. 文章出處?(2 分)
2. 第一作者與通信作者(2 分)?
3. 實驗地點與實驗設計(2 分)?
4. 請針對摘要回答本篇文章的內容，簡單敘述該文章的結果與討論，請勿超過 60 個字?(12 分)
5. 個人的看法?(2 分)

Characterizing the Emissions of Polychlorinated Dibenzo-*p*-dioxins and Dibenzofurans from Crematories and Their Impacts to the Surrounding Environment

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This study was set out to characterize PCDD/F emissions from crematories and assess their impacts on the surrounding environment. Two crematories located in southern Taiwan were investigated, including the one (C1) with no air pollution control device installed and the other (C2) installed with a bag filter. Results show the mean PCDD/F emissions (11% oxygen) from the stacks of C1 and C2 were 2.36 and 0.322 ng I-TEQ Nm⁻³, respectively. The mean emission factors for C1 and C2 were 13.6 and 6.11 μg I-TEQ body⁻¹, respectively. The removal efficiency of the bag filter on PCDD/Fs was 55.1%. The estimated PCDD/F emission rate for all crematories in Taiwan was 0.838 g I-TEQ yr⁻¹ accounting for 227% and 112% of the annual emissions from all medical waste incinerators and municipal waste incinerators, respectively. The above results indicate that PCDD/F emissions from crematories were quite significant. To assess the impact of PCDD/F emissions from a crematory to the surrounding environment, ambient air samples were collected from the downwind site of C1 with the maximum ground concentration. We found the estimated maximum ground concentration at the downwind site of C1 (= 0.521 pg I-TEQ Nm⁻³) was much higher than that found at the background, rural area, residential area, urban area, and industrial area (= 0.006, 0.023, 0.052, 0.093, and 0.190 pg I-TEQ Nm⁻³, respectively). The above results suggest that PCDD/F emissions from a crematory did significantly affect its surrounding environment. In conclusion, a proper control strategy should be taken immediately in order to eliminate PCDD/F emissions from crematories.

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Introduction

After polychlorinated dibenzo-*p*-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) were discovered in the flue gases and fly ash of municipal waste incinerators in 1977 (1), PCDD/F emissions from various sources have become a serious issue in many countries, because of their toxicological effects and associated adverse health implications. PCDD/Fs are mainly formed during anthropogenic activities and are usually referred to as dioxins. Intensive studies have been conducted on various PCDD/F emission sources, including the waste combustion sources, chemical-industrial sources, and other thermal sources. Nevertheless, only a few studies were carried out on crematories (2–7).

In a study conducted by Fledler in Germany, PCDD/F toxic equivalent (i.e., TEQ) concentrations of ~8 ng TEQ Nm⁻³ were measured in the stack flue gases of crematories (2). Takeda et al. measured PCDD/F emissions from 17 crematories in Japan found PCDD/F concentrations and their corresponding TEQ concentrations in the stack flue gases were 4.9–1200 ng Nm⁻³ (12% oxygen) and 0.064–24 ng TEQ Nm⁻³, respectively (5). In the UK, a laboratory study conducted by the Warren Spring Laboratory found the mean PCDD/F TEQ concentration of 46 ng TEQ Nm⁻³ (11% oxygen) for the cremation process (7). The wide range of PCDD/F concentrations arising from various crematories are believed to be due to their intrinsic differences in operation conditions, air pollution control devices, and involved incinerating materials (5).

In the U.S. (8), UK (7), and Japan (5), PCDD/F emission rates for the crematory source were found as ~9.1, 1–35, and 1.3–3.8 g TEQ yr⁻¹, respectively. In principle, the total PCDD/F emission from the crematory was relatively small as compared with that from the municipal waste incinerator. For example, a recent study conducted in Japan has indicated that the crematory emission accounted for only 0.13–0.29% of that emitted from municipal waste incinerators (5). But it should be noted that most crematories are equipped with a low stack and are situated in the proximity of the residential area. In particular, most of them do not adopt any air pollution control device to eliminate PCDD/F emissions from stacks. Based on these, it can be expected that PCDD/F emissions from a crematory might significantly affect its surrounding environment. Moreover, it should be noted that recently the cremation ratio has increased dramatically in Taiwan and many other countries. In Taiwan, the cremation ratio is expected to increase from 66.9% in 2000 to 85.0% in 2005. In the U.S., the cremation ratio has increased significantly from 15.2% in 1987 to 25.0% in 2000 and is expected to reach 37.0% in 2010 (8). In Japan, because of the encouragement of the governmental policy its current cremation ratio is as high as 99% (4). Based on these data, it is expected that crematories will play an important role on PCDD/F emissions not only in Taiwan area but also in many other countries.

Indeed, in addition to PCDD/Fs, PCBs, and PAHs, total suspended particles (TSP) and odor released from crematories might also cause serious problems to human health. However, the U.S. EPA has reported that there appears to be no “safe” level for dioxin exposure, and the levels of dioxin and dioxin-like chemicals found in the general U.S. population were “at or near levels associated with adverse health effects” (9). Subjected to both cost and manpower, only PCDD/F emissions from crematories were studied in this work. In this study, two crematories located in southern Taiwan with similar operation conditions were investigated. The congener