出國報告（出國類別：國際會議）

國際戴奧辛年會 2019

服務機關：行政院環境保護署

姓名職稱：劉俐君薦任技士

派赴國家：日本

出國期間：**108** 年 **8** 月 **24** 日至 **8** 月 **31** 日

報告日期：**108** 年 **10** 月 **7** 日

摘要

戴奧辛年會自 1980 年首次在義大利羅馬舉辦，隨著對持久性有機污染物之關注，至今為第 39 屆含鹵素持久性有機污染物國際研討會-戴奧辛年會 2019（The 39th International Symposium on Halogenated Persistent Organic Pollutants-Dioxin 2019）。本屆戴奧辛年會研討會期程為 108 年 8 月 25 日至 8 月 30 日，共計 6 日，主要致力於研討降低環境中戴奧辛、類戴奧辛等持久性有機污染物的方法，以及有關多氯聯苯(PCBs)政策及處理技術相關研究。

本次研討會研討議題包含戴奧辛、PCBs、全氟烷基物質(PFAS)等類戴奧辛的持久性有機污染物(POPs)之分析技術、監測與採樣方法、風險評估及風險管理、流行病學、環境流布調查及世界各地環境現況等議題。這次研討會較特別議程為參訪大阪 PCB 廢棄物處理設施(JESCO)及舞洲焚化廠 (Maishima Incineration Plant），本次會議共計約 700 員各國相關領域的人參與，發表之論文共計 595 篇，其中論文宣讀 268 篇、海報展示 327 篇，在本次研討會討論氯化物的論文約占 27%，氟化物、其他類分別占 31%，溴化物占 11%，顯示從過去對氯化物的研究與討論較多，至今研究方向逐漸擴大至含氟、含溴及其他類別。

內容

附錄

附件 1　研討會演講完整流程(DIOXIN 2019 Program)

附件 2　大阪 PCB 廢棄物處理設施及舞洲焚化爐参訪資料

附件 3　相關論文

1. A major player in cancer aggression and immune checkpoint regulation
2. Hazardous chemicals in marine plastics and their threat to marine organisms
3. Modelling persistent organic pollutants: mechanistically linking chemical production to human exposure and health effects
4. Human biomonitoring and exposomics of legacy and emerging chemicals
5. Environmental dioxin in Vietnam
6. Dioxin and health in Vietnam
7. Historical trend of dioxin emissions from municipal solid waste incineration in Japan
8. The influence of PCDD/F memory effect from scrubbing system in full-scale municipal solid waste incineration
9. The effect of desulfurization on the emissions of PCDD/Fs from coal-fired power plants
10. Co-processing aged refuse in a bench-scale simulated cement kiln

device

11. Brominated dioxins emission from the e-waste recycling facility in Japan
12. Emissions of 1325 chemicals from municipal wastewater treatment plants in Japan
13. Food trade is a major transport pathway of PCDD/Fs between the southern and northern hemisphere
14. Levels and profiles of polychlorinated dibenzo-p-dioxin and dibenzofuran in different environmental media from China
15. PCDD/F measurement at high-altitude station in Eastern Asia: evaluation of PCDD/Fs in TSP and PM2.5 via long-range transport and source apportionment during the southeast Asia biomass burning event in 2014
16. Perfluoroalkyl acid intake during childhood in Finland
17. Concentrations of perfluoroalkyl substances in drinking water, indoor air, dust and human milk in Ireland: implications for human exposure

第 1 章　目的

戴奧辛為多種具有兩個苯環的含氯化合物之異構物通稱，無色、無味而且毒性相當強的脂溶性化學物質，因此很容易累積在生物體的脂肪組織中，不易分解且具致癌性，會經由食物鏈累積而危害到人體，被稱為世紀之毒，故被列為有害空氣污染物。其他 PCBs、PFAS 等類戴奧辛的持久性有機污染物亦有類似戴奧辛的物化特性及危害性，經各國學者長期研究發現，這些物質主要是經由工業製程排放至大氣，再沈降至土壤影響植物，並經由食物鏈而對人體造成危害，需優先管制。

我國對戴奧辛排放管制策略主要以：排放標準研訂、排放清冊建置、環境監測調查、加強稽查管制等四大主軸為架構，各項管制策略間相互配合，以達維護生活環境及國民健康，世界各國對戴奧辛等有害物質亦從源頭及末端立法管制。

我國對戴奧辛排放管制肇始於大型垃圾焚化爐，於民國 86 年發布採用世界最嚴格的排放限值，讓新設的大型焚化爐在設計時即將降低戴奧辛排放納入考量，並促使各焚化爐採用高規格的污染防制設備，以有效控制戴奧辛排放，後續亦研訂中小型廢棄焚化爐標準。戴奧辛排放源主要為焚化爐，為了解是否有其他主要排放來源，環保署首先進行各業別排放檢測、解析排放現況，透過排放清冊建立，掌握優先管制對象，進而透過國外排放標準蒐集、國內排放現況調查、控制技術分析及健康風險評估後，擬定管制及排放標準。歷經多年努力，目前環保署已發布有「廢棄物焚化爐戴奧辛管制及排放標準」、「中小型廢棄物焚化爐戴奧辛管制及排放標準」…等 6 項戴奧辛管制法規，將所有固定污染源戴奧辛之排放納入管制。

後續更透過加強排放稽查及定期檢測申報制度，督促排放源落實戴奧辛排放減量工作。配合管制標準逐步生效、加強稽查，排放量逐年下降，推估 106 年全國排放量為 51.67g I-TEQ/年，較 91 年基準年之 327 g I-TEQ/年，減量達 84%，對於降低國內戴奧辛危害風險，有相當大的助益。並透過歷年的環境空氣戴奧辛監測，瞭解管制成效，依據環保署空品測站環境空氣戴奧辛監測結果，107 年 1~4 季平均濃度為 0.022 pg I-TEQ/m^3，均較 91 年、92 年監測平均濃度 0.089 pg I-TEQ/m^{3}明顯降低，遠低於目前全世界僅有日本訂定之「環境戴奧辛空氣品質基準值」0.6 pg WHO$_{2005}$-TEQ/m^3。

戴奧辛年會為國際間研究戴奧辛相關領域的盛會，從 1980 年首次在義大利羅馬舉辦開始至今，已進行 39 屆，近年除了戴奧辛外，其他持久性有機污染物(POPs)之相關研究也納入本研討會的領域內，涵蓋的領域相當廣泛，主要研討有關戴奧辛、PCBs、PFAS 等類戴奧辛的持久性有機污染物之分析技術、監測與採樣方法、風險評估及風險管理、流行病學、環境流布調查及世界各地環境現況等議題。今年透過參與日本京都戴奧辛年會，收集與我國管制規劃相關之研究資料，作為未來環保署管制的參考。

第 2 章　過程

本次出國期程：108 年 8 月 24 日至 8 月 31 日，共 8 日，主要行程內容為參加研討會，研討會行程說明如下：

108 年 8 月 24 日啟程，出發至日本京都。

108 年 8 月 25-30 日參加研討會會議，共計 6 日，本屆研討會研討議題包含戴奧辛、PCBs、PFAS 等持久性有機物之分析技術、監測與採樣方法、風險評估及風險管理、流行病學、環境流布調查及世界各地環境現況等議題。

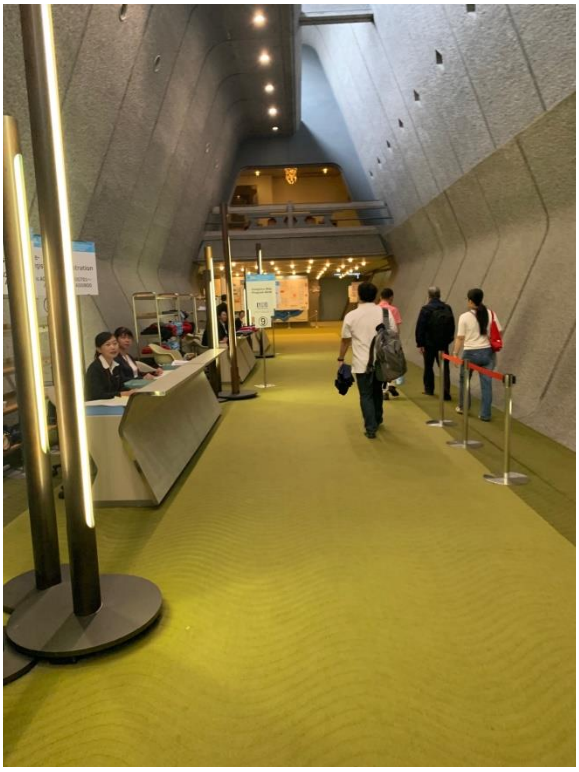
研討會官方網頁

研討會場地 (Kyoto International Conference Center)


DIOXIN 2019 KYOTO
39th International Symposium on
Halogenated Persistent Organic Pollutants
August 25▸30, 2019
Kyoto International Conference Center


会議場 本館
CONFERENCE HALL
イベントホール・ニューホール
EVENT HALL · NEW HALL
DIOXIN 2019 KYOTO
39th International Symposium on Halogenated Persistent Organic Pollutants
Venue
Kyoto International Conference Center

研討會場地-指示牌



研討會場地-報到處

研討會場地-演講廳

專題演講

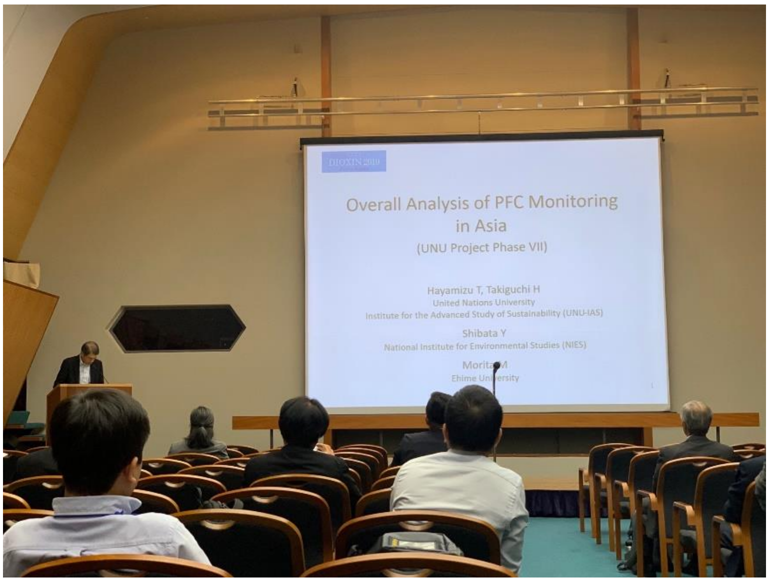
Research Objectives

- To examine whether endocrine disrupting activities could be found in indoor dust from Taiwan
- To analyze the levels of PAHs, PBDEs, OPFRs, and endocrine disrupting compounds (EDCs) in Taiwanese indoor dust
- To evaluate the correlations of target contaminants and the endocrine disrupting activities in Taiwanese indoor dust

In vitro yeast-based bioassay analysis

Gas chromatography mass spectrometry (GC-MS)

專題演講



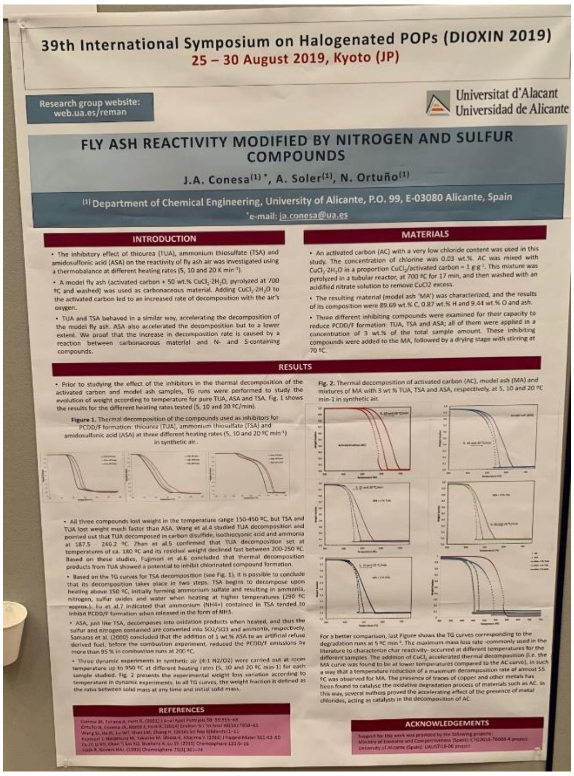
DIOXIN 2019

Overall Analysis of PFC Monitoring in Asia

(UNU Project Phase VII)

Hayamizu T, Takiguchi H
United Nations University
Institute for the Advanced Study of Sustainability (UNU-IAS)
Shibata Y
National Institute for Environmental Studies (NIES)
Morita M
Ehime University

專題演講



39th International Symposium on Halogenated POPs (DIOXIN 2019)
25 – 30 August 2019, Kyoto (JP)

Research group website:
web.ua.es/reman

Universitat d'Alacant
Universidad de Alicante

FLY ASH REACTIVITY MODIFIED BY NITROGEN AND SULFUR COMPOUNDS

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INTRODUCTION

- The inhibitory effect of thiourea (TUA), ammonium thiosulfate (TSA) and amidosulfonic acid (ASA) on the reactivity of fly ash air was investigated using a thermobalance at different heating rates (5, 10 and 20 K min^{-1}).
- A model fly ash (activated carbon + 50 wt.% $CuCl_2·2H_2O$, pyrolyzed at 700 ºC and washed) was used as carbonaceous material. Adding $CuCl_2·2H_2O$ to the activated carbon led to an increased rate of decomposition with the air's oxygen.
- TUA and TSA behaved in a similar way, accelerating the decomposition of the model fly ash. ASA also accelerated the decomposition but to a lower extent. We proof that the increase in decomposition rate is caused by a reaction between carbonaceous material and N- and S-containing compounds.

MATERIALS

- An activated carbon (AC) with a very low chloride content was used in this study. The concentration of chlorine was 0.03 wt.%. AC was mixed with $CuCl_2·2H_2O$ in a proportion $CuCl_2$/activated carbon = 1 g·g^{-1}. This mixture was pyrolyzed in a tubular reactor, at 700 ºC for 17 min, and then washed with an acidified nitrate solution to remove CuCl2 excess.
- The resulting material (model ash 'MA') was characterized, and the results of its composition were 89.69 wt.% C, 0.87 wt.% H and 9.44 wt.% O and ash.
- Three different inhibiting compounds were examined for their capacity to reduce PCDD/F formation: TUA, TSA and ASA; all of them were applied in a concentration of 3 wt.% of the total sample amount. These inhibiting compounds were added to the MA, followed by a drying stage with stirring at 70 ºC.

RESULTS

- Prior to studying the effect of the inhibitors in the thermal decomposition of the activated carbon and model ash samples, TG runs were performed to study the evolution of weight according to temperature for pure TUA, ASA and TSA. Fig. 1 shows the results for the different heating rates tested (5, 10 and 20 ºC/min).

Figure 1. Thermal decomposition of the compounds used as inhibitors for PCDD/F formation: thiourea (TUA), ammonium thiosulfate (TSA) and amidosulfonic acid (ASA) at three different heating rates (5, 10 and 20 ºC min^{-1}) in synthetic air..

- All three compounds lost weight in the temperature range 150-450 ºC, but TSA and TUA lost weight much faster than ASA. Wang et al.4 studied TUA decomposition and pointed out that TUA decomposed in carbon disulfide, isothiocyanic acid and ammonia at 187.5 – 246.2 ºC. Zhan et al.5 confirmed that TUA decomposition set at temperatures of ca. 180 ºC and its residual weight declined fast between 200-250 ºC. Based on these studies, Fujimori et al.6 concluded that thermal decomposition products from TUA showed a potential to inhibit chlorinated compound formation.
- Based on the TG curves for TSA decomposition (see Fig. 1), it is possible to conclude that its decomposition takes place in two steps. TSA begins to decompose upon heating above 150 ºC, initially forming ammonium sulfate and resulting in ammonia, nitrogen, sulfur oxides and water when heating at higher temperatures (290 ºC approx.). Fu et al.7 indicated that ammonium (NH4+) contained in TSA tended to inhibit PCDD/F formation when released in the form of NH3.
- ASA, just like TSA, decomposes into oxidation products when heated, and thus the sulfur and nitrogen contained are converted into SO2/SO3 and ammonia, respectively. Samaras et al. (2000) concluded that the addition of 1 wt.% ASA to an artificial refuse derived fuel, before the combustion experiment, reduced the PCDD/F emissions by more than 95 % in combustion runs at 200 ºC.
- Three dynamic experiments in synthetic air (4:1 N2/O2) were carried out at room temperature up to 950 ºC at different heating rates (5, 10 and 20 ºC min-1) for each sample studied. Fig. 2 presents the experimental weight loss variation according to temperature in dynamic experiments. In all TG curves, the weight fraction is defined as the ratio between solid mass at any time and initial solid mass.

Fig. 2. Thermal decomposition of activated carbon (AC), model ash (MA) and mixtures of MA with 3 wt % TUA, TSA and ASA, respectively, at 5, 10 and 20 ºC min-1 in synthetic air.

For a better comparison, last Figure shows the TG curves corresponding to the degradation runs at 5 ºC min^{-1}. The maximum mass loss rate -commonly used in the literature to characterize char reactivity- occurred at different temperatures for the different samples. The addition of $CuCl_2$ accelerated thermal decomposition (i.e. the MA curve was found to be at lower temperatures compared to the AC curve), in such a way that a temperature reduction of a maximum decomposition rate of almost 55 ºC was observed for MA. The presence of traces of copper and other metals has been found to catalyse the oxidative degradation process of materials such as AC. In this way, several authors proved the accelerating effect of the presence of metal chlorides, acting as catalysts in the decomposition of AC.

REFERENCES

ACKNOWLEDGEMENTS

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Ministry of Economy and Competitiveness (Spain): CTQ2016-76608-R project
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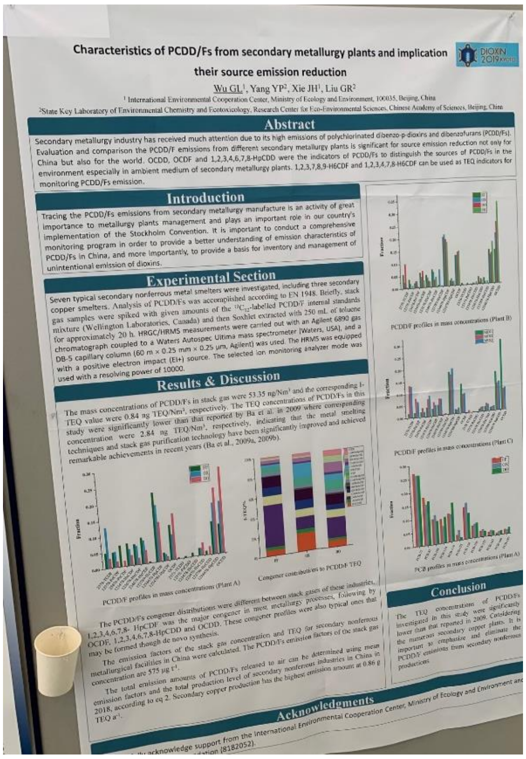
海報展覽



Characteristics of PCDD/Fs from secondary metallurgy plants and implication their source emission reduction

DIOXIN 2019 KYOTO

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[2]State Key Laboratory of Environmental Chemistry and Ecotoxicology, Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, Beijing, China

Abstract

Secondary metallurgy industry has received much attention due to its high emissions of polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/Fs). Evaluation and comparison the PCDD/F emissions from different secondary metallurgy plants is significant for source emission reduction not only for China but also for the world. OCDD, OCDF and 1,2,3,4,6,7,8-HpCDD were the indicators of PCDD/Fs to distinguish the sources of PCDD/Fs in the environment especially in ambient medium of secondary metallurgy plants. 1,2,3,7,8,9-H6CDF and 1,2,3,4,7,8-H6CDF can be used as TEQ indicators for monitoring PCDD/Fs emission.

Introduction

Tracing the PCDD/Fs emissions from secondary metallurgy manufacture is an activity of great importance to metallurgy plants management and plays an important role in our country's implementation of the Stockholm Convention. It is important to conduct a comprehensive monitoring program in order to provide a better understanding of emission characteristics of PCDD/Fs in China, and more importantly, to provide a basis for inventory and management of unintentional emission of dioxins.

Experimental Section

Seven typical secondary nonferrous metal smelters were investigated, including three secondary copper smelters. Analysis of PCDD/Fs was accomplished according to EN 1948. Briefly, stack gas samples were spiked with given amounts of the $^{13}C_{12}$-labelled PCDD/F internal standards mixture (Wellington Laboratories, Canada) and then Soxhlet extracted with 250 mL of toluene for approximately 20 h. HRGC/HRMS measurements were carried out with an Agilent 6890 gas chromatograph coupled to a Waters Autospec Ultima mass spectrometer (Waters, USA), and a DB-5 capillary column (60 m × 0.25 mm × 0.25 μm, Agilent) was used. The HRMS was equipped with a positive electron impact (EI+) source. The selected ion monitoring analyzer mode was used with a resolving power of 10000.

Results & Discussion

The mass concentrations of PCDD/Fs in stack gas were 53.35 ng/Nm^3 and the corresponding I-TEQ value were 0.84 ng TEQ/Nm^3, respectively. The TEQ concentrations of PCDD/Fs in this study were significantly lower than that reported by Ba et al. in 2009 where corresponding concentration were 2.84 ng TEQ/Nm^3, respectively, indicating that the metal smelting techniques and stack gas purification technology have been significantly improved and achieved remarkable achievements in recent years (Ba et al., 2009a, 2009b).

PCDD/F profiles in mass concentrations (Plant A)

Congener contributions to PCDD/F TEQ

The PCDD/Fs congener distributions were different between stack gases of these industries. 1,2,3,4,6,7,8- HpCDF was the major congener in most metallurgy processes, following by OCDF, 1,2,3,4,6,7,8-HpCDD and OCDD. These congener profiles were also typical ones that may be formed though de novo synthesis.

The emission factors of the stack gas concentration and TEQ for secondary nonferrous metallurgical facilities in China were calculated. The PCDD/Fs emission factors of the stack gas concentration are 575 μg t^{-1}.

The total emission amounts of PCDD/Fs released to air can be determined using mean emission factors and the total production level of secondary nonferrous industries in China in 2018, according to eq 2. Secondary copper production has the highest emission amount at 0.86 g TEQ a^{-1}.

PCDD/F profiles in mass concentrations (Plant B)

PCDD/F profiles in mass concentrations (Plant C)

PCB profiles in mass concentrations (Plant A)

Conclusion

The TEQ concentrations of PCDD/Fs investigated in this study were significantly lower than that reported in 2009. Considering the numerous secondary copper plants, it is important to emphasize and eliminate the PCDD/F emissions from secondary nonferrous productions.

Acknowledgments

acknowledge support from the International Environmental Cooperation Center, Ministry of Ecology and Environment and
(8182052).

海報展覽

研討會招待會

研討會議程

8/26(一)		
10:15 - 10:30	Room A	報到
10:30 - 11:15		開幕式
11:15 - 12:00		專題講座1 “The AhR: A Major Player in Cancer Aggression and Immune Checkpoint Regulation”, Dr. David Sherr, Boston University School of Public Health
12:00 - 13:00	午餐	
13:00 - 13:50	附樓2館	海報發表1
14:00 - 16:00	Room A	分析1
	Room B-1	亞洲POPs監測1
	Room B-2	阻燃劑
	Room C-1	風險評估
	Room C-2	人體暴露1
16:00 - 16:30	茶敘	
16:30 - 18:30	Room A	分析2
	Room B-1	亞洲POPs監測2
	Room B-2	新興阻燃劑的生物暴露
	Room C-1	代謝及毒理學
	Room C-2	人體暴露2
09:30 - 17:30	附樓1館	展覽

8/27(二)		
08:30 - 09:15	Room A	專題講座2 “Hazardous chemicals in marine plastics and their threat to marine organisms”, Prof. Hideshige Takada, Tokyo University of Agriculture and Technology
09:15 - 10:00	茶敘	
10:00 - 12:00	Room A	氯化石蠟的毒性和風險
	Room B-1	微塑料和持久性有機污染物
	Room B-2	宿命與傳輸1
	Room C-1	分析方法和應用的進步(供應商)
	Room C-2	人體暴露3
12:00 - 13:00	午餐	
	Room B-2	Dolce sponsored by Waters Corporation
	Room C-1	Dolce sponsored by MIURA CO., LTD.
	Room C-2	Dolce sponsored by Thermo Fisher SCIENTIFIC
13:00 - 13:50	附樓2館	海報發表2
14:00 - 16:00	Room A	食品中的氯化石蠟
	Room B-1	水準和趨勢(非生物群)
	Room B-2	新興阻燃劑：生物轉化和生物利用度
	Room C-1	宿命與傳輸2
	Room C-2	發展中國家的POPs
08:30 - 17:30	附樓1館	展覽

8/28(三)			8/29(四)		
08:30 - 09:15	Room A	專題講座3 “Modelling persistent organic pollutants: mechanistically linking chemical production to human exposure and health effects”, Prof. Frank Wania, University of Toronto Scarborough	08:30 - 09:15	Room A	專題講座4 “Human Biomonitoring and Exposomics of Legacy and Emerging Chemicals”, Prof. Dr. Adrian Covaci, University of Antwerp
09:15 - 10:00	茶敘		09:15 - 10:00	茶敘	
10:00 - 12:00	Room A	PCB廢棄物處理	10:00 - 12:00	Room A	PFAS：分析
	Room B-1	氯化石蠟的分析與環境現象		Room B-1	生成，來源與控制1
	Room B-2	PFAS：水準和運輸		Room B-2	水準和趨勢(非生物群2)
	Room C-1	水準和趨勢(生物群)		Room C-1	從好的科學到良好的風險管理
	Room C-2	流行病學		Room C-2	生態毒理學
08:30 - 17:30	附樓 1館	展覽	10:00 - 12:30	Yusho and Yucheng 油症(Yusho為日語英譯，Yucheng為中文英譯)	
12:20 - 18:00	參觀行程 大阪PCB廢棄物處理設施及舞洲焚化爐		12:00 - 13:00	午餐	
				Room B-2	越南會前會
				Room C-1	Dolce sponsored by Cambridge Isotope Laboratories, Inc.
				Room C-2	Dolce sponsored by Agilent Technologies Japan, Ltd.
			13:00 - 13:50	附樓 2館	海報發表3
			14:00 - 16:00	Room A	PFAS：去除和降解
				Room B-1	生成，來源與控制2
				Room B-2	越南的戴奧辛健康危害1
				Room C-1	大規模生物監測研究
				Room C-2	水準和趨勢(食物和飼料)
			16:00 - 16:30	茶敘	
			16:30 - 17:50	Room A	PFAS：暴露和毒理學
				Room B-1	生成，來源與控制3
				Room B-2	越南的戴奧辛健康危害2
				Room C-1	物理化學性質和模擬
				Room C-2	寵物的POPs及其作為人體健康模型的適用性
			08:30 - 17:30	附樓 1館	展覽

8/30(五)		
09:15 - 10:00	Room A	專題講座5 Dioxin and health effects in Vietnamese **PART 1.** ENVIRONMENTAL DIOXIN IN VIETNAM Dr. Ngyuen Minh Hung, Ministry of Natural Resources and Environment, Vietnam **PART 2.** DIOXIN AND HEALTH IN VIETNAM Prof. Teruhiko Kido, Kanazawa University
10:00 - 10:45	茶敘	
10:45 - 12:15	Room A	會議摘要
		Otto Hutzinger Awards
		歡迎参加Dioxin 2020
		閉幕
09:00 - 10:45	附樓 1館	展覽

第 3 章　研討會內容

本次研討會議舉行，發表之論文共計 595 篇，其中論文宣讀 268 篇、海報展示 327 篇，且每日上午均安排專題講座，針對斯德哥爾摩公約以來的變化、國際關切之戴奧辛對健康危害機制、POPs 的環境法醫學等課題進行近年的發展趨勢分析與演講。本次會議包含 35 個主題，討論的持久性有機物包含氯化物、氟化物、溴化物及其他類 POPs，讓大家開始關注持久性有機物的戴奧辛屬氯化物，在本次研討會討論氯化物的論文約占 27%，氟化物、其他類分別占 31%，溴化物占 11%,顯示過去對氯化物的研究與討論較多,現在的研究方向逐漸擴大至含氟、含溴及其他類別，本次共計 700 員各國相關領域的人餐與本次研討會議。

3.1　專題演講

本次會議共計六場次的主題演講，由各領域專家學者對近期的研究趨勢進行大方向的演講介紹，內容大意如下：

1. hR 對人體癌症影響機制，講者為 Boston University 的 David Sherr。

內容：

這場演講較偏向生醫工程領域，主要講述文獻指出體內的一種芳香烴受體的蛋白質(AhR)與 2,3,7,8-四氯雙苯-p-戴奧辛(TCDD)相關的多氯二苯並戴奧辛(PCDD)、多氯二苯並呋喃(PCDF)及 PCBs 的結合機制有關，顯示 AhR 與戴奧辛影響生物體機制的重要性，而講者研究重點在於 AhR 在人體形成腫瘤扮演的角色，也分享他對 AhR 在人體代謝機制的研究發現，他認為 AhR 活

性會根據開始反應物濃度做週期性波動，且 AhR 活性在擾動後會達新的穩定態，去除 AhR 將會影響腫瘤生成機制，可提升癌症存活率。

2. 洋垃圾中有害化學物質對海洋生物的威脅，講者為 Tokyo University of Agriculture and Technology 的 Hideshige Takada。

內容：

該講者指出海洋塑膠及塑膠微利被多種不同大小的海洋生物攝取，塑膠微粒吸附積累 POPs，毒性藉由食物鏈生物累積性，加速了海洋中擴散，最終藉由海鮮食物到達人體。講者強調當塑料在海洋環境中碎裂成較小的碎片時，由海洋生物攝取，它們可能與消化道的油性成分和添加劑接觸溶解在消化液中，轉移並積聚在生物組織中，這種從海洋生物暴露到人體的一種新的曝露途徑。

3. 擬 PCBs 化學製品生產到人體暴露與健康的影響機制，講者為 University of Toronto Scarborough 的 Frank Wania。

內容：

本演講簡要回顧持久性有機污染物的環境宿命模型如何從單一化學物質宿命擴大範疇到整合性模擬系統，並連結到有機化學物質的生產量對於人類及野生動物的生物反應。運用以機制為基礎的整合性持久性有機污染物暴露模型動機是多方面的，包含風險評估及管理、生物監測及流行病學研究調查、

鑑定具高暴露潛勢的化學物質與人口分布。整合性模型對於污染排放到實際暴露的時間延遲，以及暴露途徑隨時間的變化皆有考量。而排放情境、暴露參數及環境隨時間的變化皆可數據化輸入模型中，模擬食物鏈中高級消費者的污染暴露量。

4. 人體生物監測及暴露體學調查遺傳及新興化學物質方法，講者為 University of Antwerp 的 Adrian Covaci。

內容：

講者提及人體生物監測方法針對多種化學物質的暴露評估以發展很完備，透過選定的 250-300 種的持久性及非持久性化學物質在人體中濃度的時間趨勢得出參考數值，最後也影響了法規的制定。但越來越多的化學物質被製造出來，預測新興化學物質對人體暴露的方法越來越重要。篩選方法包含(1)特定目標篩選(2)可能物質篩選(3)透過高解析度質譜儀(High-resolution mass spectrometry, HRMS)進行無目標篩選。暴露體學於方法論上須包含所有內在及外在對健康有影響的暴露。使用 HRMS 可將人體生物監測及額外遺傳物質法結合。傳統上只監測數百種化學物質對於生命周期較短的化學物質，而對於暴露體學而言，短生命週期的數千種日常暴露的化學物質亦是十分重要的。透過 HRMS 非無目標性的篩選機制，搭配暴露體學研究可提供更精準的預防化學物質暴露到環境中，或是發展替代物質。

5. 南當地戴奧辛及其健康影響，講者為越南 Ministry of Natural Resources and Environment 的 Ngyuen Minh Hung 及日本 Kanazawa University 的 Teruhiko Kido。

講者說明越戰期間，約從 1961 年到 1972 年，美國陸軍為使利於軍事行動，在越南噴灑了約 7400 萬升的落葉劑，以摧毀阻礙視線的森林和作物。64%的落葉劑為橘劑(Agent Orange)，且大多數落葉劑含有 PCDD/Fs。越戰期間噴灑的 PCDD/F 總量約有 366 至 1223 kg-TEQ，可與今天全球的戴奧辛排放量相比(約為 140 kg-TEQ/年)。目前的戴奧辛污染熱點為當年美國軍方橘劑的儲存、洩漏或溢出區域，到目前為止，峴港和 Phu Cat 兩個主要橙劑熱點污染區域其土壤已分別採用熱脫附和安全掩埋等方式整治。除了越戰時間留下來的污染外，目前工業排放亦造成越南的戴奧辛污染問題。胡志明市的 PCDD/Fs 指紋顯示和工業來源有關，峴港市的指紋顯示受附近橘劑熱點的影響。由於橘劑會影響免疫系統、繁殖、神經系統等，過去關於落葉劑/戴奧辛引起對健康的影響大多數集中在美國退伍軍人身上，自 2002 年以來，越南民眾與戴奧辛健康相關問題有較多的研究。研究結果顯示，母乳中戴奧辛含量在橘劑熱點顯著高於非噴灑區域，通過母乳暴露的戴奧辛可能造成胎兒的身體負擔，至少在兒童時期，這些戴奧辛會破壞內分泌。

3.2 其他演講內容

1. 生成、來源與控制

地主國日本首先介紹都市廢棄物焚化爐的戴奧辛排放量變化，排放量從1997年到2017年顯著下降。其排放至大氣的戴奧辛排放係數約為476 ng-TEQ/公噸垃圾焚化，相當於斯德哥爾摩公約的都市廢棄物焚化爐最低排放係數500 ng-TEQ/公噸垃圾焚化。

2000年以後，引入了各種提高MSWI發電效率的方法，這些方法並沒有增加戴奧辛的排放濃度(圖1)。隨著2000年以後新建MSWI的技術更新，戴奧辛的排放係數降低(圖2)，推估至2040年的平均排放係數可降低至50 ng-TEQ/公噸垃圾焚化，預計到2040年排放量將降至2 g-TEQ /年。

此處，雖然評估了MSWI對空氣中戴奧辛的排放，但戴奧辛在焚化後會附著在飛灰或底灰上，排放至大氣的排放量推估並未考量此途徑，因此，未來的研究應擴大至各介質的戴奧辛。

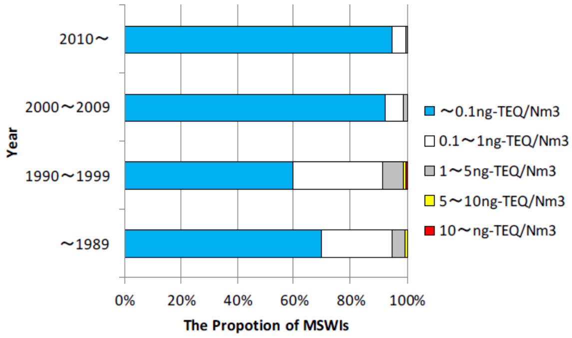


圖1 本都市廢棄物焚化爐戴奧辛排放濃度(依建造年度)

資料來源：Takaoka M, Matsuoka A, Koyama T, Masuda T, “Historical Trend Of Dioxin Emissions From Municipal Solid Waste Incinerators In Japan, Dioxin 2019

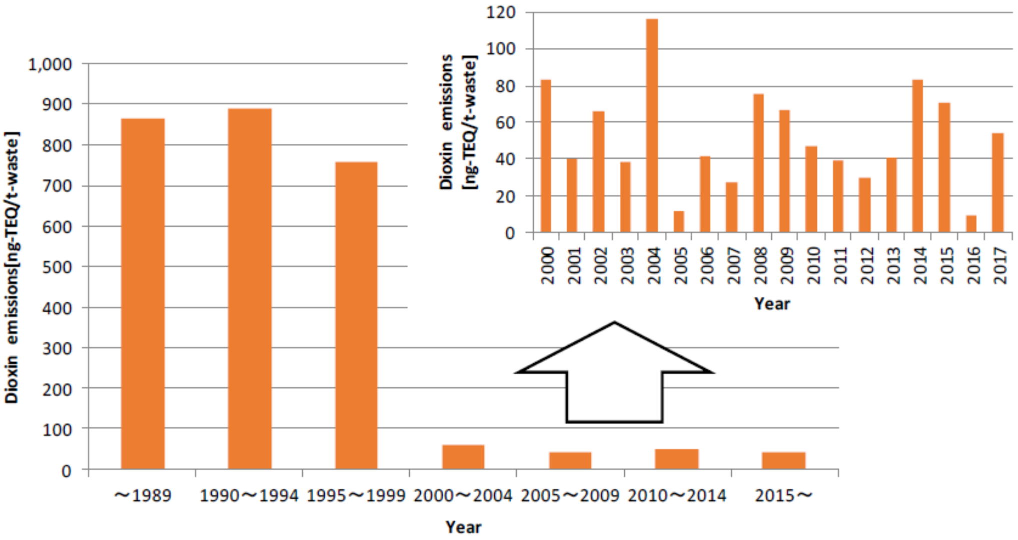


圖2 日本都市廢棄物焚化爐戴奧辛排放係數（依建造年度）

資料來源：Takaoka M, Matsuoka A, Koyama T, Masuda T, “Historical Trend Of Dioxin Emissions From Municipal Solid Waste Incinerators In Japan, Dioxin 2019

中國的實廠研究指出，使用濕式洗滌塔之都市廢棄物焚化爐可能在scrubber的填充材中提供了位址，讓戴奧辛吸附/逸出，因記憶效應使得後續的戴奧辛排放濃度上昇，甚至可達10倍（圖3），主要是增加低氯PCDD/F的比例。(資料來源：Ma Yf, Lin Xq, Li Xd, Yan Jh, “The Influence of PCDD/F

Memory Effect from Scrubbing System in Full-Scale Municipal Solid Waste Incineration”, Dioxin 2019）

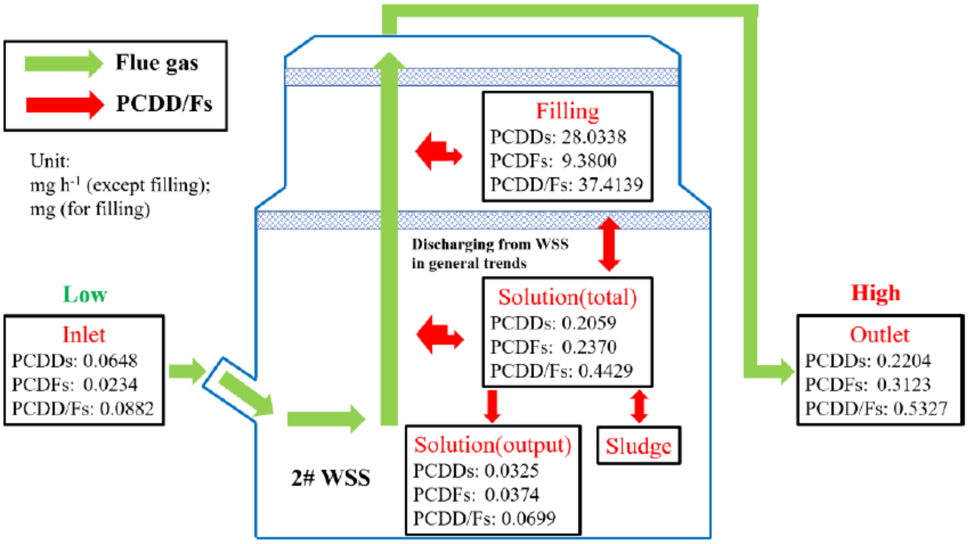


圖3　濕式洗滌塔之PCDD/F質量平衡

資料來源：Ma Yf, Lin Xq, Li Xd, Yan Jh, “The Influence of PCDD/F Memory Effect from Scrubbing System in Full-Scale Municipal Solid Waste Incineration”, Dioxin 2019

火力電廠在目前仍對世界的電力供應占舉足輕重的地位，其空氣污染防制設備是否有效控制污染物的排放，亦為許多研究的焦點。中國在兩座300 MW燃煤機組進行實廠檢測，煙氣經過脫硫設備，戴奥辛平均質量濃度從222.0 pg/m^{3}下降至78.6 pg/m^3、284.8 pg/m^{3}下降至124.9 pg/m^3，PCDD/Fs的去除率分別為35.4%和43.9%主要的戴奥辛物種為1234678-HpCDD，1234678-HpCDF，OCDD和OCDF，約占60%的煙道氣濃度。另一座600 MW機組引海水替代工業循環水，經過脫硫塔後，平均質量濃度從109.5 pg/m^{3}下降至6.6 pg/m^3，PCDD/Fs的去除率達94%。該研究指出，經過脫硫塔之

煙氣以PCDFs為是主要物種，而其中使用的循環水對戴奧辛的去除有關鍵作用，使用海水者去除效率較高。（資料來源：Wu Xiaolin, Liu Wenbin, “The Effect of Desulfurization on The Emissions of PCDD/Fs From Coal-Fired Power Plants”, Dioxin 2019）

另一個中國的研究在實驗室內模擬水泥窯處理掩埋場的廢棄物。由於原始城市固體廢棄物（OMSW）中的廚餘垃圾，植物和紙張等物質在長期垃圾掩埋後基本上分解為土壤，因此老化垃圾（CCAR）的性質基本穩定，且較OMSW具更高的熱值，再加上，許多掩埋場容量趨於飽和，如何有效地再利用CCAR，為值得研究課題。該研究利用水泥窯的較長停留時間、較高燃燒溫度和鹼性環境，處理CCAR並可抑制PCDD/Fs的形成，水泥窯燒成系統和廢氣處理系統具有高吸附、沉降和集塵特性，PCDD/Fs可固化在熟料中而不會引起再逸散，惟不宜大量協同處理CCAR，需由實廠測定決定最佳處理量。（資料來源：Zhan MX, Chen T, Gu HL, Wang JQ, Li XD, “Co-processing Aged Refuse In A Bench-Scale Simulated Cement Kiln Device”, Dioxin 2019）

除戴奧辛外，溴化戴奧辛、溴化呋喃和類戴奧辛多溴聯苯已被認為具有與其氯化相類似的毒性，因此，世界衛生組織和聯合國環境總署專家建議利用世衛組織毒性當量因子（TEF）對溴化戴奧辛類化合物進行人體健康風險評估。日本的研究指出，PBDD／DF可在回收電子家用電器工廠、

生產溴化阻燃劑、阻燃紡織品的作業環境空氣中被偵測到，甚至可能超過日本氯化戴奧辛標準（工作環境大氣：2.5 pg WHO-TEQ/m^3，廢水：10 pg WHO-TEQ /L）。（資料來源：Suzuki G, Michinaka C, Hashimoto S, Matsukami H, “Brominated Dioxins Emission From The E-Waste Recycling Facility In Japan”,　Dioxin 2019）

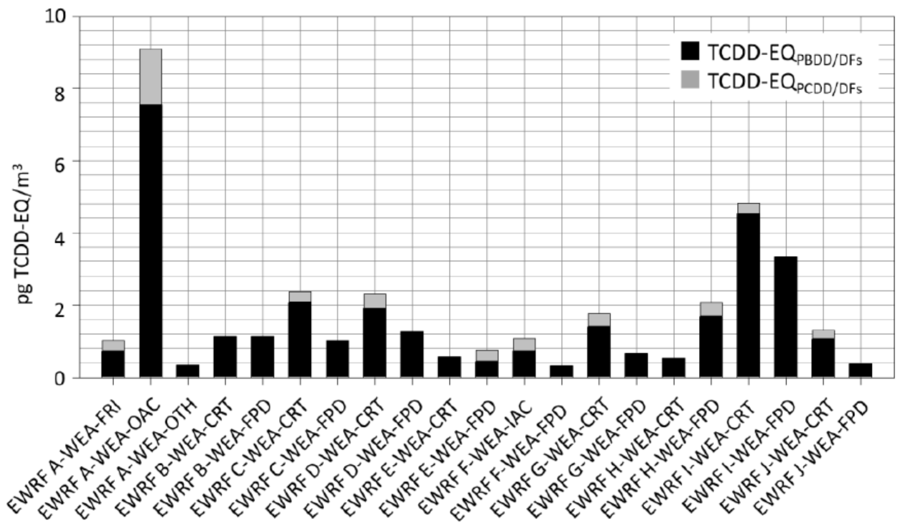


圖4　日本回收電子家用電器工廠作業環境空氣溴化戴奧辛濃度

資料來源：Suzuki G, Michinaka C, Hashimoto S, Matsukami H, “Brominated Dioxins Emission From The E-Waste Recycling Facility In Japan”,　Dioxin 2019

2.　宿命與傳輸

隨著現代生活中使用的化學物質的數量和數量的增加，人們越來越關注它們對人類健康和水生生物的不利影響。在日本，工業中使用的化學品都有相關紀錄，然家庭和企業中使用的化學品的排放並不為人所知。日本的研究，從日本各地都市廢水處理廠的流入和流出中測試了 1325 種化學物質，以便掌握日常生活中使用的化學品的排放。檢測結果看出，人造化

學物質約占 40%，其中的 PPCP (Pharmaceuticals and personal care products) 佔 25%，且人造化學品的去除率低：藥品為 87.1%，農藥為 68.6%，顯示需要研究這些物質對水生生物的影響。（資料來源：Kadokami K, Miyawaki T, Takagi S, Adachi F, Iida H, Watanabe K, Kosugi Y, Suzuki T, Iwabuchi K, Nagahora S, Tahara R, Orihara T , “Emissions of 1325 Chemicals From Municipal Wastewater Treatment Plants In Japan”, Dioxin 2019）

中國利用各國可用的戴奧辛排放清冊，以主成分分析分析與PCDD/Fs排放相關的人類社經活動因素，使用網格化人口密度建置全球網格化排放清單，再利用該排放清單進行多次北半球和南半球之間大氣傳輸的情景模擬。結果顯示，從2002年到2012年，全球大氣PCDD/Fs排放量下降，但亞洲，非洲和歐洲的PCDD/Fs排放量增加，其中中國是最大的排放國，2012年釋放了大約4.5公斤的TEQ PCDD/Fs。此外，發現PCDD/Fs在北半球和南半球之間幾乎不通過大氣傳輸進行交換，另透過將空氣，土壤，水中的模擬濃度與陸地和海洋食物網模型相結合，評估了人類暴露於全球肉類和魚類貿易中的PCDD/Fs，與大氣輸送和沈積相比，在南半球和北半球之間的食品貿易中發現了相當高的暴露風險，這表示食品貿易是北半球和南半球之間PCDD/Fs運輸的主要途徑，而不是大氣運輸。（資料來源：Kaijie Chen, Tao Huang, Hong Gao, Wanyanhan Jiang, Jianmin Ma, “Food trade is a major transport pathway of PCDD/Fs between the Southern and Northern Hemisphere” , Dioxin 2019）

環境中的PCDD/Fs具有高化學穩定性，長程運輸能力，在水中的低溶解度和易累積在食物鏈中的特性。它們可以從廢棄物焚化，有機氯化學生產，金屬冶煉，紙漿氯漂白和其他過程中釋放出來，這些不需要的戴奧辛以不同的方式進入環境。由於它們的半揮發性物理性質，它們在大氣中長距離遷移，另因為疏水性有機化合物，它們傾向於在土壤和沈積物中累積。中國北京生態環境研究中心環境化學與生態毒理學國家重點實驗室彙整各研究報告指出，2013年，中國經由各途徑排放的戴奧辛達9069 g-TEQ，包括4274 g-TEQ至大氣，84 g-TEQ到水，348 g-TEQ至各項產品，和4364 g-TEQ殘留。在各環境媒體中的PCDD/Fs濃度相對較低，但部分地區受到當地排放源的影響，例如廣東省清遠市和貴州市以及浙江省台州市大氣中的PCDD/Fs濃度相對較高（晉州約為10 pg-TEQ/m^3，我國夏季約為0.023 pg-TEQ/m^3、冬季約為0.055 pg-TEQ/m^3），海河流域、洞庭湖和雅爾湖的沉積物具有較高的PCDD/Fs濃度（附近有化學工廠）。海河流域大沽排水和南派吾河下游沉積物中PCDD/Fs濃度分別高達3,272 pg TEQ/g和22,000 pg TEQ/g。此外，洞庭湖的水污染程度高於其他水域。土壤中的PCDD/Fs污染僅限於少數特定區域，其中最高PCDD/Fs濃度為193 pg TEQ/g。(資料來源：Rongrong Lei, Wenbin Liu, “Levels And Profiles of Polychlorinated Dibenzo-P-Dioxin and Dibenzofuran in Different Environmental Media From China”, Dioxin 2019)

我國學者易於研討會中發表傳輸相關的研究成果，陽明大學於2014年在我國鹿林山及泰國Doi Ang Khang進行戴奧辛空氣品質監測，評估東南亞生物質燃燒對我國戴奧辛化合物大氣濃度變化影響，並應用PMF、PSCF和SRA模型，分析大氣中各PCDD/Fs的排放源的相對貢獻。2014年春季鹿林山測站TSP、$PM_{2.5}$和PCDD/F的監測濃度分別為12.1-65.9 μg/m^3、4.67-49.0 μg/m^3及0.92-15.7 fg I-TEQ/m^3；泰國Doi Ang Khang站TSP、$PM_{2.5}$和PCDD/F的監測濃度分別為76.7-414 μg/m^3、47.6-237 μg/m^3和3.78-28.0 fg I-TEQ/m^3。當生物質燃燒事件發生，TSP中的大氣PCDD/Fs主要為固相，相反地，$PM_{2.5}$中的PCDD/Fs主要為氣相，可能原因為排放源不同，且$PM_{2.5}$中的PCDD/PCDF比例高於TSP。由反軌跡尋找可能排放源，發現14.9%來自印度中部、34.5%來自東南亞沿海地區、50.6%來自孟加拉、華南和中南半島。

以PSCF值分析鹿林山的污染物來源，TSP中的PCDD/F之主要貢獻區域為華南和中南半島，但$PM_{2.5}$中的PCDD/F則是主要來自中國南方，中南半島和印度中部。(資料來源：Pan SY, Chen HW, Hsu SC , Chou CCK, Lin NH, Jin SY, Liu KW, Chi KH , “PCDD/F Measurement at High-Altitude Station in Eastern Asia: Evaluation of PCDD/Fs in TSP and $PM_{2.5}$ via Long-Range Transport and Source Apportionment During the Southeast Asia Biomass Burning Event in 2014”, Dioxin 2019)

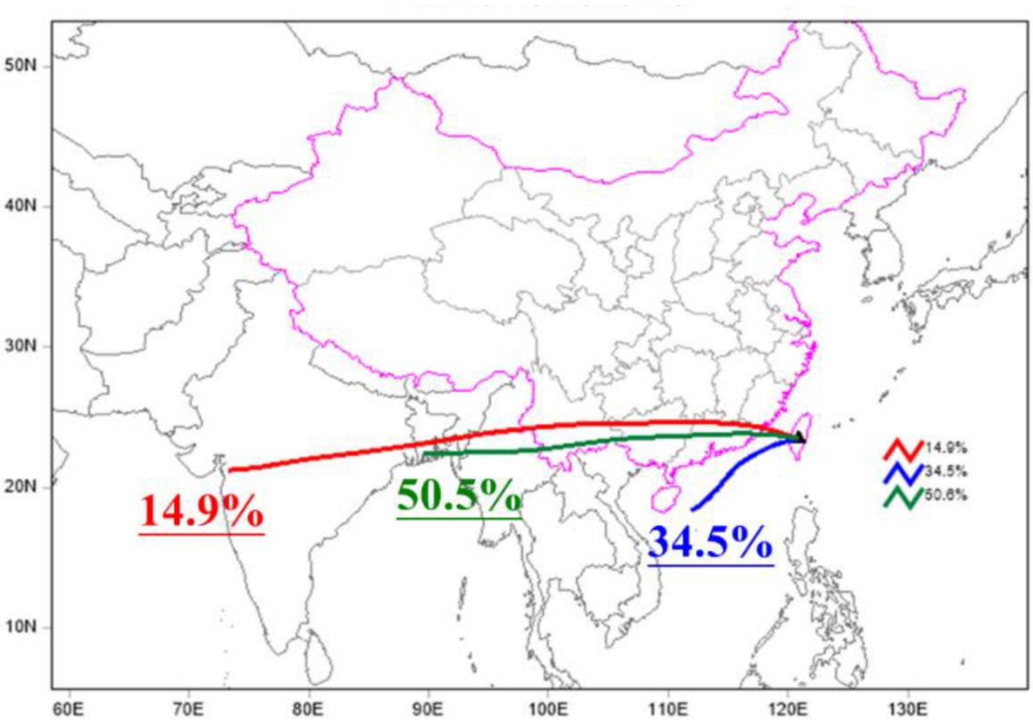


圖5　以反軌跡尋找鹿林山PCDD/Fs的主要來源

資料來源：Pan SY, Chen HW, Hsu SC , Chou CCK, Lin NH, Jin SY, Liu KW, Chi KH , “PCDD/F Measurement at High-Altitude Station in Eastern Asia: Evaluation of PCDD/Fs in TSP and PM2.5 via Long-Range Transport and Source Apportionment During the Southeast Asia Biomass Burning Event in 2014”, Dioxin 2019

3.　人體暴露

研究人體暴露主要分為兩個部分：外來劑量（模擬內在劑量）和內在劑量（直接量測），主要關注物質包含持久性化學物質之PPCPs、CPs、NBFRs、PFRs、Siloxanes、PFCs、PCDD/Fs、PCBs、dl-PCBs和OCPs及非持久性化學物質之Bisphenol A、Phthalates和Parabens。主要的研究介質為母血、母乳、血清、胎兒、尿液、飲用水及室內落塵等。

全氟烷基物質（PFAS）廣泛地使用在工業生產和商業消費品，但PFAS可能導致健康的不良影響。人類的主要暴露途徑是通過飲食，但室內空氣和灰塵以及飲用水亦為可能的來源。由於胎兒和幼兒的免疫系統暴露於污染物易受到影響，因此在子宮內和生命的最初幾年中接觸PFAS是

令人關注的問題。暴露評估一方面可以通過測量給定化學品的來源濃度與消耗量及暴露時間來進行。另一方面，暴露評估可對不同生物基質（如血清，尿液，毛髮或組織）中的化合物量測。芬蘭的研究，追蹤了相同的54個人超過10年，參與者包含1歲（2004/2005）、6歲和10.5歲。PFAS攝入量以模式估算，通過LC-MS/MS測量的PFAS血清濃度計算攝入量。結果顯示，PFAS攝入量在童年時期呈下降趨勢，在1歲、6歲和10.5歲時，全氟辛烷磺酸（PFOS）和全氟辛烷酸（PFOA）的中位攝入量為每週2.6、1.0和0.7 ng/kg bw和6.3、2.6和1.4 ng/kg bw，個體之PFAS攝入量在1歲時高於後期。歐洲食品安全局（EFSA）提出PFOS每週可接受攝入量（TWI）為13 ng/kg bw、PFOA為6 ng/kg bw，在研究對象中，1歲時只有一個人超過了PFOS的TWI，而超過50%的1歲兒童超過了PFOA的TWI，後續，由於生長稀釋和飲食從母乳改變為其他固體食物，兒童體內的PFAS逐漸下降。（資料來源：Koponen J, Karvonen AM, Pekkanen J, Kiviranta H , “Perfluoroalkyl Acid Intake During Childhood in Finland”, Dioxin 2019）

愛爾蘭研究經由呼吸、接觸室內落塵及飲用水之全氟烷基（PFAS）的人體暴露。以吸附劑（XAD-3）浸漬的PUF進行60天採樣，室內落塵則以真空吸塵來收集樣品，並收集初產婦的母乳樣品。結果在所有空氣和粉塵樣品中均檢測到PFAS，平均ΣPFAS濃度為290 pg/m^3(0.03 -2300 pg/m^3)和67 ng/g(0.4-4000 ng/g)。在空氣中，60%的樣品以PFOA為主，其濃度平均值為140 pg/m^3(<0.1 - 1200 pg/m^3)，其次21%的樣品以PFBS為主，濃度平均值為38 pg/m^3(<0.2 - 310 pg/m^3)和18%的樣品以PFOS為主，濃度平均值為73 pg/m^3(<0.2 - 1600 pg/m^3)。在粉塵中，68%的樣品中主要為PFBS，其濃度平

均為16 ng/g(<0.1 - 170 ng/g)，15%的樣品以PFOA為主，濃度平均值為27ng/g(<0.1 - 2700 ng/g)，8%樣品以PFOA為主，濃度平均值為8.1 ng/g(<0.05 - 380 ng/g)。在所有瓶裝水樣品和86%的自來水樣品中檢測到PFAS。瓶裝水樣品中的平均ΣPFAS濃度為16 ng/L(0.17 - 64 ng / L)，自來水中的平均ΣPFAS濃度顯著低於0.94ng/L(<0.5-16ng / L)。PFBS是瓶裝水中的主要物質，占平均ΣPFAS含量的75%，其次是全氟辛烷磺酸(12%)。 PFBS為自來水主要物質的比例較小(51%)，PFOA佔ΣPFAS的30%。這些數據與向低碳鏈PFAS的轉變一致。在母乳中，PFOA和PFOS的檢出率分別為100%和63%，算術平均濃度分別為0.13和0.038 ng/mL。 PFNA和PFHxS的檢出頻率分別為69%和31%，平均濃度分別為0.026和0.03 ng/mL。空氣，灰塵和水中的PFBS濃度升高未反映在母乳中。(資料來源：Harrad, S., Drage, D.S., Wemken, N., Abdallah, M., Coggins, M., “Concentrations of Perfluoroalkyl Substances in Drinking Water, Indoor Air, Dust and Human Milk in Ireland: Implications For Human Exposure”, Dioxin 2019)

3.3 參訪內容－大阪 PCB 廢棄物處理設施及舞洲焚化爐

大會於8/28下午安排自由參加的技術參訪行程，參觀的對象是大阪PCB廢棄物處理設施及舞洲焚化爐。

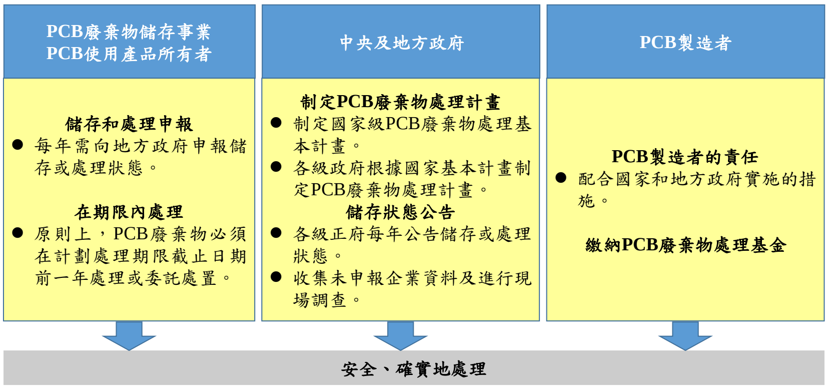
1. 大阪PCB廢棄物處理設施

多氯聯苯(PCB)具有絕緣和不易燃的特性，過去曾被廣泛應用，但在1968年發生Kanemi油症狀事件後，其毒性成為一個社會問題，日本政府在1972年起禁止PCB的生產。使用多氯聯苯的變壓器等產品在廢棄後多由使用的公司進行儲存，經過30多年是否會造成污染成了另一個需擔憂的問題。

歐美等國已意識到PCB到了環境中會長期存在，因此著手進行處理，禁止多氯聯苯生產、製造，日本則是在2001年建置的「PCB特別措置法」中規定要求：(1)存放PCB廢物的企業在一定時間內進行處理。(2)要求PCB廢物存儲企業每年報告其存儲狀態。(3)政府制定PCB廢物處理的基本計劃。(4)PCB製造商等配合國家和地方政府實施的措施（如繳納PCB廢物處理基金）。在頒布「PCB特別措置法」後，指定JEC開展多氯聯苯廢物處理方案，中間貯蔵・環境安全事業株式会社（Japan Environmental Storage & Safety Corporation, JESCO）於2004年4月接替JEC的任務，建設和運營五個區域設施，以處理全國的PCB廢物。由日本政府補助建立處理設施，PCB

廢物持有者則委託JESCO處理PCB廢物。中小型企業持有的高壓變壓器和電容器的部分費用由PCB廢物處理基金提供補貼。JESCO在北九州，豐田，東京工廠，大阪和北海道的五個區域PCB廢物處理設施已經完工並投入營運，每個設施都用於處理日本政府指定的區域的PCB廢物。日本並訂定目標於2028年以前將國內多氯聯苯廢棄物安全妥善處理完畢。

日本PCB處理架構如圖6，中央及地方政府制定相關法令，PCB廢棄物持有者需申報處理狀態，並在期限內處理，而PCB製造者則需繳納PCB廢棄物處理基金，由五個區域PCB廢物處理設施進行妥善的處理。



PCB廢棄物儲存事業
PCB使用產品所有者

儲存和處理申報
- 每年需向地方政府申報儲存或處理狀態。

在期限內處理
- 原則上，PCB廢棄物必須在計劃處理期限截止日期前一年處理或委託處置。

中央及地方政府

制定PCB廢棄物處理計畫
- 制定國家級PCB廢棄物處理基本計畫。
- 各級政府根據國家基本計畫制定PCB廢棄物處理計畫。

儲存狀態公告
- 各級正府每年公告儲存或處理狀態。
- 收集未申報企業資料及進行現場調查。

PCB製造者

PCB製造者的責任
- 配合國家和地方政府實施的措施。

繳納PCB廢棄物處理基金

安全、確實地處理

圖 6　日本含 PCB 廢棄物處理架構

日本主要含 PCB 的廢棄物包含高壓變壓器、高壓電容器及穩定劑(圖 7)，北九州、大阪、豐田、北海道等四個處理設施均以脫鹽素化分解方式、東京以水熱酸化分解方式處理高壓變壓器及高壓電容器，北九州及北海道的廢棄物處理設施另以溶融分解方式處理穩流器及其他污染物。

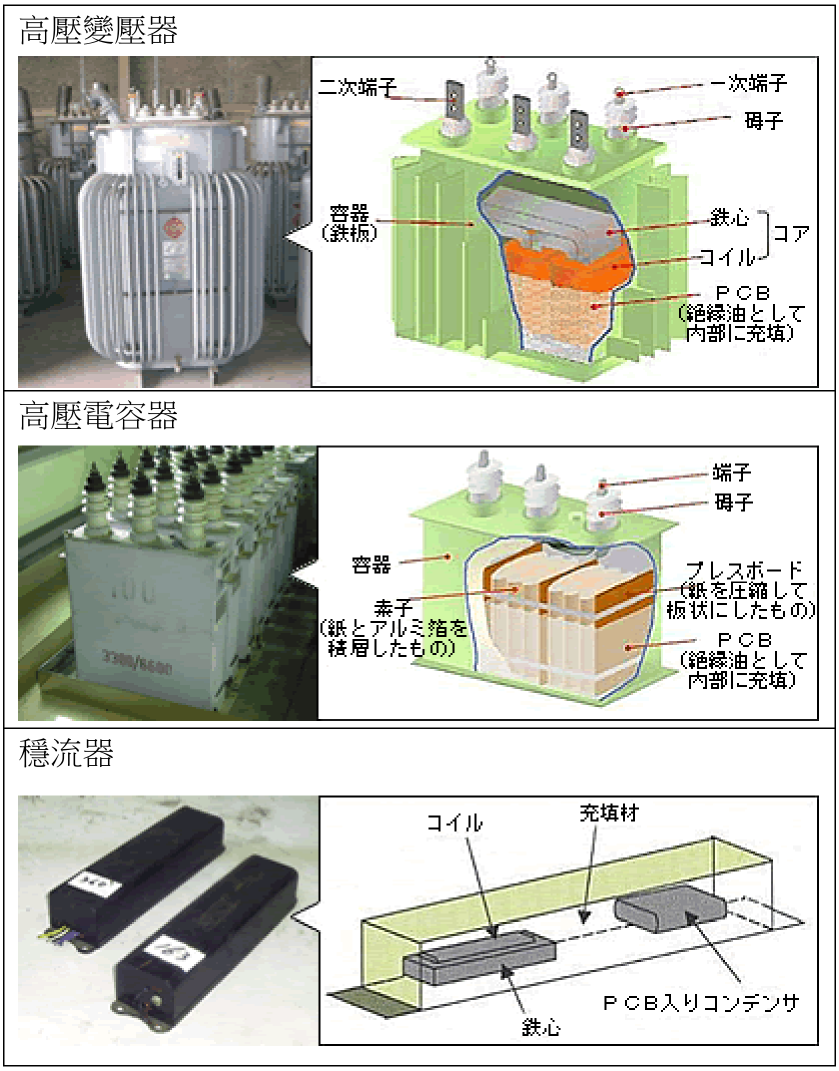


圖7　日本主要含PCB的廢棄物

本次研討會安排參訪的為大阪 PCB 廢棄物處理設施，大阪 PCB 廢物處理設施於 2005 年 1 月興建，是繼北九州，豐田和東京企業之後的第四個 PCB 處理設施，2006 年 10 月 3 日開始正式營運。

大阪 PCB 廢棄物處理設施的處理流程如圖 8，先以溶劑清洗或使用真空加熱分離將含 PCB 的變壓器、電容器中的含 PCB 油抽出，接著容器和 PCB

油分為兩部分處理，容器拆解，洗淨，最後分解為鐵、鋼、鋁等金屬及碳化物；PCB 則由觸媒輔助以脫鹽素化分解法分解 PCB，最後回收鹽酸、聯苯類及劣化觸媒。

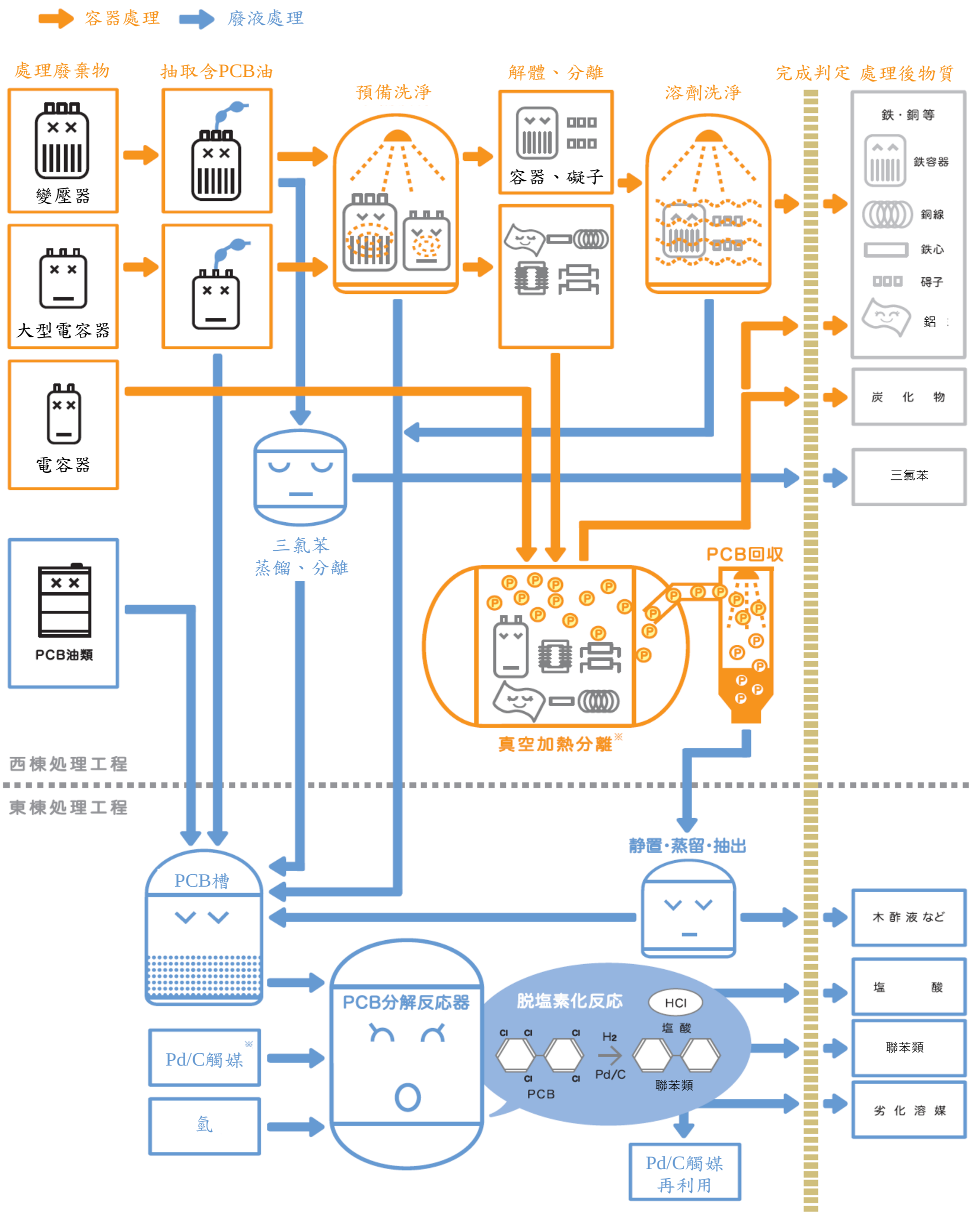


圖 8　日本大阪 PCB 處理廠處理流程

廢氣部分則在作業環境內採用負壓，避免洩漏，並設置PCB監測設備，隨時監控洩漏情形，以活性碳吸附方式處理廢氣後排放至大氣(圖9)。

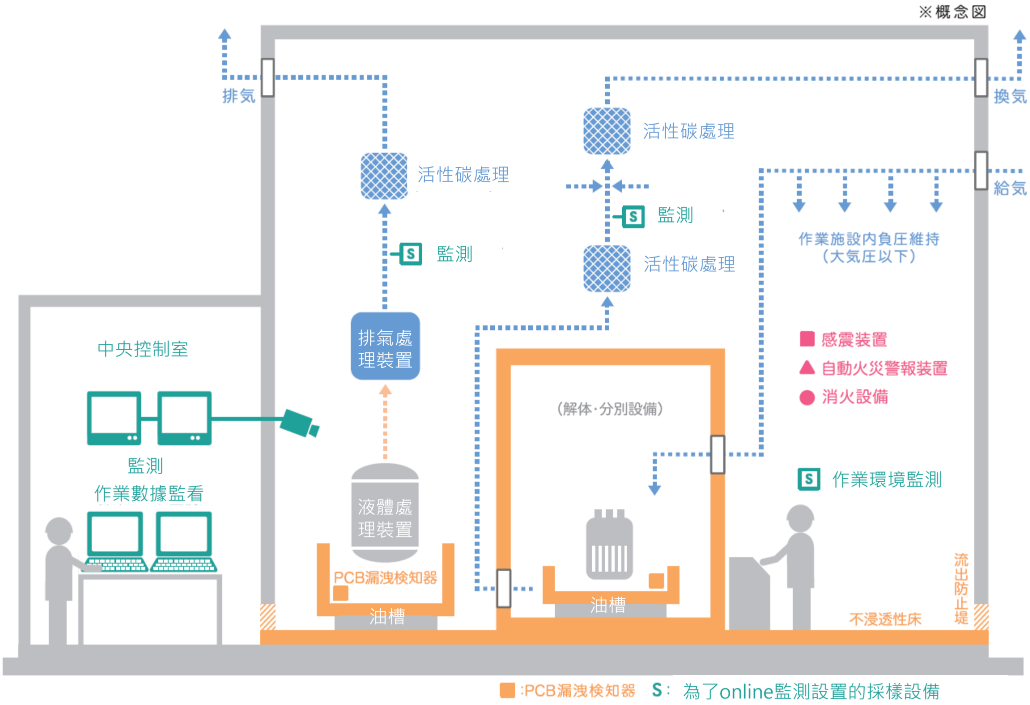


圖9　日本大阪PCB處理廠廢氣流程

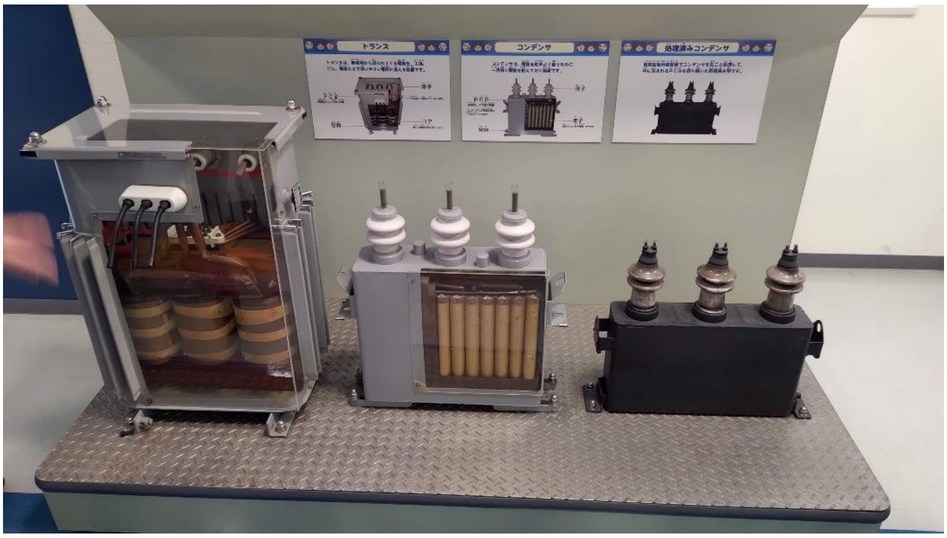
在處理 PCB 的過程中，廠方十分重視取得民眾的信任，非常歡迎民眾參觀，在廠內各單元亦設置處理流程說明和播放淺顯易懂的短片說明（圖 10），此外，處理前的電容器、變壓器和處理後的金屬等亦在廠內展示，以實物方式讓民眾了解工廠對含 PCB 廢棄物的處理成果（圖 11）。此外，亦在網站上亦公開各項監測資料，讓民眾認為處理工廠除了解決過去問題外，也不會製造新的問題。本次參訪照片如圖 12。

日本五座 PCB 廢棄物處理設施預計於 2024 至 2026 年陸續完成 PCB 處理任務後退役。

コンデンサや、PCBが浸み込んだ部材を入れ、炉内を減圧加熱し、PCBを蒸発させ、オイルシャワーで捕集します。回収したPCBは東棟へ送られ化学的に分解されます。

対象物は洗浄槽と判定洗浄槽で2段階に処理します。洗浄工程では、真空にしたタンクの中で3回洗浄し、PCBを洗い落とします。判定洗浄工程はPCBが洗い落とされていることを確認する工程で、その洗浄液にしみ出したPCBが決められた量以下になっていることをチェックします。このチェックは卒業判定と呼ばれ、東棟の分析室で行われます。

圖 10　日本大阪 PCB 處理廠各單元說明設備



(a) 處理前

(b)處理後

圖 11　日本大阪 PCB 處理廠的處理前及處理後物質

圖 12 大阪 PCB 場參訪照片

2. 舞洲焚化爐

另外一個參訪地點為舞洲焚化爐，該焚化爐於 2001 年開始營運，焚化處理量為 900 公噸/日（2 座 450 公噸焚化爐），另有一個可先行處理大型廢棄物的處理設備，處理量為 1700 公噸/日。廢氣處理設備為選擇性脫硝觸媒還原反應器

（SCR）、袋濾式集塵設備（BF）及濕式洗滌塔（Wet scrubber）。

舞洲焚化爐已運轉18年，其設備非為新穎的設備，但仍讓人眼睛為之一亮，因其外觀由維也納藝術家 Friedensreich Hundertwasser 設計，設計理念為成為技術，生態和藝術融合的象徵。由於自然界中沒有直線或相同的物體，因此各種地方的形狀都有意識地採用曲線，建築周圍有許多綠色作為與自然和諧相處的象徵。煙囪及建築物牆上的紅色和黃色條紋代表工廠內燃燒的火焰。活潑亮麗的外觀讓人有到了遊樂園的錯覺（圖 13）。

與大阪 PCB 處理設施一樣，舞洲焚化爐非常歡迎民眾參觀，尤其是小朋友，廠內介紹設施儘量設計得淺顯易懂，也吸引小朋友，例如將舞洲焚化爐的吉祥物 POM 和 Magic＆Mitta 先生的三人漫畫用 3D 圖像以易於理解的方式解釋焚燒爐的內部結構，附近小學生每年都會來到這小外參觀。可供參觀人員操作的抓斗模型則可看到大型廢棄物如何被碾碎，並以磁鐵吸附鐵、將鋁吹走，其他可燃物分佈到中間區域等，實際地了解廢棄物如何分選。此外，設置腳踏設備連動發電設施，讓參觀人員可實際體驗如何發電。

在參訪時印象最深刻的是味道，舞洲焚化爐廠區內聞不到異味，顯示此焚化爐的操作維護上相當良好。參訪照片如圖 14。

圖 13 日本大阪舞洲焚化爐外觀

圖 14 大阪舞州焚化廠参觀照片

第 4 章　心得及建議

這次研討會國外學者演講內容及各國學者發表論文內容，除傳統的戴奧辛外，其他新興污染物（PFOS、PHAs 等）之研究也不在少數，顯示各國針對這些新興污染物愈來愈關注，我國推動固定污染源戴奧辛管制工作已行之有年，已將所有固定污染源排放戴奧辛均納入管制，戴奧辛管制工作與其他國家相比，屬腳步快速且較嚴格，惟對於其他 POPs 物種亦應逐漸進行研究，作為管制的參考，另參考本次研討會在持久性有機物的討論，目前亦非僅限於排放至大氣，排放至水體、土壤、後續影響動植物，甚至經過長程傳輸影響至南、北極等，顯示目前大家關注的是持久性有機物全生命周期的影響，結合不同介質領域來管控持久性有機物對環境的影響，建議後續相關政策以持久性有機物整體生命週期作為考量依據，俾與國際接軌。

另現行戴奧辛空氣污染物排放管制方式以排放標準及持續進行環境空氣監測為主，主要排放源在於焚化處理、金屬冶煉、露天燃燒等，涉及各種污染行為、原（物）料、燃料使用、移動源管理等減量策略，本次研討會對於人體暴露的報告，均指出人體暴露到戴奧辛或類戴奧辛物質的途徑相當多元，包括從食物、空氣、土壤及水，建議應持續與各相關部會的單位共同討論、分工，俾利使管制面向更全面，更有效降低戴奧辛污染。

附錄

Monday August 26

MONDAY AT A GLANCE					
10:15	**Room A**				
	Attraction				
10:30	**Room A**				
	Opening Ceremony				
11:15	**Room A**				
	Plenary Lecture 1 - Dr. David Sherr				
12:00	Lunch				
13:00	**Annex Hall 2**				
13:50	**Poster Session 1**				
14:00	**Room A**	**Room B-1**	**Room B-2**	**Room C-1**	**Room C-2**
	Analysis 1	Asian POPs Monitoring 1	Flame Retardants	Risk Assessment	Human Exposure 1
16:00	Coffee Break				
16:30	**Room A**	**Room B-1**	**Room B-2**	**Room C-1**	**Room C-2**
18:30	Analysis 2	Asian POPs Monitoring 2	The Biotic Exposome of Emerging Flame Retardants in the Global Environment	Metabolism and Toxicology	Human Exposure 2
19:00	**Grand Prince Hotel**				
21:00	Welcome Reception (for free)				

MONDAY

11:15~12:00 *Room A*

Plenary Lecture 1

The AhR: A Major Player in Cancer Aggression and Immune Checkpoint Regulation
Dr. David Sherr, Boston University School of Public Health

12:00~13:00 ***Lunch***
13:00~13:50 ***Poster Session 1***

14:00~16:00 *Room A*

Analysis 1

Chairs: Gary Hunt, Shunji Hashimoto

14:00
Separation of PCB atropisomer and promotion of joint research
Takeshi Nakano
1A-PM1-01

14:20
Ammoniated MOF-74(Zn) derivatives as luminescent sensor for highly selective detection of tetrabromobisphenol A
Xiaolei Zhang, Sumei Li, Sha Chen, Fan Feng
1A-PM1-02

14:40
Optimization of a QUECHERS method for The GC/MS quantification of selected persistent organic pollutants in samples of Green sea turtles from United Arab Emirates
Fatin Samara, Isra Arshad Alam
1A-PM1-03

15:00
A seven consecutive year of intercalibration exercises on organochlorine compounds in China: Results on PCDD/Fs in the various environmental samples
Li Qi, Ting Zhang, Sen Zheng, Xi Yang, Yue Ren, Aimin Liu, Yeru Huang
1A-PM1-04

15:20
UN Environment Bi-ennial Global Interlaboratory Assessment on Persistent Organic Pollutants - Fourth round 2018/2019, non-dioxin-like POPs
ike van der Veen, Heidelore Fiedler, Jacob de Boer
1A-PM1-05

15:40
A global virtual laboratory for food control and incident response
Martin Rose, Sean Panton, Susan MacDonald, Yongning Wu, Lyu Bing, Jingguang Li
1A-PM1-06

16:00~16:30 ***Coffee Break***

14:00~14:20 *Room B-1*

Asian POPs Monitoring 1 Opening Session

Moderator: Mario Tabucanon

14:00

Opening remarks

Hiroaki Takiguchi

14:05

Opening special remarks

Atsuro Ueyanagi

14:10

Overview of the UNU-IAS Shimadzu Collaboration Project

Masatoshi Morita

14:20~15:00 *Room B-1*

Asian POPs Monitoring 1 Session 1: Achievements of the POPs Monitoring and Management Project in Asia

Chair: Teruyoshi Hayamizu

14:20

Science-policy interface for implementing the 2030 agenda for sustainable development and related international sustainability processes

Mario Tabucanon

1B1-PM1-01

14:30

Contribution of UNU-IAS project towards sound chemical management in East Asia - Stockholm Convention as a case study -

Yasuyuki Shibata

1B1-PM1-02

14:40

Analytical methods for monitoring POPs and quality assurance/quality control

Atsuro Ueyanagi

1B1-PM1-03

14:50 Q & A

15:00~16:00

Room B-1

Asian POPs Monitoring 1 Session 2: Perfluorinated Compounds Monitoring and Management in Asia (Outcomes of Phase VII)

Chair: Hiroaki Takiguchi

The result of monitoring and its considerations

15:00

Perfluorinated compounds in a coastal industrial area of China

Jing Guo, Jinlin Liu, Liang Dong, Chaofei Zhu, Yeru Huang

1B1-PM1-04

15:10

Perfluorinated compounds (PFCs) in Indian environment

Babu Rajendran Ramaswamy

1B1-PM1-05

15:20

The dynamics of perfluorinated compounds in water, sediment and fish of Rawa Pening Lake, Indonesia

Sri Juari Santosa, Pratyangga Surya Dyaninggar, Muhamad Ihsanuddin, Rosalind Rose Salindeho

1B1-PM1-06

15:30

Distribution of perfluoroalkyl substances (PFASs) concentration in four major river and nearby coastal areas in Korea

Hyeonseo Cho, Hung Duc Mai, Lam Hoang Nguyen

1B1-PM1-07

15:40

Distribution of perfluorinated compounds in water, sediment and biota in Langat River water, Malaysia

Didi Erwandi Mohamad Haron, Mohd Redzuan Ramli, Emmy Dayana Ahmad, Mustafa Ali Mohd, Minoru Yoneda

1B1-PM1-08

15:50 Q & A

16:00~16:30 ***Coffee Break***

14:00~16:00 *Room B-2*

Flame Retardants

Chairs: Souichi Ohta, Natsuko Kajiwara

14:00

CHEMSTRRES - A Sino-Swedish project with focus on environmental exposures and effects of pollutants in the Yangtze River Delta area

Ake Bergman, Lillemor Asplund, Anders Bignert, Magnus Breitholz, Mafalda Castro, Elena Gorokhova, Qinghui Huang, Yanling Qiu, Xiang-Zhou Meng, Daqiang Yin, Jianfu Zhao, Zhiliang Zhu

1B2-PM1-01

14:20

Development and evaluation of GC-MS, GC-ICP-MS and HPLC-ICP-MS for determination of decabromodiphenyl ether in sediments

Shanjun Song, Yan Gao, Mingwu Shao, Weihua Wang

1B2-PM1-02

14:40

Partial mineralization of chlorine- and bromine based flame-retardant during combustion

Shodai Taguchi, Seikou Tou, Nobuhisa Watanabe

1B2-PM1-03

15:00

Emission status of flame retardants in indoor air and water effluent from e-waste recycling facility in Japan

Hidenori Matsukami, Shunji Hashimoto, Go Suzuki

1B2-PM1-04

15:20

Occurrence of polybrominated dibenzo-p-dioxins and dibenzofurans (PBDD/Fs) in consumer products from recycled plastics

Jindrich Petrlik, Sam Adu-Kumi, Lee Bell, Peter A. Behnisch, Jitka Straková, Leslie Adogame, Olga Speranskaya, Jana Pulkrabová, Tomáš Gramblička

1B2-PM1-05

15:40

Rapid identification method of plastic components flame-retarded by decabromodiphenyl ether

Natsuko Kajiwara, Hidenori Matsukami

1B2-PM1-06

16:00~16:30 ***Coffee Break***

14:00~16:00 *Room C-1*

Risk Assessment

Chairs: Derek Muir, Thomas Webster

14:00

An ultra-high performance liquid chromatographic tandem mass spectrometric method for the determination of per- and polyfluoroalkyl compounds in infant formula and dairy products

Ovokeroye Akpojevwe Abafe, Linda Macheka-Tendenguwo

1C1-PM1-01

14:20

Comparison of PPCPs occurrence and human health risk in drinking water between the urban and rural area or different seasons-a case study of China

Xinshu Jiang, Jun Huang, Yingxi Qu

1C1-PM1-02

14:40

Per-and polyfluorinated substances (PFASs) in the follicular fluid of Australian women and different concentrations with infertility etiology (reproductive health) in Queensland Australia

Young Ran Kim, Nicole White, Soumini Vijayasarathy, Jennifer Braeunig, Christine Knox, Fiona Anne Harden, Rosana E. Pacella, Leisa Maree L. Toms

1C1-PM1-03

15:00

Toxicity thresholds for PPCPs, PFCs and pesticides via species sensitivity distributions

Wenxing Zhao, Gang Yu, Bin Wang

1C1-PM1-04

15:20

The effect of three types of water accommodated fraction on mortality, fecundity and lipid distribution in the copepod *Acartia tonsa*

Tamer Amr Hafez, Maren Ortiz Zarragoitia, Robert Duran

1C1-PM1-05

15:40

Screening for persistent and bioaccumulative chemicals of global concern with a focus on Asian industrial chemical inventories

Xianming Zhang, Derek Muir, Xiangfei Sun, Ruifen Jiang, Eddy Zeng

1C1-PM1-06

16:00~16:30 ***Coffee Break***

14:00~16:00 *Room C-2*

Human Exposure 1

Chairs: Chisato Mori, TBA

14:00

Total dioxin toxic equivalency and sex are associated with biomarkers of hepatic lipid metabolism, inflammation, fibrosis, and function in a subset of ACHS-II participants

Banrida Wahlang, Christina M Pinkston, Shesh N Rai, Marian Pavuk, Matthew C Cave, Linda S Birnbaum

1C2-PM1-01

14:20

Atmospheric PCDD/Fs, $PM_{2.5}$ and their health effect in Taiwan

Tuan-Hung Ngo, Wei-Ting Hsu, Yi-Na Lee, Yu-Hsuan Yang, Pei-Chun Tsai, Yune-Fang Ueng, Siao Yi Jin, Kuang-Wei Liu, Kai-Hsien Chi

1C2-PM1-02

14:40

Polychlorinated dioxins, furans (PCDD/Fs) and dioxin-like polychlorinated biphenyls (dl-PCBs) in maternal blood and breast milk from mothers living in Beijing, China

Yan Bao, Lei Zhang, Xin Liu, Lei Shi, Jingguang Li, Yunfeng Zhao, Yongning Wu

1C2-PM1-03

15:00

Congenital permanent teeth deficiency in children of the second and third generations of Kanemi Yusho patients

Yasuichi Miyakawa, Yoshiyuki Hashizume, Tadashi Fujino

1C2-PM1-04

15:20

A case report of second and third generations of a Yusho family

Reiko Takeda

1C2-PM1-05

15:40

In silico prediction of the metabolism of PCB congeners by cytochrome P450 isozymes in Yusho patients

Shusaku Hirakawa, Takashi Miyawaki, Tsuguhide Hori, Jumboku Kajiwara, Susumu Katsuki, Masashi Hirano, Yuka Yoshinouchi, Hisato Iwata, Chikage Mitoma, Masutaka Furue

1C2-PM1-06

16:00~16:30 Coffee Break

16:30~18:30 *Room A*

Analysis 2

Chairs: Jean-Francois Focant,
Hidenori Matsukami

16:30

Occurrence of newly identified chemicals in indoor dust from Belgian homes

Christina Christia, Giulia Poma, Adrian Covaci

1A-PM2-01

16:50

Nanocarbon-based mass spectrometry probes for high-throughput screening of trace environmental organic pollutants

Qian Liu, Xiu Huang, Kang Yuan, Jing Wang, Guibin Jiang

1A-PM2-02

17:10

Non target screening of halogenated substances in marine mammals stranded on French coasts based on LC-HRMS and HaloSeeker 1.0 software

Ronan CARIOU, Sébastien HUTINET, Yann GUITTON, Paula FERNANDEZ MENDEZ, Gaud DERVILLY-PINEL, Jérôme SPITZ, Florence CAURANT, Bruno LE BIZEC

1A-PM2-03

17:30

Suspect and non-target screening of halogenated compounds in Baltic Sea sediment and macroalgae

Peter S Haglund, Sofie Bjorklund

1A-PM2-04

17:50

Gas chromatography - atmospheric pressure photoionization - high resolution mass spectrometry for the determination of PCDD/Fs in environmental and food samples

Juan F. Ayala-Cabrera, Manuela Ábalos, Esteban Abad, Encarnación Moyano, F. Javier Santos

1A-PM2-05

18:10

Confirmatory measurement of PCDD/Fs and (n) dl-PCBs in food/feed using a new short collision cell triple quadrupole GC-MS/MS system

FA Franchina, E Lazzari, G Scholl, JF Focant

1A-PM2-06

09:30~17:30	***Exhibition***
19:00~21:00	***Welcome Reception (for free)***

16:30~17:30 *Room B-1*

Asian POPs Monitoring 2 Session 2: Perfluorinated Compounds Monitoring and Management in Asia (cont' d)

Chair: Hiroaki Takiguchi

16:30

Spatial and temporal distribution of perfluorinated compounds in major rivers of Pakistan

Hifza Johar, Saiqa Imran, Mufeezah Ahsan

1B1-PM2-01

16:40

Perfluorinated compounds in the Philippine environment focusing on Manila Bay and Laguna Lake

Charita S. Kwan, Kristine O. Manalang,
Jannelle O. Cristobal, Vergel G. Valenzuela

1B1-PM2-02

16:50

Monitoring of perfluorinated compounds in Singapore waters and sediments - a three-year summary report

Sze Chieh Tan, Wan Ling Cheng, Suresh Krishnasamy,
Muhammad Shabhaz Iftikharezaman,
Tuty Norashikin Suhaiemi, Hian Kee Lee

1B1-PM2-03

17:00

Concentration of perfluorinated compounds (PFCs) in environment, Thailand

Ruchaya - Boonyatumanond,
Methawaj - Rungsiriworapong, Sunitra - Thongklieng,
Ketwadee - Hengcharoungsuk, Nuchjarin - Laoleam

1B1-PM2-04

17:10

Contamination by perfluorinated compounds in selected environmental media originated from anthropogenic activities in Northern Vietnam

Viet Hung Pham, Anh Hong Duong, Tuyen Huu Le,
Quang Dinh Phan, Vi Thi Phung, Kim Thi Truong,
Quynh Thi Nguyen, Lan Anh Thi Phan,
Ngoc Thuy Nguyen

1B1-PM2-05

17:20 Q & A

17:30~18:25 *Room B-1*

Asian POPs Monitoring 2 Session 2: Perfluorinated Compounds Monitoring and Management in Asia (cont' d)

Chair: Hiroaki Takiguchi

17:30
Overall analysis of PFC monitoring in Asia (UNU project Phase VII)

Teruyoshi HAYAMIZU, Hiroaki Takiguchi,
Yasuyuki Shibata, Masatoshi Morita

1B1-PM2-06

17:40
Comments from advisers

Masatoshi Morita, Yasuyuki Shibata

17:50 Q&A and Discussion

18:25~18:30 *Room B-1*

Closing Session

18:25
Closing Remarks

Hiroaki Takiguchi

09:30~17:30 ***Exhibition***
19:00~21:00 ***Welcome Reception (for free)***

16:30~18:30 *Room B-2*

The Biotic Exposome of Emerging Flame Retardants in the Global Environment

Chairs: Stuart Harrad, Robert Letcher

16:30

Nationwide monitoring of brominated flame retardants in soil collected from South Korea

Jin-Woo Jeon, Ho-Joong Kim, Chang-Ho Lee, Seung-Man Hwang, Sung-Deuk Choi

1B2-PM2-01

16:50

Legacy and novel halogenated flame retardants in seawater and atmosphere of the Bohai Sea: Spatial trends, seasonal variations and influencing factors

Lin Liu, Jianhui Tang, Xinming Wang, xiaomei Zhen

1B2-PM2-02

17:10

Distribution characteristic and source allocation of halogenated flame retardants (HFRs) in the Yellow Sea and East China Sea

Yanan Li, Jianhui Tang

1B2-PM2-03

17:30

Suspect screening and profile analysis of stormwater runoff following 2017 wildfires in Northern California

Miaomiao Wang, Juliet Kinyua, Ting Jiang, Rebecca Sutton, Meg Sedlak, Richard Fadness, June-Soo Park

1B2-PM2-04

17:50

Contamination levels of PCBs and PBDEs in fresh water fish from Chennai and Bangalore cities in India and their toxicological risk

Vimalkumar Krishnamoorthi, Tue Minh Nguyen, Shinsuke Tanabe, Tatsuya Kunisue

1B2-PM2-05

18:10

Polybrominated diphenylethers in birds foraging at a landfill site in Pretoria, South Africa

Chino Emereole, Ray Jansen, Okechukwu Jonathan Okonkwo

1B2-PM2-06

09:30~17:30	***Exhibition***
19:00~21:00	***Welcome Reception (for free)***

16:30~18:30 *Room C-1*

Metabolism and Toxicology

Chairs: Jae-Ho Yang, Hideyuki Inui

16:30

Effects of prenatal exposure to bisphenol A in rat offspring: assessment by multi-omics analyses

Hoa Thanh Nguyen, Kimika Yamamoto, Midori Iida, Tetsuro Agusa, Mari Ochiai, Lingyun Li, Akifumi Eguchi, Kurunthachalam Kannan, Eun-Young Kim, Hisato Iwata

1C1-PM2-01

16:50

A new approach to screen for endocrine disrupting properties of perfluoroalkyl substances (PFASs) in humans

Lars Lind, Samira Salihovic, Anders Larsson, Monica Lind

1C1-PM2-02

17:10

Endocrine and metabolic disrupting effects of bisphenol A and its substitutes

Yuan Kong, Meirong Zhao, Siqing Yue

1C1-PM2-03

17:30

The transactivation activity of common polyphenols on both rat and human aryl hydrocarbon receptors (AhR) in the presence and absence of AhR endogenous (FICZ) and xenobiotic (TCDD) ligands

Que Thi Doan, Marc Muller, Lisa Connolly, Marie-Louise Scippo

1C1-PM2-04

17:50

TCDD decreases glycolysis to promote SIRT1-dependent keratinocyte differentiation

Carrie H Sutter, Kris M Olesen, Jyoti Bhuju, Xibiao Guo, Thomas Robert Sutter

1C1-PM2-05

18:10

Nutritional modulation of environmental toxicity and implications in inflammatory diseases

Bernhard Hennig, Pan Deng, Jessie Hoffman, Michael Petriello

1C1-PM2-06

09:30~17:30	***Exhibition***
19:00~21:00	***Welcome Reception (for free)***

16:30~18:30 *Room C-2*

Human Exposure 2

Chairs: Karl Schramm, Kouji Harada

16:30

Polychlorinated naphthalenes in human serum samples from an industrial city in Eastern China: Levels, sources, and sex differences

Jicheng Hu, Jingxi Jin, Shijie Wang, Jun Jin

1C2-PM2-01

16:50

The concentration ratio and chiral properties in the human transplacental transfer for legacy organochlorine pesticides

Shanshan Yin, Jianyun Zhang, Fangjie Guo, Giulia Poma, Adrian Covaci, Weiping Liu

1C2-PM2-02

17:10

Exposure of third trimester human fetuses to persistent environmental chemicals

Richelle Duque Bjorvang, Linn Salto Mamsen, Daniel Mucs, Marie-Therese Vinnars, Nikos Papadogiannakis, Hannu Kiviranta, Panu Rantakokko, Päivi Ruokojärvi, Christian H Lindh, Claus Yding Andersen, Pauliina Damdimopoulou

1C2-PM2-03

17:30

Placentome exposomics targets origin to onset of disease

Meri De Angelis, Zhong Min Li, Jan Pauluschke-Froehlich, Andreas Fritsche, Bernhard Michalke, Barbara Benker, Qibei Bao, Bernhard Henkelmann, Heqing Shen, Karl Werner Schramm

1C2-PM2-04

17:50

Associations between human milk levels of organochlorine pesticides and cord blood thyroid hormones and the infants' neurodevelopment

WEI-JUNG TSENG, How-Ran Chao, Cheng-Chih Kao, Cheng-Hsien Tsai, Yi-Ming Kuo, Men-Wen Chen

1C2-PM2-05

18:10

Pesticide metabolite concentrations in Queensland pre-schoolers - Trends and sources

Yan Li, Xianyu Wang, Leisa-Maree Toms, Chang He, Peter Hobson, Peter Sly, Lesa Aylward, Jochen Mueller

1C2-PM2-06

09:30~17:30	***Exhibition***
19:00~21:00	***Welcome Reception (for free)***

Dioxin 2019 Program

Tuesday August 27

TUESDAY AT A GLANCE

08:30	**Room A**				
	Plenary Lecture 2 - Prof. Hideshige Takada				
09:15	Coffee Break				
10:00	**Room A**	**Room B-1**	**Room B-2**	**Room C-1**	**Room C-2**
12:00	Toxicity and Risks of Chlorinated Paraffins	Microplastics as Environmental Vectors for POPs and Additives	Fate and Transport 1	Advancements in Analytical Methodologies and Applications (Vendor Session)	Human Exposure 3
12:10	**Room A**	**Room B-1**	**Room B-2**	**Room C-1**	**Room C-2**
	Lunch		Dolce Sponsored by Waters Corporation	Dolce Sponsored by MIURA CO., LTD.	Dolce Sponsored by Thermo Fisher SCIENTIFIC
13:00	**Annex Hall 2**				
13:50	**Poster Session 2**				
14:00	**Room A**	**Room B-1**	**Room B-2**	**Room C-1**	**Room C-2**
	Chlorinated Paraffins in Food	Levels and Trends (Abiotic 1)	Legacy and Emerging Flame Retardants: Biotransformation and Bioavailability	Fate and Transport 2	POPs in the Developing World 1
16:00	Coffee Break				
16:30	**Room A**	**Room B-1**	**Room B-2**	**Room C-1**	**Room C-2**
18:30	Analysis of Chlorinated Paraffins	Formation, Sources and Control: Alfons Buekens Memorial Session	Flame Retardants in Human Tissues; Implications for Human Exposure	Levels and Trends (Biota 1)	POPs in the Developing World 2

08:30~09:15 *Room A*

Plenary Lecture 2

Hazardous chemicals in marine plastics and their threat to marine organisms
Prof. Hideshige Takada, Tokyo University of Agriculture and Technology

09:15~10:00 ***Coffee Break***

10:00~12:00 *Room A*

Toxicity and Risks of Chlorinated Paraffins

Chairs: Ake Bergman, Per Ola Darnerud

10:00
Chlorinated paraffin toxicity - early findings revisited
Per Ola Darnerud
2A-AM-01

10:20
In vitro biotransformation and identification of potential transformation products of chlorinated paraffins
Chang He, Louise van Mourik, Shaoyu Tang, Phong Thai, Xianyu Wang, Pim E.G. Leonards, Kevin Thomas, Jochen Mueller
2A-AM-02

10:40
Study on the mechanism of human dermal absorption of chlorinated paraffins, the bioavailability and exposure assessment
Wei Gao, Yawei Wang
2A-AM-03

11:00
Life history traits and lipid profile changes in *Daphnia magna* exposed to chlorinated paraffins
Mafalda Castro, Elena Gorokhova, Sandra Luecke-Johansson, Anna Sobek, Magnus Breitholtz
2A-AM-04

11:20
Transfer of ingested short-, medium-, and long-chain chlorinated paraffins to eggs in laying hens (*Gallus gallus domesticus*)
Marie Meziere, Ronan Cariou, Philippe Marchand, Elisabeth Baeza-campone, Céleste Le Bourhis, Gaud Dervilly-Pinel, Bruno Le Bizec
2A-AM-05

11:40
EFSA's risk assessment on chlorinated paraffins in food and feed
Luisa R. Bordajandi, Elsa Nielsen
2A-AM-06

12:10~13:00 ***Lunch***
13:00~13:50 ***Poster Session 2***

10:00~12:00 *Room B-1*

Microplastics as Environmental Vectors for POPs and Additives

Chairs: Dorte Herzke, Hideshige Takada

10:00

Contamination, persistence, and bioaccumulations of microplastics in the pearl river catchment, China

Xianzhi Peng, Yujuan Fan, Ke Zheng, Zewen Zhu, Guangshi Chen

2B1-AM-01

10:20

Persistent organic pollutants sorbed in plastic resin pellet from coastal areas of Central Chile

Karla POZO, Williams Urbina, Victoria Gomez, Mariett Torres, Dariela Nuñez, Petra Pribylova, Bradley Clarke, Andrés Arias, Norma Tombesi, Yago Guida, Jana Klanova

2B1-AM-02

10:40

PCBs and PBDEs in buoyant microplastic particles and zooplankton on open surface water along the Coast of Japan

Bee Geok Yeo, Hideshige Takada, Rei Yamashita, Yohei Okazaki, Keiichi Uchida, Tadashi Tokai, Kosuke Tanaka, Nicole Trenholm

2B1-AM-03

11:00

Determination of temporal changes of POP sorption and plastic additive release as well as spectrometric characteristics to a variety of polymers under Arctic marine conditions

Dorte Herzke, Unni Nordang, Linda Hanssen, Andy Booth, Geir Wing Gabrielsen

2B1-AM-04

11:20

Non-target screening with GC-Orbitrap reveals massive presence of petroleum hydrocarbons as well as chloro- and bromoalkanes in a specimen of marine plastic

Vladimir Nikiforov, Dorte Herzke

2B1-AM-05

11:40

Chemical risks of marine microplastics assessed by bioreporter gene assays

Christine Schoenlau, Breanne Holmes, Maria Larsson, Magnus Engwall, Anna Kaerrman

2B1-AM-06

12:10~13:00	***Lunch***
13:00~13:50	***Poster Session 2***

10:00~12:00 *Room B-2*

Fate and Transport 1

Chairs: Noriyuki Suzuki, Wenbin Liu

10:00

Glycosylated tetrabromobisphenol A and its deglycosylation in a hydroponic exposure system for pumpkin plants

Xingwang Hou, Jiyan Liu, Guibin Jiang

2B2-AM-01

10:20

Reduction of POP contamination in Cucurbitaceae family focusing on the transporting factors for POPs by the treatment of pesticides

Kentaro Fujita, Yasumitsu Kondoh, Kaori Honda, Hiroyuki Osada, Hideyuki Inui

2B2-AM-02

10:40

Emissions of 1325 chemicals from municipal wastewater treatment plants in Japan

Kiwao Kadokami, Takashi Miyawaki, Sokichi Takagi, Fumie Adachi, Haruka Iida, Kimiyo Watanabe, Yuki Kosugi, Toshinari Suzuki, Katsumi Iwabuchi, Shinichiro Nagahora, Ruriko Tahara, Tomoaki Orihara

2B2-AM-03

11:00

Influence of ageing on the persistence of hexachlorocyclohexanes: Implications for environmental testing

Dirk Loeffler, Annika Martin, Lennart Loerke, Thomas A Ternes

2B2-AM-04

11:20

Fate of synthetic musk compounds in wastewater treatment plants

Hayley Hung, Wenlong Li, Fiona Wong, Chubashini Shunthirasingham, Mehran Alaee, Tommy Bisbicos, Grazina Pacepavicius, Shirley Anne Smyth, Steven Teslic, Korey Broad, Chris Marvin, Julia Jia, Mitra Brown, Artur Pajda, Nick Alexandrou, Edmund Luk, Liisa Jantunen

2B2-AM-05

11:40

An overlooked PFAS exposure pathway: transport of PFAS from water to riparian foodwebs via emerging insects

Alina Koch, Micael Jonsson, Anna Kärrman, Thanh Wang

2B2-AM-06

12:10~13:00	***Dolce Seminar by Waters Corporation***
13:00~13:50	***Poster Session 2***

10:00~12:00 *Room C-1*

Advancements in Analytical Methodologies and Applications (Vendor Session)

Chairs: Georg Becher, Lutz Ahrens

10:00

Semi automated clean up for persistent organic pollutants analysis in environmental samples - Complete separation of PCDD/Fs and PCBs for sample extracts in toluene

Rudolf Addink, Hamid Shirkhan, Tom Hall

2C1-AM-01

10:20

Flexible automated sample clean-up of PCDD/Fs and PCBs

Thomas Fiedler, Thomas Kerkemeier, Maximilian Baumann

2C1-AM-02

10:40

Robustness assessment of PCDD/F quantitative GC-MS/MS analysis in food and feed

Masato Takakura, Thomas Lehardy, Philippe Marchand, Emmanuelle Bichon, Bruno le Bizec

2C1-AM-03

11:00

Performance assessment of a GC-MS/MS based dioxin method

Pi Li, Xiaoyan Zhang, Richard Law, Fausto Pigozzo, Richard Fussell, Khalil Divan, Tao Bo, Bing Lyu, Jingguang Li

2C1-AM-04

11:20

Direct injection analysis of legacy and emerging PFAS in soil and sediment

Kari Organtini, Ken Rosnack

2C1-AM-05

11:40

First attempts to establish REPs and BEQs for PFAS based on their thyroid hormone competitor activities using the PFAS-CALUX® bioassay

Peter Behnisch, Faried Niamut, Harrie Besselink, Emiel Felzel, Berenice Collet, Matthijs Naderman, Sandy Falk, Thorsten Stahl, Joerg Winkler, Steven TJ Droge, Abraham Brouwer

2C1-AM-06

12:10~13:00	***Dolce Seminar by MIURA CO., LTD***
13:00~13:50	***Poster Session 2***

10:00~12:00 Room C-2

Human Exposure 3

Chairs: Teruyuki Nakao, Kouji Harada

10:00

Possible health effects of perfluoroalkyl substances (PFAS) in Norwegian adolescents recruited from the general population in Northern Norway

Maria Averina, Sandra Huber, Jan Brox

2C2-AM-01

10:20

Perfluoroalkyl acid intake during childhood in Finland

Jani Koponen, Anne M Karvonen, Juha Pekkanen, Hannu Kiviranta

2C2-AM-02

10:40

Concentrations of perfluoroalkyl substances in drinking water, indoor air, dust and human milk in Ireland: implications for human exposure

Stuart Harrad, Daniel Drage, Nina Wemken, Marie Coggins, Mohamed Abdallah

2C2-AM-03

11:00

Analyses of chlorinated paraffins and pesticides in the indoor environment for human exposure assessment

ike van der Veen, Sicco Brandsma, Stuart Harrad, Giulia Poma, Christina Christia, Adrian Covaci, Cynthia de Wit, Nina Wemken, marie Coggins, Marja Lamoree, Pim Leonards

2C2-AM-04

11:20

Air pollution by PAHs results in the increased levels of oxidized lipid species, both in mothers and their new-borns

Jana Hajslova, Vit Kosek, Radim J Sram, Jana Pulkrabova

2C2-AM-05

11:40

Identification and prioritization of ToxCast chemicals for potential exposure risk assessment

Yongfeng Lin, Ting Ruan, Guibin Jiang

2C2-AM-06

12:10~13:00	***Dolce Seminar by Thermo Fisher SCIENTIFIC***
13:00~13:50	***Poster Session 2***

14:00~16:00 *Room A*

Chlorinated Paraffins in Food

Chairs: Rainer Malisch, Kerstin Kraetschmer

14:00

Short-chain chlorinated paraffins in raw milk from selected industrial areas in China

Shujun Dong, Su Zhang, Shulin Wei, Yun Zou, Peilong Wang, Xiaoou Su

2A-PM1-01

14:20

Short-chain chlorinated paraffins (SCCPs) in eggs from six countries

Sam Adu-Kumi, Jindrich Petrlik, Eric Akortia, Martin Skalský, Jana Pulkrabová, Jakub Tomáško, Lee Bell, Jonathan N. Hogarh, Dmitryi Kalmykov, Abel Arkenbout

2A-PM1-02

14:40

Chlorinated paraffins in edible oil, concentrations, formula group profiles and the human exposure risks

Wei Gao, Lu Bai, Yawei Wang

2A-PM1-03

15:00

Characterization of C_{10}-C_{17} chlorinated paraffins in oven-baked pastry products and unprocessed pastry dough by HPLC-ESI-Q-TOF-MS

Dzintars Zacs, Ingus Perkons, Vadims Bartkevics

2A-PM1-04

15:20

Chlorinated paraffin exposure through food: a raw food and meal study in Southern Germany

Kerstin Kraetschmer, Alexander Schaechtele, Rainer Malisch, Walter Vetter

2A-PM1-05

15:40

Dietary exposure to short- and medium-chain chlorinated paraffins in Chinese people through the 5th and the 6th total diet study

Lirong Gao, Minghui Zheng, Lili Cui, Huiting huang, Runhua Wang, Jingguang Li, Lei Zhang, Yongning Wu

2A-PM1-06

16:00~16:30 ***Coffee Break***

14:00~16:00 *Room B-1*

Levels and Trends (Abiotic 1)

Chairs: Bommanna Loganathan, Yuichi Horii

14:00

Concentrations, temporal and spatial trends of PBDEs, PBDD/Fs and PXDD/Fs in radiometrically dated English fresh water sediments

Leon Peters, Stuart Harrad, Neil Rose, Jana Klanova

2B1-PM1-01

14:20

Historical records of perfluoroalkyl substances (PFASs) including their precursors and replacements in a semi-enclosed bay of Korea

Hyun-Kyung Lee, Jaewon Lee, Geunhan Bak, Jae-Eun Lim, Hyo-Bang Moon

2B1-PM1-02

14:40

Characterization of per and polyfluoroalkyl features in wastewater samples from a treatment plant based in Palo Alto, California

Ana Miralles Marco, Miaomiao Wang, June-Soo Park, Karin North, Myrto Petreas, Jana Klánová

2B1-PM1-03

15:00

Distribution of Bisphenol analogues in surface water from various locations of India

Dipa Lalwani, Eriko Yamazaki, Huiju Lin, Yuefei Ruan, Sachi Taniyasu, Nirmal Kumar J.I., Paul K. S. Lam, Nobuyoshi Yamashita

2B1-PM1-04

15:20

Dynamic estimation of PCB emissions in Japan

Junichiro Koshiba, Yasuhiro Hirai, Shinichi Sakai

2B1-PM1-05

15:40

Historical profile of polychlorinated biphenyls in a dated sediment core from Beppu Bay, southwestern Japan

Shin Takahashi, Daichi Aono, Anh Quoc Hoang, Isao Watanabe, Keidai Tomioka, Michinobu Kuwae, Tatsuya Kunisue, Shinichi Sakai

2B1-PM1-06

16:00~16:30 ***Coffee Break***

14:00~16:00 *Room B-2*

Legacy and Emerging Flame Retardants: Biotransformation and Bioavailability

Chairs: Mohamed Abdallah,
Govindan Malarvannan

14:00

Adult or developmental exposure to PBDEs alters hepatic enzymes related to carbohydrate metabolism and oxidative stress in mice that show a diabetic phenotype

Margarita C Curras-Collazo, Elena Kozlova, Julia M Krum, Karthik Basappa, Gwendolyn Gonzalez, Heather Stapleton, Bhuvana D Chinthirla

2B2-PM1-01

14:20

Multiple biomarkers of the cytotoxicity induced by BDE-47 in human embryonic kidney cells

Fei Li, Huifeng Wu, Chenglong Ji

2B2-PM1-02

14:40

Dermal exposure to polybrominated diphenyl ethers (PBDEs) via contact with microplastics indoors

Mohamed Abdallah, Gopal Pawar, Stuart Harrad

2B2-PM1-03

15:00

Inhalation and ingestion bioaccessibility of flame retardants in plastic from e-waste processing workshops in Northern Vietnam

Tatiya Wannomai, Hidenori Matsukami, Natsuyo Uchida, Fumitake Takahashi, Tuyen Huu Le, Viet Hung Pham, Shin Takahashi, Tatsuya Kunisue, Go Suzuki

2B2-PM1-04

15:20

Developmental effects of organophosphorus flame retardants and their metabolites in zebrafish

Akira Kubota, Jae Seung Lee, Yuri Morita, Yusuke K Kawai, Adrian Covaci

2B2-PM1-05

15:40

Bioaccumulation and biomagnification of organophosphate esters in the food web of fresh water

Lingyan Zhu, Xiaolei Wang, Wei Chen

2B2-PM1-06

16:00~16:30 ***Coffee Break***

14:00~16:00 *Room C-1*

Fate and Transport 2

Chairs: Mehran Alaee, Yuichi Miyake

14:00

Levels and profiles of polychlorinated dibenzo-*p*-dioxin and dibenzofurans in different environmental media from China

Rongrong Lei, Wenbin Liu

2C1-PM1-01

14:20

Using regulated and non regulated congeners of dioxins and furans to measure the contribution to the sediment signature

Rodrigo Loyola Sepulveda, Marcos Salamanca Orrego, Felipe Gutierrez Baeza, Claudia Figueroa San Martin

2C1-PM1-02

14:40

Temporal variation (2011-2014) of atmospheric PCBs, PBDEs and OCPs at King George Island, West Antarctica

Pu Wang, Wenying Meng, Yingming Li, Jianjie Fu, Lin Zhang, Qinghua Zhang

2C1-PM1-03

15:00

PCDD/F measurement at high-altitude station in Eastern Asia: evaluation of PCDD/Fs in TSP and $PM_{2.5}$ via long-range transport and source apportionment during the Southeast Asia biomass burning event in 2014

Shih-Yu Pan, Hung-Wei Chen, Shih-Chieh Hsu, Chung-Kuang Chou, Neng-Huei Lin, Siao-Yi Jin, Kuang-Wei Liu, Kai-Hsien Chi

2C1-PM1-04

15:20

Food trade is a major transport pathway of PCDD/Fs between the Southern and Northern Hemisphere

Kaijie Chen, Tao Huang, Hong Gao, Wanyanhan Jiang, Jianmin Ma

2C1-PM1-05

15:40

Exploring "Abyssal Recipes" in the context of global dynamics and sinks of persistent organic pollutants (POPs)

Rie Sakai, Itsuki C. Handoh

2C1-PM1-06

16:00~16:30 ***Coffee Break***

14:00~16:00 *Room C-2*

POPs in the Developing World 1

Chairs: Karla Pozo, Takeshi Nakano

14:00

Maize tassel-multiwalled carbon nanotubes as novel sorbent for the removal of atrazine from aqueous media

Bongeka Nomakhephu Mavumengwana, Peter Adegbenro Daso, Linda Lunga Sibali, Jonathan Okonkwo

2C2-PM1-01

14:20

Management and supervision of HBCD in EPS/XPS polymer foam products in China

Chen Jiang, Haoyang Wang, Yangzhao Sun, Wenbin Liu

2C2-PM1-02

14:40

Influences of fuel types on polychlorinated dibenzo-p-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) emission profiles from industrial boilers

Siwatt Pongpiachan, Teeraporn Wiriwutikorn, Phonethip Phetsomphou, Kwanchai Jieam, Khammanithip Vongxay, Ken Choviran, Andrea Sbrilli, Massimo Gobbi, Carmela Centeno

2C2-PM1-03

15:00

A study report on the dioxin emission during fire breakout incident at Brahmapuram municipal solid waste dumpyard in Kerala, India

Ajay S V, Amala Varghese, Prathish K P

2C2-PM1-04

15:20

Challenges and insights during the National Implementation Plan of the Stockholm Convention in Brazil

Yago Guida, Raquel Capella, Gabriel Oliveira Carvalho, Claudio Eduardo Azevedo-Silva, Fabio Barbosa Machado Torres, Adan Santos Lino, Claudio Ernesto Taveira Parente, Rodrigo Ornellas Meire, João Paulo Machado Torres, Roland Weber

2C2-PM1-05

15:40

Update of the Pakistan Stockholm Convention Implementation Plan

Zaigham Abbas, Naeem Akhtar Abbasi, Jabir Syed, Imran Hussain, Mehreen Iqbal, Roland Weber

2C2-PM1-06

16:00~16:30 ***Coffee Break***

16:30~18:30 *Room A*

Analysis of Chlorinated Paraffins

Chairs: Takumi Takasuga, Yin Daqiang

16:30

Chlorinated paraffins in human milk world-wide: first results from UNEP studies performed between 2012 and 2019

Kerstin Krätschmer, Rainer Malisch,
Alexander Schächtele, Walter Vetter

2A-PM2-01

16:50

Guidance for trace analysis of short-, medium-, and long-chain chlorinated paraffins

Bo Yuan, Derek Muir, Matthew MacLeod

2A-PM2-02

17:10

Quantification standards - the Achilles Heel of chlorinated paraffin determination?

Kerstin Kraetschmer, Alexander Schaechtele,
Rainer Malisch, Walter Vetter

2A-PM2-03

17:30

Preliminary results of interlaboratory comparison on short chain chlorinated paraffin in technical formulation prepared as candidate reference material

Nobuyasu Hanari, Takeshi Nakano

2A-PM2-04

17:50

Quantitative characterization of chlorinated paraffin congener groups in technical grade mixtures from multiple analytical techniques assessment: new source of common calibration standards

Pierre Dumas, Marie-Pier Ouellet, Normand Fleury

2A-PM2-05

18:10

Evaluation of chlorinated paraffins analysis by Orbitrap GC-MS, GC-TOFMS and GC-HRMS

Takumi Takasuga, Hiroaki Takemori,
Takafumi Matsushita, Yusuke Tsujisawa, Hiroaki Ueda,
Takuya Tomizawa

2A-PM2-06

08:30~17:30 ***Exhibition***

16:30~18:30 *Room B-1*

Formation, Sources and Control: Alfons Buekens Memorial Session

Chairs: Masaki Takaoka, Xiaodong Li

16:30

Historical trend of dioxin emissions from municipal solid waste incinerators in Japan

Masaki Takaoka, Akihiro Matsuoka, Takumi Koyama, Takahiro Masuda

2B1-PM2-01

16:50

The influence of PCDD/F memory effect from scrubbing system in full-scale municipal solid waste incineration

Yunfeng Ma, Xiaoqing Lin, Xiaodong Li, Jianhua Yan

2B1-PM2-02

17:10

PCDD/DFs emission reduction from energy from waste facility using the state-of-the-art waste gasification and melting technology

Nobuhiro Tanigaki, Morihiro Osada, Kuniyuki Suzuki

2B1-PM2-03

17:30

The distribution characteristics of PCDD/Fs, dioxin-like PCBs, CBZs and the leaching toxicity of fly ash from typical MSWIs in China

Tong Chen, Mingxiu Zhan, Chen Sun, Masafumi Nakamura, Shunkei Ko

2B1-PM2-04

17:50

Formation of dioxins from open burning of cable: Effect of copper and investigation of the mechanisms

Mengmei Zhang, Takashi Fujimori, Xiaodong Li, Kenji Shiota, Masaki Takaoka

2B1-PM2-05

18:10

Coupling effect of iron and copper compounds on the formation of UP-POPs during iron ore sintering

Yifei Sun, Lina Liu, Wenpei Li, Jiani Xu, Zesen Xiong, Wei Wang

2B1-PM2-06

08:30~17:30 ***Exhibition***

16:30~18:30 *Room B-2*

Flame Retardants in Human Tissues; Implications for Human Exposure

Chairs: Adrian Covaci, Mohamed Abdallah

16:30

Polybrominated diphenyl ethers in breast milk from different cities in China: body burden and risk assessment

Shanshan Yin, Fangjie Guo, Yingxue Liu, Mengling Tang, Muhammad Aamir, Yongchao Liang, Weiping Liu

2B2-PM2-01

16:50

Intrinsic serum elimination half-lives of tri- to hexabrominated diphenyl ethers: determined in persons moving from North America to Australia

Andreas Sjodin, Jochen F. Mueller, Richard Jones, Andre Schütze, Samuel P. Caudill, Fiona A. Harden, Thomas F. Webster, Leisa-Maree Toms

2B2-PM2-02

17:10

Full scan analysis of maternal and cord blood for target and non-target detection of synthetic compounds

Garry Codling, Veronika Schacht, Jana Klanova

2B2-PM2-03

17:30

Spatial and temporal distributions of legacy and emerging flame retardants in indoor air and dust and human exposure in Beijing, China

Qinghua Zhang, Dou Wang, Pu Wang, Yiwen Wang, Weiwei Zhang

2B2-PM2-04

17:50

Legacy and emerging contaminants in Taiwanese indoor dust and their contribution to endocrine disrupting activity

Chen-Hua Lee, Fung-Chi Ko, Mei-Chun Tseng, Pei-Hsin Chou

2B2-PM2-05

18:10

E-waste driven pollution in Pakistan: first evidence of environmental and human exposure to flame retardants in Karachi city

Mehreen Iqbal, Jabir Syed, Knut Breivik, Jun Li, Gan Zhang, Riffat Malik

2B2-PM2-06

08:30~17:30 **Exhibition**

16:30~18:30 *Room C-1*

Levels and Trends (Biota 1)

Chairs: Cynthia de Wit, Peter Haglund

16:30

Halogenated natural products were higher concentrated than anthropogenic POPs (PCBs, PBDEs) in sperm whales from the Mediterranean Sea (Italy)

Walter Vetter, Kristin Aechtler, Annika Schlienz, A. Bartalini, J. Muñoz-Arnanz, L. Marsili, S. Mazzariol, M. C. Fossi, Begona Jiménez

2C1-PM2-01

16:50

High levels of unknown perfluorocarboxylic acid precursors in shellfish from French coasts

Yann Aminot, Nadège Bely, Charles Pollono, Catherine Munschy

2C1-PM2-02

17:10

Determination of persistent organic pollutants in the European eel (*Anguilla anguilla*) and perch (*Perca fluviatilis*) in Flanders, Belgium

Lies Teunen, Govindan Malarvannan, Claude Belpaire, Maarten De Jonge, Lieven Bervoets, Ronny Blust, Adrian Covaci

2C1-PM2-03

17:30

Tissue specific distribution and total body burden of PCBs, OCPs, PBDEs, and PFASs (including F-53B) in finless porpoises (*Neophocaena asiaeorientalis*) from Korea

Yunsun Jeong, Bit-Na Gu, Sori Mok, Kyum Joon Park, Yong-Rock An, Hyo-Bang Moon

2C1-PM2-04

17:50

Concentrations of organochlorines and metals in juvenile ringed seals (*Pusa hispida botnica*) from the Baltic Sea 1978-2015

Anna Maria Roos, Britt-Marie Bäcklin, Thanh Wang, Ingrid Jogsten Ericson, Peter Haglund

2C1-PM2-05

18:10

Slow decline of PCBs in edible marine fish species from the Mediterranean Sea

Alice Bartalini, Juan Munoz-Arnanz, Matteo Baini, Cristina Panti, Matteo Galli, Dario Giani, Maria Cristina Fossi, Begoña Jimenez

2C1-PM2-06

08:30~17:30 ***Exhibition***

16:30~18:30 Room C-2

POPs in the Developing World 2

Chairs: Bondi Gevao, Tatsuya Kunisue

16:30

Spatial variability in the ambient concentrations of persistent organic pollutants across the Middle East

Bondi Gevao, Karell Martinez-Guijarro, Divya Krishnan, Smitha Rajagopalan, Hassan Alshemmari, Mariam Hajeyah, Majed Bahloul, Perihan Kurt-Karakus, Carol Sukhn, Mohamed I Orif

2C2-PM2-01

16:50

Characteristics of ambient PAHs collected in Ho Chi Minh City, Vietnam

Duy Dat Nguyen, Thi Thuan Ngo, Nhung Thi Tuyet Hoang, Thi Hien To, Moo Been Chang

2C2-PM2-02

17:10

Occurrence of dioxin and furans in landfills in African countries and Kuwait

Karell Martinez-Guijarro, Bondi Gevao, Hassan Alshemmari, Divya Krishnan, Smitha Rajagopalan, Mariam Fayez Hajeyah, Jonathan Okwonkwo

2C2-PM2-03

17:30

Persistent organic pollutants in free-range chicken eggs in Ghana

Jindřich Petrlik, Jonathan N. Hogarh, Sam Adu-Kumi, Eric Akortia, Gilbert Kuepouo, Peter Behnisch, Lee Bell, Joseph DiGangi, J. Rosmus, P. Fišar

2C2-PM2-04

17:50

Halogenated natural products and PCBs in squid from South Africa's Oceans

Qiong Wu, Hindrik Bouwman, Ryan C. Uren, Carl D. van der Lingen, Walter Vetter

2C2-PM2-05

18:10

South Atlantic environmental monitoring: POPs assessment in several marine ecosystem matrix (Argentina)

Andres Hugo Arias, Ana Carolina Ronda, Ana Laura Oliva, Melina Orazi, Lautaro Girones, Tatiana Recabarren-Villalón, Norma Tombesi, Karla Pozo, Jorge Eduardo Marcovecchio

2C2-PM2-06

08:30~17:30 Exhibition

Dioxin 2019 Program

Wednesday August 28

WEDNESDAY AT A GLANCE

08:30	**Room A**				
	Plenary Lecture 3 - Prof. Frank Wania				
09:15	Coffee Break				
10:00	**Room A**	**Room B-1**	**Room B-2**	**Room C-1**	**Room C-2**
12:00	Status and Perspectives on PCB Waste Management	Analysis and Environmental Occurrence of Chlorinated Paraffins	PFAS: Levels and Transport	Levels and Trends (Biota 2)	Epidemiology
12:20	Optional Tour				

08:30~09:15 *Room A*

Plenary Lecture 3

Modelling persistent organic pollutants: mechanistically linking chemical production to human exposure and health effects

Prof. Frank Wania, University of Toronto Scarborough

09:15~10:00 ***Coffee Break***

10:00~12:00 *Room A*

Status and Perspectives on PCB Waste Management

Chair: Shinichi Sakai

10:00

Short History of Dioxin Control to PCB Waste Management

Hideto Yoshida

3A-AM-01

10:05

PCB Waste Management Policy of Japan

Yutaka Matsuzawa

3A-AM-02

10:25

High-Concentration PCB Waste Treatment in Japan

Msaaki Kobayashi

3A-AM-03

10:45

Effect of PCB waste destruction measures in Japan

Yasuhiro Hirai, Junichiro Koshiba, Shinichi Sakai

3A-AM-04

11:00

PCB Waste Treatment in Finland

Timo Seppälä

3A-AM-05

11:20

PCB-free Indonesia 2028: policy development towards environmentally-sound management of PCB

Yun Insiani, Rio Deswandi

3A-AM-06

11:40

UNIDO's Approach on PCB Management

Carmela Centeno

3A-AM-07

08:30~12:00 ***Exhibition***

10:00~12:00 *Room B-1*

Analysis and Environmental Occurrence of Chlorinated Paraffins

Chairs: Yasuyuki Shibata, Bo Yuan

10:00

Current status of analytical methods for chlorinated paraffins

Louise van Mourik, Martin Brits, Sicco Brandsma, Jacob de Boer

3B1-AM-01

10:20

Insights to bioaccumulation of chlorinated paraffins in wildlife

Bo Yuan, Yihui Zhou, Cynthia A. de Wit, Christian Sonne, Xinyu Du, Katrin Vorkamp, Anna Maria Roos, Yin Ge, Igor Eulaers, Sara Persson, Svend Erik Garbus, Yanling Qiu, Jianfu Zhao, Åke Bergman

3B1-AM-02

10:40

Monitoring chlorinated paraffins in amphibians from Yangtze River Delta: tissue distribution, sexual difference, and maternal transfer

Xinyu Du, Bo Yuan, Yihui Zhou, Ziye Zheng, Yanling Qiu, Jianfu Zhao, Ge Yin

3B1-AM-03

11:00

Exploring the capability of liquid chromatography-electrospray ionization-tandem mass spectrometry for the identification of wastes containing short-chain chlorinated paraffins

Hidenori Matsukami, Natsuko Kajiwara, Hidetoshi Kuramochi

3B1-AM-04

11:20

Sources and occurrences of chlorinated nonane paraffins in the environment

Dan Xia, Yifei Sun, Lirong Gao, Minghui Zheng

3B1-AM-05

11:40

Bromo-/chloro paraffins and other polyhalogenatedalkanes (>C10): potential environmental contaminants?

Leah Chibwe, Bo Yuan, Amila De Silva, Anne Myers, Eric Reiner, Karl Jobst, Derek Muir

3B1-AM-06

08:30~12:00 ***Exhibition***

10:00~12:00 *Room B-2*

PFAS: Levels and Transport

Chairs: Begona Jimenez, Sachi Taniyasu

10:00

Wide-spread contamination of perfluoro-4-ethylcyclohexanesulfonate (PFECHS) in the Nordic countries

Anna Kaerrman, Rudolf Aro, Ulrika Eriksson,
Thanh Wang, Leo W.Y. Yeung

3B2-AM-01

10:20

Perfluorinated compounds in the middle part of the Danube river, distribution, levels and comparison

Biljana Skrbic, Kiwao Kadokami, Igor Antic,
Maja Buljovcic

3B2-AM-02

10:40

National background release and potential point sources of per- and polyfluoroalkyl substances in wastewater treatment plants across Australia

Hue Thi Thanh Nguyen, Michael McLachlan,
Ben Tscharke, Phong Thai, Jochen Mueller

3B2-AM-03

11:00

Side-chain fluorinated polymer surfactants are major contributors to per- and poly-fluoroalkyl substances in biosolids from Canadian wastewater treatment plants

Shaogang Chu, Shirley-Anne Symth,
Robert James Letcher

3B2-AM-04

11:20

Screening for per- and polyfluoroalkyl substances in various plant tissues

Winnie Nassazzi, Laura Gobelius, Foon Yin Lai,
Lutz Ahrens

3B2-AM-05

11:40

Transfer of Perfluoroalkyl and Polyfluoroalkyl Substances from contaminated feed into eggs of laying hens

Bernd Goeckener, Maria Eichhorn, Matthias Kotthoff,
Janine Kowalczyk, Jorge Numata, Mark Buecking

3B2-AM-06

08:30~12:00 ***Exhibition***

10:00~12:00 *Room C-1*

Levels and Trends (Biota 2)

Chairs: Bruno Le Bizec, Shin Takahashi

10:00

Persistent organic pollutants in humpback whales from the Southern Hemisphere: influence of gender, stock and trophic ecology

Anais Remili, Pierre Gallego, Marianna Pinzone, Thierry Jauniaux, Govindan Malarvannan, Adrian Covaci, Krishna Das

3C1-AM-01

10:20

Legacy and emerging organohalogen compounds in deep-sea pelagic organisms from the bay of Biscay (northeast Atlantic)

Catherine Munschy, Tiphaine Chouvelon, Nadège Bely, Karine Héas-Moisan, Charles Pollono, Aourell Mauffret, Jérôme Spitz

3C1-AM-02

10:40

Emerging organohalogen compounds in Baltic Sea biota, including top predators

Cynthia de Wit, Katrin Vorkamp, Rossana Bossi, Anna Roos, Ulla Sellström, Bo Yuan, Suzanne Faxneld, Christian Sonne, Svend Erik Garbus, Igor Eulaers, Peter Hellström, Rune Dietz, Sara Persson

3C1-AM-03

11:00

Persistent organic pollutants (POPs) in Southern Ocean seabirds: spatial and accumulation patterns among POP families and species

Roscales Luis Jose, González-Solís Jacob, Ryan Peter, Jiménez Begoña

3C1-AM-04

11:20

Trophic magnification of persistent toxic substances through a food web in Ulsan Bay, Korea: application of amino acid nitrogen isotopic analysis

Yoonyoung An, Seongjin Hong, Bohyung Choi, Kyung-Hoon Shin

3C1-AM-05

11:40

Environmental levels and trophic magnification of POPs in a coastal Mediterranean foodweb

Javier Castro-Jimenez, Daniela Bănaru, Chen Chia-ting, Begoña Jiménez, Juan Muñoz-Arnanz, Richard Sempéré

3C1-AM-06

08:30~12:00 ***Exhibition***

10:00~12:00 *Room C-2*

Epidemiology

Chairs: Paolo Brambilla, Monica Lind

10:00

Circulating levels of polychlorinated biphenyls (PCBs) are related to longitudinal change in Intima-media thickness (IMT) over 5 years

Monica Lind, Samira Salihovic, Jordan Stubleski, Anna Kärrman, Lars Lind

3C2-AM-01

10:20

Polychlorinated biphenyls, dioxins, and diabetes in the Anniston cohort

Marian Pavuk, Tara Serio, Matthew Cave, Paula Rosenbaum, Linda Birnbaum

3C2-AM-02

10:40

Serum PFASs in 10 year old girls, estradiol and menarche - Results from a Norwegian childhood cohort

Helen Engelstad Kvalem, Unni Cecilie Nygaard, Karin C Lødrup Carlsen, Kai-Håkon Carlsen, Line Småstuen Haug, Berit Granum

3C2-AM-03

11:00

Effect of prenatal exposure to perfluoroalkyl substances (PFAS) on childhood allergies: the Hokkaido Study

Yu Ait Bamai, Goudarzi Houman, Emiko Okada, Atsuko Araki, Chihiro Miyashita, Hideyuki Matsuura, Reiko Kishi

3C2-AM-04

11:20

Relation of maternal serum concentrations of halogenated persistent organic pollutants to vitamin D in California, USA

Michelle Pearl, Victor Poon, Darryl Eyles, Kristen Lyall, Marty Kharrazi, Lisa A Croen, Gayle C Windham

3C2-AM-05

11:40

Explaining correlations between persistent and non-persistent organic pollutants

Thomas F Webster, Kate Hoffman, Allison Phillips, Stephanie Hammel, Heather M Stapleton

3C2-AM-06

08:30~12:00 ***Exhibition***

Dioxin 2019 Program

Thursday August 29

THURSDAY AT A GLANCE						
08:30	**Room A**					
	Plenary Lecture 4 - Prof. Dr. Adrian Covaci					
09:15	Coffee Break					
10:00	**Room A**	**Room B-1**	**Room B-2**	**Room C-1**	**Room C-2**	**Room D**
12:00	PFAS: Analysis	Formation, Sources and Control 1	Levels and Trends (Abiotic 2)	From Good Science to Good Risk Management	Ecotoxicology	12:30 Kanemi Yusho, Taiwan Yucheng and PCB/ Dioxin Pollution
12:10	**Room A**	**Room B-1**	**Room B-2**	**Room C-1**	**Room C-2**	
	Lunch		Vietnam Session Pre-Meeting	Dolce Sponsored by Cambridge Isotope Laboratories, Inc.	Dolce Sponsored by Agilent Technologies Japan, Ltd.	
13:00	**Annex Hall 2**					
13:50	**Poster Session 3**					
14:00	**Room A**	**Room B-1**	**Room B-2**	**Room C-1**	**Room C-2**	
	PFAS: Removal and Degradation	Formation, Sources and Control 2	Dioxin Health Hazard in Vietnam 1	Large Scale Biomonitoring and Cohort Study	Levels and Trends (Foods and Feeds)	
16:00	Coffee Break					
16:30	**Room A**	**Room B-1**	**Room B-2**	**Room C-1**	**Room C-2**	
17:50	PFAS: Exposure and Toxicology	Formation, Sources and Control 3	Dioxin Health Hazard in Vietnam 2	Physico-chemical Properties and Modeling	POPs in Pets and their Applicability as Models for Human Health	
19:00	**Kodaiji-Temple & SODOH**					
21:00	Banquet					

08:30~09:15 Room A

Plenary Lecture 4

Human Biomonitoring and Exposomics of Legacy and Emerging Chemicals
Prof. Dr. Adrian Covaci, University of Antwerp

09:15~10:00 ***Coffee Break***

10:00~12:00 Room A

PFAS: Analysis

Chairs: Vladimir Nikiforov, Leo W.Y. Yeung

10:00
A very non-polar, very volatile perfluorinated substance - perfluorotributylamine (PFTBA) detected in Arctic air
Vladimir Nikiforov, Martin Schlabach, Pernilla Bohlin Nizzetto
4A-AM-01

10:20
Quantitative measurements of emerging perfluoroether carboxylic acids in surface water using UHPLC-MS/MS
Yitao Pan, Jingzhi Yao, Jiayin Dai
4A-AM-02

10:40
Determination of isomer/enantiomers of perfluorooctanoic acid in river water sample by gas chromatography-mass spectrometry with chiral derivatization
Jing Zhu, Kouji H. Harada, Xiaoli Zou, Chengjun Sun
4A-AM-03

11:00
Analysis of perfluorooctane sulfonate isomers in serum by in-port arylation-gas chromatography-negative chemical ionization-mass spectrometry
Kouji Harada, Jing Zhu, Yukiko Fujii, Yang Cao, Toshiaki Hitomi
4A-AM-04

11:20
Development of fast and efficient pretreatment method for improving detection efficiency of perfluoroalkyl acid precursors
Mehvish Mumtaz, YiXinag Bao, WenChao Li, Jun Huang
4A-AM-05

11:40
Direct injection analysis by supercritical fluid chromatography coupled to tandem mass spectrometry of trifluoroacetic acid in water connected to suspected point sources
Maria K. Bjornsdotter, Leo W. Y. Yeung, Anna Karrman, Ingrid Ericson Jogsten
4A-AM-06

12:10~13:00 ***Lunch***
13:00~13:50 ***Poster Session 3***

10:00~12:00 *Room B-1*

Formation, Sources and Control 1

Chairs: Heidelore Fiedler, Go Suzuki

10:00

Formation of PCDD/F on the surface of iron oxide particles via a precursor pathway

Sara Mosallanejad, Bogdan Dlugogorski, Eric Kennedy, Michael Stockenhuber, Takeshi Nakano, Mohammednoor Altarawneh

4B1-AM-01

10:20

Formation mechanism of persistent organic pollutants during secondary metal smelting processes by gas chromatography/Orbitrap mass spectrometry screening

Lili Yang, GR Liu, MH Zheng, YP Yang C Li

4B1-AM-02

10:40

Co-processing AGED refuse in a bench-scale simulated Cement kiln device

Mingxiu Zhan, Tong Chen, Hailing Gu, Jinqing Wang, Xiaodong Li

4B1-AM-03

11:00

Environmental performance evaluation for sintering of MSWI fly ash for production of basic building materials

Zheng Peng, Lifang Wang, Yong Ren, Yangzhao Sun

4B1-AM-04

11:20

Emission of organic micro-pollutants from informal end-of-life vehicle processing activities in northern Vietnam: environmental impacts and human exposure

Anh Quoc Hoang, Isao Watanabe, Minh Binh Tu, Tuyen Huu Le, Shin Takahashi

4B1-AM-05

11:40

Brominated Dioxins emission from the E-waste recycling facility in Japan

Go Suzuki, Chieko Michinaka, Shunji Hashimoto, Hidenori Matsukami

4B1-AM-06

12:10~13:00	***Lunch***
13:00~13:50	***Poster Session 3***

10:00~12:00 Room B-2

Levels and Trends (Abiotic 2)

Chair: Jerzy Falandysz

10:00

Pesticides in Australia: from environment to humans and from the past to the present

Xianyu (Fisher) Wang, Phong Thai, Karen Kannedy, Sara Broomhall, Frank Wania, Marc Mallet, Darryl Hawker, Melita Keywood, Carl P Meyer, Andrew Banks, Chang He, Yan Li, Daniel Drage, Leisa Toms, Peter Hobson, Jochen Mueller

4B2-AM-01

10:20

Long term air monitoring of polycyclic aromatic hydrocarbons (PAHs) in the Canadian Arctic and Great Lakes

Hayley Hung, Yong Yu, Wenlong Li, Richard Park, Nick Alexandrou, Ed Sverko, Enso Barresi, Helena Dryfhout-Clark, Phil Fellin, Jianmin Ma, Yuan Zhao

4B2-AM-02

10:40

Hexachlorobutadiene (HCBD) and POPs in ambient air: trends at frequent monitoring site of Japan

Takumi Takasuga, Takeshi Nakano, Yasuyuki Shibata

4B2-AM-03

11:00

Factors influencing atmospheric concentrations of short-chain chlorinated paraffins in Japan

Nguyen Thanh Dien, Yasuhiro Hirai, Shin-ichi Sakai

4B2-AM-04

11:20

Distribution of perfluorocarboxylic acids associated with atmospheric particulate matter from Asian countries

Dipa Lalwani, Eriko Yamazaki, Huiju Lin, Yuefei Ruan, Sachi Taniyasu, Nirmal Kumar J.I., Nan Gai, Yong Yang, Paul Lam, Nobuyoshi Yamashita

4B2-AM-05

11:40

Phthalate esters and PAHs in indoor window films in a northeastern Chinese urban center: film growth and implications for human exposure

Liyan Liu, Chunyan Huo, Yifan Li, Ed Sverko

4B2-AM-06

12:10~13:00 Vietnam Pre-Meeting
13:00~13:50 Poster Session 3

10:00~12:00 *Room C-1*

From Good Science to Good Risk Management

Chairs: Lorraine Seed, Martin Rose

10:00

Perfluorinated alkyl substances (PFAS) in food: the long and winding road to risk mitigation

David Nicholas Mortimer

4C1-AM-01

10:20

Impact of EFSA and/or national risk assessments on persistent organic pollutants at member state level: examples from Ireland

Christina Tlustos

4C1-AM-02

10:40

Emissions inventory of brominated flame retardants from vehicles management in Japan

Heping Liu, Junya Yano, Natsuko Kajiwara, Shin-ichi Sakai

4C1-AM-03

11:00

From regulating toxic substances to producing sustainable chemicals and products

Roland Weber, Peter Fantke

4C1-AM-04

11:20

On the effectiveness of multilateral environmental agreements on chemicals management: an inconvenient truth hidden in the FAOSTAT

Takuto Minekawa, Itsuki C. Handoh

4C1-AM-05

11:40

Economic evaluation of a historic Dioxins food incident

Antonio Bubbico, Susan MacDonald, Yongning Wu, Martin Rose

4C1-AM-06

12:10~13:00	***Dolce Seminar by Cambridge Isotope Laboratories, Inc.***
13:00~13:50	***Poster Session 3***

10:00~12:00 Room C-2

Ecotoxicology

Chairs: Michael Denison, Hisato Iwata

10:00

Neurotoxic effects of developmental exposure to DE-71 on forebrain social peptides, social behavior and olfaction in C57BL/6 mice

Elena V. Kozlova, Valeria Carillo, Brigitte Vazquez, Heather Stapleton, Margarita C Curras-Collazo

4C2-AM-01

10:20

Health effects of naturally produced hydroxylated polybrominated diphenyl ethers on perch from the Baltic sea

Johan Gustafsson, Jessica Legradi, Marja Lamoree, Pim Leonards, Lars Förlin, Henrik Dahlgren, Lillemor Asplund

4C2-AM-02

10:40

Are contaminants influencing the ability of Arctic seabirds to respond to climate change?

Kim J Fernie, Robert J Letcher, Birgit M Braune, Jessica A Head, Kyle H Elliott

4C2-AM-03

11:00

2,7-Dibromocarbazole disturb vascular formation in HUVECs by altering Ang2 promoter DNA methylation status

Chenyang Ji, meirong zhao

4C2-AM-04

11:20

Assessment of the effects of 1,3,7-TriBDD exposure on developing chicken embryos by hepatic transcriptome analysis

Jae Gon Park, Hisato Iwata, Hoa Thanh Nguyen, Tatsuya Kunisue, Eun-Young Kim

4C2-AM-05

11:40

Isoform- and ligand-specific activities of AHR and ARNT pairs in the chicken

Dong-Hee Koh, Ji-Hee Hwang, Jae-Gon Park, Woo-Seon Song, Hisato Iwata, Eun-Young Kim

4C2-AM-06

12:10~13:00	***Dolce Seminar by Agilent Technologies Japan, Ltd.***
13:00~13:50	***Poster Session 3***

10:00~12:30 *Room D*

Kanemi Yusho, Taiwan Yucheng and PCB/Dioxin Pollution

Chair: Toshikazu Fujiwara

10:00

Kanemi oil poisoning caused by dioxin exposure - From the past to the future -

Junko Shimoda

4D-AM-01

10:30

Symptoms in children of the second and third generations of Kanemi Yusho patients

Tadashi Fujino, Reiko Takeda, Yasuichi Miyakawa

4D-AM-02

11:00

The health care of Taiwan Yucheng patients

Touju Liao

4D-AM-03

11:30

Problems in the past manufacturing waste as a major source of dioxin pollution

Hideaki Miyata

4D-AM-04

12:00

Dioxins serious pollution incident in Taiwan

Huann-Jang Hwang

4D-AM-05

14:00~16:00 *Room A*

PFAS: Removal and Degradation

Chairs: Anna Kaerrman, TBA

14:00

Per- and polyfluoroalkyl substances in drinking water: occurrence, removal, and human health risks

Lutz Ahrens, Anna-Lena Rehrl, Erik Gunnars, Karin Wiberg, Anders Glynn

4A-PM1-01

14:20

Towards more efficient removal of per- and polyfluoroalkyl substances (PFASs) in drinking water treatment: can nanofiltration combined with active carbon or anion exchange do the trick?

Vera Franke, Philip McCleaf, Klara Lindegren, Lutz Ahrens

4A-PM1-02

14:40

Potential of low-cost alternatives for remediation of PFAS contaminated waters

Jean-Noel Uwayezu, Ingrid Maria Ericson Jogsten

4A-PM1-03

15:00

Adsorption of per- and polyfluoroalkyl substances by ferrihydrite is non-specific and governed by surface charge

Hugo Campos-Pereira, Dan Berggren Kleja, Carin Sjöstedt, Lutz Ahrens, Jon Petter Gustafsson

4A-PM1-04

15:20

Insight into the degradation mechanism of F-53B, the alternative to PFOS as chrome mist suppressant in China, by UV/sulfite process

Yixiang Bao, Jun Huang

4A-PM1-05

15:40

Characterisation of technical mixtures containing side-chain fluorinated polymers

Felicia Fredriksson, Anna Kärrman, Ulrika Eriksson, Leo W.Y. Yeung

4A-PM1-06

16:00~16:30 ***Coffee Break***

14:00~16:00 *Room B-1*

Formation, Sources and Control 2

Chairs: Minghui Zheng, Juan Conesa

14:00

Integrated adsorption and visible-light photocatalysis of diclofenac by defective MOFs

Yanxin Gao, Gang Yu

4B1-PM1-01

14:20

Effective adsorption of metronidazole antibiotic from water with Zr (IV) -MOFs

Sha Chen, Alamgir , Khalid Talhab, Feng Fan, Jian-Rong Li

4B1-PM1-02

14:40

Self-sensitization of tetracycline degradation with visible light catalyzed by Zr-based Metal-Organic Frameworks

Jing Xia, Gang Yu

4B1-PM1-03

15:00

Effect of water washing on POPs concentration during pyrolysis of MSWI fly ash

Man Minh Trinh, Been Moo Chang

4B1-PM1-04

15:20

The distribution and source apportionment of stationary source flue gas and atmospheric PCDD/Fs in Taiwan

Shih-Yu Pan, Yi-Ting Liou, Hung-Wei Chen, Shih-Chieh Hsu, Chung-Kuang Chou, Siao-Yi Jin, Kuang-Wei Liu, Kai-Hsien Chi

4B1-PM1-05

15:40

Atmospheric polycyclic aromatic hydrocarbons in fine particulate matters: source apportionment and exposure risk assessment at different areas in Taiwan

Ya Syuan Wu, Hsin Yu Yang, Shih Yu Pan, Tuan Hung Ngo, Yi Siao Jin, Kuang Wei Liu, Moo Been Chang, Kai Hsien Chi

4B1-PM1-06

16:00~16:30 ***Coffee Break***

14:00~16:00 *Room B-2*

Dioxin Health Hazard in Vietnam 1

Chairs: Do Quyet, Muneko Nishijo

14:00

Effects of perinatal dioxin exposure on fetal brain development assessed by neonatal elcetrocephalorgraphy (EEG) in the most contaminated area from Agent Orange in Vietnam

Thao Ngoc Pham, Muneko Nishijo,
Giang Thi Thuy Nghiem, Nghi Ngoc Tran,
Tai The Pham, Hoa Thi Vu, Anh Hai Tran,
Vu Huy Anh Phan, Yoshikazu Nishino, Hisao Nishijo

4B2-PM1-01

14:20

Effects of prenatal dioxin exposure on children behaviors at 8 years of age

Tai Pham The, Muneko Nishijo, Thao Pham Ngoc,
Hoa Vu Thi, Nghi Tran Ngoc, Anh Tran Hai,
Luong Hoang Van, Yoshikazu Nishino, Hisao Nishijo,
Quyet Do Ba

4B2-PM1-02

14:40

Steroid hormone disorder due to Dioxin exposure in preschool children: A five-year follow-up study of a Vietnam cohort using saliva

Xian Liang Sun, Rie Okamoto, Teruhiko Kido,
Seijiro Honma, Ho Dung Manh, Nguyen Hoang Viet,
Le Thai Anh, Hoang Duc Phuc,
Nguyen Thi Phuong Oanh, Shoko Maruzeni,
Hideaki Nakagawa, Shoji F Nakayama, Dang Duc Nhu,
Dao Van Tung, Ngo Thi Minh, Le Minh Giang

4B2-PM1-03

15:00

Dioxin levels in breast milk in herbicide sprayed and unsprayed areas in Vietnam

Muneko Nishijo, Tai The Pham, Nghi Ngoc Tran,
Thao Ngoc Pham, Hoa Thi Vu, Anh Hai Tran,
Luong Van Hoang, Vu HA Phan, Phuong T Phan,
Yoshikazu Nishino, Quyet Ba Do, Teruhiko Kido,
Hisao Nishijo

4B2-PM1-04

15:20

Risk assessment for PCDD/PCDFs bioaccumulation in mothers milk and selected food items near the Bien Hoa dioxin hotspot, Vietnam

Nguyen Hung Minh, Nguyen Thi Minh Hue,
Pham Thi Ngoc Mai

4B2-PM1-05

15:40

The endeavours of Ministry of Health in Vietnam to overcome subsequences from dioxins and chemical toxins

Nghi Tran Ngoc

4B2-PM1-06

16:00~16:30 ***Coffee Break***

14:00~16:00 *Room C-1*

Large Scale Biomonitoring and Cohort Study

Chairs: Shoji Nakayama, Linda Birnbaum,
Co-organizer: Tomohiko Isobe

14:00

Achievements and conclusions on children's development in relation to real life exposure to chemical mixtures - A report from the EDC-MixRisk EU project

Ake Bergman, Joëlle Rüegg, Carl-Gustav Bornehag, Barbara Demeneix, Jean-Baptiste Fini, Chris Gennings, Maria Jönsson, Wieland Kiess, Efthymia Kitraki, Hannu Kiviranta, Christian Lindh, Eewa Nånberg, Christina Rudén, Joachim Sturve, Olle Söder, Giuseppe Testa, Mattias Öberg

4C1-PM1-01

14:20

Effect of prenatal exposure to persistent organic pollutants on children's health in the Hokkaido study on environment and children's health.

Chihiro Miyashita, Reiko Kishi

4C1-PM1-02

14:40

The Danish National Birth Cohort: potentials for studying impact of environmental exposures during pregnancy on child health

Sjurdur F Olsen

4C1-PM1-03

15:00

Serum concentrations of legacy and emerging per- and polyfluoroalkyl substances in the Anniston Community Health Surveys (ACHS I and ACHS II)

Mike Petriello, Linda Birnbaum, Marian Pavuk, Abdul Mottaleb, Andrew J Morris

4C1-PM1-04

15:20

Determination of neonicotinoid insecticides in urine using semi-automated solid phase extraction coupled to UHPLC-MS/MS

Leonardo Trasande

4C1-PM1-05

15:40

Endocrine disrupting chemicals: a costly public health threat with opportunities for policy prevention

Tomohiko Isobe, Miyuki Iwai-Shimada, Yayoi Kobayashi, Mai Takagi, Shoji F Nakayama

4C1-PM1-06

16:00~16:30 ***Coffee Break***

14:00~16:00 *Room C-2*

Levels and Trends (Foods and Feeds)

Chairs: Jacob de Boer, Masatoshi Morita

14:00

Levels and trends of dioxins, dioxin-like compounds, and PBDEs in the U.S. Domestic meat and poultry supply, mid-1990s to 2019

Sara J Lupton, Rita Kishore, Oliver Ou, John Johnston

4C2-PM1-01

14:20

Temporal trends and spatial distribution of PCDD/Fs and dioxin-like PCBs in Taiwan foodstuffs

Jung-Wei Chang, Ching-Chang Lee, Chiao-Yi Cheng, Wei-Hsiang Chang

4C2-PM1-02

14:40

Development of PTV GC-MS/MS method on dioxins analysis in food and feedstuff

Ge Yin, Xiao Liu, Yuanjie Lin, Xiaotian Zhang, Sunyang Le, Feifei Tian, Jun Fan, Taohong Huang, Dasheng Lu, Sheng Wen

4C2-PM1-03

15:00

Analytical options for lowering legal limits for dioxins and PCB in feed and food as consequence of the EFSA revision of the TWI

Rainer Malisch, Alexander Schächtele

4C2-PM1-04

15:20

The transfer rate of PCBs from feed to adipose tissue depends on body fatness in growing cattle

Charlotte Driesen, Markus Zennegg, Isabelle Morel, Hans Dieter Hess, Sylvain Lerch

4C2-PM1-05

15:40

Short-chain chlorinated paraffins (SCCPs) in foodstuff of aquatic and terrestrial from Republic of Korea: levels and human dietary exposure

Sumin Lee, Gyojin Choo, Jeong-Eun Oh

4C2-PM1-06

16:00~16:30 ***Coffee Break***

16:30~17:50 *Room A*

PFAS: Exposure and Toxicology

Chairs: Biljana Skrbic, Anna Kaerrman

16:30
The Norwegian POPs in food study: now including PFAS'
Helen Engelstad Kvalem,
Nanna Margrete Bruun Bremnes, Cathrine Thomsen,
Line Småstuen Haug
4A-PM2-01

16:50
The first nationwide survey of exposure to legacy and emerging per- and polyfluoroalkyl substances via hair in India
Yuefei Ruan, Dipa Lalwani, Karen Ying Kwok,
Eriko Yamazaki, Sachi Taniyasu, Nirmal JI Kumar,
Paul Kwan Sing Lam, Nobuyoshi Yamashita
4A-PM2-02

17:10
PFAS and fluorine mass balance analysis of whole blood samples from Sweden
Rudolf Aro, Jean Nöel Uwayezu, Anna Kärrman,
Leo W.Y. Yeung
4A-PM2-03

17:30
PFOA induces liver and serum dyslipidemia in humanized PPARα mice fed an American diet
Jennifer Schlezinger, Wendy Heiger-Bernays,
Tuulia Hyötyläinen, Catherine Boston,
Thomas F Webster
4A-PM2-04

08:30~17:30 ***Exhibition***
19:00~21:00 ***Banquet at Kodaiji-Temple and SODOH***

16:30~17:50 *Room B-1*

Formation, Sources and Control 3

Chairs: Yifei Sun, Takashi Fujimori

16:30
Review of progress in PCB elimination under the Stockholm Convention on POPs - Status report 2019
Heidelore Fiedler, Kei Ohno, Edwin Camelo
4B1-PM2-01

16:50
The effect of desulfurization on the emissions of PCDD/Fs from coal-fired power plants
Xiaolin Wu, Wenbin Liu
4B1-PM2-02

17:10
Reducing polychlorinated naphthalenes (PCNs) emissions from municipal waste incinerator and secondary copper smelting plant
Duy Dat Nguyen, Yong-Ji Huang, Weichun Wang,
Moo Been Chang
4B1-PM2-03

17:30
Dioxins biodegradation in Sydney harbor sediment
Gan Liang, Matthew Lee, Michael Manefield
4B1-PM2-04

08:30~17:30 ***Exhibition***
19:00~21:00 ***Banquet at Kodaiji-Temple and SODOH***

16:30~17:50 *Room B-2*

Dioxin Health Hazard in Vietnam 2

Chairs: Muneko Nishijo, Tai Pham The

16:30

Distribution of PCDD/Fs in soil and sediment at former Aso airbase located in central Vietnam

Le Thi Hai Le, Nguyen Duy Dat, Nguyen Kim Anh, Nguyen Hung Minh

4B2-PM2-01

16:50

Assessment of AhR activities for determining dioxin contamination activities in hotspot and control areas of Central Vietnam

MY THI AI TRAN, Kersten Van Langenhove, Michael S. Denison, Long Thai Hoang, Hop Van Nguyen, Marc Elskens

4B2-PM2-02

17:10

Overview of dioxin remediation projects from post-war to present in Vietnam

Quyet Do Ba, Tai Pham The, Muneko Nishijo

4B2-PM2-03

17:30

Large scale thermal treatment of dioxins from Agent Orange

John Bierschenk, Hatsue Minato Braatz, Jim Galligan, Timothy Burdett

4B2-PM2-04

08:30~17:30	***Exhibition***
19:00~21:00	***Banquet at Kodaiji-Temple and SODOH***

16:30~17:50 *Room C-1*

Physico-chemical Properties and Modeling

Chairs: Hidetoshi Kuramochi, Ipek Imamoglu

16:30

Measurement of physicochemical properties of major Firemaster 550 components EH-TBB and BEH-TEBP and evaluation of their POP-like characteristics

Hidetoshi KURAMOCHI, Toshiyuki Motoki, Kazuko Yui, Satoshi Endo, Shin-ichi Sakai, Yuhao Chen, Frank Wania

4C1-PM2-01

16:50

Kovats and Lee Retention Indices for characterization of PCBs, PCNs, and dioxins

Conner Stultz, Frank Dorman

4C1-PM2-02

17:10

Temperature dependence of per- and polyfluorinated substance (PFAS) adsorption to soil and activated carbon

Georgios Niarchos, Lutz Ahrens, Dan Kleja, Fritjof Fagerlund

4C1-PM2-03

17:30

Prediction of slopes and intercepts from log-log correlations of gas/particle quotient and vapor-pressure & octanal-air partition coefficient for SVOCs

Yi-Fan Li

4C1-PM2-04

08:30~17:30	***Exhibition***
19:00~21:00	***Banquet at Kodaiji-Temple and SODOH***

16:30~17:50 *Room C-2*

POPs in Pets and their Applicability as Models for Human Health

Chairs: Hazuki Mizukawa, Kei Nomiyama, June-Soo Park

16:30

PCBs effects on comprehensive gene expression in cats and dogs

Hazuki Mizukawa, Hisato Iwata, Hoa Thanh Ngyuen, Kraisiri Khidkhan, Yoshinori Ikenaka, Shouta M.M. Nakayama, Kei Nomiyama, Nozomu Yokoyama, Osamu Ichii, Mitsuyoshi Takiguchi, Shinsuke Tanabe, Mayumi Ishizuka

4C2-PM2-01

16:50

Contamination status of organohalogen compounds in pet cats, cat food and house dust from Thailand

Makoto Shimasaki, Hazuki Mizukawa, Aksorn Saengtienchai, Kei Nomiyama

4C2-PM2-02

17:10

Exposure profile comparison and screening of unknown contaminants using LC-QToF: a cat hyperthyroidism study

Miaomiao Wang, Michiel Bastiaensen, Juliet Kinyua, Myrto Petreas, Adrian Covaci, June-Soo Park

4C2-PM2-03

17:30

Species-specific differences in extractable organochlorine and organobromine in high-trophic-level mammals

Kota Mukai, Takashi Fujimori, Hoang Quoc Anh, Satoshi Fukutani, Tatsuya Kunisue, Kei Nomiyama, Shin Takahashi

4C2-PM2-04

08:30~17:30	***Exhibition***
19:00~21:00	***Banquet at Kodaiji-Temple and SODOH***

Friday August 30

FRIDAY AT A GLANCE

09:15	**Room A**
	Plenary Lecture 5 - Dr. Nguyen Hung Minh - Prof. Teruhiko Kido
10:00	Coffee Break
10:45	**Room A**
	Summary Session
12:15	**Otto Hutzinger Awards**
12:30	**Welcome to DIOXIN 2020**
12:45 12:50	**Closing Remarks**

09:15~10:00

Room A

Plenary Lecture 5

Dioxin and health effects in Vietnamese
PART 1. ENVIRONMENTAL DIOXIN IN VIETNAM
Dr. Ngyuen Minh Hung, Ministry of Natural Resources and Environment, Vietnam
PART 2. DIOXIN AND HEALTH IN VIETNAM
Prof. Teruhiko Kido, Kanazawa University

10:00~10:45 ***Coffee Break***

10:45~12:15

Room A

Summary Session

Chair: Takashi Fujimori

Environmental Levels
Leo W.Y. Yeung

Toxicology and Health
Hazuki Mizukawa

Analytical Chemistry
Lutz Ahrens

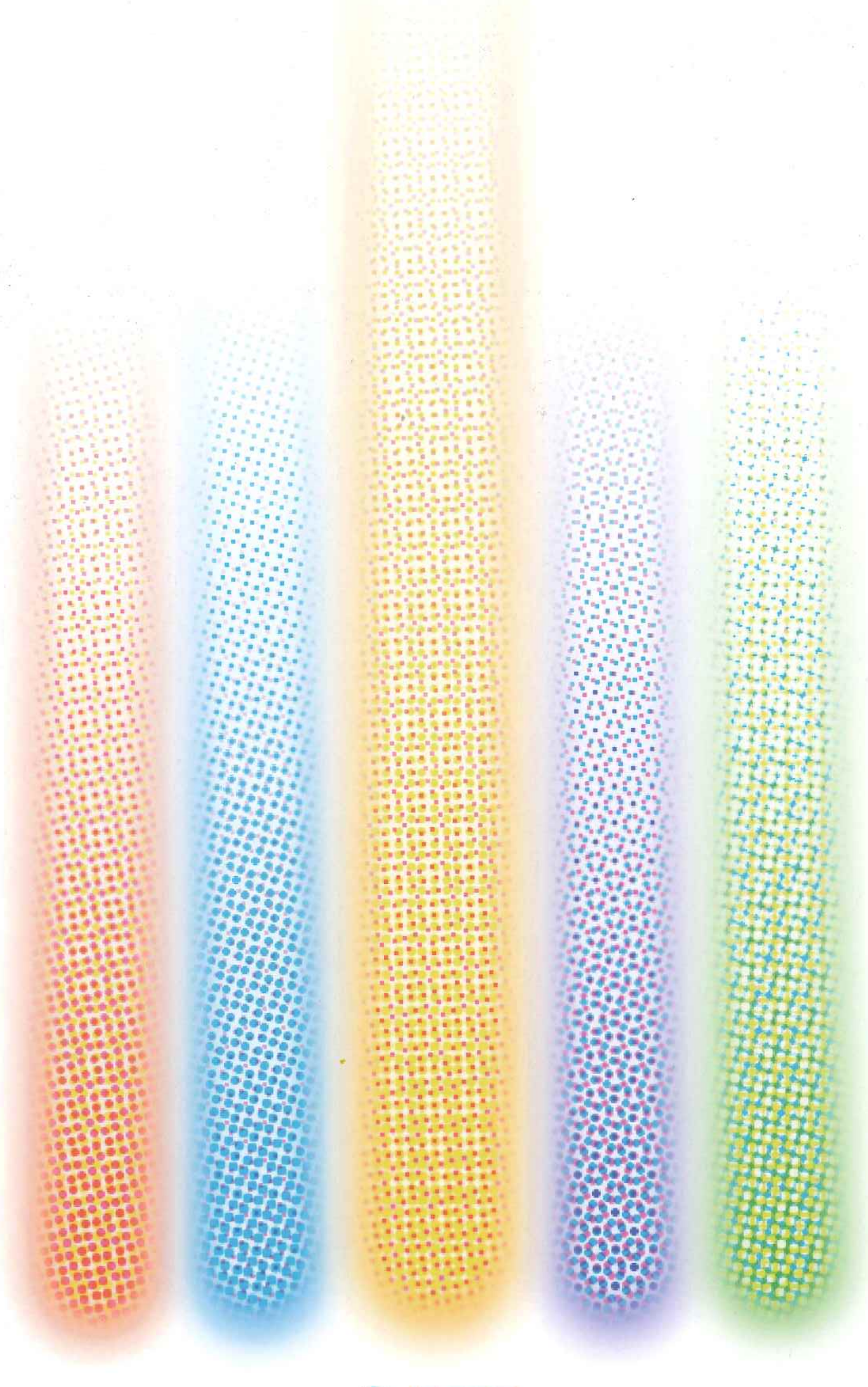
Risk Assessment and Exposure
Mohamed Abdallah

Formation, Sources and Control
Takashi Fujimori

12:15~12:30	***Otto Hutzinger Awards***
12:30~12:45	***Welcome to DIOXIN 2020***
12:45~12:50	***Closing Remarks***

Japan Environmental Storage & Safety Corporation(JESCO)

Osaka PCB Waste Treatment Facility



JESCO

JESCO is an organization which conducts Safe and secure treatment of PCB waste Under the government's supervision

With the aim of the protection of the environment where the nation can live with sense of Security, JESCO was established on April 1, 2004 to treat PCB waste as a company wholly owned by the government succeeding the PCB waste treatment business of former Japan Environment Corporation.

Since the production of PCB was banned in 1974, for more than 30 years there had been no choice but to store PCB waste. In 2001, the Law Concerning Special Measures for Promotion of Proper Treatment of PCB wastes was established, and businesses stroring PCB waste were required to treat PCB waste within the period defined by law.

With the understanding and cooperation of the nation and businesses storing PCB waste, we will do our best to create and protect the environment where the nation can live with a sense of security by safely and securely conducting the PCB waste treatment business.

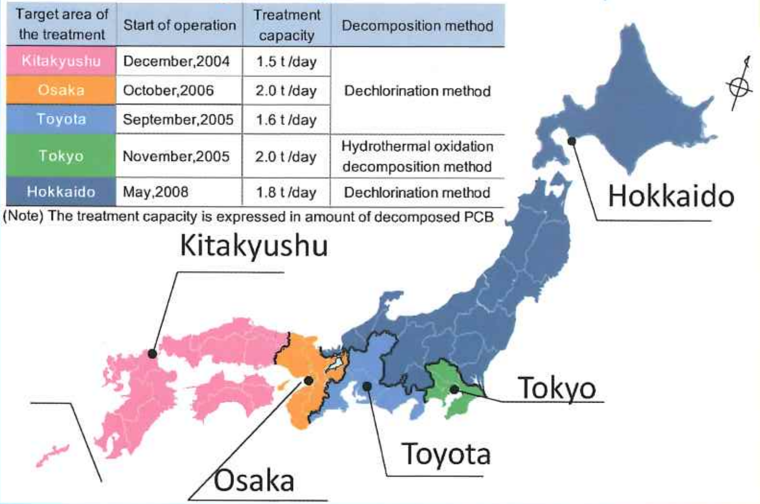
Outline of PCB waste treatment business

We conduct safe and secure treatment based on the Basic Plan for PCB Waste Treatment defined by the government

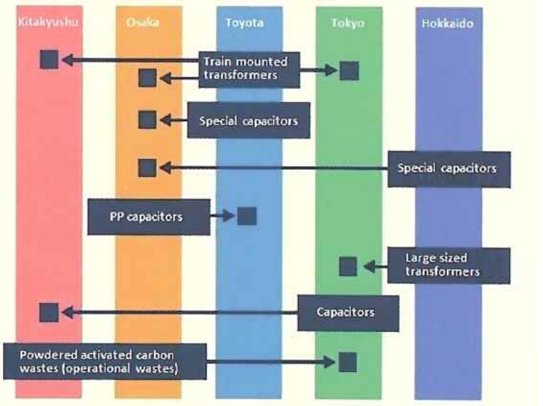
Treatment of high voltage transformers and capacitors

Target area of the treatment	Start of operation	Treatment capacity	Decomposition method
Kitakyushu	December,2004	1.5 t /day	Dechlorination method
Osaka	October,2006	2.0 t /day	
Toyota	September,2005	1.6 t /day	
Tokyo	November,2005	2.0 t /day	Hydrothermal oxidation decomposition method
Hokkaido	May,2008	1.8 t /day	Dechlorination method

(Note) The treatment capacity is expressed in amount of decomposed PCB



Wastes to be treated outside original assigned area

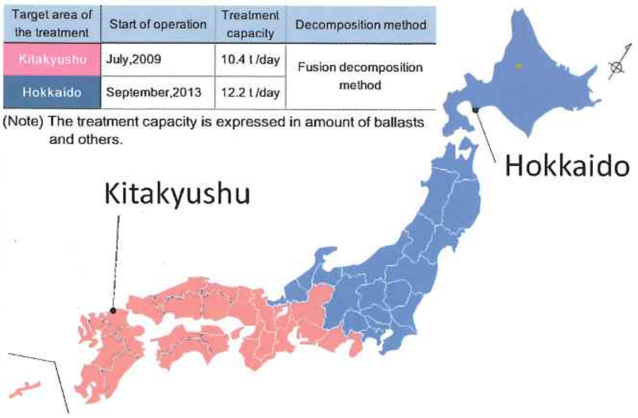


Note)
PP capacitors: Capacitors of which the elements are made of polypropylene
Special capacitors: Capacitors of which the internal elements are carbonized

Treatment of ballasts and others

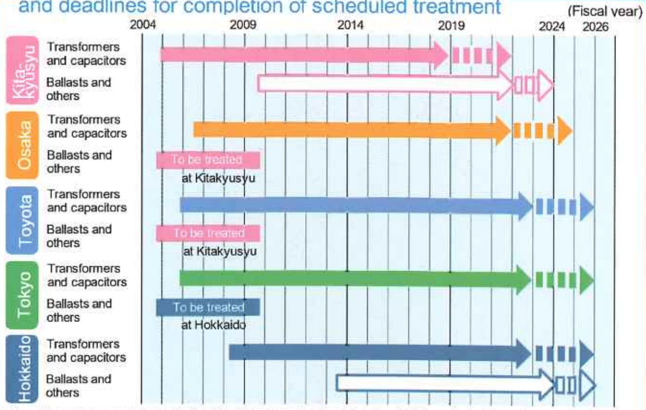
Target area of the treatment	Start of operation	Treatment capacity	Decomposition method
Kitakyushu	July,2009	10.4 t /day	Fusion decomposition method
Hokkaido	September,2013	12.2 t /day	

(Note) The treatment capacity is expressed in amount of ballasts and others.



Ballasts and others : Small low voltage transformers and capacitors containing PCB,small ballasts and other electrical equipment waste compartible such sludge.

Deadlines for completion of scheduled treatment and deadlines for completion of scheduled treatment



★Deadlines for completion of scheduled treatment : Deadline for PCB waste holders to commission JESCO to treat PCB wastes.
(A principle, the PCB holders must contract by one year before the time limit above-mentioned.)

★Preparation periods for end of business : Extra period for treatment of newly found wastes and difficult-to-treat wastes and for preparation of the ending operations and closing down facilities

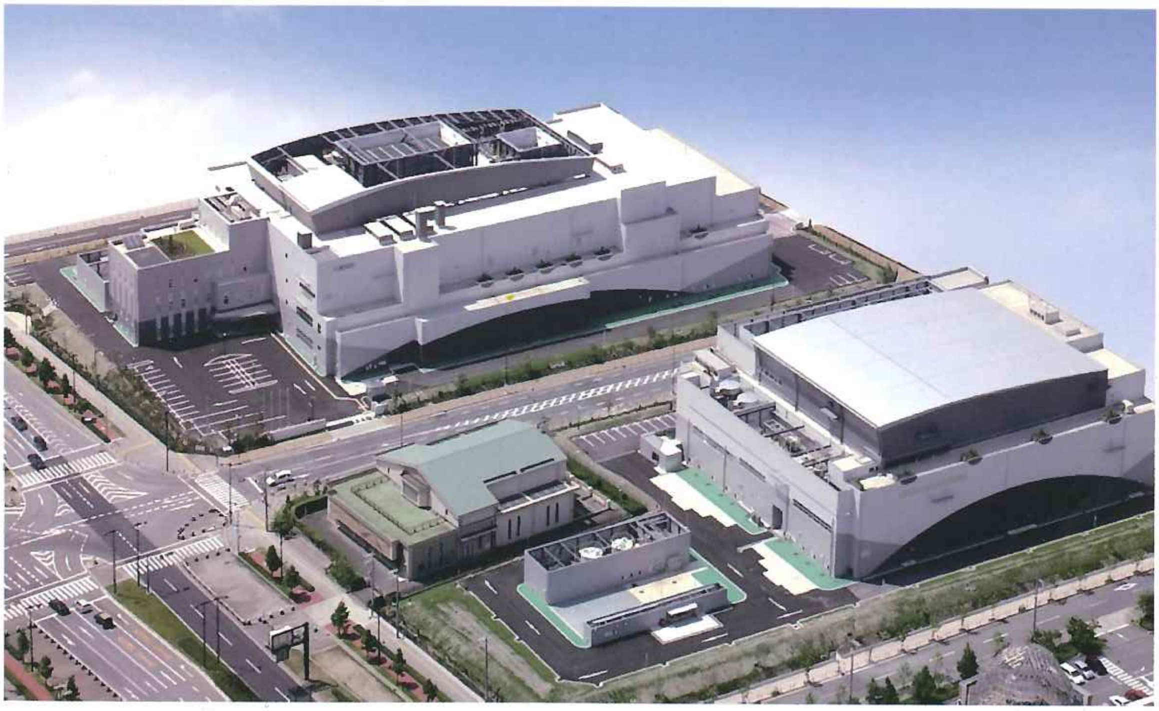
Outline of Osaka PCB waste treatment business

◇Address Hokkou-Shiratsu 2, Konohana-ku Osaka City, Osaka
◇Site area About 29,000㎡ (West Wing : about 16,000㎡, East Wing : about 13,000㎡)
◇Total floor space About 26,000㎡ (West Wing : about 18,000㎡, East Wing : about 8,000㎡)
◇Treatment capacity 2t /day(PCB decomposition volume)
◇Treatment object

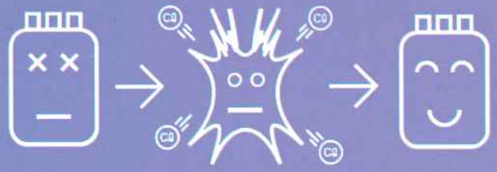
Type of waste	Wastes stored at	Wastes accepted outside assigned region
High voltage transformers and capacitors	B Region	Some train-mounted transformers and some special capacitors stored in C Region, some special capacitors stored in E Region
Ballasts and others	B Region(Only some small electrical equipment)	None

(Note) Each Region consists of the following prefectures
B Region : Shiga, Kyoto, Osaka ,Hyogo, Nara, and Wakayama Prefectures
C Region : Gifu, Shizuoka, Aichi, and Mie Prefectures
E Region : Hokkaido, Aomori, Iwate, Miyagi, Akita, Yamagata, Fukushima, Ibaraki, Tochigi Gunma, Niigata, Toyama, Ishikawa, Fukui, Yamanashi, and Nagano Prefectures

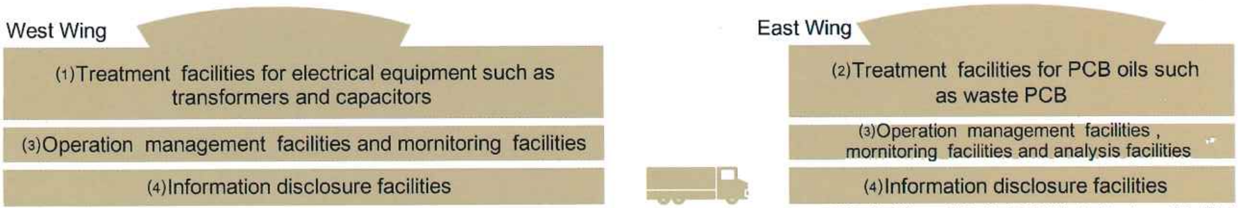
◇Treatment method PCB cleansing and separation of high voltage transformers and capacitors : Solvent Cleansing Method and Vacuum Heating Separation Method
PCB decomposition : Dechlorination Method
◇Start of operation October, 2006



Major facilities in the Treatment Facility and the outline of the treatment process are explained here



Osaka Waste Treatment Facility consists of the West Wing and the East Wing. There are (1)PCB cleansing and separation treatment facilities for electrical equipment such as transformers and capacitors in the West Wing ,(2)PCB decomposion treatment facilities for PCB oils such as waste PCB in the East Wing, (3)Management facilities to conduct safe operation, confirmation of the treatment, monitoring of discharge, etc. of these facilities in both the West and East Wings, and (4)Viewing and information disclosure facilities for active information disclosure of the PCB Treatment Facility and its operation in both the West and East Wings.

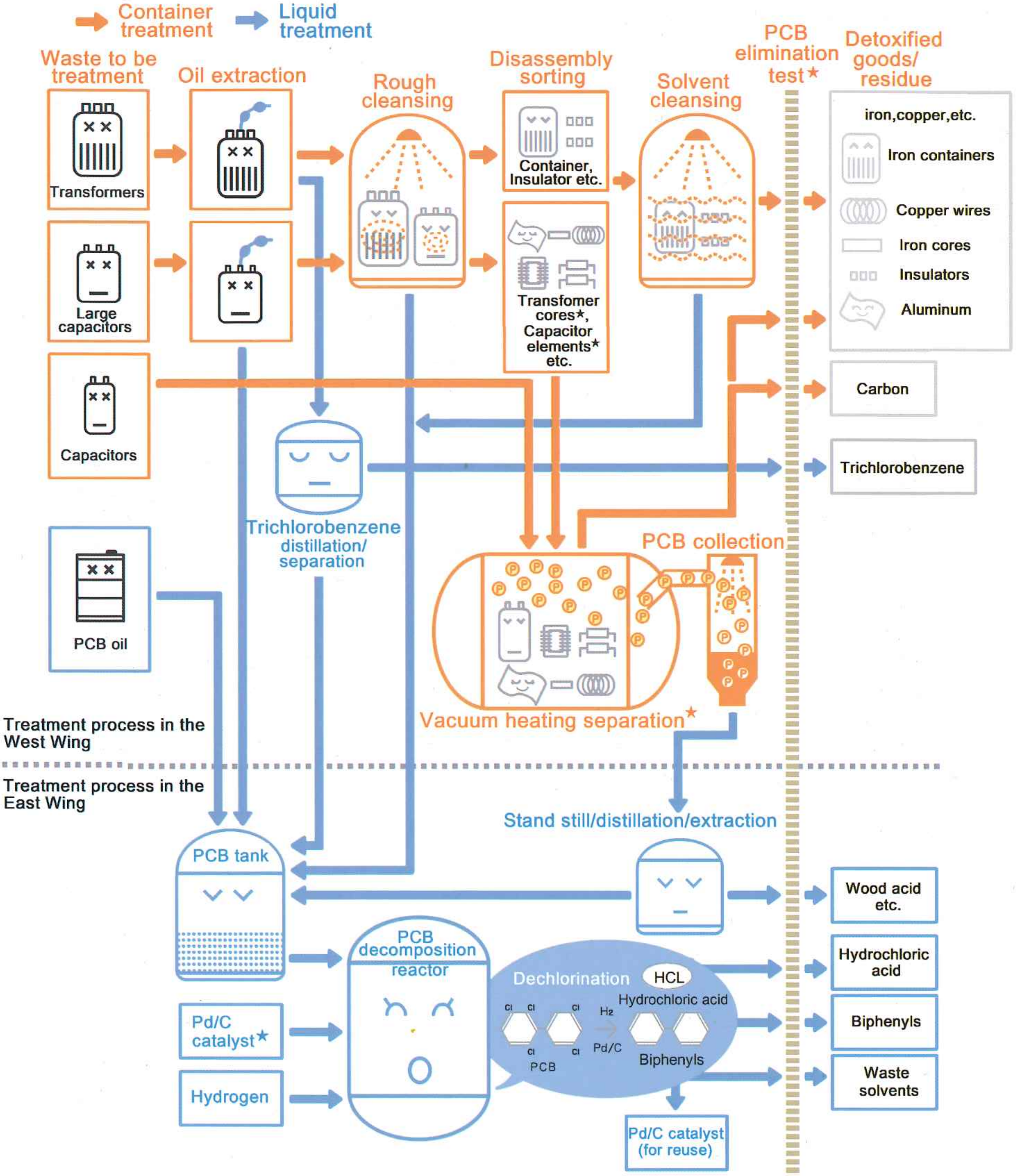


Major facilities of "Osaka PCB Waste Treatment Facility"

In the treatment facility, disassembly, sorting, Cleansing, and separation of waste containers and decomposition of liquid containing PCB are conducted

In the West Wing of the Treatment Facility, pre-treatment is conducted to remove PCB From transformers and capacitors by the Vacuum Heating Separation Method and Solvent Cleansing Method. In the East Wing, PCB which is taken out and collected in the West Wing is decomposed and detoxicated by the “Catalyst Hydrogeneration Dechlorination Method.” Materials treated in this Treatment Facility are separated into iron, copper, aluminum, hydrochloric acid, biphenyls, etc. and basically recycled.

Treatment process of electrical equipment such as transformers and capacitors and PCB oils such as waste PCB



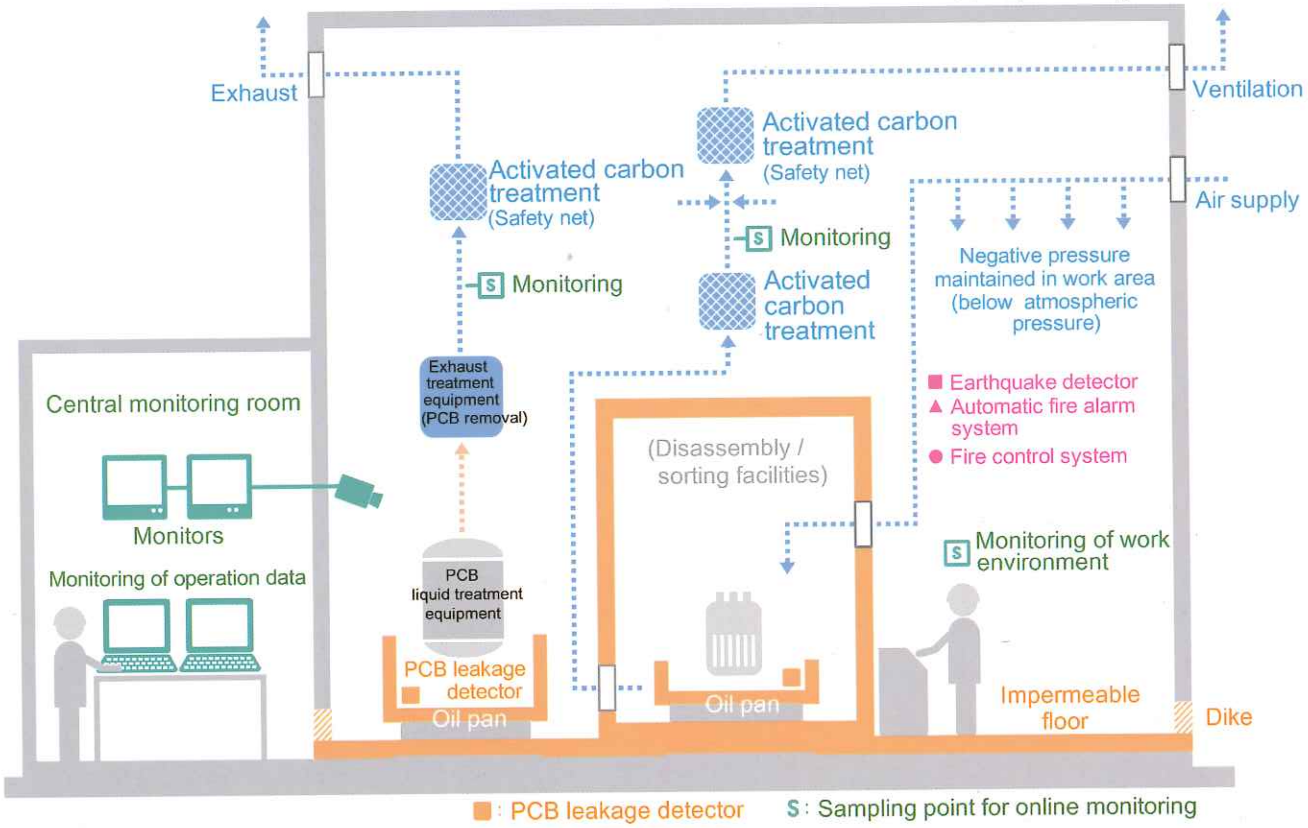
※Term description

- Pd /C catalyst ･････････(Palladium/carbon catalyst) Activated carbon with palladium (a kind of metal) on the surface
- Transformer core ･･････An internal part of a transformer that consists of an iron core and a coil (copper wire) wound around it
- Capacitor element ･････An internal part of capacitor in which pieces of insulating paper and aluminum sheets is stacked alternately
- Vacuum heating separation ････PCB in the treatment object is separated by heating under vacuum and sealed condition.
  Then separated PCB is collected by cold oil shower.
- PCB elimination test ････A test to confirm that the relevant treated material is no longer PCB waste when it is discharged from the Treatment Facility.

There are multiple safety and management measures taken In Osaka PCB Waste Treatment Facility

As safety measure facilities, Exhaust measure facilities, Leakage prevention measure facilities, and Emergency measure facilities are necessary for the PCB Waste Treatment Facility.
In addition, management facilities are installed for full-time monitoring of these safety measure facilities. The treatment operation is conducted under this thorough safety management system.

Conceptual diagram



Monitoring

Measure for Eexhaust

Measure to Prevent Leakage

Emergency Measures

Measure for exhaust : Exhaust from process is cleaned by oil scrubbers in the exhaust treatment equipment, and goes through activated carbon as a safety net before being released. Furthermore, the air pressure inside the facilities is kept lower than the atmosphere outside, to keep air from flowing outside.

Measure to prevent leakage : To prevent PCB from leaving the facilities, oil pans are set under PCB-handling areas and PCB treatment equipment. Floors are coated with epoxy resin that is impermeable, chemical resistant, and wear-resistant. These measures will prevent PCB from penetrating floors in case of a spilling. The oil pans and floors are equipped with detectors to identify leakage.

Emergency measures : When an earthquake above preset intensity is detected, facilities are shut down automatically. Also, to protect facilities from fire, automatic fire alarms, chemical fire extinguishers, and fire hydrants are installed.

Facilities for information disclosure such as information Disclosure room and tour routes are installed

Osaka PCB waste Treatment Facilities actively discloses information about the PCB treatment business such as documents about the facility, data related to the facility operation, and data related to the environment such as the monitoring condition of exhaust from the facility.
An information disclosure room and a presentation room are installed in the West Wing of the facility. In the information disclosure room, information about PCB treatment is freely accessible. In the presentation room, the outline of the facility and the safety of the PCB treatment are explained clearily. Also, tour routes are established in both West and East Wings for the safe tour of the major treatment facilities and treatment process. Furthermore, information related to the PCB waste treatment is posted on our web site.

In the West and East Wings of the PCB waste Treatment Facility

Tour route

Tour routes are installed for the safe tour of the major treatment facilities.

In the West Wing the PCB Waste Treatment Facility

Presentation room

Information such as the outline of the treatment safety is explained clearly.

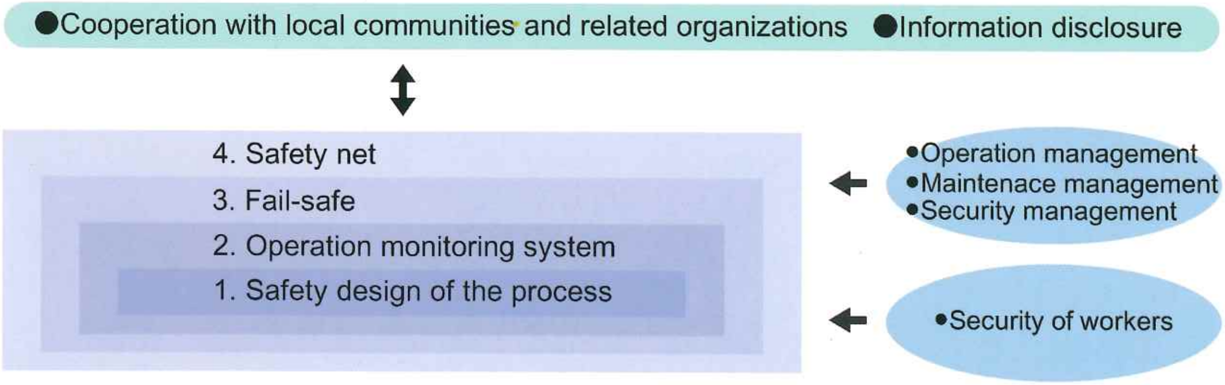
Information disclosure room

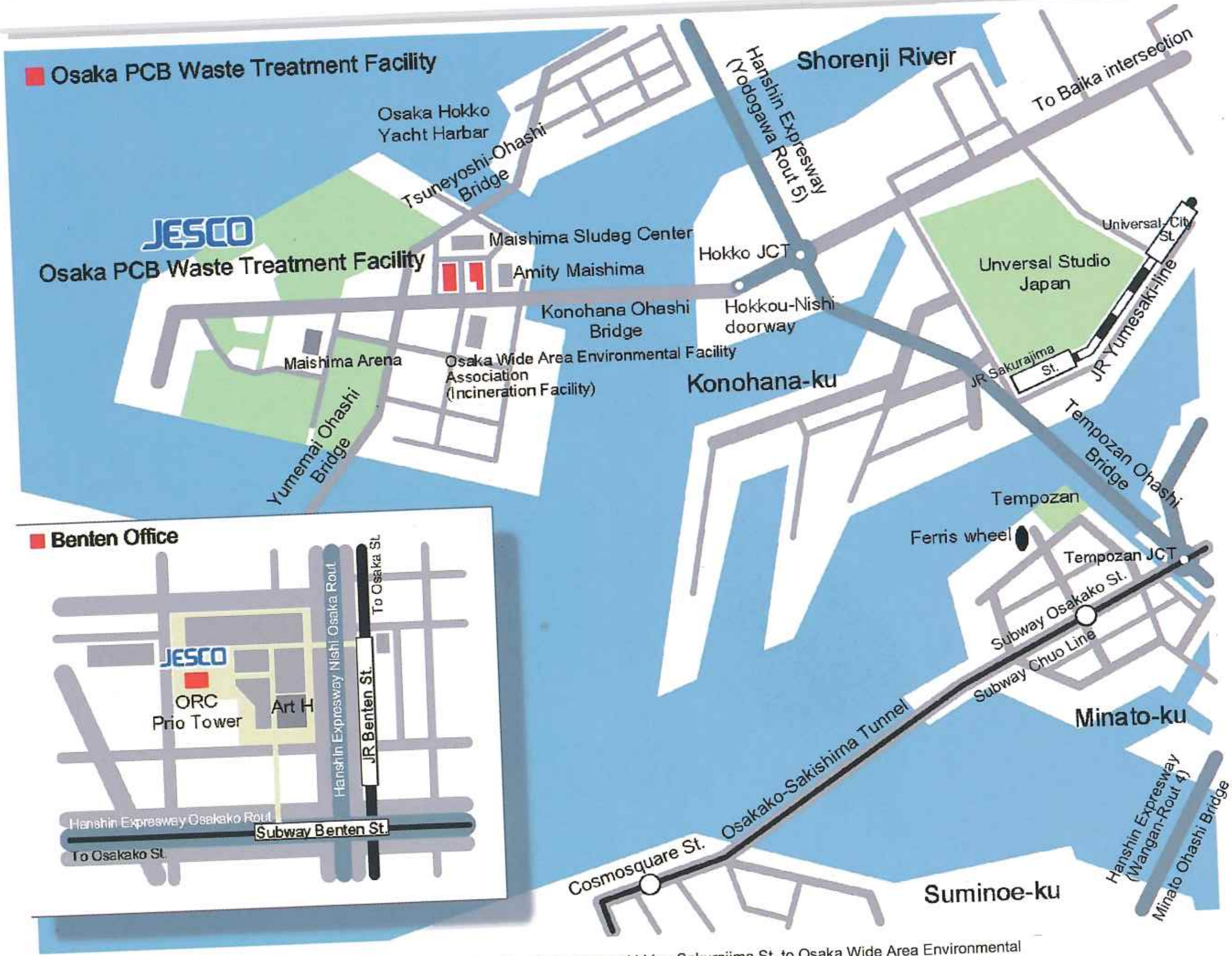
The operation and monitoring conditions of the process are displayed in real-time

Safe and secure management and operation are conducted in all PCB Waste Treatment Facilities operated by JESCO

The maintenance of PCB Waste Treatment Facility is conducted with strict confirmation of the safe and secure PCB waste treatment which reflects the local conditions, sufficient environmental and safety measures while the facility is operating, and ability to respond properly in case of emergency. In addition, thorough measures are conducted so that the exhaust, the discharged water, and the residues do not affect the environment.

●Outline diagram of safety design





■ Osaka PCB Waste Treatment Facility : Take a Maishima Acitve Bus from Yumesaki Line Sakurajima St. to Osaka Wide Area Environmental Facility Association(Incineration Facility) and walk for 3min.

■ Benten Office : Walk 1 min. from JR Osaka Loop Line Bentencho St. or walk 1 min. from Subway Chuo Line Benten St.

Osaka PCB Waste Treatment Facility,Osaka PCB Waste Treatment
Office : Japan Environmental Storage & Safety Corporation
2-4-13 Hokkou-Shiratsu Konohana-ku, Osaka City, Osaka 554-0041
TEL : +81-6-6468-0575 FAX : +81-6-6468-0576

(High Voltage transformers and capacitors)
Benten Office(Marketing), Osaka PCB Waste Treatment Facility
701, Prio Tower office 7F, ORC , Benten, Minato-ku, Osaka City, Osaka 552-0007
TEL : +81-6-6575- 5575 FAX : +81-6575-5576

(Ballasts and others)
Marketing Section(Kinki and Tokai Area Branch Office) Kitakyushu PCB Waste Treatment Office
702, Prio Tower office 7F, ORC , Benten, Minato-ku, Osaka City, Osaka 552-0007
TEL : +81-6-6575- 5585 FAX : +81-6575-5586

Japan Environmental Storage & Safety Corporation**(Headquarters)**
Sumitomo Fudosan Shiba Bldg, No.3 4F
1-7-17 Shiba Minato-ku, Tokyo 105-0014
TEL : +81-3-5765-1911 FAX : +81-3-5765-1938

■Inquiry contact <Commission of treatment > TEL : +81-3-5765-1933
<General aspects about PCB Treatment Business> TEL : +81-3-5765-1919
■Web site of Japan Environmental Storage and Safety Corporation https://www.jesconet.co.jp/
■Mail address for comments and questions jesco@jesconet.co.jp

R80
Percentage of Waste Paper pulp 80%

VEGETABLE OIL INK

(2019/5)

一般廃棄物焼却炉ボイラーのオンラインクリーニング技術
（水噴射方式＋圧力波方式）

近年、廃棄物焼却施設は発電施設としての機能も求められており、ボイラーの熱回収率は発電効率向上における重要な要素となります。
しかし、運転に伴い付着・堆積するダストが、ボイラーの熱回収率を低下させます。
この度当社では、欧州で実績があり大型ボイラーにも対応できる「SBG※製 水噴射クリーニング装置」を国内施設にてカスタマイズ。
実証試験を行い、その効果を確認しました。
この「水噴射クリーニング」を、「圧力波クリーニング」と共に**「JFE 高効率発電技術」**として展開してまいります。

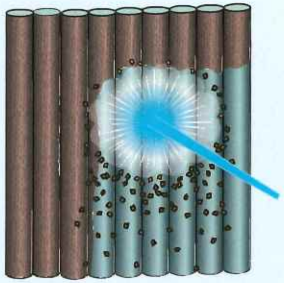
※Standardkessel Baumgarte GmbH 社（当社グループ会社）

従来の清掃方法

- 足場を組み人手でそぎ落とす
- ボイラー運転中には清掃できない（概ね年１回のボイラー停止時のみ清掃できる）

→ダストの堆積に伴い熱回収性能が低下

新技術

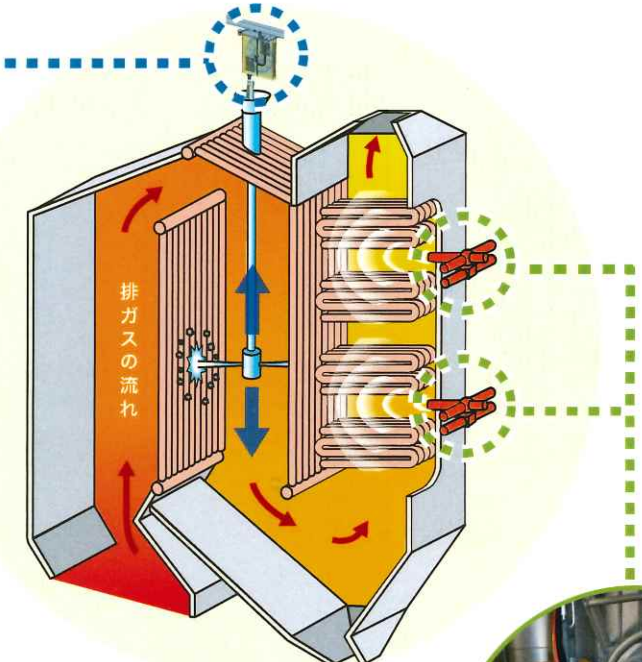


- 水の力でダストを剥離（壁面全体に適用可能）
- **ボイラー運転中でも清掃できる**

→常に熱回収性能をキープ

発電量UP!

水噴射クリーニング装置



圧力波クリーニング装置

水噴射クリーニングなし

水噴射クリーニングあり

蒸気式スートブロワ運転時

圧力波クリーニング装置運転時

JFE エンジニアリング 株式会社

On-line boiler cleaning technology for MSW incinerator

(Spray cleaning system + Shock pulse sootblower system)

In recent years, waste incineration facilities are also required to function as power generation facilities, and the heat recovery efficiency of the boiler is an important factor in improving the power generation efficiency.

However, dust that adheres and deposits during the operation, reduces the heat recovery efficiency of the boiler.

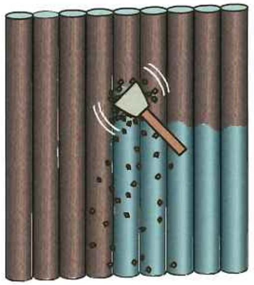
To solve this problem, JFE have optimized the "SBG* Spray cleaning system" at our domestic facilities. This system can be applied in large-scale boilers, and has a track record in Europe .

After the optimization, we conducted confirmed the effect.

Along with "Shock pulse sootblower system", we will develop this "water jet cleaning" as "JFE high efficiency power generation technology"

*Standardkessel Baumgarte GmbH (Overseas Subsidiary)

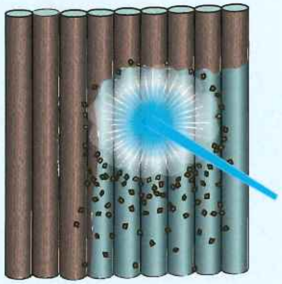
Conventional Technology



- Build scaffold inside the boiler, and remove the dust by hand.
- Cleaning cannot be done during the operation.
  (Can be cleaned during annual maintenence period)

→Heat recovery efficiency drops ad dust adheres.

New technology

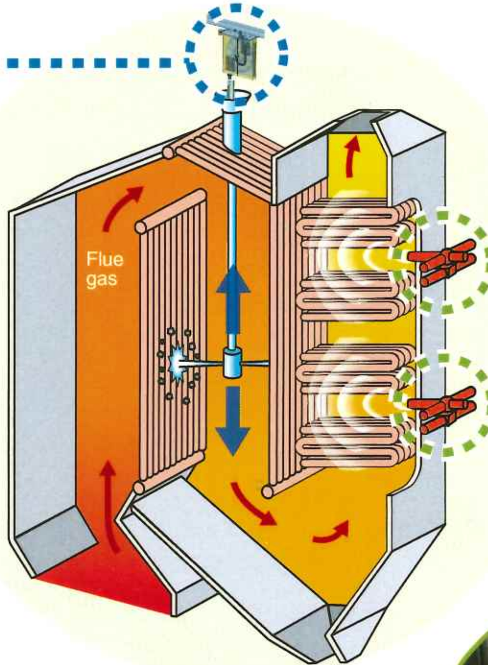


- Revoves the dust by water spraying. (Effects to all the radiation walls)
- Cleaning can be achieved during the operation.

→Keeps the efficiency high and stable.

Increase Power Output!!

Spray cleaning system



Shock pulse sootblower system

Without Spray cleaning

With Spray cleaning

Cleaning with steam sootblower

Cleaning with Shock pulse sootblower

JFE Engineering Corporation

舞洲工場

Maishima Incineration Plant

所在地 Location	大阪市此花区北港白津1丁目2番48 TEL.06-6463-4153 1-2-48 Hokkoshiratsu, Konohana-ku, Osaka
敷地面積 Area	約33,000m² Approx. 33,000 m²
処理能力 Disposal capacity	焼却設備　900t／日 Incineration: 900 t/day 粗大ごみ処理設備　170t／日 Bulky waste: 170 t/day
事業費 Cost	約609億円 Approx. 60.9billion Yen

工期 Construction period	着工　平成9年3月 Started in March 1997 竣工　平成13年4月 Completed in April 2001
建築規模 Construction	鉄骨鉄筋コンクリート造（一部鉄骨造） Reinforced concrete structure (Steel in some parts) 7階建（一部地下2階建） 7 stories aboveground, 2 stories partly below ground 建築面積　約17,000m² Building area: A7prox. 17,000 m² 延床面積　約57,000m² Floor area: Approx. 57,000 m² 煙突　内筒鋼板製、外筒鉄筋コンクリート造　高さ　120m Stack: Steel plate surrounded by reinforced concrete jacket, height:120 m

舞洲工場は環境マネジメントシステム
ISO14001の認証を受けた工場です

大阪市・八尾市・松原市環境施設組合

Osaka city・Yao city・Matsubara city environment facilities association

●粗大ごみ処理設備

不燃性粗大ごみの破砕

自転車などの不燃性粗大ごみは、いったん不燃性粗大ごみピットに貯えられた後、(ア)回転式破砕機に供給され、おおむね15cm以下の小片に破砕されます。回転式破砕機の中は蒸気で満たされ、可燃性ガスによる爆発を防止しています。

可燃性粗大ごみの破砕

一方、畳などの可燃性粗大ごみは、いったん可燃性粗大ごみピットに貯えられたあと、(イ)低速回転式せん断破砕機に供給され、約40cm以下の小片に切断されます。

鉄とアルミのリサイクル

回転式破砕機で破砕されたごみは、(ウ)磁選機(エ)アルミ選別機等で鉄・アルミを取り除かれます。その後、低速回転式せん断破砕機で破砕されたごみとともにコンベアでごみピットへ運ばれ焼却されます。

磁選機・アルミ選別機で回収された鉄・アルミは、それぞれ(オ)鉄造粒機(カ)アルミ造粒機により減容され、(キ)(ク)貯留バンカに貯えられます。その後、搬出、リサイクルされます。

Bulky Waste Disposal

Bulky waste that cannot be incinerated straight away is first crushed and then fed to the incinerator.

Incombustible Bulky Waste Crushing

Incombustible waste, such as bicycles, is dumped into a separate waste pit and fed to a hammer crusher (a) where it is crushed into pieces of 15 cm or smaller. The crusher is filled with steam to prevent explosion of combustible gas.

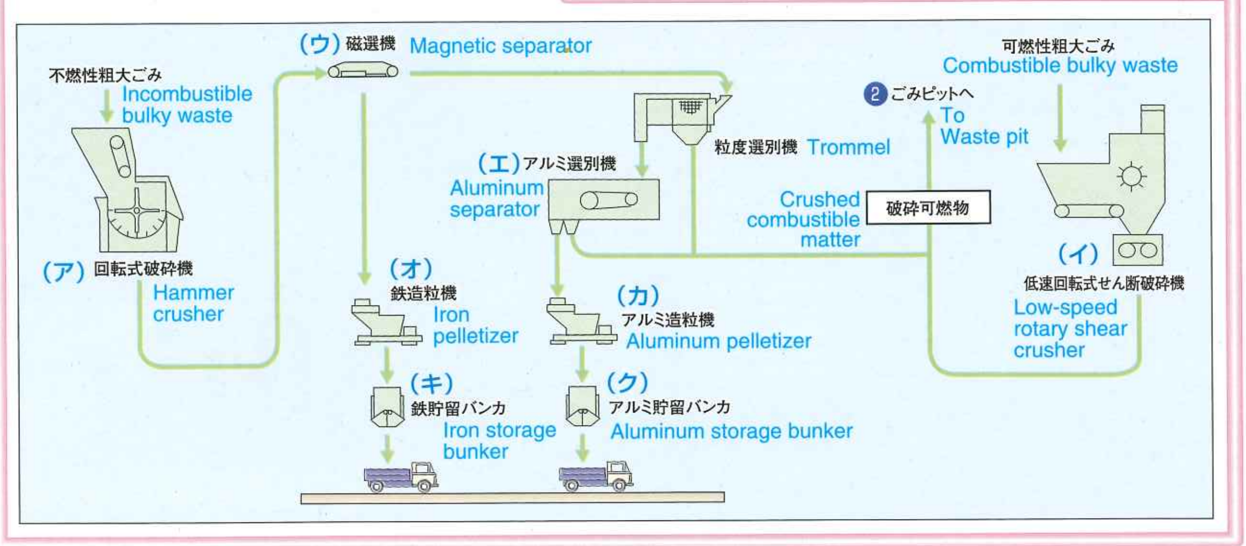
Combustible Bulky Waste Crushing

Combustible waste, such as tatami mats, is dumped into a separate waste pit and then fed to a low-speed rotary shear crusher (b) where it is sheared into pieces of 40 cm or smaller.

Iron and Aluminum Recycling

Iron and aluminum scrap is recovered from crushed waste by hammer crusher using a magnetic separator (c) and an aluminum separator (d). Everything left over after that is carried by conveyor to a waste pit and eventually incinerated.

The iron and aluminum recovered at the plant is reduced in size by an iron pelletizer (e) and an aluminum pelletlzer (f), respectively, and stored in bunkers (g) (h) until carried out for recycling.



焼却のしくみと公害対

■ごみの投入

収集してきたごみは、①投入扉から②ごみピットに投入します。③ごみクレーン操作室では、④ごみクレーンを遠隔操作し、ごみピットに貯留されたごみを⑤投入ホッパまで運びます。

■焼却

焼却炉には、給じん装置⑥乾燥火格子⑦燃焼火格子⑧後燃焼火格子が設備され、各火格子は固定火格子と往復運動する可動火格子で構成されています。投入ホッパに投入されたごみは、給じん装置により適量ずつ乾燥火格子上に送られ、乾燥したのち、燃焼火格子で燃焼、さらに後燃焼火格子で完全に灰となり、かさは燃焼前の約1/20になります。

■焼却灰

焼却灰は、水封された⑨灰出しコンベア上に落下し、冷却され、⑩灰ピットに送

一時貯留された灰は、

み込まれ埋立処分地まで

■空気の供給

② ごみピット内の臭気

機で吸引し、⑬空気予熱

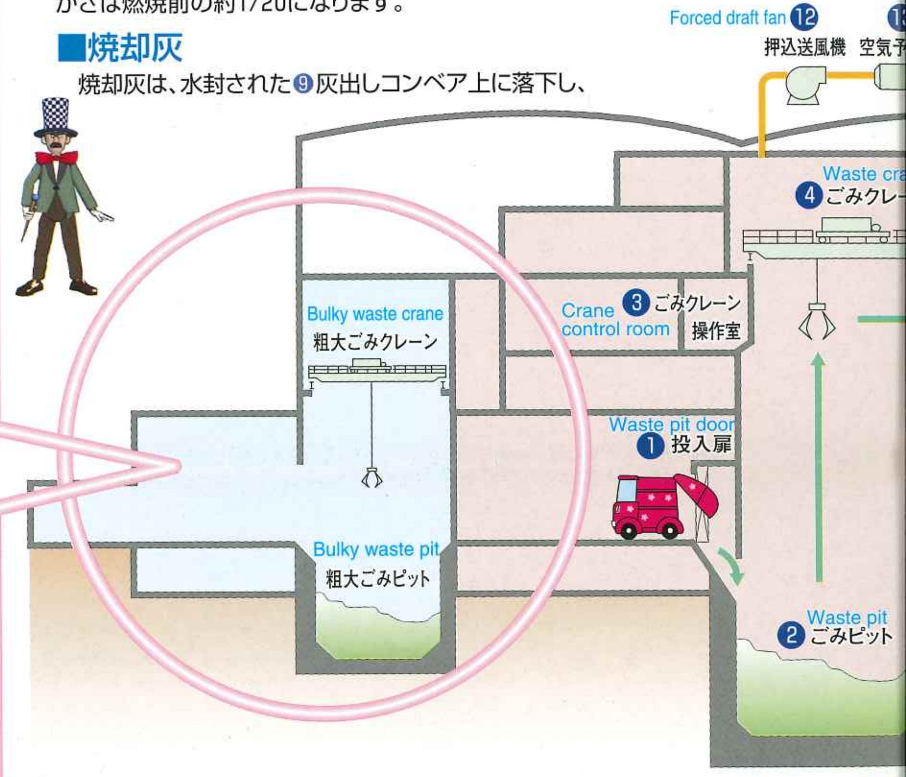
ごみの燃焼用空気として

給します。

■燃焼ガス・排水

燃焼ガスは約850℃～

るため、⑭ボイラで熱を



Waste Dumping

Waste is dumped into a pit ② through waste pit doors①. It is then dropped by a crane ④ which is operated remotely from the crane control room ③, into a feeding hopper⑤.

Incineratio

The waste incin
and a burn-out
repeat a recipro
The waste in th
feeder and is d
and then turned
waste is reduce

Incinerator

The incinerator
cooled, and it is
After sitting for
and carried to la

Air Supply

Air in the waste
a forced draft
supplied to the

Combustio

Combustion ga
by a boiler ⑭
cooled even fu

● Incineration of Combustible Waste ●

れます。
灰クレーンでトラックに積
ばれます。

含んだ空気は⑫押込送風
で約180℃に加熱したあと、
火格子の下から焼却炉に供

処理

0℃とな
収し、約

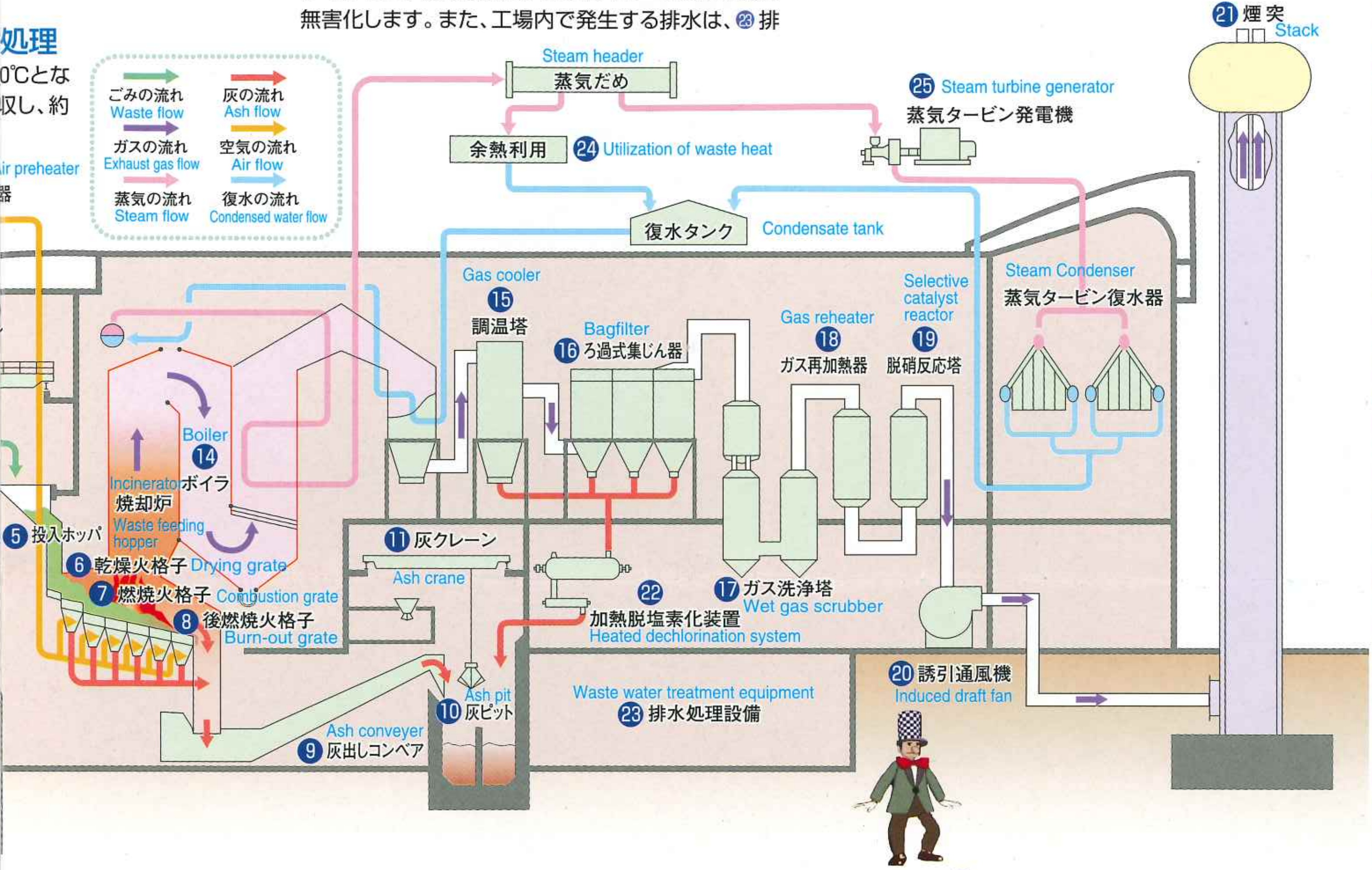
200℃としたのちに⑮調温塔で約150℃まで降温します。降温された排ガスは、⑯ろ過式集じん器でガス中のばいじんを除去したのちに⑰ガス洗浄塔で塩化水素、いおう酸化物を除去します。その後、⑱ガス再加熱器で約230℃に加熱し、⑲脱硝反応塔で窒素酸化物を除去します。きれいになった排ガスは⑳誘引通風機で㉑煙突に送り、大気中に放出します。

⑯ろ過式集じん器で除去したばいじんは㉒加熱脱塩素化装置で約400℃に加熱し、ばいじんに含まれるダイオキシン類を分解し、その後キレート処理により無害化します。また、工場内で発生する排水は、㉓排水処理設備で凝集沈澱及びろ過し、下水道に放流します。

■余熱利用

⑭ボイラで発生した蒸気は、建設局舞洲スラッジセンターへ供給、㉔工場内の暖房・給湯、洗浄後の排ガスの再加熱、(ア)回転式破砕機への供給などに利用すると共に、余剰の蒸気は積極的に㉕発電に利用し、工場内で使用する全ての電気をまかなっています。

さらに余った電気は電力会社に送電します。



ator is equipped with a drying unit ⑥, a combustion unit ⑦,
t ⑧. Each unit has both a fixed- and a moving grate that
ing motion.
hopper is carried little by little to the drying unit ⑥ by the
l. Once dried, it is incinerated on the combustion grate ⑦
mpletely into ash on the burn-out grate ⑧. In the process,
1/20 from its original size in volume.

sh

h is dropped onto a water-tight ash conveyor ⑨ where it is
en carried to a separate ash pit ⑩.
while, the ash is loaded onto trucks using an ash crane ⑪
fill sites.

② has a bad odor, so it is forced into an air preheater ⑬ by
⑫ and heated to about 180°C. After that, the hot air is
nerator as combustion air from underneath the grates.

Gas and Waste Water Disposal

s roughly between 850°C and 950°C. The heat is absorbed
order to bring the temperature down to about 200°C. It is
r to about 150°C in a gas cooler ⑮. The cooled gas is then removed of any fly ash by a bagfilter ⑯ and thereafter removed of toxic HCl and SOx by a wet gas scrubber ⑰. It is then heated to about 230°C by a gas reheater ⑱ and, in order to remove NOx, it is treated in a selective catalyst reactor ⑲. The clean gas is drawn to the stack ㉑ by an induced draft fan ⑳ and released into the atmosphere.

The fly ash removed by the bagfilter ⑯ is heated to about 400°C and the dioxins contained in the fly ash are broken down by the heated dechlorination system ㉒. The resulting ash is rendered harmless by treating it with chelate. In addition, the waste water generated by plant operations is treated on-site by coagulation sedimentation and filtration in the waste water treatment equipment ㉓ and discharged into the sewage system.

Thermal Recycling

The steam from the boilers is utilized on-site for floor heating, hot water, reheating gas㉔, and for preventing explosion in the hammer crusher (a). It is also used to generate electric power and enough electricity is generated ㉕ to meet the plant's entire demands.

Any surplus electricity that is generated is transmitted to the local power company.

自然との調和をめざして

Harmonize with Nature and Dream

舞洲工場の外観は、ウィーンの芸術家であるフリーデンスライヒ・フンデルトヴァッサー氏によりデザインされたものであり、建物が地域に根ざして、技術・エコロジー・芸術の融和のシンボルとなるよう意図されています。

自然界に直線や同一物が存在しないことから、各所の形状には意識的に曲線が採用されるとともに、建物は自然との調和の象徴として多くの緑で囲まれています。

壁面の赤と黄色のストライプは工場の内部で燃焼する炎をイメージし、表現しています。

The exterior of the Maishima Plant was designed by Viennese artist Master Friedensreich Hundertwasser. His intentions were to symbolize the harmony of technology, ecology and art by creating a structure with roots in the local area.

Since straight lines and identical objects do not exist in nature, Hundertwasser incorporated curved lines into each shape and encompassed the buildings in green as a symbol of harmony with nature.

The red and yellow stripes on the outside walls represent the combustion flames and tell what is being accomplished inside the plant.

1928年ウイーン生まれの画家で、自然保護建築のデザインでも有名です。

この舞洲工場も彼のデザインで、「技術、エコロジーと芸術の調和」をコンセプトに、自然を大切にする考え方が取り入れられております。

自然界には定規で引いたような直線や、全く同一のものは無いとの主張から、曲線を多く使い、極力同じものが無いデザインとなっております。

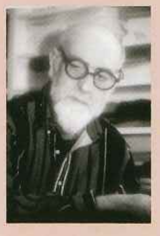
また、建物を建てると自然を破壊するので、それを補うために工場の周辺並びに建物緑化を積極的に行っています。

氏は世界各国を回り、世界循環展を催したり、浮世絵など日本の文化への関心も高く、名前を和訳した「百水」の雅号を持っていましたが、残念ながら、舞洲工場の完成を見ずに、2000年に71歳で永眠されました。

Master Friedensreich Hundertwasser (1928〜2000)

The exterior of the Maishima Plant was designed by Viennese artist Master Friedensreich Hundertwasser. His intentions were to symbolize the harmony of technology, ecology and art by creating a structure with roots in the local area.

Since straight lines and identical objects do not exist in the nature, Master Hundertwasser incorporated curved lines into each shapes and encompassed the buildings in green as a symbol of harmony with nature.



フリーデンスライヒ・フンデルトヴァッサー

フンデルトヴァッサー氏によるデザイン画
Drawing by Master Friedensreich Hundertwasser

■設備の概要 Equipment and specifications

焼却設備 Incineration

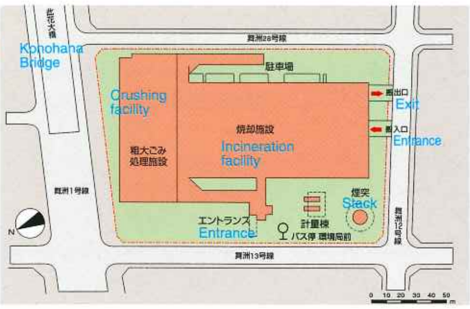
焼　却　炉 Incinerator	450t／日（階段式火格子） 450 t/day (Step combustion grates)	2基 2units
ごみ供給設備 Waste feeding	投入扉 Waste pit door	9面 9units
	ごみピット Waste pit	約15,000m³ Approx. 15,000 m³
	ごみクレーン Waste crane	2基 2units
灰出し設備 Ash unloading	灰出しコンベア Ash conveyor	2基 2units
	灰ピット Ash pit	約1,200m³ Approx. 1,200 m³
	捕集灰ピット Fly ash collection pit	約500m³ Approx. 500 m³
	灰クレーン Ash crane	2基 2units
通風設備 Ventilation	押込送風機 Forced draft fan	2基 2units
	誘引通風機 Induced draft fan	2基 2units
燃焼ガス冷却設備 Combustion gas cooling	自然循環式ボイラ Natural circulating boiler	2基 2units
排ガス処理設備 Exhaust gas treatment	ろ過式集じん器 Bagfilter	4基 4units
	ガス洗浄塔 Wet gas scrubber	2基 2units
	脱硝反応塔 Selective catalyst reactor	2基 2units
	捕集灰処理装置（加熱脱塩素化装置及び薬剤処理装置） Fly ash treatment equipment(Heated dechlorination and chemical treatment)	2系列 2units
排水処理設備 Waste water treatment		1式 1unit
計　装　設　備 Instrumentation	分散制御システム Distributed Control System	
	自動燃焼制御 Automatic combustion control	1式 1unit
余熱利用設備 Surplus heat use	場内暖房給湯 Hot water supply at plant	1式 1unit
	蒸気タービン発電機 Steam turbine generator	1基 1unit

粗大ごみ処理設備 Bulky waste Disposal

回転式破砕機 Hammer crusher	120t／5h 120 t/5h	1基 1unit
低速回転式せん断破砕機 Low-speed rotary shear crusher	50t／5h 50 t/5h	1基 1unit
粗大ごみ供給設備 Bulky waste feeding	不燃性粗大ごみピット Incombustible bulky waste pit	約2,400m³ Approx. 2,400 m³
	可燃性粗大ごみピット Combustible bulky waste pit	約1,000m³ Approx. 1,000 m³
	粗大ごみクレーン Bulky waste crane	2基 2units
選　別　装　置 Sorter		1式 1unit

配置図

Building layout



位置図 Site layout

公共交通機関でお越しの場合

- 大阪市営バス「此花大橋西詰」下車すぐ（JR環状線「西九条」駅から81系統「舞洲スポーツアイランド」行き乗車）
- 北港観光バス（循環バス）「環境施設組合前」下車すぐ（JRゆめ咲線「桜島」駅・大阪市営地下鉄「コスモスクエア」駅から乗車）

お車でお越しの場合

- 阪神高速5号湾岸線湾岸舞洲出口を出て、此花大橋をわたり一つ目の信号を左折
- 国道43号線梅香交差点から西へ直進し、此花大橋をわたり一つ目の信号を左折

再生紙を使用しています。　平成30年3月発行

The AhR: A Major Player in Cancer Aggression and Immune Checkpoint Regulation

David Sherr[1]

[1]School of Public Health, Boston University, Boston, USA, dsherr@bu.edu

Dr. Sherr received his B.A. from Brandeis University in 1973 and his PhD from Cornell University in 1978. He was a postdoctoral fellow at Harvard Medical School in the laboratories of Drs. Baruj Benacerraf (Nobel Laureate, 1980) and Martin Dorf from 1978 to 1981, after which he was appointed to the position of Assistant Professor (1982) and then Associate Professor (1987) of Pathology at Harvard Medical School. In 1993 Dr. Sherr was recruited to Boston University as Professor of Environmental Health and Professor of Pathology and Laboratory Medicine and is the Director of the Boston University Superfund Research Program and Director of the Find The Cause Breast Cancer Foundation Research Consortium. Since that time he has studied the role of the AHR in immune cell development and in tumorigenesis, specifically with regard to its role in production and function of immunosuppressive immune cells. He has published 127 peer-reviewed manuscripts. His lab has been continually funded by the NIH since 1986. He has trained 26 postdoctoral and 13 predoctoral fellows and 8 undergraduates, has served on 67 doctoral committees, and has won The Boston University School of Public Health Excellence in Teaching Award 3 times.

Hazardous chemicals in marine plastics and their threat to marine organisms

Takada H[1]

[1]Tokyo University of Agriculture and Technology

Marine plastic and microplastics are ingested by various sizes of marine organisms depending on the sizes of plastic fragments. Ingestion of larger items (e.g., ~ cm) by large marine organisms such as whales, sea turtles, and seabirds has been often reported since 1970s. Recently, ingestion of smaller plastics, i.e., microplastics (< 5 mm), by shellfish and fish has been reported. Trophic transfer accelerates dispersion of plastic throughout marine ecosystem. Large plastic items give physical damages on the biota. Microplastics may pose particle toxicity to marine organisms and ultimately to human.

In addition to the physical damages, marine plastics pose chemical threat to marine organisms because they contain variety of hazardous chemicals (Yamashita et al., 2018). Most of plastic products (i.e., user plastics) contain additives such as plasticizers, UV stabilizers, antioxidants, flame retardants to maintain their properties. Hydrophobic additives are retained in plastics and microplastics (Yeo et al., in this conference) in marine environment. Furthermore, plastics and microplastics sorb and accumulate persistent organic pollutants (POPs) from surrounding seawater due to their hydrophobic nature. International Pellet Watch (IPW; http://www.pelletwatch.org/) has been demonstrating the accumulation of POPs in microplastics on beaches across the world. Important finding of IPW is that microplastics with high concentrations of POPs are sporadically detected in remote areas, implying that microplastics carry POPs to remote areas with low background pollution. This is due to slow sorption/desportion of POPs to/from plastics and non-degradable nature of plastics.

Transfer of the hazardous chemicals from ingested plastics and their accumulation into the tissue of marine organisms has been demonstrated by leaching experiment (Tanaka et al., 2015), feeding experiment (Tanaka et al., in this conference; Teuten et al., 2009), exposure experiment (Wardrop et al., 2016), and field observations (Yamashita et al., 2011; Tanaka et al., 2013). Though hydrophobic additives are compounded into consumer plastics, their leaching from the products to food and drinks and exposure to human are basically unlikely due to their hydrophobic nature. However, when plastics are fragmented into smaller pieces in marine environment, and ingested by marine organisms, they may contact with oily components of digestive tract and additives can be leached to digestive fluid, transferred and accumulated in biological tissues. This is a new route of exposure of plastic additives to marine organisms and ultimately to human who consume seafood.

When risk associated with chemical exposure from ingested plastics is evaluated, it should be compared with that through natural prey. In case where background pollution level is higher such as industrial areas with legacy PCBs pollution, plastic-mediated exposure could be insignificant. However, in remote beaches where background pollution is low but huge amounts of plastics are stranded, plastic-mediated exposure is significant (e.g., Mizukawa et al., in this conference). Also, plastics could be a significant pathway of such additive that is not biomagnified to higher-trophic-level organisms. Accumulation of higher brominated diphenylethers in seabirds ingesting plastics is a typical example (Tanaka et al., 2013).

Microplastics are originally floating on sea surface but some of them sink to the bottom following the attachment of biofilm on microplastics (Zettler et al., 2013) which gives settling force to the microplastics. Microplastics were detected in bottom sediments (e.g., Matsuguma et al., 2017). Because of their low density, microplastics can be easily resuspended and laterally transported. Plastics have high affinity of hydrophobic compounds including legacy POPs in bottom sediments. Therefore, microplastics may remobilize the legacy POPs and may prolong the legacy pollution for longer time. Dynamic transport of microplastics in marine environments as well as their role as vector of POPs should be studied in future efforts.

MODELLING PERSISTENT ORGANIC POLLUTANTS: MECHANISTICALLY LINKING CHEMICAL PRODUCTION TO HUMAN EXPOSURE AND HEALTH EFFECTS

Wania F[1], Li L[1], Arnot JA[1], McLachlan MS[2]

[1]Department of Physical and Environmental Sciences, University of Toronto Scarborough, Toronto, Ontario, Canada M1C 1A4, frank.wania@utoronto.ca; [2] Department of Environmental Science and Analytical Chemistry, Stockholm University, Stockholm, Sweden

This presentation will seek to briefly retrace the history of mechanistic environmental fate modeling of persistent organic pollutants, with a particular focus on how the scope of such modeling has gradually expanded from initial efforts to quantify individual chemical fate processes to integrated modeling systems that can link the production volume of an organic chemical with the biological effects that may be expected to occur in humans and wildlife. The motivations for mechanistic modeling of exposure to persistent organic pollutants are manifold, and include risk assessment and management, support of biomonitoring and epidemiological investigations, and the identification of chemicals and human populations with high exposure potential. A particular focus will be on highlighting the benefits of adopting an integrated modelling strategy for persistent organic pollutants, specifically with respect to the ability to account for lag periods between emissions and exposure as well as for shifts in the main exposure route over time. If there had been a change in chemical use and emission scenario, exposure factors, or the environment over time, a mechanistic representation of the relevant processes allows for the quantification of the implications of such changes for the time-variant contaminant exposure of organisms at the top of the food chain. Examples include bans on production and use of a substance, intergenerational changes in the dietary habits of an exposed population, or climate change. We will also address the key challenge of integrated modelling approaches, which is to preserve the simplicity and parsimony of successful modeling practice while acknowledging the inherent complexity of the processes and relationships to be described.

HUMAN BIOMONITORING AND EXPOSOMICS OF LEGACY AND EMERGING CHEMICALS

Covaci A[1]

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Human biomonitoring methods are well established for the exposure assessment of many chemicals, including persistent organic pollutants (POPs). Such methods have resulted in establishing measures for regulations, following time trends of concentrations in human populations and in establishing reference values and ranges for a selected group of 250–300 known persistent and non-persistent chemicals.

Yet, as more and more chemicals are added to the market, there is an increasing need to estimate the human exposure to these emerging contaminants. Recent efforts and advances in mass spectrometry have seen the unprecedent rise of screening techiques with the aim to identify emerging contaminants and/or their metabolites present in humans. Such analytical approaches are 1) target screening; 2) suspect screening and 3) non-target (or untargeted) screening by high-resolution mass spectrometry (HRMS). Using such advanced tools, we can capitalize even more on the identification of life style-specific exposure profiles, i.e. compounds that may differ in relation to specific behavioural patterns.

Furthermore, the use of HRMS screening techniques allows the coupling of human biomonitoring with the exposome approach. An exposomic approach (exposomics) theoretically includes all exposures of potential health significance, whether they are derived from exogenous sources (e.g., pollutants, diet, drugs) or endogenous sources (e.g., hormones, human and microbial metabolites). Since levels of chemicals in biological samples reflect a wide range of exposures (biomarkers of exposure), but also consequences of exposures (biomarkers of effect), exposomic biomonitoring offers an efficient means for characterizing the overall individual exposure profiles. Incorporating the exposome paradigm into traditional biomonitoring approaches offers a means to improve exposure assessment in many ways.

With only a few hundred chemicals routinely measurable through targeted methods and with limitations for short-lived compounds, exposomic approaches are critical to understanding the daily exposure to thousands of chemicals and the consequences of exposure in exposome-wide association studies (EWAS).

The processing of rich sets of data from untargeted analyses offers a path for discovering health-impairing exposures that have thus far escaped scrutiny, a largely unrecognized benefit of exposomics. This should give guidance towards more accurate prevention measures that protect against exposure to (emerging) environmental contaminants and their substitutes in new materials and products.

DIOXIN AND HEALTH EFFECTS IN VIETNAMESE

PART 1. ENVIRONMENTAL DIOXIN IN VIETNAM

Minh NH
Ministry of Natural Resources and Environment, Hanoi, Vietnam, lab.dioxin@gmail.com

Introduction

From 1961 to 1972, under the Operation Ranch Hand carried out by the US Army, about 74 million litres of defoliants were sprayed to destroy forest canopies and crops belonging to the North Liberty Army[1]. The defoliants contained the chlorinated phenoxy herbicides as active ingredients in the formulations labelled as Agent Orange, Agent Purple and Agent White with Agent Orange nearly contributing half of total defoliant volume[2].

More importantly, most of the defoliants contained the extremely toxic by-products dibenzop-dioxins and polychlorinated dibenzofurans (PCDD/Fs). The total amount of PCDD/F sprayed during Vietnam war was between 366 and 1223 kg toxicity equivalency quotient (TEQ)[2] which can be compared to today's global dioxin inventory of approximately 140 kg/year[3].

Agent Orange/Dioxin hot spots that exist today are USA military areas where Agent Orange was stored, leaked and spilled thereby causing elevated contamination of PCDD/Fs in soils[4]. It should be noted that so far, the contaminated soil in two major Agent Orange hot spots in Da Nang and Phu Cat have been remediated using "in-pile thermal desorption" and "secure landfill", respectively.

Besides, about 1.125 million ha of land was sprayed once by the defoliants while 0.382, 0.136, 0.048, and 0.019 million ha were documented as being sprayed 2, 3, 4, and ≥5 times, respectively[5]. The results of this spraying were that large areas of land were denuded of broad leaf vegetation as well as grasses.

PCDD/Fs are also known to be formed and emitted from different thermal processes such as waste incineration, metallurgical production, cement production, coal-fired power plants and industrial boilers. Besides, concerns on emission of dioxin and dioxin related chemicals with regards to uncontrolled burning of wastes in Vietnam have also been increasing. In this context, open burning of municipal wastes and thermal processing of e-waste for metal recovery are of concerns.

In this study, results from recent studies in Vietnam on contamination and emission of dioxin from such above important source categories are compiled to provide an assessment on current status of the environment contamination and sources of PCDD/Fs in Vietnam.

Material and method

Soil and sediment were collected from various sites in Vietnam for determination of the 17 most toxic PCDD/Fs congeners. Sampling sites included Agent Orange hotspots and their vicinities, lands sprayed by Agent Orange in the past, open dumping sites and e-waste recycling villages.

Stack gas samples were collected by isokinetic method (US EPA method 23) from industrial facilities for waste incineration, metallurgical production, cement production, coal-fired power plants. Bottom ash samples were also collected accordingly.

All samples were determined for 17 PCDD/Fs congeners by isotope dilution method using high resolution gas chromatography coupled with high resolution mass spectrometer (HRGC/HRMS, R>10,000).

Results and discussion

Contamination of PCDD/Fs in AO hot spots and their vicinities

The Da Nang airbase was a major Ranch Hand facility during the American War in Vietnam. Levels of dioxin have been found to be as much as 365,000 pg TEQ/g, more than 365 times the Vietnamese standard for industrial soil. In a joint US-Vietnam project, about 94,000 m^3 of the contaminated soil/sediment plus an additional 68,000 m^3 of "lower risk material" were decontaminated using in-pile thermal desorption and landfill technologies, respectively[6].

In Phu Cat airbase, several sites were found to have levels of PCDD/Fs higher than the remediation standard (1000 pg TEQ/g for in soil or 150 pg TEQ/g for sediment). The Government of Vietnam implemented a cooperation project with UNDP for containment of 7,000 cubic meters of dioxin contaminated soil on the base using secure landfill technology.

The Bien Hoa airbase (south of Vietnam) is now the most severe AO hot spot in Vietnam. PCDD/Fs concentration was 7.6-960,000 and 17-4,860 pg TEQ/g in soil and sediment, respectively, implying very high contamination in this airbase. A study funded by USAID has estimated 408,500 to 495,300 m^3 of contaminated soils and sediments are located on or nearby the airbase. On May 11, 2018, USAID and the Vietnam Ministry of National Defense signed a non-refundable aid agreement for the decontamination of Bien Hoa airport. The cooperation was projected to take 10 years at an estimated cost of $390 million and approximately 500,000 m^3 of soil and sediment are to be decontaminated[7].

Surveys on bioaccumulation of PCDD/Fs in animals living in the above airbases demonstrated that local animals such as fish, chicken, duck can accumulate elevated PCDD/Fs levels depending on their habitats. For example, in Bien Hoa airbase, PCDD/F concentration in fish collected within the airbases are from 75 to 288 pg TEQ /g wet wt. Biota samples outside of the hot spots have lower PCDD/F concentrations. In Bien Hoa airbase, TEQ in lipid basis were 26 pg/g for fish, 13 pg/g for eggs, 20 pg/g for chicken, 4.5 pg/g for meat. The mean TEQ in Da Nang airbase was slightly lower, 12.9 pg/g for fish, 8.7 pg/g for eggs, 5.9 pg/g for chicken, 6.7 pg/g for meat and 0.17 pg/g for vegetables[8-9].

Elavated concentrations of PCDD/Fs in mother breast milk are observed in corhots living near the Bien Hoa, Da Nang and Phu Cat hot spots, ranging from 9.3 - 23 pg TEQ/g lipid which is significantly higher compared to those in the scraft communes and agriculture villaages (1.4 – 4.3 pg TEQ/g lipid)[10-12].

Contamination of PCDD/Fs from industrial and municipal sources

In open dumping sites, toxic chemicals such as PCDD/Fs, PCBs, etc can be formed and released to the environment due to uncontrolled burning of municipal solid wastes by waste pickers and natural methane gas generation. PCDD/F levels in soil from dumping areas in Hanoi and Hochiminh city ranged from 0.4 to 850 TEQ pg/g compared to 1 to 1.15 pg/g in control sites[13]. Suzuki et al also reported elevated PCDD/Fs levels in soil at open-burning sites (3.8-143 TEQ pg/g) compared to those in e-waste processing workshops (0.28-17.6 pg TEQ/g)[14].

Studies for PCDD/F releases from industrial thermal processes in Vietnam showed that stack gas PCDD/F concentrations were 0.048 - 0.166 ng TEQ/Nm^3 in steel plants, 0.033 - 0.837 ng TEQ/N m^3 in cement kilns[15], 0.07 – 44 ng TEQ/Nm^3 in industrial waste incinerators, 0.012 – 0.44 TEQ ng/Nm^3 in medical waste incinerators, 0.016 – 0.31 ng TEQ/Nm^3 in coal-fired power plants, 0.016 – 1.66 ng TEQ /Nm^3 in coal-fired industrial and craft boilers[16]. PCDD/Fs in ambient air in three different regions in Vietnam (Hochiminh, Da Nang and Lao Cai cities) were studied, showing concentration of 139 fg I-TEQ/ Nm^3, 65.2 fg I-TEQ/ Nm^3 and 21.3 fg I-TEQ/ Nm^3, respectively[17]. Interestingly, while congener profile of PCDD/Fs in Hochiming city is mostly related to industrial sources, those in Da Nang city demonstrated an important source of 2,3,7,8-TCDD which is suspected to be from the nearby Agent Orange hot spot.

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PART 2.   DIOXIN AND HEALTH IN VIETNAM

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Introduction

Between 1962 and 1971, the United States Air Force sprayed approximately 107 million pounds of herbicides in South Vietnam for the purpose of defoliation and crop destruction. During the course of this operation, hundreds of thousands of U.S. service personnel and millions of Vietnamese were exposed to the chemicals in the air, water, and soil and through food raised on contaminated farms. Agent Orange is known to affect immune system, reproduction, nervous system, and changing steroid hormone levels. Most studies on the adverse health effects induced by herbicide/dioxin have been focused on American veterans, whereas there are few studies concerning the relationship between dioxin and health effects in Vietnamese. Since 2002, we have been continuously researching the dioxin and health in Vietnam. Recently, we have focused the steroid hormone as an early indicator of dioxin-induced health effects[1-3]. The aim of this study is to evaluate the endocrine-disrupting effect of dioxin levels on adrenal steroid hormones in children from 1 to 7-year-old children in a previous herbicide-exposed regions in Vietnam.

Materials and methods

Three regions, namely Phu Cat, Binh Dinh Province and Bien Hoa, Dong Nai Province (hot-spots) and Kim Bang, Ha Nam Province (non-exposed region), were selected for study. Breast milk samples were obtained from lactating mothers aged 20 to 30 years from both regions between 2008 and 2011, who had given birth to their children aged from 4 to 16 weeks. In the first cohort study, in 2011 saliva samples from 3-year-old children and in 2013 and 2015, blood samples from grown-up 5 and 7-year-old children were collected in the morning each time in Phu Cat and Kim Bang. Finally, 78 children (34 from Phu Cat region and 44 from Kim Bang region) participated in this cohort study. In the second cohort study, since 2011 saliva samples from 1-year-old children and in 2013 and 2015, saliva and blood samples from grown-up 3 and 5-year-old children were collected in the morning each time in Bien Hoa and Kim Bang. Finally, 52 children (26 from Bien Hoa region and 26 from Kim Bang region) participated in this cohort study.
Three salivaly hormones (cortisol, cortisone, dehydroepiandrosterone (DHEA)) and 6 serum hormones (cortisol, cortisone, 17-OH- progesterone (p4), progesterone, androstenedione (A-dione), testosterone) were determined by liquid-chromatography/tandem mass spectrometry (LC-MS/MS); dioxin levels in breast milk were measured by gas-chromatography-high resolution mass spectrometry (GC-HRMS).

Results and discussion

Dioxin levels in breast milk were siginificantly higher in hot-spot than non-sprayed region. In the first cohort study, on comparison of steroid hormones in saliva of 3-year-old children between two regions, DHEA was siginificantly lower in female of hot-spot than those in non-exposed region, while other steroid hormones showed no siginificant difference. On comparison of steroid hormones in serum of 5-year-old children between two regions, testosterone showed siginificantly lower concentrations in both sexes of hot-spot rather than those in non-exposed region. On comparison of steroid hormones in serum of 7-year-old children between two regions, progesterone and A-dione showed siginificantly higher concentrations in both sexes of hot-spot rather than those in non-exposed region, while testosterone showed siginificantly lower concentrations in both sexes of hot-spot rather than those in non-exposed region . On the relationship between dioxin levels in breast milk and steroid hormones in serum of 5-year-old children, testosterrone showed significantly negative relationships of both sex. On relationship between dioxin levels in breast milk and steroid hormones in serum of 7-year-old children, progesterone and A-dione showed significantly positive relationships of both sex and testosterrone showed significantly negative relationships only in male.
In the second study, age-related change in DHEA, cortisol and testosterone levels are given. Levels of DHEA increased from 1 year of age to 3 years of age, and decreased from 3 years of age to 5 years of age in Bien Hoa. Levels of testosterone decreased from 3 years of age to 5 years of age in the hotspot district, but increased from 3 years of age to 5 years of age in the non-sprayed district.
Our recent study showed dioxins effected the synthesis of dehydroepiandrosterone in three-year-old Vietnamese children[2]. From this study, we could confirm dioxin affected some steroid hormones till seven-year-old children. Dioxin exposure through breast milk might reflect the body burden of fetus and suppose a critical period of

dioxin exposure to disrupt endocrine at least in the childhood. Levels of testosterone decreased from 3 years of age to 5 years of age in the hotspot district, but increased from 3 years of age to 5 years of age in the non-sprayed district.

Acknowledgements

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HISTORICAL TREND OF DIOXIN EMISSIONS FROM MUNICIPAL SOLID WASTE INCINERATORS IN JAPAN

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Introduction

Municipal solid waste (MSW) incineration is a major source of dioxin emissions to the atmosphere. In Japan, a large proportion of MSW is incinerated for sanitary reasons, and because of a shortage of disposal sites. To prevent emissions, various countermeasures have been applied since dioxins were first discovered in MSW incinerator (MSWI) fly ash in Japan [1]. In 1990, the Ministry of Health and Welfare (MHW) issued Guidelines for Preventing the Emission of Dioxins from MSWI and examined potential solutions to the problem of these emissions [2]. However, because the guidelines were not regulatory and follow-up assessments were inadequate, it was difficult to determine whether the proposed solutions had the desired effect. In January 1997, the MHW produced the updated Guidelines for Preventing the Emission of Dioxins from MSWI—Program to Reduce Dioxins [3]. At almost the same time, high levels of soil contamination were found in Nose, Osaka [4]. After amending the ordinances in the Air Pollution Control and Waste Management and Public Cleansing Acts, the Act on Special Measures against Dioxins, the world's first legislation pertaining specifically to dioxins, was enacted on January 15, 2000.

Figure 1 shows the trend in total dioxin emissions to the atmosphere in Japan from 1997 to 2017. Over that 20-year period, dioxin emissions decreased dramatically, from 7,680–8,135 g toxic equivalent concentration (TEQ)/year in 1997 to 106–107 g-TEQ/year in 2017. The emissions from small-capacity waste incinerators, industrial waste incinerators and MSWIs all decreased remarkably. The ratio of waste incineration to total waste decreased from 94% in 1997 to 50% in 2017. MSWIs accounted for 65~69% of all waste incinerated in 1997, but this had decreased to 38% by 2017.

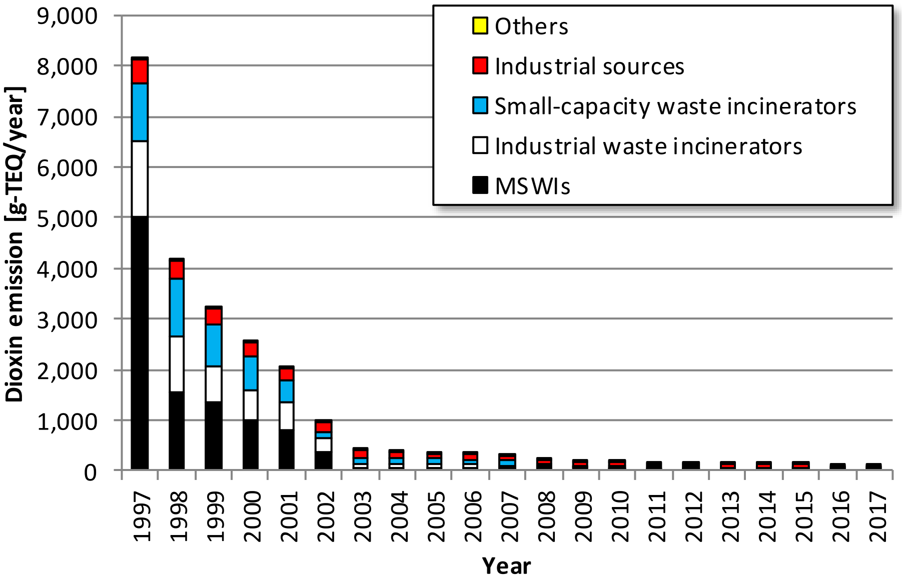

Figure 1 Total dioxin emissions to the air in Japan from 1997 to 2017.

Several papers have discussed the effectiveness of various measures for preventing dioxin emissions [3,5], and large reductions were observed following the improvement of combustion condition and introduction of bag filters and catalytic reactors. Although dioxin emissions from waste incineration decreased, Minomo reported that dioxins originating from combustion predominated in the atmosphere in Saitama Prefecture, Japan, and that the dioxin concentrations in rainfall still largely exceeded the environmental standard (1 pg-TEQ/L) [6].

To determine the effects of MSWIs on future dioxin levels, it is important to forecast changes in dioxin emissions from this source. The effects of renovating old MSWIs on dioxin emissions should be evaluated. MSWIs have recently been characterised as facilities for recovering energy from waste, and various technologies have been developed to achieve this [7]. These technologies can have positive or negative effects on dioxin formation and emissions from MSWIs. It is necessary to confirm that state-of-the-art MSWIs are effective in terms of both energy recovery and dioxin reduction.

Using national dioxin emissions data, this study evaluated the dioxin concentrations in exhaust gas and emissions to the air (ng-TEQ/ton of MSW incinerated) in the year of construction of MSWIs, to determine the effectiveness of the dioxin reduction and energy recovery policies. Future emissions were estimated according to renovation and renewal of MSWIs.

Materials and methods

The data used in this paper were collected by local governments and the Ministry of the Environment of Japan, as mandated by the Act on Special Measures against Dioxins of 2018. The data on dioxin concentrations in exhaust gas were analysed. Here, dioxins include polychlorinated dibenzodioxins (PCDDs), dibenzofurans (PCDFs) and dioxin-like polychlorinated biphenyls (PCBs). The emissions from each facility were calculated by multiplying the amount of MSW incinerated (tons /year) by the dioxin concentration in the exhaust gas (ng-TEQ/Nm^3), and by the amount of exhaust gas per ton of incinerated MSW (Nm^3/ton-MSW). However, due to data entry errors in the amount of exhaust gas data, we used only the amounts of exhaust gas ranging from 2,000 to 10,000 (Nm^3/ton-MSW).

Results and discussion

Concentration distribution of dioxin in exhaust gas

Figure 2 shows the dioxin concentrations in exhaust gas according to the year of construction of the MSWIs. In 60~70% of the MSWIs constructed up to 2000, the dioxin concentration was less than 0.1 ng-TEQ/Nm^3; it was 0.1–1 ng-TEQ/Nm^3 in 25~30% of the MSWIs and exceeded 1 ng-TEQ/Nm^3 in the remainder. The MSWIs constructed up to 2000are treated as existing facilities, such that the emission standard differs from that for facilities constructed after 2000, as shown in Table 1[8]. Overall, 20~30% of the MSWIs produced 0.1–1 ng-TEQ/Nm^3. All of the MSWIs complied with the emission standards after renovations had been completed.

For more than 90% of the MSWIs constructed after 2000, the dioxin concentration was less than 0.1 ng-TEQ/Nm^3; it was 0.1–1 ng-TEQ/Nm^3 in the remainder. None of the MSWIs produced more than 1 ng-TEQ/Nm^3 dioxin, which suggests that the various policies introduced were effective at reducing dioxin emissions.

The dioxin concentrations in exhaust gas decreased with increasing capacity of the MSWIs. Compared with MSWIs constructed up to 2000, dioxin concentrations were lower in those constructed after 2000, even in small facilities.

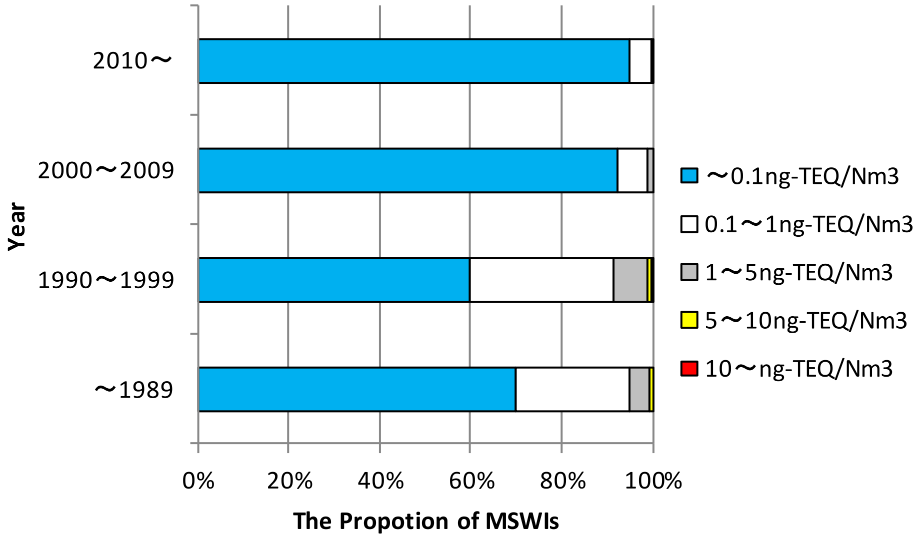

Figure 2 Dioxin concentration distribution in exhaust gas according to the year of construction of municipal solid waste incinerators (MSWIs)

Table 1 Dioxin emission standards for MSWI exhaust gas [8]

Source	Capacity (t/h)	Newly constructed facility (ng-TEQ/Nm^3)	Exsiting facility (ng-TEQ/Nm^3)
MSWIs (grate area: > 0.5 m^2 or capacity : >50 kg/h)	> 4	0.1	1
	2 to 4	1	5
	< 2	5	10

Dioxin emission factors

As mentioned above, there were errors in some of the exhaust gas volume data; these were removed from the analysis. However, 96.4% of the total available data were still included in the analysis, allowing major trends to be accurately determined. The total emissions amount, for all MSWIs combined, was 15.56 g-TEQ/year. This value was divided by the total waste incinerated yearly (32.6 million tons), to yield an average dioxin emissions per ton of incinerated waste of 476 ng-TEQ/ton of MSW incinerated. According to the PCDD/PCDF emission factors for a category 1a MSWI, as stated in article 5 of the Stockholm Convention on Persistent Organic Pollutants (POPs) pertaining to the identification and quantification of dioxins, furans, and other unintentional POPs, this value is roughly equivalent to the emission factor in class 4 “High technology combustion, sophisticated APCS”: i.e. 500 ng-TEQ/ton of MSW incinerated [9]

Figure 3 shows the dioxin emissions to the air according to the year of construction of the MSWIs. The emissions from facilities constructed after 2000 were dramatically lower than those for facilities constructed up to 2000 (700~900 ng-TEQ/ton-MSW incinerated for the older MSWIs). There was variability in emission amounts among MSWIs constructed after 2000; the average emission amount was 50 (range: 10–120) ng-TEQ/ton of MSW incinerated, which is 1/10 of the lowest PCDD/PCDF emission factor for a category 1a MSWI according to article 5 of the Stockholm Convention on POPs.

The power-generation efficiency of MSWIs has recently improved. In 2009, the Ministry of the Environment of Japan produced a publication pertaining to the development of high-efficiency waste-based power plants. Energy recovery from flue gas can be improved by installing an economiser, instead of a cooling tower, before the air pollution control device, or lowering the operating temperature of (or removing) the denitrification reactor. Although these measures might increase dioxin emissions, this was not seen for recently constructed MSWIs, which suggests that there is no trade-off between dioxin emissions and energy recovery.

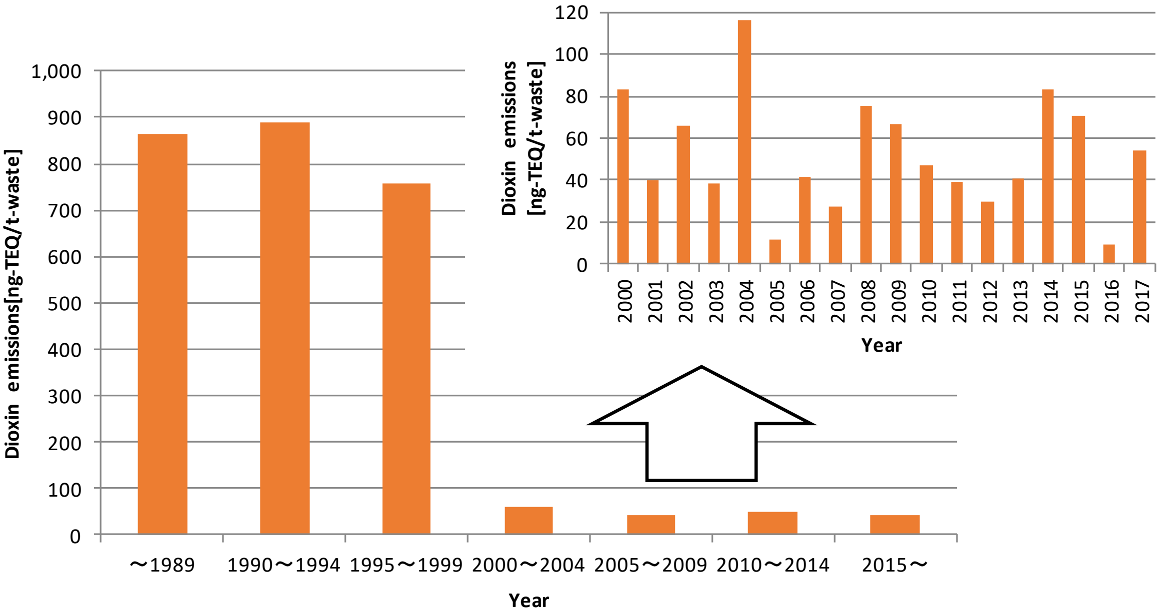

Figure 3 Dioxin emissions to the air according to year of construction of MSWIs

Future dioxin emissions from MSWIs

Figure 4 shows the number of MSWIs by years of operation. The service lifetime of an MSWI depends on maintenance efforts (in turn dependent on technological innovations therein and the budget of the local government), among other factors. The typical service lifetime of an MSWI is considered to be 40 years. Therefore, MSWIs constructed up to 2000 should be completely renovated by 2040, to achieve the levels of emissions of facilities constructed after 2000. The Japanese population is projected to decrease to 110.9 million by 2040.

Assuming that the amounts of MSW generated and MSW incineration rate remain the same, dioxin emissions from MSWIs will decrease to 2 g-TEQ/year by 2040, such that the contribution of MSWIs to total dioxin emissions will be reduced significantly.

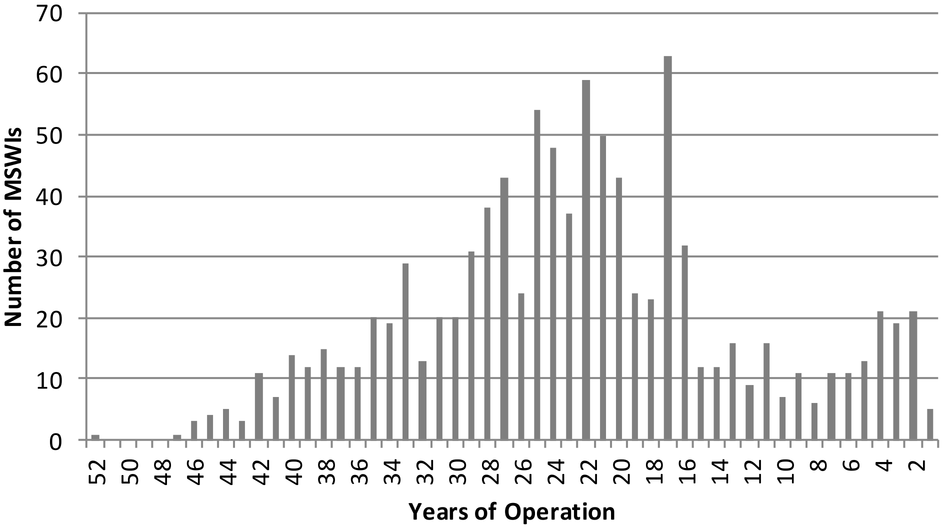

Figure 4 The number of MSWIs according to years in operation.

Conclusions

The dioxin emissions from MSWIs in Japan decreased dramatically from 1997 to 2017, with the introduction of various countermeasures. In all facilities, the dioxin concentration in exhaust gas complied with emission standards based on capacity and year of construction. The dioxins emissions to the air averaged 476 ng-TEQ/ton of MSW incinerated, which is equivalent to the lowest PCDD/PCDF emission factor for an MSWI according to article 5 of the Stockholm Convention on POPs. For MSWIs constructed after 2000, the average emission amount was 50 ng-TEQ/ton of MSW incinerated, or 1/10 of the lowest PCDD/PCDF emission factor for MSWIs of the Stockholm Convention. After 2000, various methods for increasing the power generation efficiency of MSWIs were introduced, none of which have influenced dioxin emissions. As the MSWIs constructed up to 2000 are renovated, dioxin emissions will decrease, and are projected to fall to 2 ng-TEQ/year by 2040. Herein, although dioxin emissions to the air from MSWIs were assessed, dioxins as incineration residues, such as fly ash and bottom ash, were not examined due to data limitations. Therefore, future studies should evaluate examine the total dioxin emissions from MSWIs.

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THE INFLUENCE OF PCDD/F MEMORY EFFECT FROM SCRUBBING SYSTEM IN FULL-SCALE MUNICIPAL SOLID WASTE INCINERATION

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1. Introduction

Municipal solid waste incineration (MSWI), an effective waste disposal method, gets increasingly popular for the advantages of volume reduction, safe disposal, and energy recovery[1-3]. However, polychlorinated-ρ-dibenzodioxins and dibenzofurans (PCDD/Fs) have received the global attention because of their extreme toxicity and high risk to human health[4-6].

For some waste-to-energy plants, especially the newly-built ones, usually a wet scrubber as the final step to be set for achieving ultra-low emission of acid pollutant and dust. Wevers et al. and Lehner et al. reported the positive effect of PCDD/Fs removal efficiency by WSS[7-8]. Other researchers found the converse results that wet scrubbing system (WSS)ncreased the emission concentrations of PCDD/Fs in flue gas by ten-folds, even though the inlet concentrations were very low[9]. Previous studies explain the obvious rise of PCDD/Fs from inlet to outlet of WSS as "memory effect"[10-11]. Some researches were carried out[9-10, 12], summarizing two mechanisms of memory effect including (i) surface adsorption/desorption of PCDD/Fs; (ii) entraining of scrubbing solution and fine particles[10] have been proposed, and the former is usually considered as the major one.

Few studies concerning "memory effect" have been conducted in China for the less utilization of WSS before. In addition, almost no study focuses on the gas- and solid-phase distribution and the mass balance of PCDD/Fs around the inlet/outlet flue gases, sludges, fillings and solutions of WSS. The present study is mainly carried out in three full-scale municipal solid waste (MSW) incinerators subordinated with WSS, two mechanical grate (MG) (30 t h^{-1}) incinerators and one circulating fludized bed (CFB) (23 t h^{-1}) incinerator. The PCDD/F characteristics in flue gas at the inlet and outlet, in sludges, fillings, and solutions are systematically analyzed to reveal the influencing mechanisms of memory effect on PCDD/F emissions in a WSS of MG MSW incinerator. A comprehensive mass balance model for PCDD/Fs of 1# WSS is also built.

2. Materials and methods

2.1 MSWI system

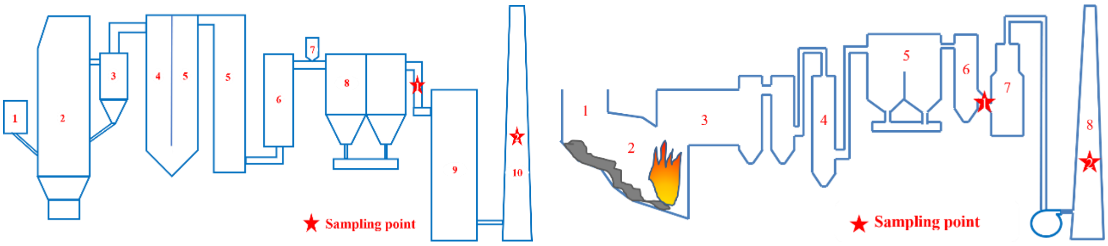
2.1.1 CFB incinerator

The CFB incinerator co-combusts MSW of high moisture content and with coal. The weight ratio of coal/MSW is 0.2.

This MSWI system (Figure 1a) mainly includes a feeder (1), a furnace (2), a cyclone separator (3), a secondary combustion chamber (4), a boiler (5), a semi-dry scrubber (SDS) (6), a fabric filter (FF) (7-8), a WSS, (9) and a stack (10).

2.1.2 MG

As shown in Figure 1b, the two similar incinerators with the same technological process are mainly composed of a feeder (1), a furnace (2), a superheater (3), a SDS (4), a FF (5), a selective catalytic reduction (SCR) (6), a WSS (7), and a stack (8).



(a) (b)

Figure 1. Systemic diagram of the MSWI

2.2 Experimental design

This study focuses on the emission signatures and changes between the inlet and outlet of WSS, and further analyzes the potential mechanisms and influencing factors of memory effect. All three MSW incinerators were operating normally during sampling period.

Two sampling positions of flue gas are set for each WSS, which are inlet (sampling position 1#) and outlet (sampling position 2#), in order to observe the influence of memory effect on PCDD/F emissions. The WSS was cleaned (renewing the scrubber solution and cleaning the sludge) after the first round of sampling (A). Then the second round of sampling (B) started after 12 hours. Further sampling about the sludges, the fillings and the scrubbing solutions were conducted only in the WSS of 2# MSWI. Memory effect is investigated through comparing the PCDD/F concentrations and signatures from inlet to outlet of the WSS at each condition, combining with building the mass balance in 2# WSS. Sampling PCDD/Fs in the flue gas of MSWI was conducted under stable operation and lasts for 6 h (2 h for each one Sample), Thus three parallel samples at each sampling position were obtained. As for the sludge, filling and scrubbing solution, only one sample for each of them is collected for analysis.

2.3 Sampling and analysis

PCDD/Fs in flue gases were collected by an isokinetic sampler (Model KNJ23, KNJ, Korea) followed the US EPA method 23a. The pretreatment procedures of PCDD/F samples follow the US EPA method 1613. The purified samples are analyzed through a high-resolution gas chromatography/high-resolution mass spectrometry (HRGC/HRMS) (JMS-800D, JEOL, Japan). The toxic equivalents (TEQ) are calculated using NATO/CCMS factors[13]. The concentration of PCDD/Fs in gaseous samples is normalized to dry air of 11% O_2 at 101.3 kPa and 0 ℃.

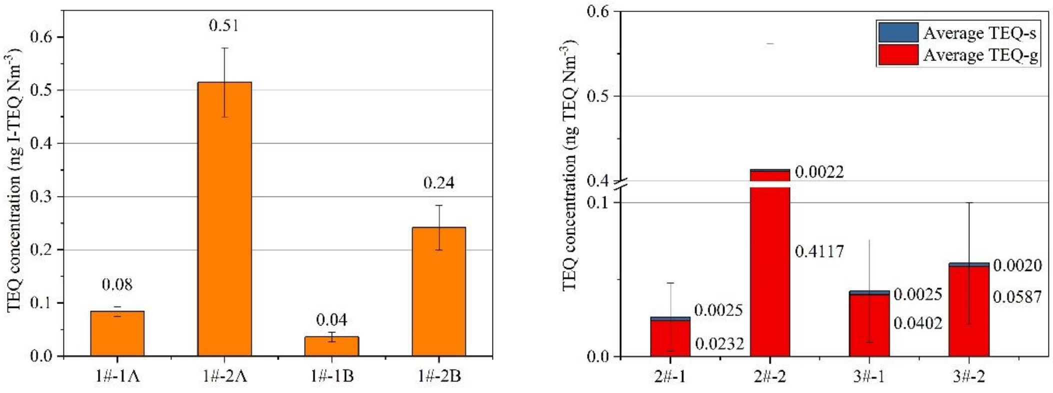
For observing the distribution of PCDD/F congeners from the MG samples detailly, the gas-phase part (adsorbed by XAD-2 resin) and solid-phase part (fine particulars on filter membrane) of all flue gas samples were separated for pretreatment and analysis. In laboratory, the concentration of PCDD/Fs in filling is analyzed by cleaning the surface ash and resining the surface by acetone and toluene, respectively, then the concentration is calculated through dividing the total amount by the weight of surface ash, whose average value is about 0.37 g in each PP filling.

3. Results and discussion:

3.1 Influence of memory effect

3.1.1 Influence on PCDD/F concentration

The TEQ concentration of PCDD/Fs in flue gas is elevated by 6.2, 6.7, 13.6 and 3.0 times, respectively, for 1# (A and B) and 2#, 3# WSS (Figure 2 and Table 1). The TEQ concentrations in inlet flue gas are 0.08, 0.04, 0.03 and 0.02 ng I-TEQ Nm-3 (Fig.2), which all meet the national standard for PCDD/F emissions from MSW incineration in China (0.1 ng I-TEQ Nm^{-3}). The WSS raises the PCDD/F emission concentrations of 1# and 2# WSS to beyond the national standard. As shown in Figure 2 and Table 1, the PCDDs/PCDFs-ratios in flue gas are decreased by the WSS. The PCDD/F concentrations of sludge, filling and solution are 220.32 ng g^{-1}, 77.15 ng g^{-1}, and 4.66 ng L^{-1} (7.28 ng I-TEQ g^{-1}, 1.80 ng I-TEQ g^{-1}, and 0.23 ng I-TEQ L^{-1}), respectively, as in Table 1. The PCDDs/PCDFs-ratios in sludge and filling are 2.69 and 2.99, respectively, showing a dominative position of PCDDs. Conversely, the ratio in scrubbing solution is 0.87, closer to that in outlet flue gas (0.71). Considering the better desorption capacity of PCDFs than PCDDs, the decline of PCDDs/PCDFs-ratios from inlet to outlet flue gases (i.e., from 2.76 to 0.71) is attribute to the PCDD/F desorption from solution, more accurately, from suspended solid (SS).



(a) (b)

Figure 2. TEQ concentration of PCDD/Fs

3.1.2 Influence on gas-solid distributions

As shown in Figure 2b and Table 1, The memory effect mainly affects the gas-phase PCDD/Fs, and the solid-phase PCDD/Fs barely change between the inlet and outlet flue gas. The concentrations of solid-phase PCDD/Fs slightly increase (Table 1), although the proportions of solid-phase PCDD/Fs in outlet flue gas decrease compared with that of inlet, directly indicating the solid-phase PCDD/Fs discharging from WSS.

Specifically, a part of particles existing as SS in solution and the surface ash of filling, which adsorb PCDD/Fs, discharge from solution and filling to the flue gas flow.

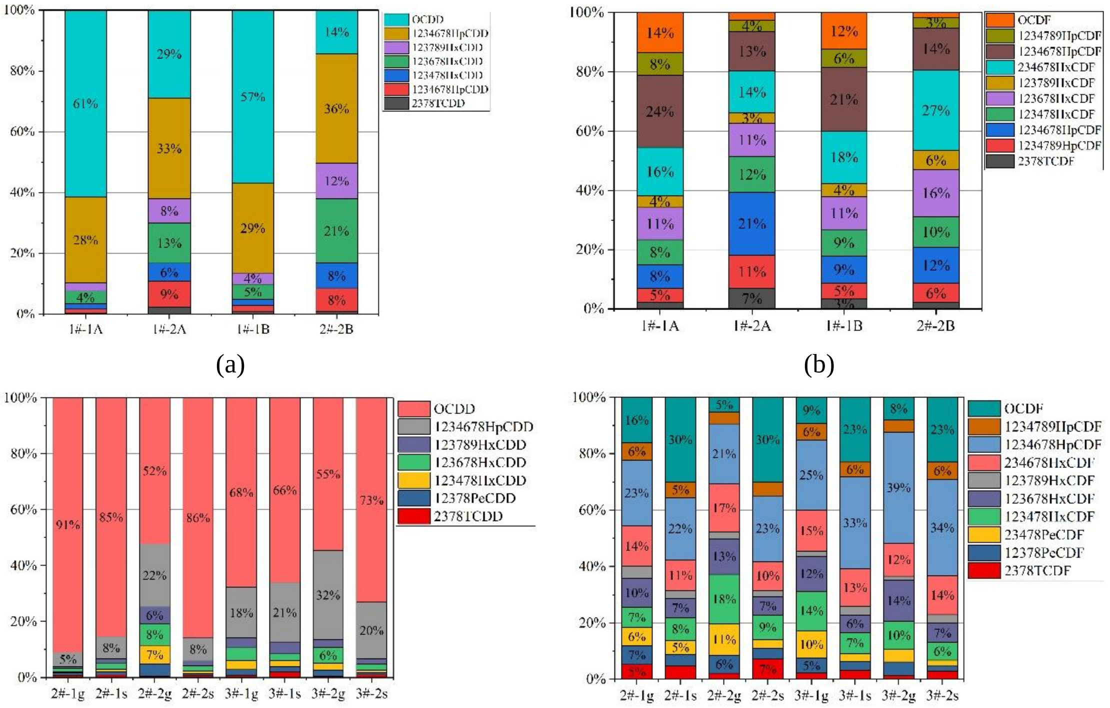
Table 1. Concentrations of PCDD/Fs in different wet scrubbing systems

	1#				2#					3#		Unit
	Inlet Flue A	Outlet Flue A	Inlet Flue B	Outlet Flue B	Inlet Flue	Outlet Flue	Sludge	Filling	Water	Inlet Flue	Outlet Flue	
∑PCDDs	0.71	0.58	0.22	0.36	0.58	1.98	160.61	57.80	2.17	0.29	0.46	ng Nm^{-3}
∑PCDFs	0.78	2.84	0.3	1.63	0.21	2.81	59.71	19.34	2.49	0.21	0.52	
∑PCDD/Fs	1.49	3.42	0.52	1.99	0.80	4.79	220.32	77.15	4.66	0.50	0.98	
∑TEQ	0.08	0.51	0.04	0.24	0.03	0.41	7.28	1.80	0.23	0.02	0.06	ng I-TEQ Nm^{-3}
∑PCDD/Fs-gas	\	\	\	\	0.73	4.72	\	\	\	0.47	0.92	
∑PCDD/Fs-solid	\	\	\	\	0.07	0.07	\	\	\	0.04	0.06	
∑PCDD/Fs-gas/∑PCDD/Fs	\	\	\	\	0.91	0.98	\	\	\	0.93	0.94	
∑PCDDs/∑PCDFs	0.92	0.20	0.75	0.22	2.76	0.71	2.69	2.99	0.87	1.36	0.87	
∑PCDFs/(∑PCDD/Fs)	0.52	0.76	0.57	0.82	0.27	0.59	0.27	0.25	0.54	0.42	0.53	
Stand. Dev. PCDD/Fs	0.49	0.57	0.13	0.34	0.35	2.71	\	\	\	0.04	0.39	Duplicate experiments
Stand. Dev. TEQ	0.009	0.065	0.0091	0.042	5.36	0.28	\	\	\	0.00	0.04	

3.1.3 Influence on the distribution of PCDD/F homologues

The profiles of seventeen 2,3,7,8-substituted PCDD/F-congeners in flue gas are shown in Figure 3. Both the gas-phase and solid-phase PCDD/Fs are dominated by the high-chlorinated homologues of PCDDs (HxCDDs to OCDD). Comparing the samples of inlet and outlet, the distribution of gas-phase PCDD/Fs changes apparently, however, the congener distribution of 2# and 3# WSS almost keep similarly changing trends (Figure 3c, d). In particular, the proportions of high-chlorinated homologues of PCDD/Fs (e.g., OCDD/F) in gas-phase and solid-phase both decrease. The congener distribution of solid-phase PCDD/Fs slightly changes, reflecting a slight or even ignorable influence of WSS. It is concluded that memory effect mainly increases the lower-chlorinated homologues in gas-phase, but barely affects the PCDD/Fs in solid-phase. Usually, higher chlorinated homologues are easily adsorbed onto particles due to their lower saturated vapor pressure, i.e., higher chlorinated homologues are harder release from particles, thus influence the distribution of PCDD/Fs.

In summary, the memory effect works on the following three aspects: (i) increasing the total mass concentration of PCDD/Fs, (ii) enhancing the occupations of low-chlorinated PCDD/Fs, and (iii) rising the proportions of PCDFs in PCDD/Fs.



(a) (b)

(c) (d)

Figure 3. Distribution of the 2,3,7,8-substituted PCDD/Fs: (a, c) PCDD fingerprints; (b, d) PCDF fingerprints.

3.2 Mass balance in 2# WSS

For 2# WSS, the mass balance of PCDD/Fs in WSS mainly has two stages since the first operating day of WSS: (i) dominated by accumulating; (ii) dominated by discharging. And the former is the preparation for the second stage or the memory effect. And the latter is the reflection of memory effect. In other words, a similar model can be established as following equation:

Input = (Adsorption - Desorption) + Output

Considering that the samples stand for few hours, the mass balance of PCDD/Fs in WSS 2# is calculated throughout 1 h as a period based on the operation parameters and Table 1. The results are shown in Figure 4.

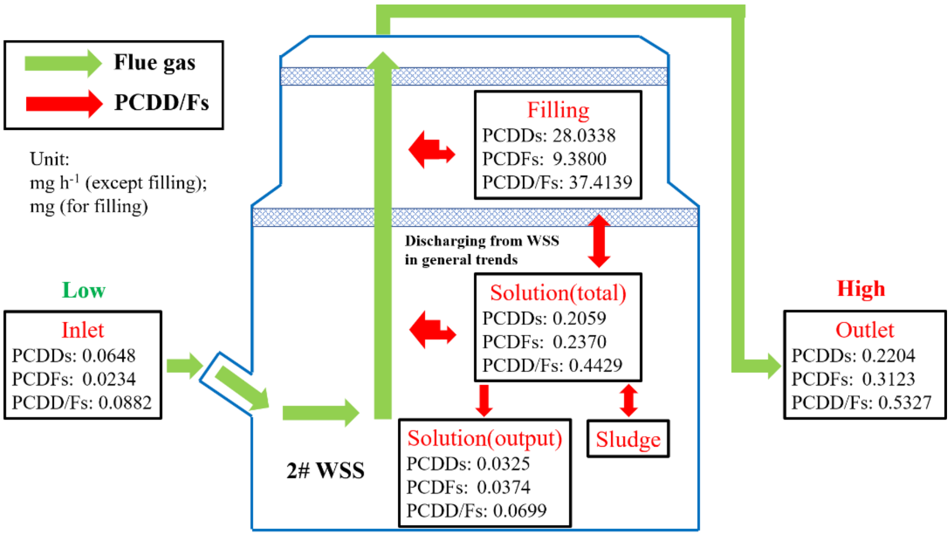


Figure 4. The mass balance of PCDD/Fs in 2# WSS.

The PCDD/Fs in solution and filling are 1-3 orders of magnitude higher than that in the inlet flue gas. The solution/inlet ratio for PCDD and PCDF (3.18 and 10.11) is similar to that of outlet/inlet ratio for PCDD and PCDF (3.40 and 13.32), however, both are smaller, indicating the discharge of PCDD/F from scrubbing solution to flue gas. Considering the obviously higher ratio of filling/inlet and outlet/inlet for PCDDs and PCDFs, the filling is supposed to be the largest potential discharging source of PCDD/F. Such high amount of PCDD/Fs is closely related with the long operation period without changes of filling since the WSS was put into operation.

Acknowledgements:

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THE EFFECT OF DESULFURIZATION ON THE EMISSIONS OF PCDD/FS FROM COAL-FIRED POWER PLANTS

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Introduction: PCDD/Fs, a kind of unintentionally produced POPs with endocrine-toxicity and bioaccumulation and persistence, had huge harm to the biological environment and the health effects of people and animals. According to China's emission inventory, coal-fired power generation is a very significant source of PCDD/F emissions. However, little research has been done on the emission and profile of PCDD/Fs in China. From 1990 to 2015, China increased its coal consumption from 1.05 billion tons to 3.97 billion tons. In 2016, coal made up 62 percent of China’s energy use. Although very low levels of PCDD/F concentrations in the flue gases of coal-fired power stations have been reported in other countries(ng I–TEQ /Nm^3: Estonia,0.0029–0.0039 ; Netherlands, 0.0015–0.0032; Spain, 5x10^{-5}–0.009; Poland, 0.0012–0.0032; Malaysia, 0.0105 to 0.0137), the total amount of PCDD/F emissions cannot be neglected in China because of billions of tons of coal consumption and high volume of gas flow emission. The purpose of this study is to: provide local data for coal-fired power plants, deepen the understanding of the potential mechanism and ascertain the effects of air pollution control device (APCD) configuration on PCDD/Fs, and to explore effective ways to reduce PCDD/Fs in coal-fired power plants.

Materials and Methods: Some typical coal-fired power plants were selected to study the formation and emission of PCDD/Fs. A series of flue gases, fly ash samples and desulphurization gypsum were collected in front of the desulfurization and flue of 300 MW, 600 MW and 1000 MW coal-fired power plants. The PCDD/F stack flue gas samples were collected according to US EPA modified Method 23. The samples were extracted by toluene and each extract was concentrated and the concentrated extracts were purified using an several silica gel columns. PCDD/Fs were analyzed by high resolution gas chromatography/high resolution mass spectrometry (HRGC/HRMS) with an Agilent 6890 gas chromatograph coupled (California, USA) to a Waters Autospec Ultima high-resolution mass spectrometer (Massachusetts, USA).

Results: Flue-gas desulfurization process (FGD) can reduce PCDD/Fs emissions. In the desulfurization process, PCDD/Fs was transferred from flue gas to desulfurized gypsum, and the gas-liquid equilibrium was established. During the desulfurization process of two 300 MW coal-fired units in ZJK Power Plant, the average mass concentration decreased from 222.0 pg m^{-3} to 78.6 pg m^{-3}, and from 284.8 pg m^{-3} to 124.9 pg m^{-3}, respectively. The most abundant congeners were 1234678-HpCDD, 1234678-HpCDF, OCDD, and OCDF, which accounted for about 60% of the total concentration in the stack gas. The removal efficiency of PCDD/FS is only 35.4% and 43.9%, respectively, because of the introduction of industrial circulating water into desulfurization tower. On the contrary, in the desulfurization process of 600 MW units in TS power plant, the average mass concentration decreased from 109.5 pg m-3 to 6.6 pg m-3. The removal rate of PCDD/Fs is as high as 94%. TS coal-fired power plant is constructed at the seaside. Seawater is used to replace industrial circulating water in desulfurization process. Therefore, the circulating water entering the desulfurization tower plays a key role in reducing PCDD/Fs.

Figure. 1 the PCDD/Fs concentrations of coal-fired power plants in FGD process (pg Nm^{-3})

	300MW（150MW）		600MW（450MW）	
	Before FGD（n=4）	After FGD (n=4)	Before FGD (n=2)	After FGD (n=2)
∑2378-PCDD/Fs	253.4	109.5	109.5	6.6
∑dl-PCBs	147	67.4	66.1	54.6
∑I-TEQ	14.8	4.24	4.61	0.04
∑TEQ (dl-PCBs)	0.8	0.69	0.82	0.46

Conclusions: PCDFs were the dominant congeners. The chlorinated dioxin/furans (1234678-, octa-CDD/Fs) accounted for over 60%. Though that operation of FGD reduced the emissions of PCDD/Fs, the industrial circulating water in desulfurization process affected the removal efficiency. Therefore, the circulating water entering the desulfurization tower plays a key role in reducing PCDD/Fs.

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CO-PROCESSING AGED REFUSE IN A BENCH-SCALE SIMULATED CEMENT KILN DEVICE

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Introduction

Aged refuse that is bio-stabilized through years in the landfill can also be called stabilized waste or mineralized waste. Substances such as kitchen waste, plants, and paper in the original municipal solid waste (OMSW) are basically decomposed into soil after long-term landfill, so the nature of the aged refuse is basically stable. Aged refuse can be divided into two categories according to the size of the particle: fine-grained (<15mm) and coarse-grained (>15mm). The main combustible components of coarse-grained aged refuse are substances that can be recycled and utilized such as plastics, textiles, and woods[1,2]. According to statistics, the total aged refuse in the world reached 2 billion tons, of which at least 200 million tons of aged refuse exist in China[3]. The landfill capacity of the existing domestic landfills tends to be saturated, and the combustible components of aged refuse (CCAR) have a higher calorific value than the OMSW. Mining aged refuse from landfills and disposing of it properly can make room for landfilling more domestic waste. The key is how to achieve energy efficiently and clean utilization of CCAR.

According to the research results, cement kiln co-processing solid waste technology requires a long residence time and high combustion temperature. Flue gas disturbance is beneficial to the complete incineration and decomposition of waste. An alkaline environment can inhibit formation of polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCDD/Fs). The cement kiln firing system and the exhaust gas treatment system have high adsorption[4], sedimentation, and dust collection characteristics, and the PCDD/Fs can be solidified in the clinker without causing re-diffusion of PCDD/Fs.

With regard to the co-processing of CCAR in cement kilns, the pollution profiles and mechanisms, especially with respect to PCDD/Fs, have not yet been studied, although many field investigations of flue gas emission levels and profiles of PCDD/Fs in cement kilns have been done. It is important to study these issues to ensure sustainable development of CCAR co-processing in cement kilns.

Materials and methods

Materials The aged refuse was sampled at the landfill of Tianziling Waste Treatment Plant in Hangzhou, Zhejiang Province, China. The designed use period of this landfill was 13 years, and it holds more than 9 million tons of solid waste from Hangzhou and surrounding municipal areas. After screening of aged refuse, samples of fine-grained refuse (grains smaller than 15 mm) and samples of coarse-grained refuse (grains larger than 15 mm) were obtained. We studied mainly the combustible components (plastics, textiles, and woods) in coarse-grained aged refuse. The landfill time is about 11 (S1), 15 (S2), and 19 years (S3), respectively. The fractions of the three combustible components are shown in **Fig. 1**:

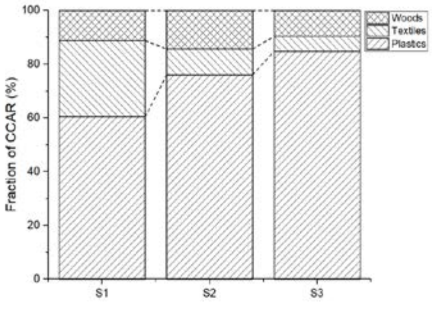

Fig. 1. Fraction of combustibles in the CCAR samples

The bench-scale simulated cement kiln device In the new dry-process cement production system, the cement clinker is produced in three main stages: (1) the high temperature incineration stage, (2) the precalciner burner and cyclone preheater stage (850-250°C), and (3) the post-preheater stage. On the one hand, a lot of scholars have verified that the second stage is the main area for pollutant formation. On the other hand, the main components of CCAR are plastics, textiles, and woods, the content of heavy metals and chlorine are relatively high, and co-processing of CCAR may affect the normal operation of the cement kiln and increase PCDD/F emissions. So, a bench-scale simulated cement kiln device (**Fig. 2**) was designed and manufactured to simulate the precalciner burner and cyclone preheater stages, and to study the formation of pollutants such as PCDD/Fs in the flue gas. The overall height of the device is about 1.8 m, the height of the precalciner burner is about 0.7 m, and the total height of the five-stage cyclone preheater is 0.7 m. It is equipped with a temperature controller to control the temperature in the precalciner burner and keep it above 850°C. There are two automatic screw feeders that can achieve continuous feed, which will be used to study the effects of adding CCAR from different locations on the formation of pollutants such as PCDD/Fs. The device has a total of 6 sampling holes for collecting flue gas from each stage of the cyclone and the precalciner burners. A raw meal bucket and an ash bucket are used to collect raw meal and ash.

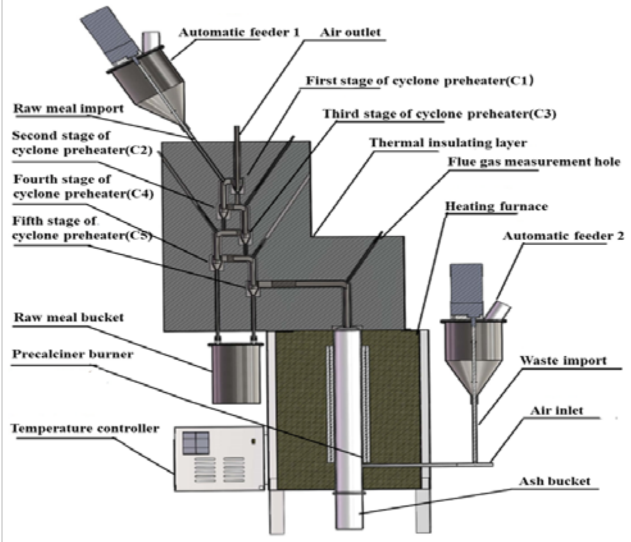

Fig. 2. Simulated cement kiln device

Experimental design The experimental conditions are presented in **Table 1**. Each group is carried out twice to ensure the accuracy and stability of the experimental results. The temperature of the precalciner burner was controlled at 850°C and of the first stage of the cyclone separator (C1) was about 320°C measured by a thermocouple during the experiment.

Experiments in groups A, B, C, D and E were conducted to learn the possible factors that influence pollutant formation from different CCAR and different adding positions. Experiments in group A can be regarded as controls. First, the pollution formation from a mixture of 5% sample 1 (S1) and raw meal was tested in test B to investigate the role of different CCAR in pollution formation. Then a similar test was conducted on a mixture of 5% sample 2 (S2) and raw meal in test C. Finally, a mixture of 5% of sample 3 (S3) and raw meal was tested in test D. Test groups C and E are conducted to determine the influence of adding CCAR in different positions (automatic feeder 1 and 2) on pollution formation.

Heavy metals in the flue gas were absorbed by a solution of 5% nitric acid and 10% hydrogen peroxide and HCl was absorbed by a 0.1 mol/L sodium hydroxide solution. PCDD/Fs were collected by an XAD-II resin and toluene solution, and the toluene solution was placed in an ice bath. The total device inlet flow rate was 20 L/min.

Table 1 Experimental conditions

Group	Reactants	Feeders	Quantity	Flue gas	Time
A	Raw meal	Automatic feeder 1	20g/10min	1L/min	30min
B	5%S1+Raw meal	Automatic feeder 1	20g/10min	1L/min	30min
C	5%S2+Raw meal	Automatic feeder 1	20g/10min	1L/min	30min
D	5%S3+Raw meal	Automatic feeder 1	20g/10min	1L/min	30min
E	Raw meal/S2	Automatic feeder 1/2	19g/10min/1g/10min	1L/min	30min

PCDD/Fs analysis

The cleanup procedure of PCDD/Fs samples was conducted according to the USEPA 1613 method. A DB-5ms (60 m × 0.25 mm I.D., 0.25 μm film thickness) capillary column was used for separation of the different PCDD/Fs congeners. All tests were conducted in duplicate; the arithmetic average of the results was further used in our analysis of suppression. Target compounds were the 17 toxic 2,3,7,8-substituted PCDD/Fs congeners.

Results and discussion

The analysis of heavy metals and HCl in C1 flue gas

It can be seen from **Table 2** that the content of the volatile heavy metal Hg and the semi-volatile heavy metals As, Pb, and Cd in C1 flue gas is low. Except for group B, the two types of heavy metal concentrations before and after co-processing of CCAR is in the same range. The concentrations of low-volatility heavy metals such as Cr, Cu, and Sn were high. The concentrations of such heavy metals increased (from 1.62 mg/m^3 to 1.99, 5.76 and 6.42 mg/m^3, respectively) significantly after co-processing of CCAR, because the concentrations of these heavy metals CCAR are high, especially Cr and Cu, which is consistent with the results reported by researchers who investigated cement kiln co-processing of waste tires. In addition, most of the low-volatility heavy metals, such as Cr and Cu, will be solidified in the cement clinker, and the change in concentration of these heavy metals will affect the cement compressive strength. HCl is mainly derived from the combustion of PVC substances and inorganic chlorides present in CCAR. In the case of full combustion, the chlorine in the PVC can be completely converted into HCl. The release of HCl is increased in the presence of moisture and sulfur, and about 50-60% of NaCl is converted to HCl.

Except for Group A and Group E, the emissions of HCl by other groups are higher than the limit of 10 mg/m^3 specified in the national standard of China (GB 30485-2013). Because the main CCAR components are plastics, textiles, and woods, the content of Cl is high, and the flue gas at the C1 has not passed through the air pollution control device. In addition, the existence of a large number of Cl will cause much harm. First of all, the existence of HCl, O_2, and precursors, at an appropriate temperature (250-600°C), will lead to synthesis of PCDD/Fs. Second, chloride, sulfate, and their compounds are responsible for the formation of low-temperature melt and crusts, which can cause different degrees of blockage in the kiln. Finally, the excessive presence of Cl in cement will cause freezing and thawing of concrete and the corrosion of steel bars in concrete, affecting the service life and safety of concrete buildings.

Table 2 Concentrations of heavy metals and HCl in C1 flue gas (mg/m^3)

No.	As+Pb+Cd	Cr+Cu+Sn+Mn+Ni+Be	Hg	HCl
A	0.17	1.62	0.010	6.81
B	0.38	1.99	0.040	11.31
C	0.15	5.76	0.009	11.10
D	0.17	6.42	0.016	12.58
E	0.19	3.21	0.007	7.36

The formation characteristics of PCDD/Fs in C1 flue gas

The PCDD/F formation increased as CCAR was added (results are shown in **Table 3**). The concentration of PCDD/Fs increased in groups B, C, and D compared with group A, from 5.16 ng/m^3 to 5.82, 7.91, and 7.44 ng/m^3, respectively, and the corresponding TEQ value increased from 0.33 ng I- TEQ/m^3 to 0.56, 0.69, and 0.72 ng I-TEQ/m^3, respectively. The results show that the co-processing of CCAR does promote the formation of PCCD/Fs, which is consistent with the results reported by other research. The toxic equivalents are much higher than the limits (<0.1 ng I-TEQ/m^3), because no air pollution control system was used in this simulated device.. Meanwhile, the weight average level of chlorination (Cl-PCDD/Fs) decreased slightly, indicating that the chlorination of PCCD/Fs was inhibited and lower chlorinated PCDD/Fs are synthesized; this is maintained at around 6.5 basically.

In terms of raw meal, the ratio of PCDFs/PCDDs is 1.7, and it is indicated that de novo synthesis was the dominant PCDD/F formation pathway for the cement kiln. The ratio of PCDFs/PCDDs increased from 1.7(Group A) to 1.98 (Group B), 3.83 (Group C), and 3.45 (Group D) after co-processing of CCAR, indicating that co-processing of CCAR in a cement kiln further promotes the de novo synthesis of PCCD/Fs. It is well known that $CuCl_2$ is an important metal catalyst for de novo synthesis. S1 (11 years), S2 (15 years), and S3 (19 years) have different compositions of combustible components due to different landfill age, and the heavy metal concentration (especially Cu and Fe) and chlorine content are also different, which is the main reason for the difference in PCDD/Fs produced in Group B, Group C, and Group D. The overall trend is that CCAR with more chlorine and Cu is likely to generate more PCDD/Fs when co-processing.

Comparing the data of Groups C and E, it can be seen that CCAR has different impacts on the formation of PCDD/Fs when input from different feed inlets. The addition of CCAR at the raw meal preparation system produces more PCDD/Fs than addition at the precalciner burner. The PCDD/F concentrations are 7.91 and 7.41 ng/m^3, respectively, corresponding TEQ values of 0.69 and 0.55 ng I-TEQ/m^3, respectively. The reason may be that the temperature at the precalciner burner is 850-900°C, the CCAR is more likely to be burned completely, and less PCDD/Fs are formed. It is also confirmed that the main formation area of PCDD/Fs in the cement kiln is the cyclone preheater at the temperature range 250-500°C, which verifies previous work of other researchers who believe that this area is the major area for PCDD/F formation[5,6].

Table 3 Concentration and distribution of 17 2,3,7,8-subsituteds-PCDD/Fs in groups

	A	B	C	D	E	Unit
PCDDs	1.91	1.95	1.64	1.67	3.59	ng/m^3
PCDFs	3.25	3.87	6.27	5.77	3.82	ng/m^3
PCDD/Fs	5.16	5.82	7.91	7.44	7.41	ng/m^3
PCDF/PCDD	1.70	1.98	3.83	3.45	1.07	/
Cl-PCDD	7.39	6.72	6.34	6.47	7.53	/
Cl-PCDF	6.71	6.34	6.43	6.41	6.38	/
Cl-PCDD/Fs	6.97	6.47	6.41	6.42	6.94	/
I-TEQ	0.33	0.56	0.69	0.72	0.55	ng I-TEQ/m^3

Principle component analysis

Principal component analysis (PCA) was used to learn the similarities and differences of congener distributions among various samples (**Fig. 3**). The matrix is used to statistically investigate the signatures representing 10 PCDD/F homologue groups of all 5 samples. Before statistical analysis, no data transformation was performed. Factor 1 and factor 2 separate all samples into two clusters (A and B), which separately explains 65.5 and 22.1% of the total variance. PCA shows that homologue profiles of group E are closer to those of group A, and homologue profiles of groups B, C, and D are similar. In general, results of clustering obtained from PCA are in accordance with the former discussion. This further verified that the CCAR is completely burned at the precalciner burner, which has little effect on the distribution of congeners (E is compared with A), but is added at the raw meal preparation system, which significantly influences the distribution (B, C, and D is compared with A).

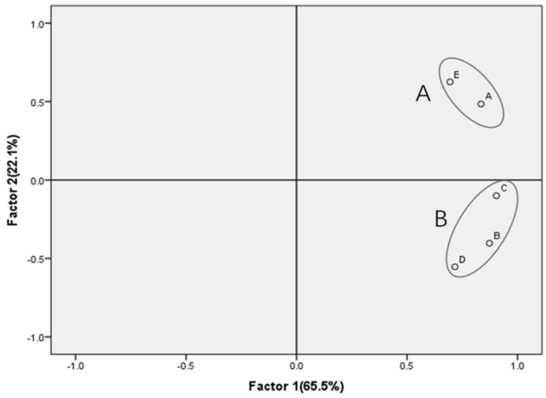

Fig. 3. Principle component analysis of homologue profiles

Acknowledgements

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BROMINATED DIOXINS EMISSION
FROM THE E-WASTE RECYCLING FACILITY IN JAPAN

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Introduction

Brominated dioxins such as polybrominated dibenzo-*p*-dioxins (PBDDs), polybrominated dibenzofurans (PBDFs), and dioxin-like polybrominated biphenyls (dl-PBBs) have been recognized to have similar toxicity profiles to those of their chlorinated analogues[1] and may have contributed significantly in daily human background exposure to the total dioxin toxic equivalents (TEQs) as the results of their unintentional release via the lifecycle of product containing brominated compounds such as brominated flame retardants (BFRs)[2-5]. Therefore, a joint World Health Organization (WHO) and United Nations Environment Programme (UNEP) expert panel recommended to utilize the WHO toxicity equivalency factor (TEF) scheme for the human health risk assessment of brominated dioxin-like compounds[6].

In Japan, the Law Concerning Special Measures against Dioxins of Japan requires the government to promote "the research and study of PBDD/DFs with regard to the extent of their effects on human health, the process of generation, and others". Since 2002, the Ministry of the Environment of Japan (MOE) has conducted a series of field studies to survey the emissions of PBDD/DFs and related compounds from the potential sources related with BFRs[7]. Past surveys clearly revealed that PBDD/DFs tended to be detected in working air and effluents from the facilities recycling the waste of electric household appliances (e-waste) and producing flame-retarded textiles and plastics with BFRs such as deca-BDE and TBPh at concentration in excess of the standards for chlorinated dioxins in Japan (Working air: 2.5 pg WHO-TEQ/m^3, Effluents: 10 pg WHO-TEQ/L).

In this study, brominated dioxins and related compounds in the e-waste recycling facility investigated by MOE were evaluated to reveal the current status of their emission from significant emission source. First, as their sources of human exposure and/or emission into the environment, working environment air and effluent were collected in the e-waste recycling facility. Brominated dioxins and related compounds were measured by using the *in vitro* cell-based reporter gene assay called as the DR-CALUX assay combined with the method separating brominated dioxins from chlorinated dioxins[8]. Samples indicating significant dioxin-like activity were also evaluated by GC-HRMS measurement. And then, the current status and perspective of brominated dioxins and related compounds in Japan were discussed based on obtained results.

Materials and methods

E-waste recycling facility. In Japan, 47 facilities have been established for e-waste recycling (as of July 2018). According to the Law for Recycling of Specified Kinds of Home Appliances (Home Appliance Recycling Law), e-wastes such as TVs, refrigerators, air conditioner and washing machines were collected and recycled properly in the e-waste recycling facilities. It has been reported that the total amount of materials recycled in 47 facilities was 464 kt for e-waste collected in FY2016[9]. Composition ratios of that were 42.4%, 3.6%, 3.3%, 17.0%, 2.7%, and 31.0% for ferrous, copper, aluminum, mixed metal of ferrous and non-ferrous, glass panel for cathode-ray tube (CRT), and plastics. Here, 10 of 47 facilities were investigated for brominated dioxins emission from the e-waste recycling facility in Japan, which were the same facilities as previous MOE investigation. Based on questionnaire survey, the total amount of materials recycled in 10 facilities was 203 kt for e-waste collected in FY2016, which was about 42% of those in 47 facilities.

Sampling. Storage, manual dismantling, shredding and material recovery of e-waste are normally conducted for the shipment of the recycled resources in the e-waste recycling facility. Working environment air in the site of manual dismantling of e-waste such as CRT TV (*n*=8), flat panel display (FPD) TV (*n*=9), refrigerator (*n*=1), air conditioner (*n*=2) and another electric appliance (*n*=1) were collected on a quartz filter and polyurethane foam (PUF) using a high-volume air sampler. The sampling rate and time were approximately 500 L/min and 4 hours in operation, respectively. Final effluents (*n*=12) in operation were collected in amber glass bottles. Wastewaters (*n*=4) before the treatment in the wastewater treatment equipment were also collected. Sampling was conducted during December 2017 to January 2018.

Extraction. For working environment air samples, dioxin-like compounds such as brominated and chlorinated dioxins were extracted from the quartz filter and PUF samples with toluene and acetone, respectively, for 16 hours in a Soxhlet extractor. After filtering the final effluent and wastewater samples, extraction from the glass fiber filter and the filtrate were conducted using toluene for 16 hours in a Soxhlet extractor and a liquid-liquid extraction with dichloromethane. Obtained extracts were evaporated on a rotary evaporator, the residue was transferred to toluene, and the resulting solution called as crude extract was stored at 4 °C until analysis.

TCDD-EQ. Separate detection of the chlorinated and brominated dioxins by means of a process involving a silica gel impregnated with 55% sulfuric acid (cleanup column) and a silica gel impregnated with 10% silver nitrate (separation column) with glass columns (Fujifilm Wako Pure Chemical Co. Osaka, Japan) was conducted in this study[8]. Briefly, an aliquot of each crude extract was evaporated and transferred from toluene to *n*-hexane. The *n*-hexane fraction equivalent to 1 m^3 of working environment air or 0.02-0.2 L of water sample was applied to a cleanup column and eluted with *n*-hexane. The eluates were evaporated and loaded onto the separation column. The first fraction, which was eluted with *n*-hexane, contained chlorinated dioxins such as PCDD/Fs and dl-PCBs. The second fraction, which was eluted with 4% (v/v) acetone/*n*-hexane, contained brominated dioxins such as PBDD/Fs. Each fraction was evaporated under a gentle stream of nitrogen, and the residue was re-dissolved in dimethyl sulfoxide for subsequent analytical evaluation. We used the DR-CALUX assay using the rat hepatoma H4IIE cell line[10] obtained from BioDetection Systems B.V. (Amsterdam, The Netherlands) for measurement of the dioxin-like activities of the prepared fractions. The conditions for cell culture and the procedure for the DR-CALUX assay to calculate 2,3,7,8-TCDD equivalent (TCDD-EQ) are described in detail elsewhere[11].

WHO-TEQ. An aliquot of several crude extract with high dioxin-like activity was spiked with ^{13}C-labeled internal standards, the solvent was exchanged from toluene to *n*-hexane, and the resulting solution was cleaned-up by treatment with sulfuric acid, passage through a sulfuric acid- and silver nitrate-impregnated silica gel column, and fractionation on an activated carbon-impregnated silica gel column. Each eluate was evaporated under a gentle stream of nitrogen, and the residue was re-dissolved in nonane containing ^{13}C-labeled standards as syringe spike for subsequent GC-HRMS analysis. We used the GC-HRMS for determination of PBDD/DF, PCDD/DF, and dl-PCB concentrations. The WHO-TEQs for PCDD/DFs and dl-PCBs were calculated by multiplying their measured concentrations by the corresponding WHO-TEFs[12] (WHO-TEQ$_{\text{PCDD/DFs}}$). The WHO-TEQs for the PBDD/DFs were also calculated from the WHO-TEFs of their chlorinated analogues (WHO-TEQ$_{\text{PBDD/DFs}}$).

Results and discussion

Working environment air. For all working environment air samples (*n*=21), TCDD-EQs for extract containing brominated dioxins (TCDD-EQ$_{\text{PBDD/DFs}}$) were 0.32 to 7.5 pg/m^3 (median 1.1 pg/m^3) and TCDD-EQs for extract containing chlorinated dioxins (TCDD-EQ$_{\text{PCDD/DFs}}$) were <0.25 to 1.6 pg/m^3 (median <0.25 pg/m^3), indicating that the TCDD-EQ$_{\text{PBDD/DFs}}$ tended to be higher than TCDD-EQ$_{\text{PCDD/Fs}}$. The TCDD-EQ$_{\text{PBDD/DFs}}$ in 3 samples collected in the site of manual dismantling of FPD TV, CRT TV and air conditioner were 3.3, 4.5 and 7.5 pg/m^3, which were higher than the working air standard for chlorinated dioxins in Japan. Because not only PBDD/DFs but also other dioxin-like compounds can be detected by using DR-CALUX assay, PBDD/DFs were analyzed by using GC-HRMS to obtain WHO-TEQ for these samples. As well as TCDD-EQ$_{\text{PBDD/DFs}}$, WHO-TEQ$_{\text{PBDD/DFs}}$ were 3.7, 6.2 and 6.8 pg/m^3, which were also higher than the standards for chlorinated dioxins in Japan. Based on TCDD-EQ$_{\text{PBDD/DFs}}$ and WHO-TEQ$_{\text{PBDD/DFs}}$ results, PBDD/DFs concentration of working environment air at FY2017 were equivalent to or lower than those at FY2002 (3.2 to 180 [median 37] pg WHO-TEQ$_{\text{PBDD/Fs}}$/m^3, *n*=10) 13) and FY2011 (0.34 to 9.8 [median 3.1] pg WHO-TEQ$_{\text{PBDD/Fs}}$/m^3, *n*=16) 13). Removing dust from working environment air was considered effective to reduce potential human exposure and discharge of brominated and chlorinated dioxins in/from the site of manual dismantling of e-waste because more than 85% of TCDD-EQ were detected in dust on a quartz filter, but not PUF (data not shown).

Effluent and wastewater. For all effluent samples (*n*=12), TCDD-EQ$_{\text{PBDD/DFs}}$ were <1.0 to 1,500 pg TCDD-EQ/L (median 5.4 pg/L) and TCDD-EQ$_{\text{PCDD/DFs}}$ were <1.0 to 50 pg/L (median 1.4 pg/L), indicating that the TCDD-EQ$_{\text{PBDD/Fs}}$ of 4 samples and TCDD-EQ$_{\text{PCDD/DFs}}$ of 1 sample were higher than the effluent standard for chlorinated dioxins in Japan. Because not only PBDD/DFs but also other dioxin-like compounds can be detected by using DR-CALUX assay, PBDD/DFs were analyzed by using GC-HRMS to obtain WHO-TEQ for these samples. As a result, WHO-TEQ$_{\text{PBDD/DFs}}$ (74 pg/L) in 1 sample was higher than the effluent standard for chlorinated dioxins in Japan. Based on TCDD-EQ$_{\text{PBDD/DFs}}$ and WHO-TEQ$_{\text{PBDD/DFs}}$ results, PBDD/DFs concentration of effluent at FY2017 were equivalent to or lower than those at FY2002 (2.5 to 65 [median 31] pg WHO-TEQ$_{\text{PBDD/Fs}}$/L, *n*=6) 13) and FY2011 (1.4 to 530 [median 88] pg WHO-TEQ$_{\text{PBDD/Fs}}$/L, *n*=10) 13). For wastewater samples treated in facility (*n*=4), TCDD-EQ$_{\text{PBDD/DFs}}$ were 31 to 3,700 pg TCDD-EQ/L and TCDD-EQ$_{\text{PCDD/DFs}}$ were 8.5 to 230 pg/L. WHO-TEQ$_{\text{PBDD/DFs}}$ in wastewater with high TCDD-EQ$_{\text{PBDD/DFs}}$ was 100 pg/L, which was also higher than the effluent standard for chlorinated dioxins in Japan. Removing suspended solid (SS) from water sample was considered effective to reduce potential brominated and chlorinated dioxins emission into the environment from facility because more than 89% of TCDD-EQ were detected in SS on a glass fiber filter, but not filtrate (except 1 effluent sample that 83% of TCDD-EQ$_{\text{PBDD/DFs}}$ was detected in the filtrate) (data not shown).

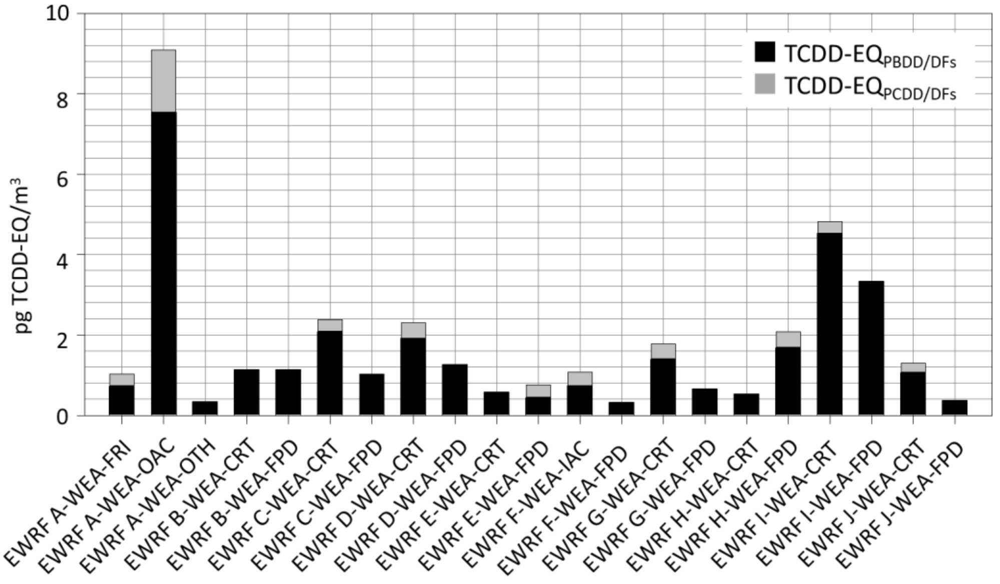

Figure 1 TCDD-EQ in the working environment air from the e-waste recycling facility in Japan
EWRF, e-waste recycling facility; WEA, working environment air; FRI, fridge, OAC, outdoor air conditioner; OTH, other; CRT, cathode ray tube; FPD, flat panel display; IAC, indoor air conditioner

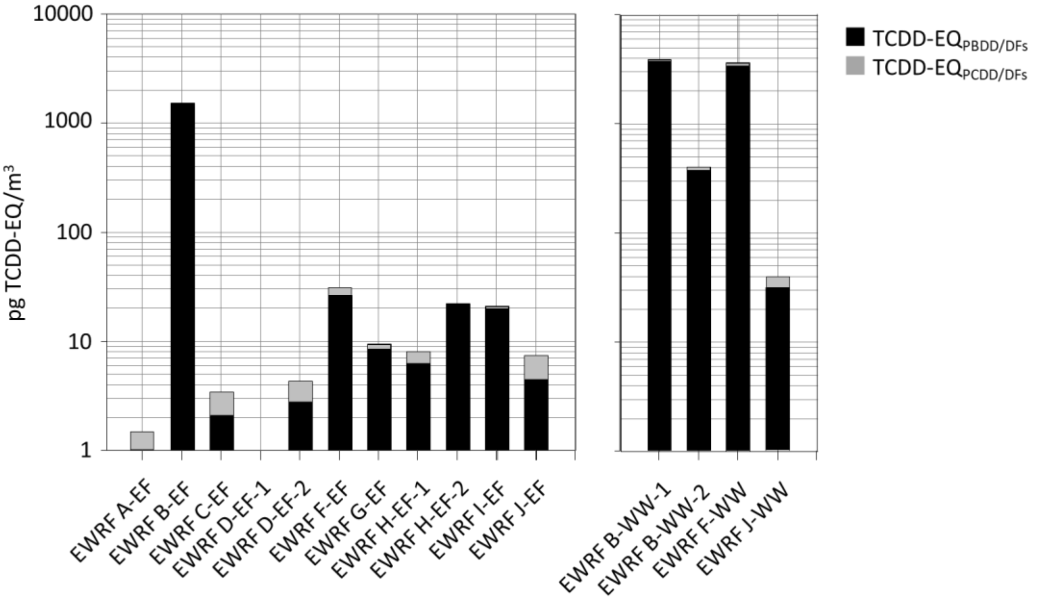

Figure 2 TCDD-EQ in the effluent and wastewater from the e-waste recycling facility in Japan
EWRF, e-waste recycling facility; EF, effluent; WW, wastewater

Conclusion

In this study, by using DR-CALUX assay and GC-HRMS, brominated and chlorinated dioxins concentration were evaluated in working environment air, effluent and wastewater collected from the e-waste recycling facility in Japan, suggesting that PBDD/Fs emission at FY2017 was lower than those at FY2002 and FY2011 and is on a declining trend. Obtained results also indicates that it is important for the environmentally sound management of brominated and chlorinated dioxins to control particulate matter derived from e-waste in the facility. There are other persistent chemicals that indicate response in the DR-CALUX assay but have not yet been detected by GC-HRMS approach.

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EMISSIONS OF 1325 CHEMICALS FROM MUNICIPAL WASTEWATER TREATMENT PLANTS IN JAPAN

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Introduction: As the number and volume of chemical substances used in modern life increase, concern is rising regarding their adverse effects on human health and aquatic organisms. In Japan, environmental emissions of chemicals used in industry are recorded in the Pollutant Release and Transfer Register; however, emissions of chemicals used in homes and businesses are not well known because these substances are used in a wide variety of commercial products. In this study, we tested 1325 chemicals in inflow and outflow of municipal wastewater treatment plants (WWTPs) across Japan in order to grasp emissions of chemicals used in daily life. **Methods:** We surveyed eight WWTPs (conventional activated sludge process) servicing populations of over 200,000 across Japan. Twenty-four hour composite samples were taken before the first sedimentation tank (inflow) and after the final sedimentation tank (outflow) in each season of 2017. Semi-volatile organic compounds (972 substances) in samples were liquid–liquid extracted with CH_2Cl_2 and then concentrated. The concentrates were measured by GC-MS and GC-MS-MS-SRM. Polar compounds (484 substances) were solid-phase extracted with a Waters HLB and an AC-2 and then measured by LC-QTOF-MS-Sequential Window Acquisition of All Theoretical Fragment-ion Spectra (SWATH). **Results and Discussion:** The number of substances detected at least once in inflows and outflows and their average total concentrations and average daily loads are listed in Table 1. Sterols from human feces and food residues comprised 60% of measured substances in inflow and man-made chemicals comprised 40%; in particular, PPCPs comprised 25%. Although the removal rate of sterols was 98.8%, that of man-made chemicals was low: 87.1% for pharmaceuticals and 68.6% for pesticides, indicating the need to study the effects of these substances on aquatic organisms. Although the substances detected and their concentrations in the inflows did not differ greatly among the WWTPs, seasonal similarities within the same WWTP were higher than similarities among the WWTPs. Nevertheless, we did find seasonal differences in the concentrations of substances detected in the inflows; the concentrations of most detected substances other than pharmaceuticals were lower in winter than in other seasons. Table 2 shows the 10 substances other than sterols with the largest emission load. Since their removal rates in WWTPs are relatively low, they seem to persist in environmental water. Finally, we extrapolated our results to estimate total annual Japan-wide inflow amounts (26,819 Mg/y) and outflow amounts (1412 Mg/y). The top five substances other than sterols in inflows were caffeine (1411 Mg/y), 2-phenoxyethanol (939 Mg/y), squalane (789 Mg/y), 2-butoxyethanol (504 Mg/y), and L-menthol (486 Mg/y). The top five substances in outflows were sucralose (214 Mg/y), metformin (131 Mg/y), distyrylbiphenyl disulfonate (FBA 351, 65 Mg/y), galaxolide (56 Mg/y), and bis(2-ethylhexyl)phthalate (DEHP, 53 Mg/y). The total outflow of nine organo-phosphorus flame retardants was 134 Mg/y.

Table 1 Detected concentrations and inflow/outflow loads

Item	Inflow	Outflow	Removal rate, %
Detec sub/All sub	292/1325	302/1325	
Total conc, µg/L	1180±175.5*	62.4±3.1*	94.5
Sterols	700±122.8*	8.16±3.95*	98.8
Pharmaceuticals	148±11.6*	19.1±2.7*	86.7
Personal care prod	149±27.7*	10.3±0.9*	93.1
Pesticides	1.72±1.84*	0.54±0.12	68.6
Others**	181±20.6*	24.3±4.2*	86.6
Load, g/1000 capita/day	581±77.0*	30.6±1.6*	—
Sterols	348±55.2*	3.91±1.86*	—
Pharmaceuticals	74.0±4.6*	9.73±1.28*	—
Personal care prod	71.8±12.3*	4.85±0.20*	—
Pesticides	0.76±0.66*	0.28±0.07*	—
Others**	86.5±8.8*	12.2±2.3*	—

*: mean ± SD (n=32), **: Sweeteners, plasticizers, flame retardants, etc. ND was treated as 0.

Table 2 The 10 substances with largest emission load (g/1000 capita/day)

Substance	Inflow	Outflow	Use
Sucralose	5.26	4.63	Sweetener
Metformin	9.89	2.85	Diabetes medicine
FBA 351	4.15	1.41	Optical brightener
Galaxolide	4.33	1.22	Fragrance
DEHP	6.05	1.14	Plasticizer
TBEP	4.56	1.08	Flame retardant
Crotamiton	1.38	0.96	Antipruritic
FB-71	2.65	0.76	Fluorescent brightener
Squalane	17.1	0.71	Cosmetics
Ofloxacin	1.84	0.71	Antibiotic

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Food trade is a major transport pathway of PCDD/Fs between the Southern and Northern Hemisphere

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Introduction: Polychlorinated dibenzo-p-dioxins/furans (PCDD/Fs), known as dioxins, are one of the most toxic chemicals. Their persistence in the environment and lipophilic property result it their bioaccumulate and biomagnify in food webs, which pose potential health risks to humans. Establishment of dioxin inventory is a crucial step toward elimination of worldwide dioxins contaminations and risk assessment. In this study, based on available national dioxin inventories worldwide, and human social economic activities factors related to PCDD/Fs emission using principle component analysis (PCA), we established a multiple linear regression model to estimate the global atmospheric PCDD/Fs emissions by country. Then, gridded population density was used as surrogate data to construct a global gridded emission inventory for PCDD/Fs with 1° longitude by 1° latitude resolution. Using this emission inventory CanMETOP (Canadian Model for Environmental Transport of Organochlorine Pesticides) model was employed to conduct multiple scenario simulations of the atmospheric transport between the Northern and Southern Hemisphere. The results show that global atmospheric PCDD/Fs emission decreased from 2002 to 2012. Higher emissions of PCDD/Fs were identified in Asia, Africa, and Europe. Of which China is the largest emitter, releasing approximately 4.5kg TEQ PCDD/Fs in 2012. It was found that PCDD/Fs were almost not exchanged between the Northern and Southern Hemisphere through atmospheric transport. We also assessed the human exposure to PCDD/Fs embodied in global meat and fish trade by combining CanMETOP modeled concentrations in air, soil, water with terrestrial and marine food web models. The considerable higher exposure risks were found in the food trade between the Southern and Northern Hemisphere as compared with atmospheric transport and depositions, suggesting that the food trade is a major pathway of PCDD/Fs transport between the Northern and Southern Hemisphere, rather than atmospheric transport.

LEVELS AND PROFILES OF POLYCHLORINATED DIBENZO-*P*-DIOXIN AND DIBENZOFURAN IN DIFFERENT ENVIRONMENTAL MEDIA FROM CHINA

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Introduction: PCDD/Fs in the environment are characterized by high chemical stability, long-range transport capability, low solubility in water, and enrichment in the food chain. They could be released from waste incineration, organochlorine chemical production, metal smelting, pulp chlorine bleaching and other processes. These unwanted dioxins enter the environment in different ways. Due to their semi-volatile physical properties, they migrate over long distances through the atmosphere. As hydrophobic organic compounds, they tended to accumulate in soil and sediments. As the largest developing country in the world, China has a large number of emission sources, and the dioxins generated enter the environment through the air, soil, water and other media. In 2013 in China, 9069 g TEQ of dioxin emissions were produced from various sources, including 4274 g TEQ to the atmosphere, 84 g TEQ to water, 348 g TEQ through the product environment, and 4364 g TEQ through residue acording to our research. The purpose of this study was to present a comprehensive survey via summarizing the scientific data on the literatures published in the journals and overview of spartial distribution of PCDD/Fs in China. And assessment of the current state of pollution from PCDD/Fs was represented in this study. Various environmental media including air, water, sediment, and soil were analyzed and the spatial characteristics of PCDD/Fs pollution in each environmental medium was determined. Across China, PCDD/Fs levels in these environmental media were relatively low. But some areas are affected by local emission sources. Air in Qingyuan and Guiyu in Guangdong province and Taizhou in Zhejiang province had relatively high levels of PCDD/Fs. Sediments in the Haihe River Basin, Dongting Lake, and Ya'er Lake had relatively high level of PCDD/Fs. The concentrations of PCDD/Fs in the sediments of the Dagu Drainage and Nanpaiwu River downstream of the Haihe River Basin were as high as 3,272 pg TEQ/g and 22,000 pg TEQ/g, respectively. In addition, Dongting Lake had a higher level of water pollution than other waters. PCDD/Fs pollution in soil was limited to a few specific areas, in which the highest PCDD/Fs level was 193 pg TEQ/g. Point source pollution was the most common source of contamination, influenced primarily by local geographic, economic, and historical factors.

Conclusion: In general, the concentrations of PCDD/Fs in the uncontaminated areas of various environmental media are equivalent to that of the world. But regional pollution is found in some areas due to the influence of various emission sources, where the content of PCDD/Fs in each medium was significantly increased. Some areas have reached a level of serious pollution, and relevant departments should be given enough attention to protect the health of residents and the environment. High concentrations of PCDD/Fs have been found in sediments such as in the Nanpaiwu River and the Dagu Drainage River in Tianjin. The Haihe River Basin has been affected by the production of chemicals such as PCP, Na-PCP, and HCB in the Dagu Chemical Plant. The PCDD/Fs concentrations in sediments of Wuhan Ya'er Lake can be explained the local chlor-alkali industry, chlor-alkali production by ethylene-oxychlorination emits PCDD/Fs. Concentrations of PCDD/Fs in the water systems in Hunan are elevated due to the use of Na-PCP for the prevention and treatment of schistosomiasis in the Dongting Lake area. The concentrations of dioxins are high in Qingyuan and Guiyu in Guangdong and Taizhou in Zhejiang, due to the long term involvement in the e-waste dismantling industry. Illegal local incineration of debris and metal wires result in a large amount of environmental release of dioxins.

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PCDD/F MEASUREMENT AT HIGH-ALTITUDE STATION IN EASTERN ASIA: EVALUATION OF PCDD/FS IN TSP AND PM$_{2.5}$ VIA LONG-RANGE TRANSPORT AND SOURCE APPORTIONMENT DURING THE SOUTHEAST ASIA BIOMASS BURNING EVENT IN 2014

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Introduction

The source of aerosols can be divided into primary aerosols and secondary aerosols. Moreover, atmospheric particulate matter, such as TSP (total suspended particulate matter) and PM$_{2.5}$ (particulate matter with an aerodynamic diameter less than 2.5 µm) were the sources of air pollution. Particulate air pollution includes solid and vapor phase pollution directly emitted into the atmospheric. On the other hand, previous studies indicated that uncontrolled combustions including those from forest fires, open burning of agricultural residues, house fires, and backyard household waste combustion have been identified as a large potential source of PCDD/Fs but has not been regulated[1]. A previous study[2] showed that the PCDD/F emission factor via biomass burning which contributes between 0.5% and 68% in developing countries. Annual emissions of PCDD/Fs from the open burning of crop residues in China mainland were estimated to be ranging from 1.38 to 1.52 g I-TEQ/year between 1997 and 2004, which contributed to approximately 10%-20% of the total PCDD/F emissions in China mainland. Another previous study[3] indicated that around 70 to 80% PCDD/F concentrations in the atmosphere were essentially bound to particles.

Positive matrix factorization (PMF) has become a factor analytic (FA) model of choice for quantitative source apportionment of contaminant species in many air quality monitoring studies[4,5]. In addition, the Potential Source Contribution Function (PSCF) computations identify potential source regions and the preferred pathways of pollutant species to a receptor region. Many studies have employed PSCF to give spatial renderings of contaminant species such as inorganic components of aerosols [6,7]. In this study, the atmospheric concentrations of seventeen 2, 3, 7, 8-substituted PCDD/Fs, trace metal content in suspended particles and PM$_{2.5}$ were monitored in receptor region (Mountain Lulin in Taiwan) and source region (Doi Ang Khang in Thailand) using high volume ambient air samplers with cascade impactor during the spring seasons in 2014. The objective of this study is to evaluate the particulate in TSP and PM$_{2.5}$ effects of Southeast Asia biomass burning on the atmospheric concentration variation of dioxin compounds and assess the potential for long-range transport of PCDD/Fs in 2014. Moreover, speculate the relative contribution of various emission sources by applying PMF, PSCF and SRA model using tracers to apportionment of PCDD/Fs in atmosphere.

Materials and methods

To measure the long-range transport of PCDD/Fs, two high-altitude sampling sites were selected based on the meteorological information and location relative to the biomass burning in Eastern Asia (Fig. 1). In central Taiwan, the sampling station is located at the peak of Mt. Lulin (23.51-°N, 120.92-°E; 2,862 m above mean sea level). Its high elevation means it is generally free from local pollution, and is able to investigate the impact of long-range transported air pollutants in the free troposphere in East Asia. In northern Thailand, the sampling station is located at Doi Ang Khang (19.93-°N, 99.05-°E; 1,536 m above mean sea level) Thai-Myanmar border junction. No significant PCDD/F emission sources existed in the vicinity of the high-altitude station. During a special long range transport season (N=40), one sample was taken every day for 24 hours at Mt. Lulin and Doi Ang Khang in the meantime. Ambient air samples for both vapor phase and particle phase of dioxin compounds were collected using high volume sampling trains (Shibata HV-1000R) for TSP and cascade impactor to collect PM$_{2.5}$. The HV-1000R samplers were equipped with Whatman quartz fiber filters for collecting particle-bound compounds while polyurethane foam (PUF) plugs were used for retaining PCDD/F compounds in the vapor phase. The total volume of the air sampled was more than 900 m^3 for a typical sampling duration of 1 day. The detailed information regarding the extraction and clean-up procedure of PCDD/F samples is provided elsewhere[8]. In this study, only the seventeen 2,3,7,8-substituted PCDD/F congeners were analyzed with high-resolution gas chromatography (HRGC)/high-resolution mass spectrometry (HRMS) (Thermo DFS) equipped with a fused silica capillary column DB-5 MS (60 m x 0.25 mm x 0.25µm, J&W). For metal analysis, total suspended particles (TSPs) and fine particles (PM$_{2.5}$) collected by quartz fiber filters in ambient air were digested in an acid mixture of concentrated HNO$_3$/HF (4 ml/2 ml) using an ultra-high-throughput microwave digestion system (MARSX press, CEM Corporation, Matthews, NC, USA). Digested solutions were analyzed for several trace major metals using inductively coupled plasma optical emission spectrometry (ICP-OES) (Optima 2100DV, Perkin-Elmer™ Instruments, USA).

To identify the different sources of TSP and $PM_{2.5}$ in Southeast Asia biomass burning episode that occurred during spring seasons in 2014, the back trajectory analyses using HYSPLIT at the altitudes of 3 km from the location of Lulin station in central Taiwan was also evaluated. The software Positive Matrix Factorization (PMF, version 5.0), available from U.S. EPA (2014) was used to identify and quantify sources that contribute to ambient PCDD/F concentrations in TSP and $PM_{2.5}$ at Lulin station. Moreover, to identify the likely source regions of PCDD/Fs at the Lulin station during the biomass burning period (2014, March, N=40), the PSCF was calculated using three-day backward trajectories calculated using the HYSPLIT model. Furthermore, speculate the relative contribution of various emission sources by applying the methods as SRA (Source Regional Apportionment, SRA) to apportionment of PCDD/Fs in atmosphere.

Results and discussion:

During the regular sampling periods, the average mass concentration of TSP, $PM_{2.5}$ and PCDD/F in different phases distribution at Mt. Lulin station in spring 2014 range from12.1-65.9 μg/m^3, 4.67-49.0 μg/m^3 and 0.92-15.7 fg I-TEQ/m^3, respectively (Fig. 2a and Fig. 3a). Otherwise, the average mass concentration of TSP, $PM_{2.5}$ and PCDD/F in different phases distribution at Doi Ang Khang station range from76.7-414 μg/m^3, 47.6-237 μg/m^3 and 3.78-28.0 fg I-TEQ/m^3, respectively (Fig. 2b and Fig. 3b). In this study, the high concentration event was used the higher than potassium 75th percentile for the definition. Fig. 3 showed that variation of atmospheric TSP, $PM_{2.5}$ and vapor phase PCDD/F concentrations measured in Mt. Lulin, (Taiwan) and Doi Ang Khan (Thailand). The result indicted that biomass burning event occurred and atmospheric PCDD/Fs in TSP was major for solid phase. Otherwise, PCDD/Fs in $PM_{2.5}$ was major for vapor phase. It's probably due to the emission source were different. The proportion of PCDD/F in $PM_{2.5}$ and TSP were also different. As Fig. 3 showed that PCDD/F in $PM_{2.5}$ was higher than in TSP. Tracer for biomass burning were using potassium to identify potential source. Correlation of TSP and potassium was 0.85 at receptor region. Composition of metal were major for Al, Fe, Na, Mg, K and Ca at receptor region (Mt.Lulin). Moreover, the composition of metal at source region (Doi Ang Khang) as the same as receptor region (Mt.Lulin) was major for Al, Fe, Na, Mg, K and Ca. In addition, it's also major for Ti and Mn.

The backward trajectory statistics result showed three possible pathways including 14.9% backward trajectory from Central India, 34.5% backward trajectory from coastal areas of southeast Asia and 50.6% backward trajectory from Bengal, Southern China and Indochina (Fig. 4). Based on the predicted results of PSCF, Fig. 5 shows the maps of potential PCDD/F emission source regions for the Lulin station in TSP and $PM_{2.5}$ during the biomass burning period. The PSCF values range from 0.3-0.7 and 0.7-1.0 in TSP were located between Bengal, Southern China and Indochina; North India and Southern China, respectively. On the other hand, The PSCF values range from 0.3-0.7 and 0.7-1.0 in $PM_{2.5}$ were located at Indochina; North India, respectively. It's indicating that the major atmospheric PCDD/F in TSP emission source areas for Mt. Lulin were northern areas of southeast Asia which corresponds to the prediction of backward trajectory analysis. To identify the different sources of the Southeast Asia biomass burning episode in TSP and $PM_{2.5}$ that occurred during spring seasons in 2014, the backward trajectory analyses using HYSPLIT at the altitudes of 3 km from the location of Lulin station in central Taiwan and PMF model were also evaluated. Combining the results of factor analysis receptor model (PMF) model and trajectory cluster analysis (PSCF) to quantify directional contributions for each source category. In spring, the SRA result of PCDD/Fs in TSP and $PM_{2.5}$ (Fig. 6) indicated that the higher cotribution were provided by R3 (69.3% for TSP, 39.4% for $PM_{2.5}$, Southern China, Indochina), R2 (13.9% for TSP, Central China) and R5 (24.2% for $PM_{2.5}$, Central India). The main source contribution region of PCDD/F in TSP measured at Mt. Lulin was Southern China and Indochina, but PCDD/F in $PM_{2.5}$ mostly provided from Southern China, Indochina and Centrial India.

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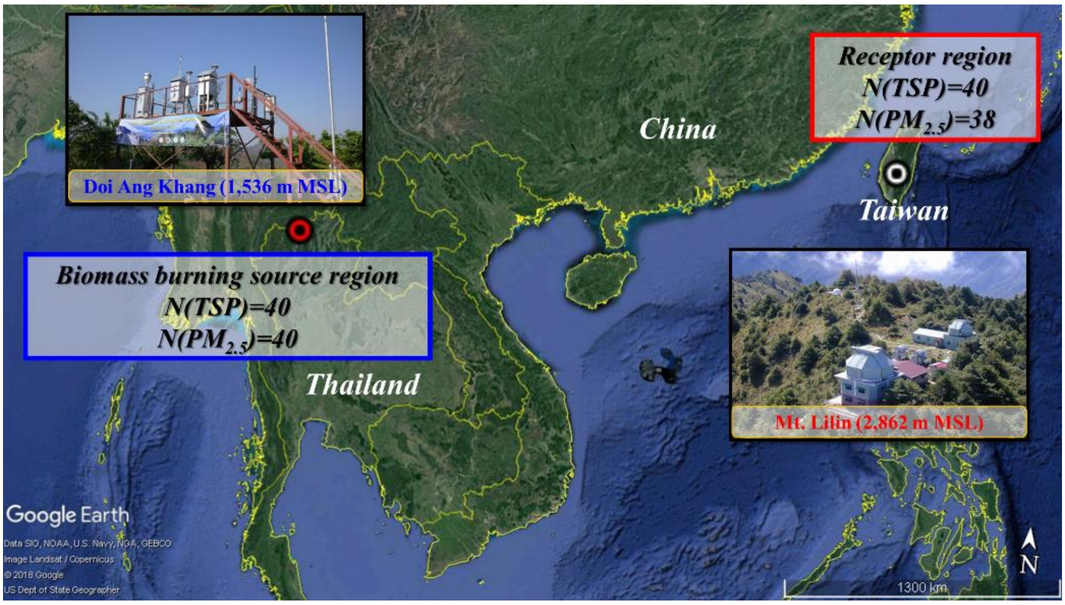

Fig. 1 Relative locations of the high-altitude sampling sites in Southeast Asia during 2014/03/01~04/12.

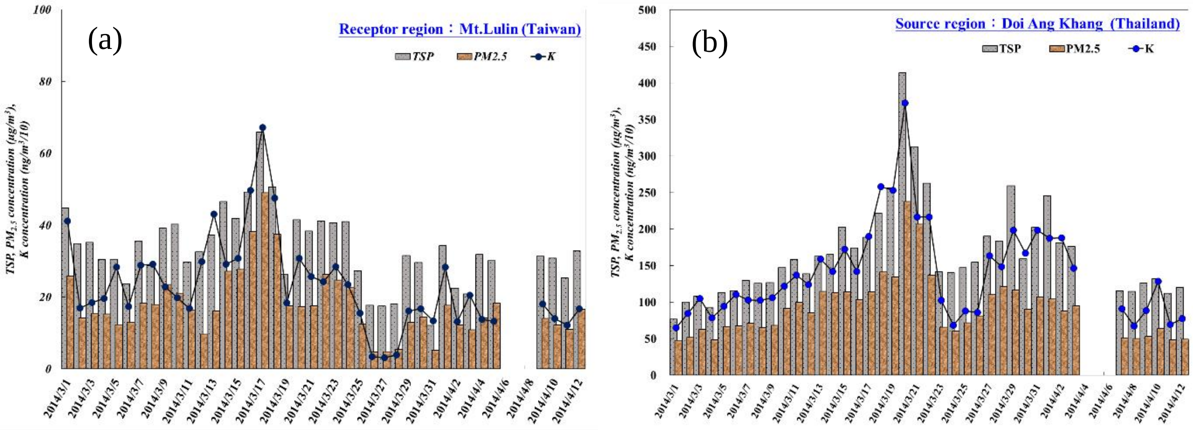

Fig. 2 Atmospheric PCDD/Fs, Potassium, total suspended particles and fine particles measured at Lulin and Doi Ang Khang station during 2014/03/01~04/12.

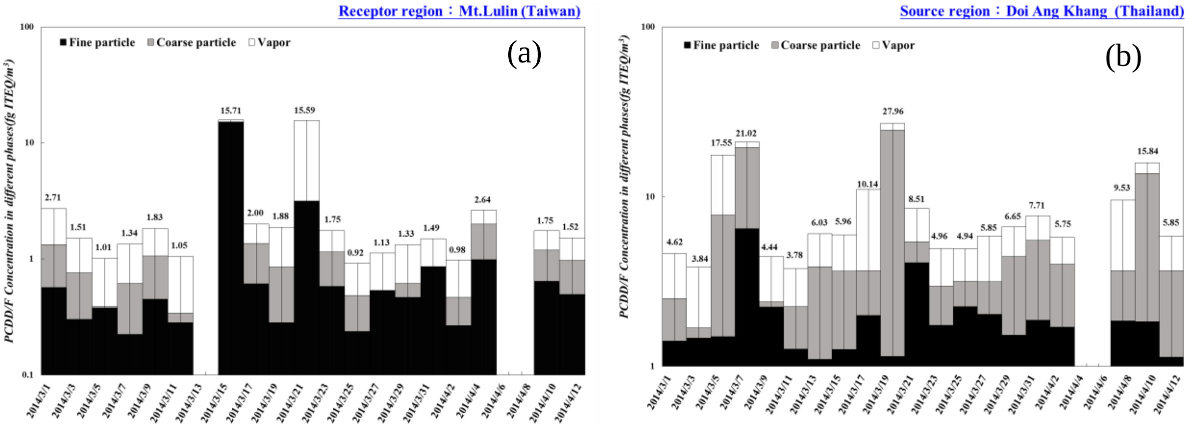

Fig. 3 Atmospheric PCDD/F concentrations in different phases measured in Mt. Lulin, (Taiwan) and Doi Ang Khang (Thailand) during 2014/03/01~04/12.

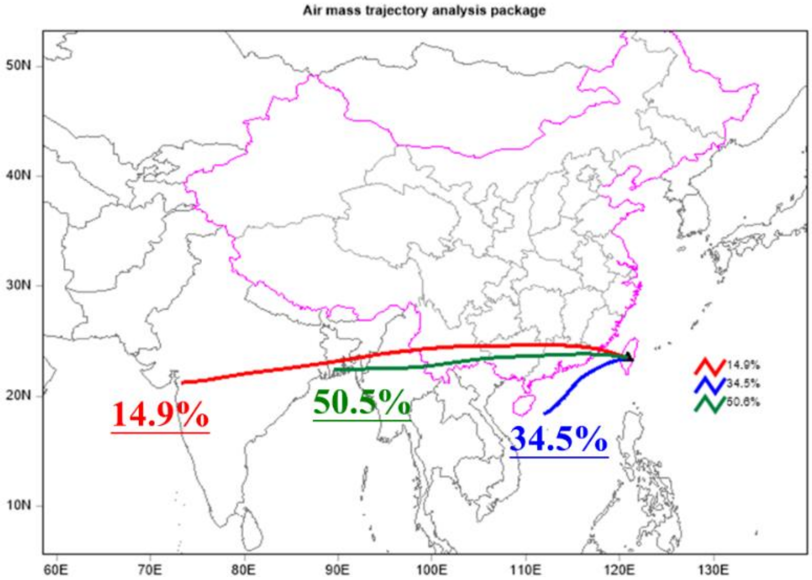

Fig. 4 Maps of potential PCDD/Fs source regions for the Mt. Lulin station during 2014/3/1~4/12.

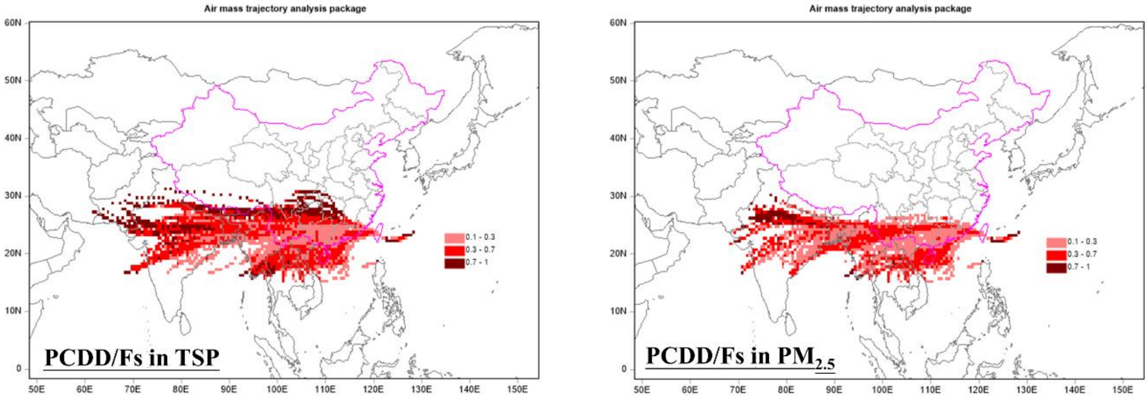

Fig. 5 PSCF value of potential PCDD/Fs in TSP and $PM_{2.5}$ source regions for the Mt. Lulin station.

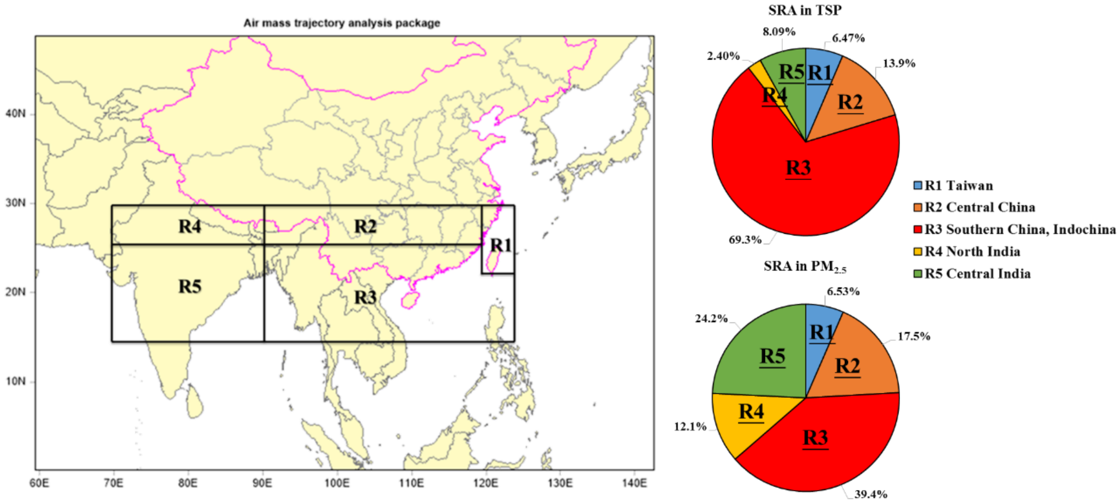

Fig. 6 Result of SRA in atmosphere PCDD/F distributed in TSP and $PM_{2.5}$ for the Mt. Lulin station during the sampling period (2014)

PERFLUOROALKYL ACID INTAKE DURING CHILDHOOD IN FINLAND

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Introduction: Perfluoroalkyl substances (PFAS), found in both environmental and human samples, are widely produced and used in many industrial and commercial consumer product applications. PFAS have been associated with various adverse health effects, and are therefore a chemical class of high concern. The main exposure route for humans is via diet, but also indoor air and dust as well as drinking water can be relevant exposure sources. PFAS exposure in utero and in the first years of life is of special concern since the developing immune system of fetuses and young children is highly vulnerable to pollutant exposure. Exposure assessments can be performed on one hand by measuring the source concentrations of a given chemical combined with knowledge of the consumption or exposing time with these sources. On thew other hand assessment of the exposure can rely on the targeted measurement of selected compounds in different biological matrices such as serum, urine, hair or tissues. **Materials and Methods**: To investigate PFAS exposure levels and trends during childhood, we followed the same 54 individuals over decade. The participants belonged to a larger birth cohort, named LUKAS2 in Kuopio, Eastern Finland. The samples were taken at the age of 1 year (2004/2005), 6 and 10.5 years. PFASs intakes in the Finnish children were estimated using previously published model[1]. The intakes were calculated based on the PFAS serum concentrations measured by LC-MS/MS. **Results**: PFAS intake displayed decreasing trends during the childhood. The median intakes for the main PFASs, perfluorooctane sulfonate (PFOS) and perfluorooctane acid (PFOA) at 1, 6 and 10.5 years of age were 2.6, 1.0 and 0.7 ng/kg body weight (bw) per week and 6.3, 2.6 and 1.4 ng/kg bw per week, respectively. Variation in PFAS intake between the individuals was higher at the age of 1 year than in later sampling points. European Food Safety Authority (EFSA) has established a tolerable weekly intake (TWI) of 13 ng/kg bw per week for PFOS and 6 ng/kg bw per week for PFOA. In this population only one individual at 1 year of age exceeded the TWI for PFOS, whereas over 50 % of the children at 1 year of age had higher PFOA intake as compared to TWI. **Conclusions:** Our data indicate that Finnish children are exposed to PFASs, especially during the first year of life. Over 50 % of the children exceed the TWI for PFOA at the age of 1 year. At later years in childhood the intake values for PFAS are below the level of tolerable intakes. The lower PFAS intakes observed in the later years of childhood results from a growth dilution and dietary changes from breastfeeding to solid foods.

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CONCENTRATIONS OF PERFLUOROALKYL SUBSTANCES IN DRINKING WATER, INDOOR AIR, DUST AND HUMAN MILK IN IRELAND: IMPLICATIONS FOR HUMAN EXPOSURE

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Introduction: This study assesses for the first time, exposure of the Irish population to selected perfluoroalkyl substances (PFASs) via inhalation of air and ingestion of dust from common indoor microenvironments and drinking water. We also measure concentrations of our target PFASs in 16 pooled samples of human milk from Irish primiparas.

Materials and methods: Passive air sampler (PAS) and floor dust samples were collected from Irish homes, cars, offices and primary school classrooms (n=30 per microenvironment (ME)) between August 2016 and January 2017. PAS consisting of a sorbent (XAD-3) impregnated polyurethane foam disk (PUF) were deployed for 60 days, placed on elevated surfaces in homes, offices, and schools, and the floor behind the passenger or driver's seat in cars. Dust samples were collected by vacuuming floors following methods previously described. In addition, 60 tap water samples were collected from the same homes and offices, with a further two samples of each of five major mineral water brands (i.e. 10 bottled water samples in total). Human milk samples were collected between 2016 and 2018 from 92 primiparas from Dublin and Galway. These individual samples were combined to give 16 pooled samples for analysis. All samples were analysed for PFASs via LC-MS/MS.

Results: PFASs were detected in all air and dust samples with an average ΣPFAS concentration of 290 pg/m^3 (range: 0.03 –2300 pg/m^3) and 67 ng/g (range: 0.4 – 4000 ng/g) respectively. In air, PFOA (average: 140 pg/m^3, range: <0.1 – 1200 pg/m^3) was the dominant congener in 60% of samples. This was followed by PFBS (average: 38 pg/m^3, range: <0.2 – 310 pg/m^3) and PFOS (average: 73 pg/m^3, range: <0.2 – 1600 pg/m^3) that were dominant in 21% and 18% respectively. In dust, PFBS (average 16 ng/g, range <0.1 – 170 ng/g) was the dominant PFAS in 68% of samples. PFOS (average: 27 ng/g, range: <0.1 – 2700 ng/g) was dominant in 15% of samples, and PFOA (average: 8.1 ng/g, range: <0.05 – 380 ng/g) was dominant in 8% of samples. PFAS were detected in all bottled water samples and in 86% of tap water samples. The average ΣPFAS concentration in bottled water samples was 16 ng/L (range: 0.17 – 64 ng/L). The average ΣPFAS concentration in tap water was considerably lower at 0.94 ng/L (range: <0.5 – 16 ng/L). PFBS was the dominant congener in bottled water making up 75% of the average ΣPFAS content followed by PFOS (12%). PFBS was less dominant in tap water (51%) with PFOA making up 30% of ΣPFAS. These data are consistent with a shift towards the use of lower carbon chain PFAS. In human milk, PFOA and PFOS predominated at detection frequencies of 100% and 63% and arithmetic mean concentrations of 0.13 and 0.038 ng/mL respectively. PFNA and PFHxS were also detected at frequencies of 69% and 31% and average concentrations of 0.026 and 0.03 ng/mL respectively. The elevated concentrations of PFBS in air, dust, and water were not reflected in human milk, as PFBS was not detected (<0.1 ng/mL) in any of the 16 pooled samples.

Conclusions: Our data demonstrate ubiquitous exposure of the Irish population to PFASs. Concentrations in human milk from Irish mothers are within the range reported globally, and currently do not indicate a health concern, based on breastfeeding exposure scenarios carried out by EFSA.

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